Scaling up Maize Production through Weather Resilient Processes

Examples from Sub-Saharan Africa

Rodney Witman Lunduka, (PhD).

Africa Food Security Conference and Agro-Exhibition
October 12 – 13, Crowne Plaza Hotel
Nairobi, Kenya
Climate Change Impact is Here

The Genetic Response

The Agronomic Response

Scaling Up and Out + Crop Insurance

Sample Success Story
Increase in temperature in maize mega environments: The Double-edged sword!

Maize yield losses double under drought stress when temperatures exceed 30°C

Cairns et al., 2013
Survey Question to Farmers:

List the **three most important** variety characteristics you consider when selecting maize seed.
**ANGOLA**

- **Male**
  - Marketability of grain
  - Input requirements
  - Quality and taste
  - Grain colour
  - Pest and disease resistant
  - Storage pest resistance
  - Drought escape
  - High yielding

- **Female**

**Malawi**

- **Male**
  - Stover yield
  - Uniform maturity
  - Input requirements
  - Quality and taste
  - Pest and disease resistant
  - Grain to flour ratio
  - Storage pest resistance
  - High yielding
  - Drought escape

- **Female**

**Mozambique**

- **Male**
  - No lodging
  - Uniform maturity
  - Marketability of grain
  - Grain to flour ratio
  - Pest and disease resistant
  - Input requirements
  - Quality and taste
  - Storage pest resistance
  - Drought escape
  - High yielding

- **Female**
Response

Kenya

Zimbabwe

Zambia

Grain to flour ratio
Marketability of grain
Stover yield
Pest and disease resistance
Input requirements
Storage pest resistance
Taste and quality of food
Drought escape
High yielding

Grain colour
Quality and taste
Storage pest resistance
Input requirements
Marketability of grain
Pest and disease resistant
Drought escape
High yielding
The Genetic Response: New Maize Varieties

DROUGHT TOLERANT VARIETIES

Varieties that can survive at least 6 weeks during flowering period with little or no rain.
<table>
<thead>
<tr>
<th>Country</th>
<th>Number of Varieties</th>
<th>Varieties with additional traits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hybrid</td>
<td>OPV</td>
</tr>
<tr>
<td>Zambia</td>
<td>20</td>
<td>7</td>
</tr>
<tr>
<td>Nigeria</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Benin</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Ghana</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>Tanzania</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Malawi</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Kenya</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Uganda</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Angola</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Mali</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Mozambique</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>147</td>
<td>86</td>
</tr>
<tr>
<td><strong>Percentages</strong></td>
<td>63.1</td>
<td>36.9</td>
</tr>
</tbody>
</table>

Over 230 new varieties developed.
Performance of new DT varieties
Heat stress performance of new varieties

![Graph showing grain yield (t/ha⁻¹) for new experimental hybrids and commercial hybrids.](image)

**Grain yield (t/ha⁻¹)**

- Mean
- CH1315
- CH1319
- CH11367
- CH1315
- CH1318
- C2H113
- CH12236
- CH11111
- CH124794

**New Experimental hybrids**

**Commercial hybrids**

1

2

*Magorokosho in prep.*
Farmers’ grain quality preferences: New vs. Commercial Maize Varieties

Both early and late maturing DT varieties preferred by farmers
Nutritional preferences: Pro-Vitamin A Maize vs. White Maize Sadza (Ugali)

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefer orange Sadza</td>
<td>80.47%</td>
<td>83.78%</td>
</tr>
<tr>
<td>Better taste and flavour</td>
<td>81.25%</td>
<td>81.08%</td>
</tr>
<tr>
<td>Better smell</td>
<td>17.19%</td>
<td>26.13%</td>
</tr>
<tr>
<td>Better texture</td>
<td>8.59%</td>
<td>3.6%</td>
</tr>
</tbody>
</table>
Impact of DT varieties on maize production. (Case of Zimbabwe, household survey)

A change from non-DT maize varieties to DT maize varieties can increase total maize production by 270kg/acre (670kg/ha).
Reasons for low adoption of DT varieties

Government Policies affecting Supply/Demand
- Public agriculture input subsidy programs (Malawi)

Market Penetration: Old and Big vs. New and Small Producers
- “Cash cows”

Step-wise Adoption Patterns
- Local varieties → OPV → Hybrids

Increasing Frequency of Drought
- The “good” evil?
Agronomic Response: Better Management
Performance of DT Maize + Conservation Agriculture
(2005-2015, Malawi)

Grain yield (t ha\(^{-1}\))

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
<th>CA + maize</th>
<th>CA + maize/leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>DKC 80-53, control</td>
<td>d</td>
<td>c</td>
<td>a</td>
</tr>
<tr>
<td>ZM 523</td>
<td>d</td>
<td>c</td>
<td>b</td>
</tr>
<tr>
<td>MH 31</td>
<td>d</td>
<td>c</td>
<td>b</td>
</tr>
<tr>
<td>PAN 53</td>
<td>d</td>
<td>c</td>
<td>b</td>
</tr>
<tr>
<td>SC 719</td>
<td>c</td>
<td>c</td>
<td>a</td>
</tr>
<tr>
<td>DKC 80-53, control</td>
<td></td>
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</tr>
</tbody>
</table>

Key:
a, b, c, d indicate significant differences at the 0.05 level.

Dibble stick-Maize - Cowpea rot
Dibble stick-Maize/Cowpea intercrop
Dibble stick Maize continuous
Ridge & furrow Maize continuous

Net benefits (in USD)

Mutenje et al. 2016
Scaling up uptake of DT maize varieties and good agronomic practices.
CIMMYT Current Approaches to Reducing Risk in Maize Production

1. Scaling up production and supply of new varieties
   • Support to public and private producers
   • Training of producers and agro-dealers

2. Inducing and increasing demand of the new varieties by smallholder farmers
   • Mounting extensive demonstration plots
   • Providing information on the benefits of DT maize varieties
   • Direct-to-farmer information (Fliers, posters, SMS, etc.)
CIMMYT Current Approaches to Reducing Risk in Maize Production

3. Adding good agronomic management to varieties
   • Training producers, dealers and extension agents
   • Direct-to-farmer information (fliers, posters, SMS, e.t.c)

4. Bundling the DT maize varieties with weather index insurance (pilot: 2015-18)
   • Mozambique
   • Tanzania
3 Prong approach

- Improved Genes + Good agronomic practices
- Improved Genes (DT) + Good Agronomic practices
- Crop Insurance??
Mrs. Miriam Phiri of Chifwiti Village, Chief Nyampande, Petauke, Zambia with her full granary Drought Tolerant Maize (Pan 53).

A bumper harvest even in a drought year 2015/16 season.
Thank you for your interest!