Impact Pathway

Identifying effective entry points of intervention and M&E

Data System

Spatial database of harmonized baseline indicators on high-resolution grids

Farming Systems Modeling

Assessing biophysical impacts of investments on productivity, environment, and GHG emissions

Bioeconomic Modeling

Assessing technology impacts on the economy of households, country, and region
Maize in Tanzania

Can maize farmers profit from investments on improved seeds and inorganic fertilizer?

Legumes in Malawi

Can farmers profit from rotating maize with legume crops?

Weather Risk in Sub-Saharan Africa

How does weather risk change the yield benefits of fertilizer and improved maize varieties?
Can maize farmers profit from investments on improved seeds and inorganic fertilizer?

- Combined crop simulation modeling with household data on costs and prices to investigate field-scale profitability.
- Scaled up the household-level results to the regional and national level using an economic surplus model.
Can maize farmers profit from investments on improved seeds and inorganic fertilizer?

- Use of improved seeds and fertilizer increased yields and profits without negative effect on yield or profit stability.
- Economic benefits to farmers and consumers both increased with the uptake of seed and fertilizer, despite negative effects on prices.
Can farmers profit by rotating maize with legumes?

- Combined crop modelling and an agricultural household survey with an economic analysis.
- Explored the economic, risk, and labor implications of using different legume and fertilizer practices in maize-based cropping systems in central Malawi.
Can farmers profit by rotating maize with legumes?

- The maize-groundnut rotation increased risk-adjusted profits.
- The maize-groundnut rotation had 54% lower caloric yield and used more labor than the maize monoculture, augmenting the increased chance of labor shortages for farm households.
How does weather risk change the yield benefits of fertilizer and improved maize varieties?

- Combined crop modeling with the willingness to pay bounds analysis to provides a practical strategy for dealing with farmer’s risk tolerances.
- Comprehensive continental-scale analysis using a grid-based crop modeling framework to account for spatio-temporal heterogeneity.
How does weather risk change the yield benefits of fertilizer and improved maize varieties?

While the benefits of fertilizer increase over time without improved seeds, the benefits of improved seeds decrease overtime without fertilizer. Introducing improved seeds first would help raising farmer adoption of both fertilizer and improved seeds.
Better Data

- **Crop geography** (2010)
- **Daily weather** (since 2008)
- **CMIP6 monthly mean climate** (2030/2050/2080)
- **Soil properties** (250m/1 km)
New Model

DSSAT v4.7 (2017)

- Temperature responses updated for high temperature response.
- ET functions and effect of CO\textsubscript{2} has been improved.
- Updated the hourly energy balance routines, which have a finer grained simulation of water uptake and plant stress due to water deficit.
- Includes growth stage-controlled irrigation routines and allows deficit irrigation regimes.
- GHG emissions (CO\textsubscript{2}, N\textsubscript{2}O) now predicted. Working on methane.
Simulation of Risk Management Policy Options

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**Case Study #5**

**Household consumption losses during strong El Niño events in Ethiopia**

(percentage reductions)

<table>
<thead>
<tr>
<th>Without interventions</th>
<th>Food import subsidies</th>
<th>Distribute stored grains</th>
<th>Cash transfers</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0%</td>
<td>0.9%</td>
<td>0.4%</td>
<td>0.9%</td>
<td>0.2%</td>
</tr>
<tr>
<td>2.6%</td>
<td>2.5%</td>
<td>3.6%</td>
<td>2.6%</td>
<td>3.4%</td>
</tr>
</tbody>
</table>

Source: Authors.

Note: CGE = computable general equilibrium; DSSAT = Decision Support System for Agrotechnology Transfer; GDP = gross domestic product.
More Sophistications

- Modeling to understand considerably more complexity in changes in yields at the pixel-level.

- Capability to understand possible unintended consequences (e.g., export ban in Zambia increased poverty of net sellers)

Simulated yield differences between baseline and El Niño in 2015/16 in Zambia
Case Studies


