### Study #4602

**Contributing Projects:**
- P1264 - Seed production research on maize hybrids in ESA
- P1008 - Molecular (pre)breeding for priority traits demanded in SSA, incl thru collaboration with NARS
  - P964 - Identify, analyze and map key maize (a)biotic stresses in selected countries in SSA
  - P1019 - Improve and mainstream Genetic Selection in all or specific maize breeding programs, including in NARS
  - P1851 - Develop improved maize germplasm through temperate introgressions, with selection for key traits relevant for smallholders in SSA
- P1263 - Design and implement participatory methods in breeding in SSA
- P1035 - Forward breeding for select economic trait (PVA, MSV, Aflatoxin, QPM, and MLN)
- P1010 - Forward breeding haplotypes for MLN and MSV in partner breeding programs - NaCCRI, Uganda; KALRO, Kenya
  - P1254 - QPM germplasm support to partners in ESA
  - P968 - Implementing Adoption/Impact and Learning portfolio in MAIZE AFS, including syntheses, new studies/methods, resource mobilization and inter-CRP collaboration
- P1874 - Strengthening capacity of breeding for native genetic resistance to FAW in ESA
- P2144 - Stacking MLN resistance and SPT traits in ESA-adapted maize germplasm
- P1240 - Exploring incorporation of gender-responsive traits in maize breeding and seed systems in ESA
- P2212 - Test a high-throughput phytic acid assay for phenotypic evaluation of nutrition in maize.
- P1239 - Proximal- and remote-sensing based phenotyping and yield component analysis in maize breeding
- P1031 - Genotype progenies of a bi-parental mapping populations involving inbred lines with contrasting levels of resistance to Sesamia calamistis, Eldana sacharina for QTL analysis

### Part I: Public communications

**Type:** OICR: Outcome Impact Case Report  
**Status:** Completed  
**Year:** 2021

**Title:** Better breeding research and partnerships enable 43 million farmers to access and grow stress-tolerant maize in sub-Saharan Africa  

**Short outcome/impact statement:**  
Rapid-cycle breeding to steadily deliver improved varieties to farmers is essential to adapt maize systems to increasing climate variability. So is varietal replacement linked to a farmer-accessible, competitive seed sector. Investment over the past decade has increased breeding efficiency and varietal replacement. Over 37 million people benefit from new stress tolerant maize varieties, which cover almost 5.5 million hectares in sub-Saharan Africa. These varieties have demonstrated increased yield and yield stability resulting in greater production and improved livelihoods.
Outcome story for communications use:
Improving maize yields in sub-Saharan Africa in an increasingly variable climate is essential to improve the livelihoods of millions of smallholder farmers and sustainably meet future food security needs (Cairns et al. 2021; Erenstein et al. 2022). Investment over the past decade has strengthened partnerships between national and international breeding programs, increased human capital and fostered an enabling environment for the adoption of new tools and technology within breeding pipelines. These changes have increased genetic gains across a range of environments and reduced cycle time, allowing for the faster development of stress tolerant maize varieties with better adaptation to the current environment. The deployment of molecular tools has been an essential component in defending these gains against new threats, including maize lethal necrosis (MLN) disease and fall armyworm (Prasanna et al. 2020).

Previously, obsolete varieties dominated the market, and farmers were unable to access improved genetics. A key milestone for success was reducing the product life cycle of varieties through active engagement with seed companies, including around the development of seed road maps, sensitization to new genetics, and support in early generation seed production. In Ethiopia, old hybrids, which accounted for up to half of market share, were replaced with drought tolerant hybrids. Almost 5.5 million hectares in 13 countries in sub-Saharan Africa are now planted with stress-tolerant maize varieties; equivalent to almost 40% of the area under smallholder production (Krishna et al. 2021; Prasanna et al. 2021; Chivasa et al. 2022). Ca. 7.1 million households, or 43.2 million people, are benefitting from stress tolerant maize varieties with improved input use efficiency (e.g. greater yield per unit input such as fertilizer, water, or labour), which also mitigate production risks such as drought stress or diseases. Increased yields and yield stability have enabled greater productivity, consumption and improved livelihoods in increasingly variable climates (Hansen et al. 2018; Lunduka et al. 2019).

Links to any communications materials relating to this outcome:
- https://tinyurl.com/yazxsbvk
- https://tinyurl.com/y7q4mwwr
- https://tinyurl.com/ya6xohsy
- https://tinyurl.com/ych66mda
- https://tinyurl.com/y8ox98do

Part II: CGIAR system level reporting

Link to Common Results Reporting Indicator of Policies: No

Stage of maturity of change reported: Stage 2

Links to the Strategic Results Framework:
Sub-IDOs:
- Adoption of CGIAR materials with enhanced genetic gains

Is this OICR linked to some SRF 2022/2030 target?: Yes

SRF 2022/2030 targets:
- Increased rate of yield for major food staples from current 1%/year
- # of more farm households have adopted improved varieties, breeds or trees

Description of activity / study: <Not Defined>
**Geographic scope:**
- Multi-national

**Country(ies):**
- Mozambique
- Nigeria
- Tanzania, United Republic
- Zimbabwe
- Zambia
- Uganda
- Benin
- Ethiopia
- Malawi
- Kenya
- Ghana
- South Africa

**Comments:** <Not Defined>

**Key Contributors:**

**Contributing CRPs/Platforms:**
- Maize - Maize

**Contributing Flagships:**
- FP4: Sustainable intensification of maize-based systems for improved smallholder livelihoods
- FP2: Novel Diversity and Tools for increasing Genetic Gains
- FP1: Enhancing Maize's R4D Strategy for Impact
- FP3: Stress Tolerant and Nutritious Maize

**Contributing Regional programs:** <Not Defined>

**Contributing external partners:**
- IITA - International Institute of Tropical Agriculture

**CGIAR innovation(s) or findings that have resulted in this outcome or impact:**
- Crop genetic improvement - Stress tolerant maize

**Innovations:** <Not Defined>
Elaboration of Outcome/Impact Statement:

Historic gains in maize production in sub-Saharan Africa (SSA) were largely associated with an increase in maize area (Erenstein et al. 2022). Stress tolerant maize is a key intervention to improve the livelihoods of millions of resource-constrained smallholder farmers, offset potential losses under climate change, and sustainably meet the needs of future generations. Crop genetic improvement strategies to improve yields on-farm are reliant on the ability of breeding programs to deliver genetic gain, varietal replacement, and adoption of new genetics by farmers.

Maize breeding programs in SSA were modernized using molecular breeding, doubled haploidy, and improved phenotyping technologies. Almost three-quarters of the product profiles in eastern and southern Africa now use molecular markers for biotic stress screening to enrich populations prior to field testing. The average breeding cycle time has decreased from 5-6 to 3-4 years. These innovative breeding tools, techniques, and methods increased the rate of genetic gain per unit of investment in maize breeding. The capacity of several national maize breeding programs has been strengthened, with increased co-development of new genetics. Slow varietal turnover has been a major bottleneck in delivering improved genetics to smallholder farmers. Extensive engagement with small- and medium-sized seed companies across 13 countries in SSA has facilitated faster replacement of obsolete varieties. The replacement of dominant, yet obsolete, hybrids in major maize producing countries, and a significant decline in the area-weighted average age of varieties in the market, has been key to improved farmer access to new varieties better suited to the current climate.

In Ethiopia, where maize yields have steadily increased over the past decade, two old hybrids accounting for almost three-quarters of total seed production were replaced by two drought tolerant hybrids. The area under drought tolerant maize production in target countries has increased incrementally over the past decade, from 2.4 million hectares in 2016 to 5.5 million hectares in 2021. In Uganda, the area covered by drought tolerant maize increased from 13% in 2016 to 52% in 2021. Similarly, in Ethiopia and Zimbabwe, the area covered by drought tolerant maize has increased from 13% and 10% (respectively) in 2016 to 37% and 44% in 2021.
References cited:


## Quantification:

<table>
<thead>
<tr>
<th>Type of quantification</th>
<th>Number</th>
<th>Unit</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Actual counts or estimates from a particular study (please provide reference)</td>
<td>5.00</td>
<td>million</td>
<td>5.5 million hectares under new stress tolerant maize varieties in 13 countries in sub-Saharan Africa (Chivasa et al. 2022);</td>
</tr>
<tr>
<td>b) Extrapolated estimates</td>
<td>7.00</td>
<td>million</td>
<td>More than 7 million households, or 43 million people, benefited from new stress tolerant varieties</td>
</tr>
</tbody>
</table>

### Gender, Youth, Capacity Development and Climate Change:

**Gender relevance:** N/A - Not applicable  
**Youth relevance:** N/A - Not applicable  
**CapDev relevance:** 1 - Significant  
Main achievements with specific CapDev relevance: NARS breeding partners are integral to achieving faster breeding cycle successes, in particular with regard to molecular breeding collaborations and national release trials.  
**Climate Change relevance:** 1 - Significant  
Describe main achievements with specific Climate Change relevance: climate change adaptation-relevant traits, in particular drought tolerance, whilst remaining high-yielding.

### Other cross-cutting dimensions:

**Other cross-cutting dimensions description:** <Not Defined>

**Outcome Impact Case Report link:** Study #4602

**Contact person:**  
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