Leveraging Optimal Portfolio of Drought Tolerant Maize Varieties for Weather Index Insurance and Food Security

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Research questions

- Does an optimally selected combination of maize varieties offer better protection against drought risk than common practices?

- What are the implications on scaling weather index insurance?
Data

- **On farm trial data by CYMMYT & Partners in 2011**
  - 20 varieties; DT1, DT2, …., DT19, Local variety (LV)
  - 49 locations
    - 20 Zimbabwe
    - 8 Malawi
    - 4 in Zambia, Uganda, Ethiopia
    - 3 Mozambique
    - 5 Kenya
    - 1 Tanzania

- **5 Mega environment**
  - Dry lowland
  - Dry mid-altitude
  - Wet lower mid-altitude
  - Wet lowland
  - Wet upper mid altitude

- **High resolution spatial daily rainfall data (1983-2013) from NOAA**
  - Cumulative rainfall over growing season
Simulations & Downside Risk Portfolio Optimization

- Simulate 500 years of correlated space-time growing seasonal rainfall
- Predict yields & farm returns from 500 growing seasons
- Select an optimal combination of varieties in each environment that diversify drought risk and maximizes farm returns
- Compare performance of optimal portfolio to 3 baseline practices:
  - Portfolio of equal weights (**Naive**)
  - Relatively high yielding variety (**DT12**)
  - Popular local maize variety (**LV**)

Awondo/Genti (UA/UGA)  Optimal Portfolio of DTMVs  4/8
Optimal downside risk portfolios by environment

Dry lowland

Dry mid-altitude

Wet lower mid-altitude

Low wetland

Wet upper mid-altitude
### Insurance performance analysis (Gross returns)

<table>
<thead>
<tr>
<th>Region</th>
<th>Optima</th>
<th>Naive</th>
<th>DT12</th>
<th>LV</th>
<th>Naive</th>
<th>DT12</th>
<th>LV</th>
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</thead>
<tbody>
<tr>
<td><strong>Dry lowland</strong></td>
<td></td>
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<tr>
<td>Premium rate</td>
<td>0.279</td>
<td>0.501</td>
<td>0.730</td>
<td>0.509</td>
<td>-44.35</td>
<td>-61.18</td>
<td>-45.27</td>
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<tr>
<td><strong>Dry mid-altitude</strong></td>
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<tr>
<td>Premium rate</td>
<td>0.687</td>
<td>0.733</td>
<td>1.025</td>
<td>0.852</td>
<td>-6.30</td>
<td>-33.03</td>
<td>-19.40</td>
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<td><strong>Wet lower mid-altitude</strong></td>
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<tr>
<td>Premium rate</td>
<td>0.193</td>
<td>0.344</td>
<td>0.431</td>
<td>0.158</td>
<td>-43.76</td>
<td>-55.12</td>
<td>22.20</td>
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<tr>
<td><strong>Low wetland</strong></td>
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<td>Premium rate</td>
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<td>0.452</td>
<td>0.884</td>
<td>0.921</td>
<td>-23.36</td>
<td>-60.81</td>
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<td><strong>Wet upper mid-altitude</strong></td>
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<td>Premium rate</td>
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<td>0.708</td>
<td>1.100</td>
<td>1.100</td>
<td>-40.36</td>
<td>-61.60</td>
<td>-61.60</td>
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</tbody>
</table>
Key results & policy implications

- Optimally diversified portfolios - promising holistic risk management tool
  - Increases expected farm returns by 12 to 127 times
  - Reduces actuarially fair premium rates up to 31% - 55%
  - Potential to spur demand and supply of risk mitigation and transfer products

- Leverage diversified crop/varieties portfolios and Insurance across zones

- Combine seasonal weather forecast & optimum portfolio for better pricing

- Need for regulations to promote pilots/supply by insurers and reinsurance

- Complementary for contract farming and commodity trading
Thank you!

Questions, Comments?

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