

Impacts of Use Restriction in Agriculture on Poor Countries

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Approaches to Innovation Management in Agriculture

- Stage I: Open Access and Information Sharing
- Stage II: Plant Variety Legislation - IPR in Plant Varieties
- Stage III: Use Restriction Technologies

Stage I: Open Access and Public Investment

- Departments of Agriculture and genetic resource collection (19th C.)
- Development of Agricultural Research Stations and sharing of resources (early 20th C.)
- Development of International Agricultural Research Centres (IARCs) –1970s
- Common heritage and open access for scientific research

Stage II: IPR in Agriculture

- Plant Breeders Rights Developed in DCs
- Reciprocity through UPOV
- Attempts to Extend via TRIPs 27(b)(3)
- LDCs Required to Implement by 2006

BUT

Compliance is Dependent on National Monitoring
and Implementation

Share of Benefits from R&D is (to some extent)
National Choice Variable

Stage III: Use Restriction Technologies

- Divorcing Reproductive Technologies
- Hybrid Crops (F1 HYVs 1960s)

But

- Limited to Maize and Sorghum

Future: Increasing B-T Use Restriction Technologies?

- Recognition that Reproduction Technology could be Divorced from all Biotech Innovations
- V-GURTs and T-GURTs
- Patents on Methods for Generation

Impacts of Movement Toward Increasing Use Restriction in Agriculture?

- Low Cost Enforcement
 - Independent of National Compliance Strategy
- Universally Enforceable Uniform IPR

Impacts of Uniform Enforceable IPR

- Enhanced Appropriation
- Enhanced Investment
- Enhanced Innovation
- Enhanced Diffusion?!

Enhanced Diffusion?

- First Order Effect is Restriction
 - Depends on Investment
 - Investment Patterns (Frontier-Off Frontier)
 - Investment Opportunities (Off Frontier)
- Aggregate Impact is Dependent on Investment in Diffusion

Impacts on LDCs

- Increased Rate of Growth at Frontier
 - First Order Effect of Restricted Diffusion
 - Trade-off Between Frontier Growth & Restricted Diffusion
 - Incentive to Invest in Diffusion
- Aggregate Impact on LDCs Dependent on Investment in Diffusion

The Experience with Prior Use Restriction

- Examined Hybrid Maize (1960-1999)
versus NonHybrid Plant Varieties
 - Yield Growth at Frontier
 - Yield Growth in LDCs
- Trade-off in Frontier Growth-Diffusion?

| <i>Crop</i> | Global Acreage in million ha in 1999 | Average Growth Rate in Developed Countries, 1961-1999 | Average Growth Rate in Developing Countries, 1961-99 | Relative Yield Gap in 1961 | Relative Yield Gap in 1999 |
|-----------------|---|--|---|-----------------------------------|-----------------------------------|
| <i>Barley</i> | 58.6 | 1.53% | 1.03% (40) | -57% | -59.9% |
| <i>Cotton</i> | 34.3 | 2.45% | 1.54% (60) | -24% | -47.4% |
| <i>Maize</i> | 139.2 | 2.27% | 1.42% (95) | -65% | -72.4% |
| <i>Millet</i> | 37.2 | 0.93% | 0.41% (46) | -49% | -57.4% |
| <i>Rice</i> | 153.1 | 0.85% | 1.24% (60) | -64% | -57.9% |
| <i>Sorghum</i> | 44.8 | 2.08% | 0.54% (64) | -48% | -67.2% |
| <i>Soybeans</i> | 72.1 | 1.24% | 1.58% (32) | -46% | -40.0% |
| <i>Wheat</i> | 214.2 | 1.75% | 1.89% (54) | -60% | -54.5% |

Model Estimation

$$\Delta \hat{y}_t = \Delta y_t^* - (1 + \beta + \gamma \cdot D) \cdot G_{t,t-1} + \hat{a} + \varepsilon \quad (2)$$

The model has the form where G is the gap (difference) in logarithm between the yields in a specific country and the lead country and Δ signifies the change in the gap. The intercept term ai is the fixed effects term, and denotes the long-term difference in productivity growth in equilibrium.

The coefficient β that is to be estimated then reports the diffusion coefficient across all crops and $gamma$ is the diffusion rate differential for hybrids crops identified through the dummy variable D . For observations involving hybrid crops, $D=1$.

Estimation Results

Regressions for Diffusion of Innovations (Goeschl and Swanson 2003)

| | Coefficient |
|--------------|-----------------------------|
| β | -0.313 (0.008)*** |
| <i>Gamma</i> | 0.071 (0.011)*** |
| \hat{a} | -0.33611 |

R2 (14858) **0.16**

DW-statistic

2.39

The figure in parentheses is the standard error.

Implications

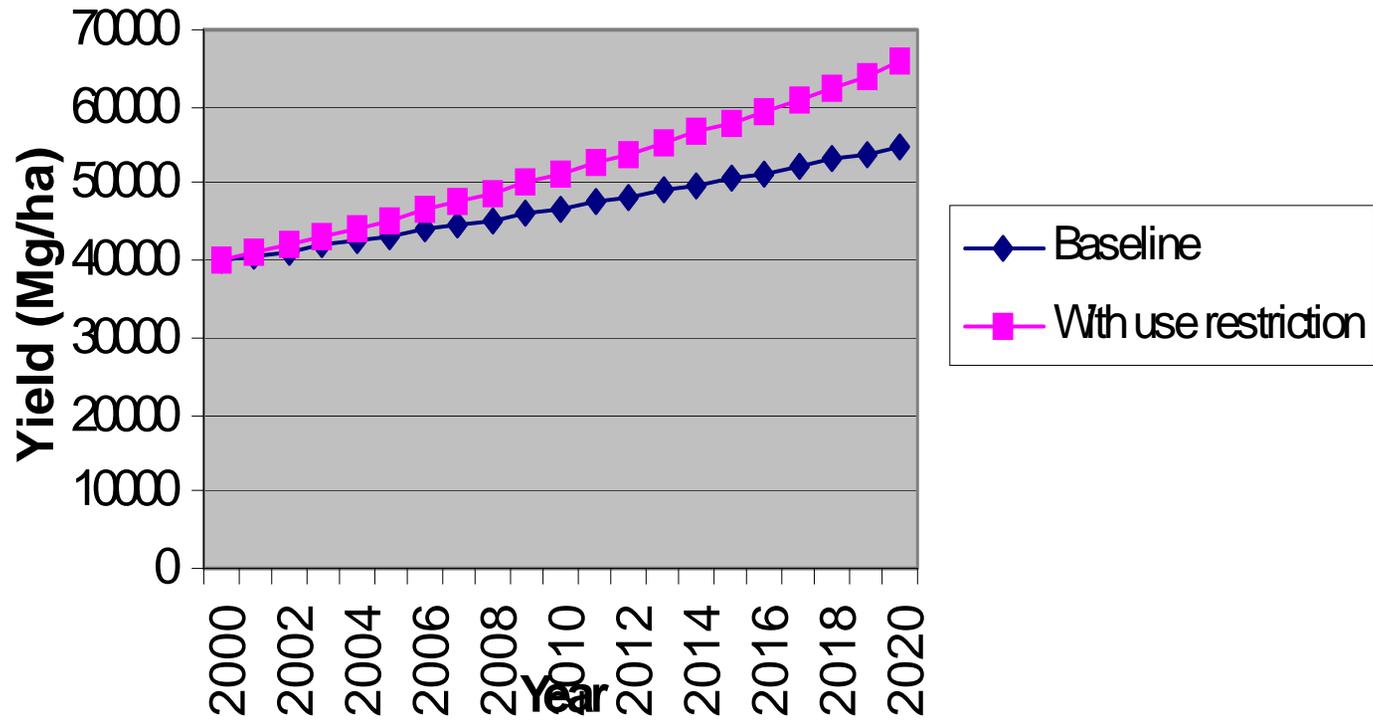
The “diffusion penalty” involved in having innovations occur in hybridised crops is about 7.1 percent per year.

This means that developing countries retained about 7 percent more of the yield gap each year in hybrids than in non-hybrids. This explains an important part of the cumulative yield gap that has developed in hybrids.

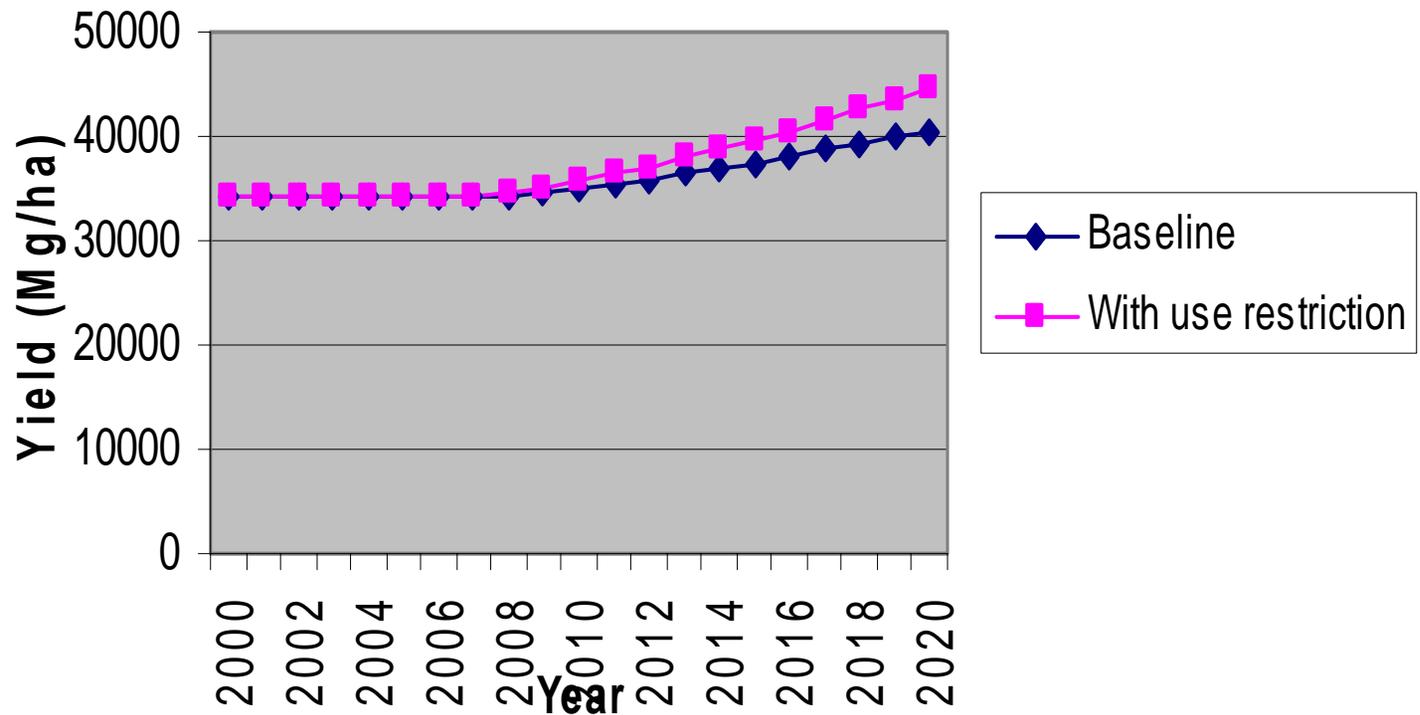
Forecasts: The Distributive Impacts of Use Restrictions

- Assuming that Use Restrictions Extends Experience with F1 Hybrids (harmonised enforced restrictions) relative to baseline of non-F1 diffusion process
 - What is the anticipated impact of movement toward general use restriction on diffusion/distribution?

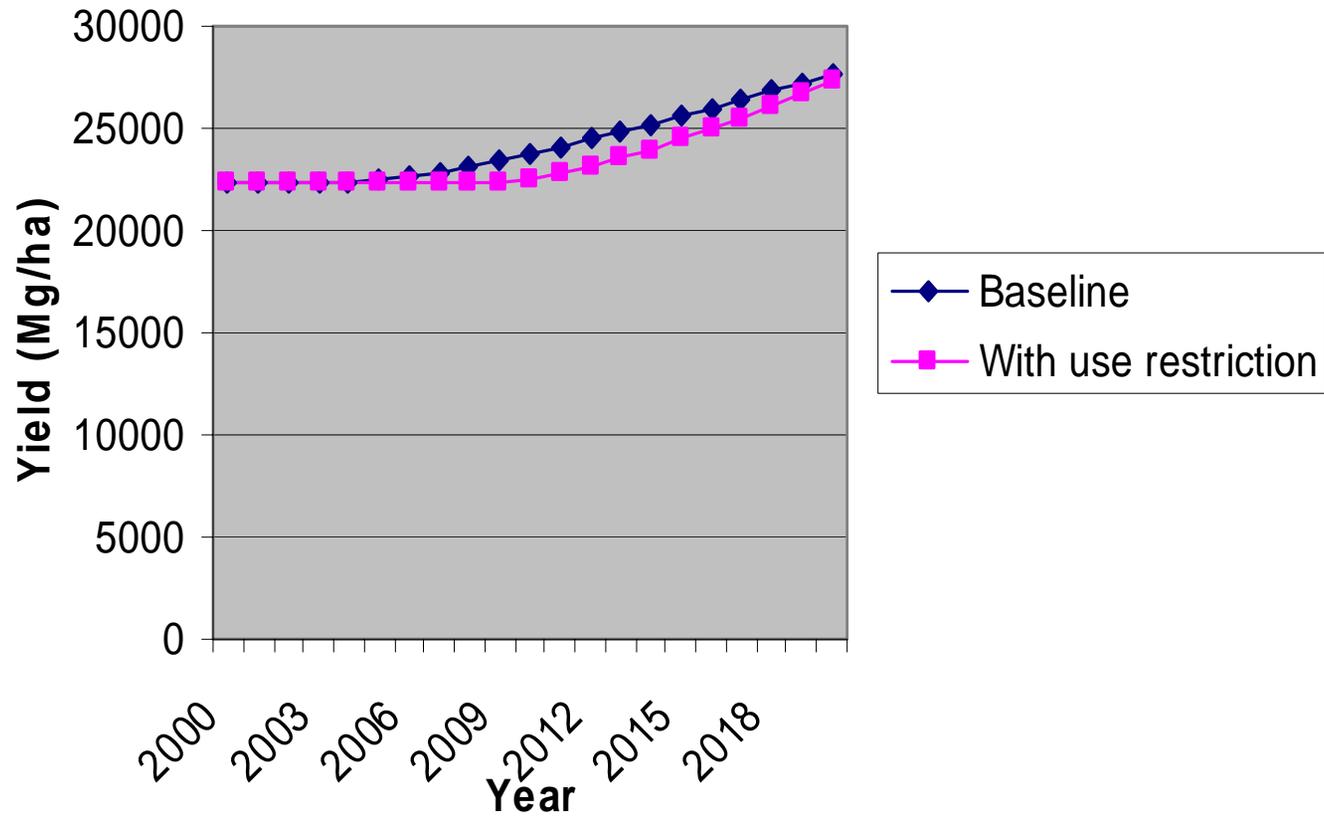
Comparison of yields under the use restriction and baseline scenarios, developed countries, 2000-2020



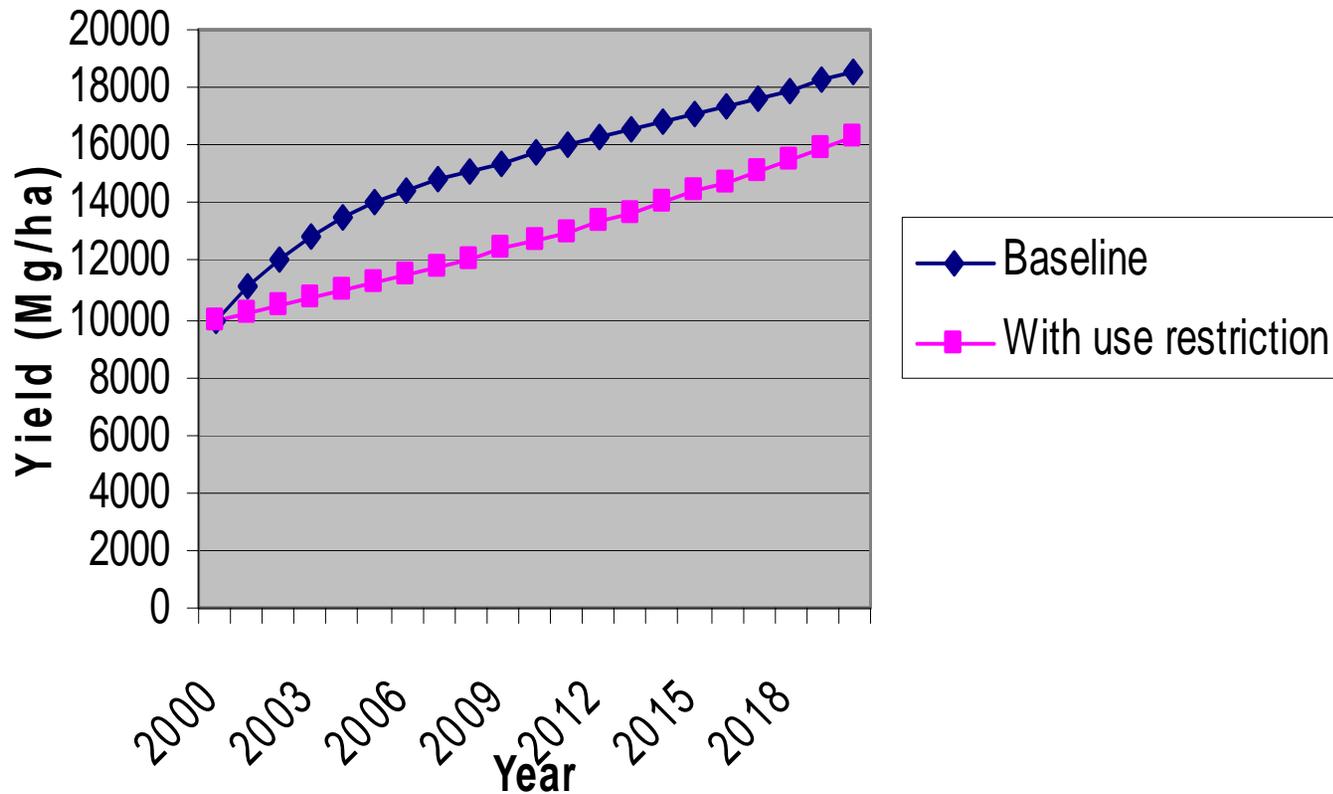
Comparison of yields under the use restriction and baseline scenarios, China, 2000-2020



Comparison of yields under the use restriction and baseline scenarios, Ethiopia, 2000-2020



Comparison of yields under the use restriction and baseline scenarios, Tanzania, 2000-2020



Conclusion

- Use Restriction versus IPRs

Removes International Negotiation and
National Discretion as Determinants of
Global Benefit Distribution

Conclusion – impact on distribution?

- Use Restriction has First Order Effect of Restricting Diffusion (Of Course)
- But has General Effect of Enhancing Growth at Frontier
- And Second Order Effect of Creating Incentives to Invest in Diffusion

Conclusion

- Aggregate Impact of Use Restriction Must be Assessed Relative to all of these Effects
- Hybrid Experience Indicates Inadequate Investment in Diffusion
- Diffusion is Slowed and Benefit Distribution is even more Skewed
- Move from IPR to Use Restriction is Against Interests of the Poorest Countries