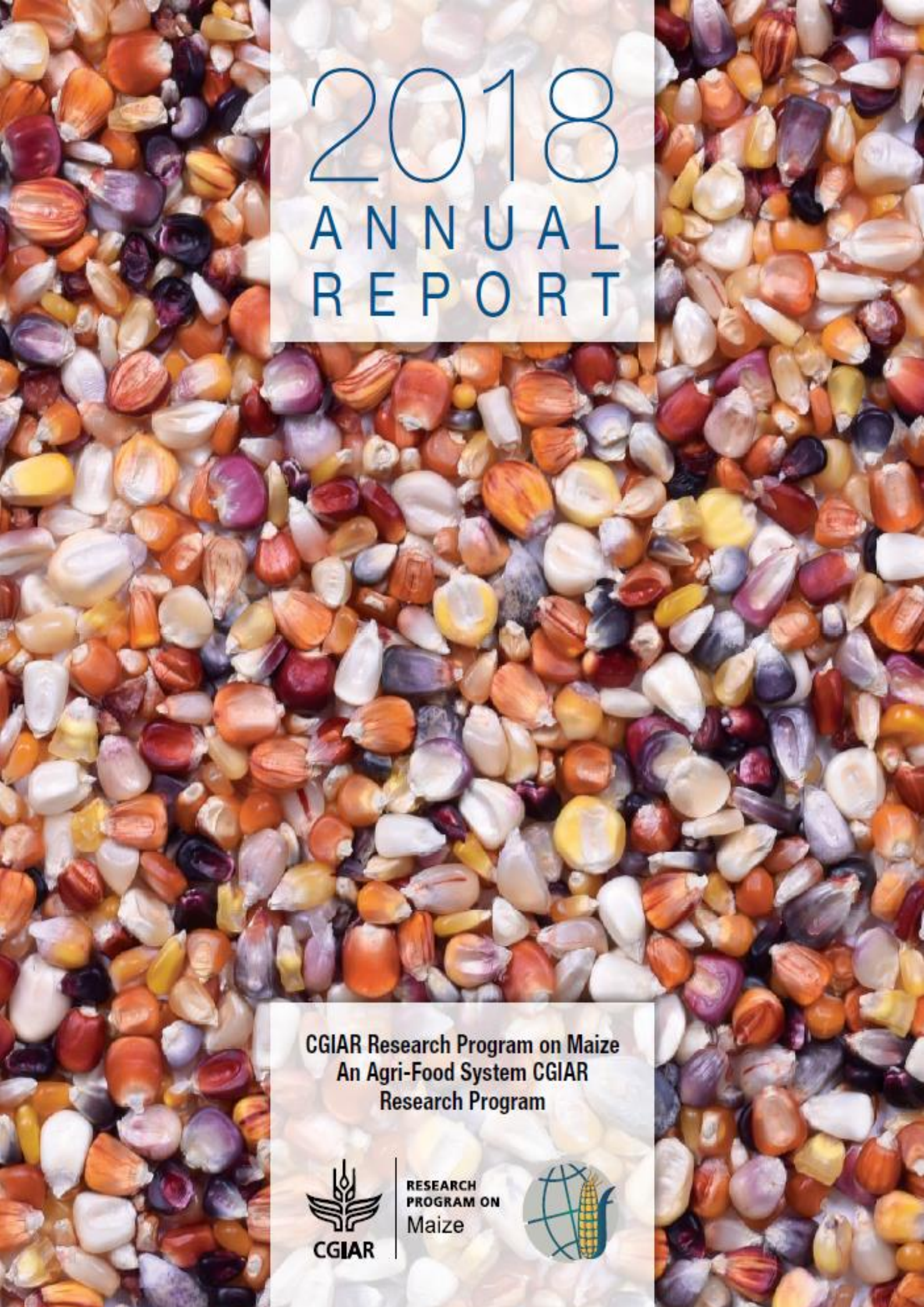


2018 ANNUAL REPORT

CGIAR Research Program on Maize
An Agri-Food System CGIAR
Research Program

CGIAR | RESEARCH PROGRAM ON Maize

MAIZE-AFS 2018 Annual Technical Report

Name of the CRP: MAIZE
Name of the Lead CGIAR Center: CIMMYT
Flagship lead institutions (CGIAR Centers or lead partners)
Flagship 1: CIMMYT & IITA
Flagship 2: CIMMYT & IITA
Flagship 3: CIMMYT & IITA
Flagship 4: CIMMYT & IITA
Other participating CGIAR Centers: IITA, **ICAR (India), IDS (UK), KIT (NL), DArT (AU), JHI (UK), Monsanto, DuPont-Pioneer (now Corteva Agriscience), KALRO (Kenya), NARO (Uganda) and WUR (NL). The complete list/map of 274 partners (2018) is accessible** here.

Acknowledging our funders:
In 2018, Australia (ACIAR), UK (DFID) and USA (USAID) supported the CGIAR Agrifood-Systems Research Program on MAIZE (MAIZE) with Window 2 funding and 12 funders supported this CRP with Window 1 funds through the CGIAR Fund. Bilateral funders supported programs and projects matched to MAIZE Flagship Projects (FPs) and Clusters of Activity (CoAs) to US$49 million.

Table of Contents

CGIAR System Institutions and Processes

AFS	Agri-food systems
A4NH	CGIAR Research Program on Agriculture for Nutrition and Health
AR	Annual Report
ARI	Advanced Research Institute
BoT	Board of Trustees
Buena Milpa Project	The Feed the Future Buena Milpa Guatemala Project
CAP-DEV	Capacity Development
CASI	Conservation Agriculture for Sustainable Intensification
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CCEEs	CRP-Commissioned External Evaluations
CGIAR	CGIAR, a global research partnership for a food-secure future
CIMMYT	International Maize and Wheat Improvement Center
CLARISA	CGIAR-Level-Agricultural-Research-Interoperability-System-Architecture
Crop Trust	The Global Crop Diversity Trust
CSISA	Cereal Systems Initiative for South Asia
CSISA MI	Cereal Systems Initiative for South Asia Mechanization and Irrigation
CRP	CGIAR Research Program
DG	Director General
DV-AM Method	Dichlorvos–Ammonia Method
DTMA	Drought Tolerant Maize for Africa
EiB Platform	Excellence in Breeding Platform
FACASI	Farm Mechanization and Conservation Agriculture for Sustainable Intensification
FAW Consortium	Fall Armyworm R4D International Consortium
FP	Flagship project
GENNOVATE	Global Comparative Gender Norms Research Initiative
Harvest Plus	A program that is part of the CGIAR Research Program on Agriculture for Nutrition and Health
IA	Impact Assessment or Intellectual Asset
IDO	CGIAR Intermediate development outcome
IEA	Independent Evaluation Arrangement
IITA	International Institute of Tropical Agriculture
IMIC-Africa	International Maize Improvement Consortium in Africa
IMIC-Asia	International Maize Improvement Consortium in Asia
IMIC-LATAM	International Maize Improvement Consortium in Latin America
IRRI	international Rice Research Institute
ISC	Independent Steering Committee
LMS	Learning Management System
MAIZE	CGIAR Research Program on Maize Agri-food Systems
MARLO	Managing Agricultural Research for Learning and Outcomes
MC	Management Committee
MEL	Monitoring, Evaluation & Learning
MEL CoP	Monitoring, Evaluation and Learning Community of Practice
MELIA	Monitoring, Evaluation, Learning and Impact Assessment
NE	Nutrient expert

NSAF	Nepal Seed and Fertilizer Project
OICR	Outcome impact case report
POWB	Plan of Work and Budget
R4D	Research-for-Development
SC	System Council
SIMLESA	Sustainable Intensification of Maize and Legume Systems for Food Security in Eastern and Southern Africa
SLO	System Level Outcome
SMB	System Management Board
SMO	System Management Office
SRF	Strategy and Results Framework
TAMASA	Taking Maize Agronomy to Scale in Africa
2gtails	Second generation tropicalized haploid inducers
W1, W2, W3/bilateral	CGIAR Windows 1, 2 and 3/bilateral
WHEAT	CGIAR Research Program on Wheat Agri-food Systems

Research and Development Partners

DArT	Diversity Arrays Technology, Australia
DFID	Department for International Development, UK
DoH	Department of Horticulture, Karnataka, India
DuPont-Pioneer	Now Dow Dupont (Division Corteva Agriscience)
GENDES	Género y Desarrollo A. C., Mexico
ICAR	Indian Council of Agricultural Research
ICTA	Agricultural Science and Technology Institute
IDS	Institute of Development Studies, University of Sussex, Brighton, UK
IIASA	International Institute for Applied Systems Analysis, Austria
JHI	James Hutton Institute, UK
KALRO	Kenya Agricultural & Livestock Research Organization
KIT	Royal Tropical Institute, the Netherlands
MONSANTO	MONSANTO Company (now part of Bayer)
NARO	National Agricultural Research Organisation, Uganda
Semilla Nueva	Semilla Nueva Project, Guatemala
UAHS	University of Agricultural and Horticultural Sciences, India
UAS-B	University of Agricultural Sciences, Bangalore, India
UAS-F	University of Florida
USAID	United States Agency for International Development
WUR	Wageningen University, the Netherlands
YPARD	Young Professionals for Agricultural Development

Miscellaneous

AIPs	Agricultural Innovation Platforms
CA	Conservation agriculture
CSA or CSAPs	Climate smart agricultural practices
CASI	Conservation Agriculture for Sustainable Intensification
DH	Double haploid

DOI	Digital Object Identifier
FAW	Fall armyworm
Fe	Iron
GS	Genomic Selection
IP	Intellectual Property
ISI	International scientific indexing
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
MIS	Management Information System
MLN	Maize lethal necrosis
M&E	Monitoring and Evaluation
MT	Minimum Tillage
N	Nitrogen
NARS	National agricultural research system(s)
NO_3	Nitrate
NOC	No-Objection Certificate
OICR	Outcome Impact Case Reports
QTL	Quantitative trait locus or loci
PICS	Purdue Improved Crop Storage
PP	Polypropylene
Q3	Third quarter
SSA	Sub-Saharan Africa
SDGs	Sustainable Development Goals
SNP's	Single nucleotide polymorphisms
WTP	Willingness to pay
Zn	Zinc

Statistical analysis applications

CERES-Maize	Crop model. Part of the Decision Support System for Agro technology Transfer
DArT seq	Diversity Arrays Technology sequence

Part A: NARRATIVE SECTION

Today, maize is the most important food crop in Sub-Saharan Africa and Latin America, and is a key Asian crop. In Sub-Saharan Africa, 50 percent of the population consume maize. It is the preferred food for one third of all malnourished children and 900 million poor people worldwide. As the world's population increases and more people start including (higher) amounts of meat, poultry and dairy into their diets, demand for maize is expected to rise: Between now and 2050 the demand for maize in the developing world is expected to double. By 2025, maize will be the developing world's largest crop. This puts pressure on agricultural research and development to further enhance sustainable productivity of maize-based systems, and significantly expand the uptake of improved maize technologies[1]. In 2018, more than 50% of MAIZE innovations were germplasm-based and the majority belonged to stage 3 (ready for up-take).

1. Key Results

1.1 Progress Towards SDGs and SLOs

Germplasm improvement

Future priority traits in Africa: A crop growth simulation study using CERES-Maize quantified the impact of climate change on maize and the potential benefits of incorporating drought and heat tolerance into commonly grown maize varieties in Eastern and Southern Africa and South Asia. Incorporating those trait(s) into benchmark varieties increases simulated maize yield under both the baseline and future climates. Average simulated **benefit from combined drought & heat tolerance was at least twice** that of heat or drought tolerance and **increased with the increase in warming levels**. The lesson learnt for future targeting and prioritizing of MAIZE R4D is to incorporate combined drought and heat tolerance as part of a multi-trait breeding strategy, which has the potential to offset predicted yield losses and sustain productivity under climate change in vulnerable sites. Also important: Research and development partners should properly target varieties where they fit best and benefit most (see MAIZE product profiles) – *See Table 1, SLO 1.1.*

Welfare impacts of improved maize varieties in Nigeria: The result of a survey about the impact of improved maize varieties in Nigeria showed a 6% reduction in the likelihood of poverty incidence in the communities studied. An adopter of improved maize enjoyed a yield increase of about 574 kg/ha compared to a non-adopter. Furthermore, adopters had USD 77 more per capita total expenditure. The findings underscore the significance of public-private partnership in addressing agricultural developmental challenges in SSA – *see Table 1, SLO 1.2.*

After El Niño, Ethiopian farmers doubled their yields with heat- and drought-tolerant varieties – an economic value of US$30M, US$10M more than anticipated ex ante. The authors found that a major success factor was the replacement of old, climate-vulnerable maize varieties with improved climate-resilient hybrids, especially the hybrid BH661. The high extension agent to farmer ratio (1:476) has further enabled rapid adoption - *See Table 1, SLO 1.1.*

Sustainable Intensification

Combining technologies improve impacts: Improved sets of technologies choices have significant impacts on farm-level maize yield and maize production costs, especially when various technologies are combined. In Ethiopia (2011-2013 data), changes in maize yield and production costs results increased the producer and consumer surpluses by US$ 140 and US$ 105 million per annum,

[1] See *Gender and Innovation Processes in Maize-Based Systems, GENNOVATE Report to the CGIAR Research Program on Maize.*

respectively. This helped to reduce the number of poor people by an estimated 788,000 p.a. – *See Table 1, SLO 1.2.*

During the El Nino year in Southern Africa, stress tolerant maize in combination with Conservation Agriculture practices led to higher yield gains, compared to non-stress tolerant maize planted under Conventional Practices. Farmers need access to combinations of climate-smart agriculture technologies to mitigate negative effects of extreme events like El Niño and increase resilience of low-input farming systems (FP3, FP4) – *see Table 1, SLO 3.2*.

In a similar vein, a study on Climate Smart Agricultural Practices (CSA or CSAPs) in Bihar (India) showed significant correlations between multiple CSAPs, indicating that their adoptions are interrelated, providing opportunities to exploit the complementarities – *see Table 1, SLO 3.2.*

1.2 CRP Progress towards Outputs and Outcomes (spheres of control, influence)

1.2.1 Overall CRP progress

During 2018, MAIZE made strong progress in terms of varietal release research outcomes. National partners released 81 unique CGIAR-derived maize varieties across Africa, Asia and Latin America. 14 varieties were hybrid combinations, showing that regional/multinational seed companies use MAIZE improved germplasm to develop and release improved maize hybrids. 20 of the released varieties are nutritionally enriched (Provitamin A, Quality Protein Maize, High Zinc); the result of the MAIZE partnership with Agriculture for Nutrition and Health (A4NH; Harvest Plus).

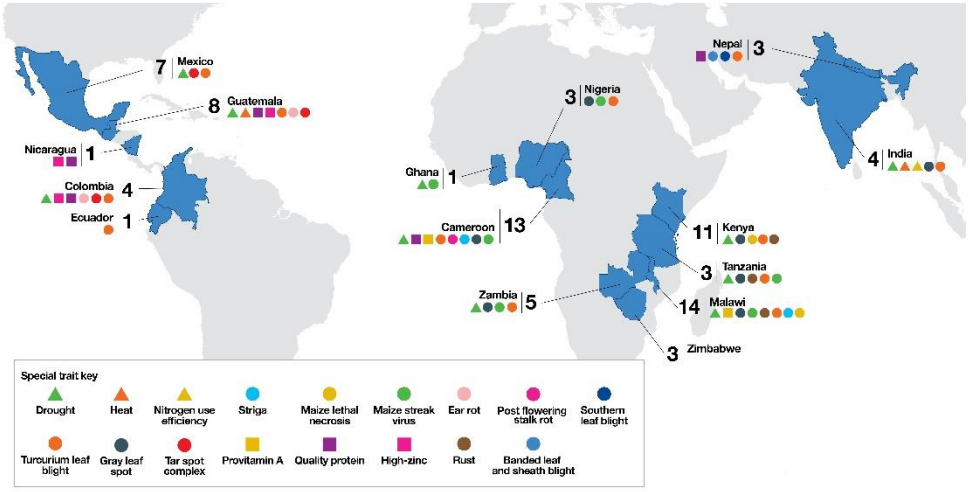


Figure 1: Elite maize varieties released by MAIZE CRP partners in 2018, with depiction of key traits.

For an interacive version of the MAIZE 2018 Variety Release Map please click here.

With both public and private sector partners, MAIZE made strides in combating Maize Lethal Necrosis (MLN), from providing capacity building to partners on preventing the spread of the disease to releasing four new MAIZE-derived MLN tolerant maize hybrids in Kenya. The multi-partner, intensive MLN efforts have paved the way and offer guidance for the more recent battle against the fall armyworm, which has been marching across Africa since 2016 and is now spreading throughout Asia. MAIZE has worked alongside regional and international partners to launch the FAW Consortium, an integrated pest management guide, trainings and videos, to support smallholder farmers in fighting against this devastating insect pest.

Scientists tested scaling out and up approaches, making use of the 'Scaling Scan' in ongoing R4D projects. Thanks to a collaboration with IIASA, Mexican farmers can use the mobile farmer App "agrotutor" to register and geo-locate field parcels and crops, document use of sustainable intensification technologies and track their farming activities including costs and products used.

1.2.2 Progress by flagships

FP1 Enhancing MAIZE's R4D Strategy for Impact

Adoption impact studies for future targeting: In Ethiopia, studies found that improved maize adoption has a positive impact on per capita food consumption and significantly increases the probability of a smallholder being in food surplus, and that land rental vs ownership does not discourage improved crop variety adoption. In Tanzania, higher profits are attained when farmers use PICS bags, PP bags and Shumba for maize storage. MAIZE researchers and partners cited increased maize productivity and fertilizer availability as reasons for increased use of maize in food preparation in Benin. Researchers documented the major maize varieties in India and estimated their adoption rates.

Building capacity in value chains: In an examination of guides for gender-equitable value chain development, MAIZE researchers raise important issues and identify opportunities for designing more inclusive value chain interventions. In Mexico, research suggests the development of local markets that are economically equitable is a viable economic model.

Ex-ante targeting and stress modelling: Researchers found that low rates of fertilizer use and improved seed variety adoption can be attributed to landscape factors[2]. Combining the two gives farmers more sustained productivity benefits, though not always, as the Sub-Saharan African landscape is so heterogeneous. A crop growth modelling study quantified the impact of climate change on maize and found combined drought and heat stress tolerance has a benefit at least twice that of either one alone – *See Table 1, SLO 1.1.*

FP 2 Novel diversity and tools for improving genetic gains

Second generation tropicalized haploid inducers (2gtails) for faster and better breeding: MAIZE delivered 2gtails to 15 different organizations in 7 countries in 2018. MAIZE researchers produced 65,384 doubled haploid (DH) lines from 385 populations in 2018, passed onto maize breeders in Africa, Asia and Latin America.

MLN gene editing—discovery and validation of markers: Through a combination of genetic and molecular tools, MAIZE researchers and partners have reduced the number of candidate genes for MLN resistance to only two. Editing of the two candidate genes for MLN resistance is underway.

Double health benefits of provitamin A biofortified maize: Research conducted in 2018 showed that biofortification of maize with provitamin A can reduce aflatoxin load, both improving nutrition and greatly reducing the risk of health complications from vitamin A deficiency and poisonous aflatoxins.

Potential genomic regions associated with cross resistance to stem borers and fall armyworm were found from QTL analyses of 238 F3 lines genotyped using DArTseq SNP.

Genomic regions for high zinc: A study led to identification of 20 single nucleotide polymorphisms (SNPs) associated with kernel-Zn. Researchers further validated these markers in independent mapping populations and in breeding populations to identify three genomic regions, which when selected in breeding populations, led to an 18% improvement of kernel-Zn.

FP 3 Stress tolerant and nutritious maize

The first zinc-enriched biofortified maize varieties in Colombia and Guatemala were released in 2018 by CIMMYT, MAIZE, HarvestPlus and A4NH to improve nutrition. More than 40% of Guatemala's rural population and 22-65% of Colombians are zinc deficient.

The Fall Armyworm R4D International Consortium launched in 2018 with 35 partner organizations to develop and implement a unified plan to fight FAW, which spread to Asia in 2018. MAIZE, USAID and

[2] For example, lack of credit, labor; limited education, information, infrastructure and markets; weak land tenure arrangements; and low risk tolerance; farms and farmers heterogeneous in their behavior. Cited from working paper.

partners released comprehensive manual "Fall Armyworm in Africa: A Guide for Integrated Pest Management".

Continued success in limiting spread of MLN by training partners to diagnose/conduct disease surveys on commercial seeds and MLN phenotyping services, with more than 185,000 germplasm entries screened. Eighteen of the most promising hybrids developed through marker assisted back crossing were advanced to stage 3 trials.

The International Maize Improvement Consortium for Africa (IMIC-Africa) was launched in May 2018 with 25 seed companies and partners to achieve enhanced maize yields and variety replacement in Africa, building off the success of IMIC-Asia and IMIC-LATAM.

Innovations in scientific approaches, methods and tools: Data collected in 2018 showed that use of proximal and aerial sensing tools for phenotyping reduces time and cost of data collection by 25-75% compared to conventional methods.

FP4 Sustainable intensification of maize-based systems for improved smallholder livelihoods

CSISA Phase III and CSISA-MI continued their work with partners and farmers to apply improved technologies and management practices, including new crop varieties and maize intensification. CSISA provided training on operation of the seed drill and power weeder – which could reduce cultivation costs by 50% – for potential service providers and technicians.

The Taking Maize Agronomy to Scale in Africa project (TAMASA) worked with partners to provide fertilizer recommendations to farmers using the Nutrient Expert (NE) decision-support tool. In Nigeria, TAMASA trained 37 extension staff in NE services, benefitting 717 farmers. A win-win collaboration with a major Africa fertilizer company facilitated NE reaching over 10,000 farmers in Nigeria alone.

The Farm Mechanization and Conservation Agriculture for Sustainable Intensification project (FACASI) delivered training for 79 small mechanization service providers across Ethiopia and Zimbabwe, and helped setting up of at least 64 shelling and 17 planting businesses. In Tanzania, research showed 95% of farmers are willing to pay market rates for shelling rental services.

The Buena Milpa project in Guatemala trained 3,331 farmers in 2018 on different maize conservation technologies, including post-harvest techniques, distributing more than 140 silos to improve the post-harvest quality of maize and reduce mycotoxins.

1.2.3 Variance from Planned Program for this year

No research lines were dropped. FPs' impact pathways and Theories of Change (e.g direction) remain unchanged. However, CIMMYT had to suspend their project operations and close their offices in Iran in November, as sanctions made even basic R4D operations impossible.

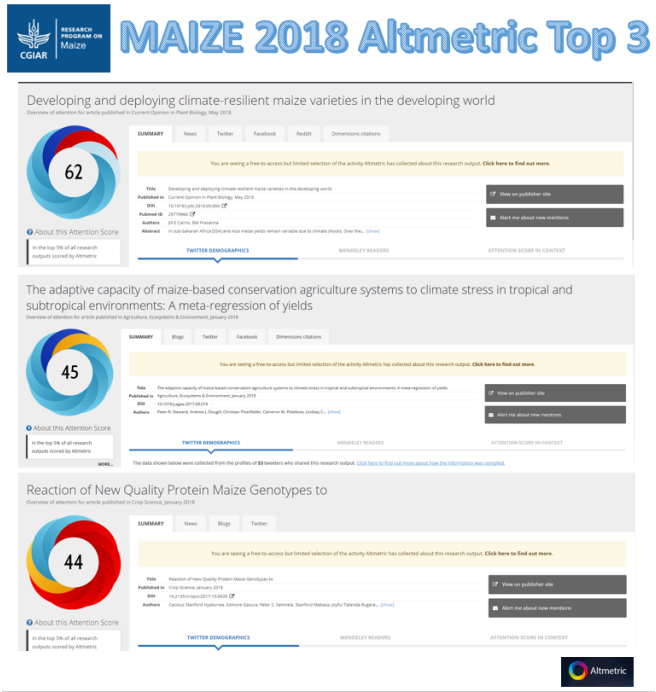
Program research scope. No significant change to overall and per FP research scope.

Program delivery. The Double Haploid Facility, to be established in India, is taking longer than planned. Intensive negotiations during 2018 with the Government of Karnataka led to a Jan 08, 2019 No-Objection Certificate (NOC). The tripartite agreement is under development, to be signed by Karnataka Department of Horticulture (DoH), The University of Agricultural Sciences, Bangalore (UAS-B) and CIMMYT (MAIZE Lead Center).

1.2.4 Altmetric and Publication highlights (max. 400 words, reference Table 6 & Evidence E)

MAIZE research Altmetrics falls under the following categories: news outlets, Twitter, blog sites, peer review sites, Facebook, reddit, citations and number of Mendeley readers.

MAIZE-Management Committee questions whether Altmetric actually reflects impact or only 'empty data resonance' through social media. The Knowledge Management Team plans to correlate Altmetric to existing measures, predict citations from Altmetric, and compare Altmetric with expert evaluation. Please click here for more detail on Altmetric analysis.



1.3 Cross-cutting dimensions (at CRP level)

1.3.1 Gender

A special issue of the Journal of Gender, Agriculture and Food Security comprised six studies drawing on data collected for the GENNOVATE initiative – a CIMMYT-led, cross-CRP global comparative research initiative, part-funded by the CGIAR Research Program on Maize (MAIZE). (See also 2017 Annual Report, p.4 & p.9; GENNOVATE involved 7,000 women and men from diverse backgrounds and varied age groups in 137 rural communities across 26 countries). Some of the learnings about what influences women's and men's agency and how they are empowered to utilize agricultural innovations to improve their livelihoods:

MAIZE and Gender in Nigeria (methods): The case study villages were purposefully chosen to enable the exploration of innovation processes across diverse ethnic, economic, agro-ecological, and gender contexts (publication to be released in 2019).

Gender norms and economic opportunities: New wage labor and agricultural opportunities are emerging in three Tanzanian villages, in which more favorable attitudes of women and, most importantly, of men towards gender equality were observed (publication to be released in 2019).

Policy-wise, there is evidence of gender awareness and gender-sensitive approaches spreading into Ethiopian agricultural research, extension and policy – *see Report Table 2*.

MAIZE remains committed to co-invest with WHEAT and other CRPs in extracting more learning from GENNOVATE case studies and data. As indicated above, several findings will be published in 2019 and in their totality should contribute to influencing MAIZE research direction by 2020. During 2019-2020, the MAIZE Gender Team will assess to what extent the 2017-2018 investments in Gender awareness and competency training across the Flagships has paid off.

Turning the spotlight on masculinities in agricultural research and development: 20 female and 26 male Mexican agricultural extension professionals turned the spotlight on the topic of "masculinities", defined as "a set of attributes, values, and behaviors that are characteristic of being a man in a given

society and time", in a workshop organized by facilitated by Genero y Desarrollo (GENDES) CIMMYT's Gender and Social Inclusion Unit.

1.3.2 Youth and other aspects of Social inclusion / "Leaving No-one Behind[3]"

Launch of 2018 Maize-Asia Youth Innovators Awards. The first MAIZE Youth Innovators Awards, a MAIZE initiative in collaboration with YPARD Asia, aimed to promote youth participation in maize-based agri-food systems. The awards recognized the contributions of young women and men implementing innovations in Asian maize-based agri-food systems, including research-for-development, seed systems, agribusiness, and sustainable intensification. With the annual awards program, MAIZE aims to identify young innovators who can inspire other young people to get involved in maize-based agri-food systems. MAIZE agreed with YPARD to create a platform to allow young maize innovators from around the world to network and share their experiences.

GENNOVATE: Voices of young women and men in agriculture. Rural young GENNOVATE participants predominantly aspire for formal blue and white-collar employment. But many aspirations go unfulfilled, due to lack of access to educational pathways to secure such formal employment. So young people tend to fall back on family agriculture. The researchers discuss implications for agricultural policy and research for development, in terms of catalyzing uptake of agricultural innovation in the study sites. The study also highlights how youth and gender issues are inextricably linked.

As part of the SIMLESA project, researchers in Mozambique have been investigating interests and perceptions of Agriculture among Rural Youth. The survey-based study recommends including youth in the targeting of interventions and taking greater advantage of Information and communication technologies, to better reach out specifically to rural youth and grow their agricultural knowledge. Expansion of the survey base to different African countries resulted in a paper advocating policy change and strategic planning instruments to enable greater investments in rural youth: Promoting Gender and Youth Inclusiveness through AIPs: Voices from SIMLESA.

Leave No-one Behind

MAIZE breeding researchers (CIMMYT, U Florida) have identified two varieties that out-yield any other grown in Haiti in both irrigated and rain-fed conditions – the best bet varieties for the next decade. Haitian farmers have begun to multiply and disseminate these varieties. This work builds on the 2017 distribution of 150 tons of new and improved maize seed to the Caribbean nation, to jump-start its maize seed sector, improve food security and decrease malnutrition. A third of the island's population is 15 or younger; the median age is 25.

Preserving native maize and culture in Mexico. The Chatino indigenous community in humid southern Oaxaca is one of eleven marginalized indigenous communities involved in a CIMMYT-led participatory breeding project that aims to naturally improve the quality and preserve the biodiversity of native maize. The indigenous farmers have been custodians of maize biodiversity since generations. Their maize varieties represent a portion of the diversity of the 59 native Mexican landraces that farmers have diversified through generations of selective breeding.

1.3.3 Capacity Development

Demand for maize in South Asia is rapidly increasing. Bangladesh, Nepal, and Pakistan produce nearly 10 million metric tons of maize annually and nearly all of the hybrid maize seeds have to imported. Often, those seeds are too expensive for smallholder farmers, at US$4-8 per kg. The Nepal Seed and Fertilizer Project (NSAF) is engaging 100+ Nepalese seed companies and service providers in a business

[3] Leaving no-one behind is a key facet of the SDGs: https://unstats.un.org/sdgs/report/2016/leaving-no-one-behind

mentoring process, to equip them with the required skills to run viable and competitive seed businesses. A key project component are digital soil maps. In the future, seed companies and farmers can use them to recommend, or make decisions about input, whose yield impacts in turn depend on site-specific soil properties and variation in agro-ecological conditions. NSAF, with its 5 lead implementation partners, aims to establish a robust seed system that enhances availability and affordability of quality seeds for 340,000 smallholder farmers.

During 2018, the Learning Management System (LMS) was successfully launched. It currently has 2,420 CIMMYT-internal and –external users. LMS has attracted 3,147 visitors to the CIMMYT Academy web portal (fellowships, visiting scientists, internships), is used to manage internal staff training, to archive course material and other functionalities. LMS is being implemented and rolled out at IITA (2019) and, depending on funding, to select NARS partners.

See Table D-2 and click here to see training numbers and analysis

1.3.4 Climate Change

MAIZE R4D incorporates climate change aspects in all its Flagships.

- FP1,2&3: An ex ante study on the **potential of benefits of drought and heat tolerance for adapting maize to climate change in tropical environments** shows that varieties, which incorporate drought, heat and combined drought & heat tolerance have the potential to offset the negative impacts of hotter and/or hotter and drier conditions – *see Table 1, SLO 1.1.*
- FP1&4: Research on **the adaptive capacity of maize-based conservation agriculture systems to climate stress in tropical and sub-tropical environments** finds evidence for Conservation Agriculture for Sustainable Intensification (CASI) enhancing the adaptive capacity of maize-based cropping system to drought stress in the sub-Tropics. See also a study on Climate Smart Agricultural Practices in Bihar (India) – *see Table 1, SLO 3.2.*
- FP3&4: Stress tolerant crop varieties were identified as one of the "10 best bet innovations for adaptation in agriculture" according to a new working paper from the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). As the world's changing climate makes it more difficult to feed a growing population, smallholder farmers need sustainable solutions to improve food security and livelihoods while adapting to the impacts of climate change.

2. Effectiveness and Efficiency

2.1 Management and governance (max. 300 words)

In 2018, MAIZE-Independent Steering Committee (-ISC) recommendations focused on

- future fall armyworm strategy (continue to build coalitions, enable science-based evidence and knowledge sharing);
- alternative or complementary approaches to monitoring breeding research impact on farmers' fields (overcome constraints and hurdles in data collection from NARS partners and seed companies) and
- further developing the breeding product profiles for its target regions (feed, fodder, specialty, nutrition demand-side analysis at regional level).

MAIZE-ISC noted that MAIZE, with its public and private partners, periodically monitors the product profiles-driven pipeline, to determine gaps or overloading and to assess funding potential for the gap

areas - and that only very few larger seed companies invest in products for smaller farmers. MAIZE is filling a gap and addressing market failure.

WHEAT- and MAIZE-MCs decided to re-structure their shared CRPs-PMU effective 1st January, to better streamline routine work processes and associated methods and tools.

W1&2 volatility and unpredictability remained a challenge in 2018. MAIZE-MC maintained a buffering budget. In December, MAIZE learnt that it would receive a budget $518k higher than anticipated. SMO had adjusted W1&2 per CRP FinPlan2018 figures three times during the year.

2.2 Partnerships

2.2.1. Highlights of External Partnerships

The 13th Asian Maize Conference and Expert Consultation on Maize for Food, Feed, Nutrition and Environmental Security, held in October 2018, in Ludhiana, India, brought together 280 maize experts from around the world to discuss the major challenges and opportunities facing maize in Asia. Recommendations included continued focus on enhancing genetic gain, protecting farmers from major emerging threats such as the recent fall armyworm invasion in Asia, strengthening maize seed systems and improving income for smallholder farmers, among others. The conference also saw the launch of the first MAIZE Youth Innovators Awards (see section 1.3.2).

Novel approach to detect aflatoxin-producing fungi in maize fields. 'Detection of Aflatoxigenic and Atoxigenic Mexican Aspergillus Strains by the Dichlorvos–Ammonia (DV–AM) Method; was developed together with Japanese partners and co-funded by MAIZE (W1&2). Using soil samples from a CIMMYT experimental maize field in Mexico, fungal isolates were chemically treated in-line with a method recently developed in Japan, resulting in a color change indicative of toxicity. The method was found to be accurate and effective.

ICAR and CIMMYT have a long-standing partnership. In 2018, both parties agreed on the joint workplan to 2020, whose deliverables include the development, delivery of stress resilient and nutritionally enriched germplasm, sustainable and climate smart agricultural practices, socio-economic analyses and policy recommendations. The plan also covers capacity building on identified areas for benefitting researchers, technicians, students and other stakeholders in South Asia. Linkages will be made with other International Centers and national institutions in Asia.

Fall armyworm (FAW) policy progress: Scientists from the College of Agriculture, University of Agricultural and Horticultural Sciences (UAHS) confirmed the arrival of FAW in South Asia and Bangladesh in particular, which had been forecast by several institutions, including the CGIAR. To formulate an emergency response plan, CSISA convened a workshop with senior officials from USAID, Ministry of Agriculture, Department of Agriculture Extension other Bangladesh NARS partners and IRRI.

2.2.2. Cross-CGIAR Partnerships (300 words)

In the meantime, in Africa**,** CIMMYT and IITA led the setting-up of an International Consortium to connect research with practical field solutions against the pest, to globally roll out a sustainable integrated Fall Armyworm management program, in which 35 organizations have united their efforts in a global coalition of research for development partners.

Partnership around zinc maize improves nutrition in Guatemala. After many years of breeding research, Guatemala's first biofortified zinc maize hybrid, ICTA HB-18, was released in May 2018. It was developed by CIMMYT, the CGIAR Research Program on Maize (MAIZE) and Agriculture for Nutrition and Health (A4NH) and Guatemala's Institute for Agricultural Science and Technology (ICTA), with support from HarvestPlus. Commercialized by Semilla Nueva, the biofortified zinc maize hybrid

contains 6-12ppm more zinc and 2.5 times more quality protein compared to conventional maize varieties.

The Global Crop Diversity Trust looked into the science behind Provitamin A maize, a biofortified maize variety with the power to reduce malnutrition and vitamin A deficiency. Vitamin A deficiency is the leading cause of preventable blindness in children. Approximately one third of children under 5 are at risk. Simply substituting Vitamin A maize for conventional maize can result in a 50 percent increase in Vitamin A consumption in maize-eating regions. The authors explain how the biofortified variety was bred using conventional technique and pointed to the crucial role of genetic diversity and conservation (genebanks) in its development.

2. 3. Intellectual Assets

(a) *Have any intellectual assets been strategically managed by the CRP (together with the relevant Center) this year?*

To support the sub-IDOs on diversification of enterprise opportunities and increasing the use of genetic resources, during 2018 the Lead Center worked towards further standardization and expansion of the hybrid maize product allocation principles and the associated strategic licenses for commercialization. As a result, the Lead Center allocated one or more hybrids to fifty-three different entities across Africa and Asia, in support of the efforts to disseminate research results. Further information can be found at https://www.cgiar.org/wp/wp-content/uploads/2018/10/CGIAR-2017-Intellectual-Asse.

Additionally, to support the sub-IDO on more efficient use of inputs, during 2018 the CRP MAIZE Lead Center started to work (in collaboration with other CGIAR Centers and partners) on the development of open source software that will improve the ability to manage the Center's germplasm, including any IA related restrictions or specific conditions. Once the development is completed, the software solution will be made available to other CGIAR Centers.

Finally, the Lead Center, during 2018 and continuing in 2019, is reviewing its research policies that will support and provide more transparency in different areas, including partnerships and different strategies to disseminate results. Such Policies will be made available to other Centers and the public at large.

(b*) If relevant, indicate any published patents and/or plant variety right applications (or equivalent) associated with intellectual assets developed in the CRP and filed by Centers and/or partners involved in the CRP.*

CIMMYT has not filed, nor has any CIMMYT partner informed CIMMYT, of any application for patent or plant variety protection associated with intellectual assets developed in MAIZE.

(c) *List any critical issues or challenges encountered in the management of intellectual assets in the context of the CRP.*

- Ensure sufficient funding (including sufficient human resources), to implement on a timely basis all actions needed for a proper IA management.
- Lack of IP policies in some NARS; lack of knowledge among NARS of IA management practices at CGIAR Centers and/or insufficient capacity to conduct adequate IA management.
- Collecting, exporting and licensing seed in view of the ITPGRFA and the Nagoya Protocol.
- Some IP policies or practices from certain MAIZE partners are not aligned with CGIAR IA management Policies;
- Harmonization of licensing practices to disseminate digital sequence data with the Open Access obligation, in light of concerns raised among some ITPGRFA stakeholders in relation to the use of such datasets;

- The rising bar for Centers' privacy protection and accountability in the context of dealing with datasets, wherein such data include personal information that carry with them accompanying dissemination obligations under Open Access.

2.4 Monitoring, Evaluation, Impact Assessment and Learning (MELIA)

MAIZE was represented on the steering committee of the MEL CoP in 2018, where it contributed to practical guidance for the common reporting indicators, adjusted POWB and AR templates, development of a CGIAR MEL glossary, and helped generate MEL-related consensus across the CGIAR.

Due to budget restrictions, MAIZE was not able to commission its planned evaluation of FP2. This will be re-considered for 2019, budget permitting.

MAIZE continued its efforts to build project management capacity, conducting two more trainings in 2018. These trainings include sections to strengthen project monitoring, evaluation and learning.

CRP scientists reviewed and reflected on FP theories of change at the end of 2018 based on performance data collected and lessons learned. Best practices have been taken into account for next year.

MAIZE has also conducted regular follow-ups on evaluation recommendations, which are implemented. MAIZE-MC has closed follow-up tracking in 2018 and FP Leads monitor implementation routine (see Table 11).

MAIZE is now fully utilizing MARLO to more strongly link individual projects and areas of research to FP theories of change, as well as more easily plan and budget its work, and monitor research progress. MARLO also helps the CRP to collect important lessons from projects, and incorporate these in program decision making and institutional learning.

2.5 Efficiency

Due to past years' budget uncertainty and shifting donor priorities, it was a challenge for MAIZE to operate within budget and adequate output quality levels. MAIZE has adopted Project Management practices and monitoring and learning tools, to operationalize the following principles:

- Avoid duplication (redundant overlap) with existing projects/ programs;
- Operate within budget even with W1&2 budget volatility and uncertainty;
- Continuous efforts to increase process efficiency and cost effectiveness;
- MAIZE competitive partner grants as an alternative approach for value for money, building partnership and deliver more efficiently.

2.6 Management of Risks to Your CRP

The three major risks identified remained unchanged during 2018:

1. W1&W2 budget insecurity and delayed transfer of W1&2 funds, which directly affects CRP research and development operations;
2. Unfulfilled obligations by the partners for commissioned and competitive grants;
3. Lack of a systematic and integrated approach for monitoring and evaluation at the outcome level.

To mitigate risk (1), the CRP Management Committee gives priority to multi-year investments of centers and partners, and uses the issuing of new partner grants as the most flexible component of the budget. MAIZE continues to sign only one-year partner grant contracts, to manage partner expectations and minimize any delays of payments to them. For risk (2), MAIZE regularly monitors the fulfillment of obligations by partners and intervenes when necessary to ensure proper completion of grant requirements. As for risk (3), the MAIZE and WHEAT counts with the support of a shared Senior Monitoring, Evaluation and Learning Specialist to strengthen the CRP monitoring and evaluation

system. A number of CIMMYT/ MAIZE initiatives were also identified to contribute to minimizing risk, including the implementation of MARLO.

2.7 Use of W1-2 Funding

MAIZE uses W1&2 funding to invest in upstream, discovery and product development focused on research. It is also used resource mobilization at CRP level, for CRP management and governance and to bridge research gaps not covered by bilaterally funded projects within a Flagship. MAIZE is guided by the high-level framework for W1&2 deployment shown below. Table 11 shows in more detail where W1&2 has been invested during 2018, based on the W1&2-per-Cluster of Activities annual work plan.

	Strategic, longer-term research, seed invests	**Rapid response (incl flexibility)**	**Cross-Portfolio, -CRP learning for impact**	**CRP Gov. & Mgmt.**
Discovery (upstream)	FP1, 4: *ex ante* IA & ex post IA / adoption studies for new knowledge for better targeting, prioritizing; ARI, national partners FP2-4: Generate new knowledge for R-to-D pipeline: New alleles for heat and drought, other climate change-related traits identified; GS models using high throughput phenotyping & environmental data	FP3 new diseases & pests: FAW, MLN, Spittlebug	FP2-3: Germplasm improvement methodologies, methods, data mgmt (e.g. Genetic gain, cross-crops) FP4: Research on scaling out, innovation pathways	MAIZE ISC, MAIZE -MC. SMB Board Member (DG), CRPs Rep in SMB, MEL CoP co-leadership
Validation	FP3: New traits into elite lines: Heat & Drought. Precision Phenotyping Platforms with NARS partners; yield testing FP1: draw lessons from the previous MAIZE years and across MAIZE W3/bilateral studies and geographies to identify implications and priorities for enhancing the impact of MAIZE in Phase-II		FP4: Country coordination, systems research approaches; , strategic support to national research programs, private-sector led scaling FP2: develop decision support tools to enhance genetic gains in breeding programs, in partnership with EiB Platform	
Scaling out (downstream)	FP1, 4: Research on adoption dynamics, scaling out, targeting, prioritizing, M&E approaches FP3: Research on farmer adoption, seed systems innovation	FP3-4: post-conflict emergency support	FP3.7, 4.4: Country coordination, companion crops into maize- based systems, capacity development	
CGIAR-SRF Cross-cutting themes	Gender / social inclusion applied to 2 to 4 MAIZE innovation pipelines and assessments rapid value chain assessments with proper gender lens		FP1, 4: AFS-CRPs & CCAFS FP3: MAIZE & A4NH on improved nutrition How to improve gender mainstreaming into research	

3. Financial Summary

Given W1&2 new income uncertainty, MAIZE–MC agreed to budget based on 85% (9.519 M, see table below) of SC- endorsed 2018 allocation ($ 11.2 M). The 2018 W1&2 budget was adjusted in December 2018, when W1 contributions were confirmed and received, to $11.2 M. MAIZE-MC intends to deploy all carry-over from 2018 during 2019.

	2018	
	SMB Approved (100%)	M-MC 85%
CRP Management	1,000,442	1,000,442
IITA	2,822,921	1,760,808
CIMMYT	6,586,815	5,968,926
Partners	789,823	789,823
Total	11,200,000	9,519,999

B. TABLES

Introduction: This template now distinguishes between **'Report Tables'** that are required to be attached to the CRP Annual Report and **'Evidence Tables'** that are not required to be attached. **Report Tables** (generated by CRPs, usually from the MIS, and included as attachments to the narrative report) include:

Table 1: Evidence on Progress towards SRF targets (Sphere of interest)

Table 2: Condensed list of policy contributions in this reporting year (Sphere of Influence)

Table 3: List of Outcome/ Impact Case Reports from this reporting year (Sphere of Influence)

Table 4: Condensed list of innovations by stage for this reporting year

Table 5: Summary of status of Planned Outcomes and Milestones (Sphere of Influence-Control)

Table 6: Numbers of peer-reviewed publications from current reporting period

Table 7: Participants in CapDev Activities

Table 8: Key external partnerships

Table 9: Internal Cross-CGIAR Collaborations

Table 10: Monitoring, Evaluation, Learning and Impact Assessment (MELIA)

Table 11: Update on Actions Taken in Response to Relevant Evaluations

Table 12: Examples of W1/2 Use in this reporting period (2018)

Table 13: Platform Financial Report

Evidence Tables (generated by SMO from evidence input by CRPs into MIS and included in CLARISA) include:

- Table: Full list of Policy Contributions - Common Reporting Indicator
- Table: Full list of Partners - Common Reporting Indicator
- Table: Full list of innovations -Common Reporting Indicator
- Table: Altmetrics - Common Reporting Indicator
- Table: List of capacity development activities (with numbers of participants),
- Table: Milestones
- Table: List of activities funded by W1/2 funding

Table 1: Evidence on Progress towards SRF targets (sphere of interest) (Report Table)

Please complete this table as best you can based on solid evidence, such as findings of published adoption or impact studies.

SLO Target (2022)	Brief summary of new evidence of CGIAR contribution Please click on hyperlinks for access to publications	Evidence
1.1. 100 million more farm households have adopted improved varieties, breeds, trees, and/or management practices	Ex ante, global, germplasm improvement: Combined hotter and drier climate change scenarios (more warming, less rainfall) result in greater average simulated maize yield reduction than hotter only climate change scenarios. Incorporating drought, heat and combined drought & heat tolerance into benchmark varieties increases simulated maize yield under both the baseline and future climates. Average simulated **benefit from combined drought & heat tolerance was at least twice** that of heat or drought tolerance and increased with the increase in warming levels. The magnitude of the simulated benefits and potential acceptability of the varieties by farmers varied across sites and climate scenarios, indicating the need for proper targeting. Ex post: After El Niño, model based, concerning 0.8 million Ethiopian maize producing households indicates they doubled their yields with heat- and drought-tolerant varieties – an economic value of US$30 million. Major success factor was the replacement of old, climate-vulnerable maize varieties with improved climate-resilient hybrids. Ex post: Adoption of improved maize varieties increased per capita food consumption (3.3% points), and probability of a smallholder being in food surplus (by 1.8% points) in Ethiopia. Increased adoption of improved maize has contributed significantly to the households' food security, confirming the role of crop improvement in contributing to food security of agrarian households. Based on sample of 2327 maize producing households in 39 districts. Land ownership and technology adoption revisited: Improved maize varieties in Ethiopia In maize-producing Ethiopia, improved varieties are popular also among the farmers not owning land. While land rental does not affect crop variety adoption of cash-renters, it encourages adoption by sharecroppers. As the farmers renting land for cultivation are relatively poorer and vulnerable to yield variations, this finding suggests significant livelihood implications. Based on data from Ethiopian maize farmers in 4 regions covering 93% total maize production. – also relevant to SLO 1.2. Adoption of modern maize varieties in India: Insights based on expert elicitation methodology: Maize germplasm contributions from CIMMYT helped to expand the genetic base and productivity of a number of modern varieties,	Link here, here, and here here

	reaching an estimated 3.9 million farmers. While promising public sector hybrids have not reached the farmers' fields as intended, mainly due to lack of seed availability, private sector maize hybrids have successfully diffused to mainly commercial farmers' fields (feed, other), on account of strong marketing initiatives. The area under modern maize varieties and hybrids varied from about 57% (Rajasthan and Uttar Pradesh) to as high as 98% (Andhra Pradesh and Karnataka). 2) Targeting, policy, ex ante: Seeding eastern Africa's maize revolution in the post-structural adjustment era: A review and comparative analysis of the formal maize seed sector: The regional seed sectors evolved at different speeds and in different directions, driven by diverging agricultural growth opportunities and varying degrees of regulation, liberalization and restructuring. Despite the regional diversity, there are some similarities, including a proliferation of private seed companies, an increasing emphasis on hybrid maize seed and the emergence of national seed traders' associations to help organize the increasingly complex and evolving maize seed sector. A number of market failures hamper maize seed markets in the sub-region. The mid-term goal should be to create an enabling environment for private seed companies, allowing them to service the diverse farmer communities, for them to adopt and benefit from existing and future improved maize varieties.	here here
1.2. 30 million people, of which 50% are women, assisted to exit poverty	Ex post, Ethiopia: Farm- and market-level impacts of multiple technology adoption choices using comprehensive household survey data. Improved technology set choices have significant impacts on farm-level maize yield and maize production costs; greatest effect generated when various technologies are combined. Change in maize yield and production costs results in an average 26.4% cost reduction per kilogram of maize output = increases producer and consumer surpluses by US$ 140 and US$ 105 million p.a., respectively = changes in economic surplus help to reduce # poor people by an estimated 788,000 per year. Ex ante; Ex ante; Maize lethal necrosis disease: Evaluating agronomic and genetic control strategies for Ethiopia and Kenya. With MLN threat ongoing, the food and economic security of maize-based agrarian economies in eastern Africa will critically depend on the successful mainstreaming of MLN tolerance in their maize seed systems. The study concludes that scaling MLN-tolerant germplasm proves highly viable, with estimated multiplier benefits of US$245-756 million in Ethiopia and US$195-678 million in Kenya, and benefiting up to 2.1 million people in Ethiopia and 1.2 million in Kenya. **Ex post, Nigeria, DTMA:** Welfare impacts of improved maize varieties: Survey about the impact of improved maize varieties in Nigeria showed a 6% reduction in the likelihood of poverty incidence in the communities studied. Note: Over 80% of Nigerian farming households are smallholders (World Bank, 2017, link provided) and they produce an estimated 70% of total maize production (Agra, IITA). Estimated rural population is 50% of 202 million (World Bank, CIA, 2017/18). **Ex post, qualitative:** Gender and equitable benefit-sharing mechanisms through agricultural innovation platforms in Rwanda. Study shows how women in Rwanda are getting equitable sharing of benefits supported by social, policy and capacity factors, by the integration of agricultural innovation platforms.	Here Here Here, Here, Here and Here Here

	Ex post impact of conservation agriculture (CA): Using survey data from rural households in 9 SSA countries, shows that adoption of a CA technology significantly increases household income and income per adult equivalent in the maize systems. Disaggregating the CA components, authors found that **adoption of the components in combination is associated with larger income gains** than when the components are adopted in isolation, and the largest effect is achieved when households implement the three practices jointly (Tambo and Mockshell 2018). Note: MAIZE targets 6.8 million households in 8 SSA countries (Phase II Proposal, SLO targets 1.1 & 1.2) **Ex ante**, impacts of minimum tillage (MT) on crop yield and crop income in Zambia: Based on 751 fields, of which 17% were under MT. Adopting MT associated with an average yield gain for maize, groundnut, sunflower, soybean and cotton of 334 kg/ha; had no significant effects on crop income (from sales and for subsistence) in the short-term. If the longer-term productivity gains from MT are large enough, may offset the higher implementation costs of MT due to economies of scale and may eventually result in improved incomes and food security.	Here Here
2.1. Improve the rate of yield increase for major food staples from current <1% to 1.2-1.5% per year	**Ex ante, global, germplasm improvement:** Average simulated **benefit from combined drought & heat tolerance was at least twice** that of heat or drought tolerance and increased with the increase in warming levels – *see above under 1.1.* In **Nigeria**, adoption of **improved maize varieties** increased maize grain yield by 574 kg/ha – *see above under 1.1.*	Here
2.2. 30 million more people, of which 50% are women, meeting minimum dietary energy requirements	**Ex post: Adoption of improved maize varieties** increased per capita food consumption (3.3% points), and probability of a smallholder being in food surplus (by 1.8% points) and decreased food insecurity (2.5%) in Ethiopia, which is home to 9 million maize-producing households– *see 1.1.*	Here
2.3. 150 million more people, of which 50% are women, without deficiencies in one or more essential micronutrients	N/A	

3.1. 5% increase in water and nutrient efficiency in agroecosystems	**Ex post, targeting, methods**: Ion exchange resin samplers to estimate nitrate leaching from a furrow irrigated wheat-maize cropping system: Study a estimated NO3-N leaching losses for 3 tillage-straw management systems in the intensely cropped Yaqui Valley, Northern Mexico using ion exchange resin samplers. As 19% of N applied to wheat and 34% of N applied to maize was lost through leaching, farming practices that could lower the risk of nitrate contamination during cropping should be promoted. Further multi-annual studies needed, to assess the effects of reduced irrigation, climatic variation and different fertilizer application on nutrient leaching in different tillage-straw systems. **Ex post, adoption, IA**. Improved water-management practices: empirical evidence from rural Pakistan: Shows that rural households mainly adopted 4 water-management practices and that the wealth, education, and gender of the farmer (male) positively influences the adoption of improved water-management practices. **Adoption of improved water-management practices improves wheat and rice yields, household income and food security levels, reduces poverty levels**. Higher food security levels for adopting households, in range of 3–12%, higher yields and higher household income levels, in the range of rupees 2,573–4,926, lower poverty levels (2–7% range). Agricultural policy should promote improved water-management practices among rural households.	Here Here
3.2. Reduction in 'agriculturally'-related greenhouse gas emissions by 5%	**Ex ante IA**. Researchers show, based on data from a long-run field trial, India, that conservation agriculture and diversified crop rotations in maize systems have significant potential to ensure food security, restore of soil health and climate change mitigation. CA-based Zero-till and Permanent Bed practices, coupled with diversified maize-based cropping systems, effectively enhanced maize yield and soil carbon sequestration (SOC), as well as water- and energy-use efficiency, in northwestern India.	Here and Here
3.3. 55 M ha degraded land area restored	Changes in soil biology under conservation agriculture based sustainable intensification of cereal systems in Indo-Gangetic Plains- https://doi.org/10.1016/j.geoderma.2017.10.041	Here
3.4. 2.5 M ha forest saved from deforestation	N/A	

Table 2: Condensed list of policy contributions in this reporting year (Sphere of Influence)

Name and description of policy, legal instrument or investment	Level of Maturity	Link to sub-IDOs	CGIAR cross-cutting markers				Whose policy is this	Geographic Scope	Evidence(s)
			Gender	Youth	CapDev	Climate Change			
N/A									

Table 3: List of Outcome/ Impact Case Reports from this reporting year (Sphere of Influence)

Title of Outcome/ Impact Case Report (OICR)	Maturity level	Status	SRF Targets	Sub-IDOs
OICR2744 - Uptake and use of gender research methodologies, approaches and tools from the project "GENNOVATE" by agriculture researchers worldwide	Level 1	New Outcome/Impact Case	# of people, of which 50% are women, assisted to exit poverty	• Improved capacity of women and young people to participate in decision-making • Gender-equitable control of productive assets and resources
OICR2800 - Fast-tracking maize varietal replacement in Ethiopia.	Level 2	New Outcome/Impact Case	# of more farm households have adopted improved varieties, breeds or trees	• Adoption of CGIAR materials with enhanced genetic gains • Increased resilience of agro-ecosystems and communities, especially those including smallholders

Title of Outcome/ Impact Case Report (OICR)	Maturity level	Status	SRF Targets	Sub-IDOs
			# of people, of which 50% are women, assisted to exit poverty	
OICR2801 - Improved drought tolerant maize varieties have led to improved yields and livelihoods in Nigeria	Level 1	New Outcome/Impact Case	# of more farm households have adopted improved varieties, breeds or trees # of people, of which 50% are women, assisted to exit poverty	• Adoption of CGIAR materials with enhanced genetic gains • Increased resilience of agro-ecosystems and communities, especially those including smallholders

Table 4: Condensed list of innovations by stage for this reporting year

Title of innovation	Innovation type	Stage of innovation	Description of Stage reached	Lead organization	Top five contributing partners	Geographic Scope
251 - Out-yield hybrids selected for the three agricultural environments of Mexico: lowland tropical, subtropical and highlands.	Genetic (varieties and breeds)	Stage 1: discovery/ proof of concept (PC - end of research phase)	47 hybrids selected due to their competitive yield and favorable agronomic characteristics in comparison with commercial-testers (three-to-nine evaluation sites). In 2019, yield-validation-trials will be carried out in more than 40 locations. In 2020, the competitive hybrids from the validation-trials can be released to the project seed-companies. lowland tropical (WHITE MAIZE: CLTHW16138, CLTHW16135, CLTHW16136, CLTHW16133, CLTHW15141; YELLOW MAIZE: CLTHY16002, CLTHY161155, CLTHY16003, CLTHY16031) subtropical(WHITE MAIZE: CSTHW17396,CSTHW17405; YELLOW MAIZE: CSTHY17407, CSTHY17411) and highlands (WHITE MAIZE:CHLHW16007, CHLHW16013; YELOW MAIZE: CHLHY16018, CHLHY16016) resulted in the 47 hybrids under Different Commercial Names	Centro Internacional de Mejoramiento de Maíz y Trigo	• INIFAP - Instituto Nacional de Investigaciones Forestales, Agricolas y Pecuarias • UACh - Universidad Autónoma Chapingo • SEMUAC - Semilleros Mexicanos Unidos AC • AMSAC - Asociación Mexicana de Semilleros A.C.	**Sub-national** Mexico

Title of innovation	Innovation type	Stage of innovation	Description of Stage reached	Lead organization	Top five contributing partners	Geographic Scope
252 - 5 hybrids of high yield potential for the seed sector of Mexico	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Five hybrids were selected to be released to the project (MasAgro Maize) seed companies. These hybrids are competitive in terms of yield and agronomic characteristics compared to commercial testers. The hybrids to be released are two for lowland tropical, two for subtropical and one for the highlands of Mexico´s mega-environments. derived from CSL1668, CSL1661, CSL1619, CLWN871, CLWN879, CLWN829, CLYN752 CLYN748 hybrids under Different Commercial Names	Centro Internacional de Mejoramiento de Maíz y Trigo	• INIFAP - Instituto Nacional de Investigaciones Forestales, Agricolas y Pecuarias • UACh - Universidad Autónoma Chapingo • SEMUAC - Semilleros Mexicanos Unidos AC • AMSAC - Asociación Mexicana de Semilleros	**Sub-national** Mexico
253 - 4 new out-yield hybrids of CIMMYT in the Mexican maize seed market.	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	MasAgro-Maize project has released more than 40 maize hybrids and varieties to Mexican seed sector . In 2018, 41 CIMMYT hybrids and varieties produced and sold by the MasAgro-Maize seed companies, including four hybrids, which were integrated for the first time into the Mexican maize seed market.	Centro Internacional de Mejoramiento de Maíz y Trigo	• INIFAP - Instituto Nacional de Investigaciones Forestales, Agricolas y Pecuarias • UACh - Universidad Autónoma Chapingo • SEMUAC - Semilleros Mexicanos Unidos AC • AMSAC - Asociación Mexicana de Semilleros	**Sub-national** Mexico

Title of innovation	Innovation type	Stage of innovation	Description of Stage reached	Lead organization	Top five contributing partners	Geographic Scope
Improved multiple stress tolerant varieties that effectively address emerging and future production challenges.	Genetic (varieties and breeds)	Stage 4: uptake by next user (USE)	N/A	International Institute of Tropical Agriculture	• INERA - Institut de l'Environnement et de Recherches Agricoles • IAR&T - Institute for Agricultural Research & Training • ZARI - Zambia Agriculture Research Institute • CCRI - Cereal Crops Research Institute • EIAR - Ethiopian Institute of Agricultural Research	**Regional** Sub-Saharan Africa / Western Africa
323 – 68 Hybrids offcially released/registered for commeciali-zation	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Among the released/registered hybrids two are take-up by producers, including RCRMH-2 released by UAS-Raichur, India, sub-licensed to Mahyco, India and commercialized in Karnataka & Maharashtra states of India with commercial name "MRM-4070" and Lall-454 is registered by LALL Seeds Odisha, India and commercialize with same name in Odisha, India.. licensed under different commercial names derived from following lines: CIM17MHS02 , CIM17MHS16, CAH1418, S99TLYQ-B, Across 9331 RE, Across 9942 x Across 9944	Centro Internacional de Mejoramiento de Maíz y Trigo	• BAU - Bihar Agricultural University • Mahyco • NARC - Nepal Agricultural Research Council • BARI - Bangladesh Agricultural Research Institute	**Regional** Southern Asia

Title of innovation	Innovation type	Stage of innovation	Description of Stage reached	Lead organization	Top five contributing partners	Geographic Scope
325 - Three CIMMYT Maize Lines (CML) released	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Enough seed of all three released CMLs produced and available on demand through CIMMYT Gene bank, El Batan, Mexico, climate relsilent for Asia : CML578, CML-579 and CML-580	Centro Internacional de Mejoramiento de Maíz y Trigo	CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo	**Global**
327 - Field manual for drought phenotyping	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	The protocol for quantitative management of drought stress in field phenotyping developed and published as hard and soft copy through CIMMYT website.	Centro Internacional de Mejoramiento de Maíz y Trigo	CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo	**Global**
328 – 5 Sanility tolerant hybrids selected based en performance	Genetic (varieties and breeds)	Stage 1: discovery/ proof of concept (PC - end of research phase)	A set of 305 experimental hybrids were evaluated under managed salinity stress at International Center for Bio-saline Agriculture (ICBA). Top-ranking 5 promising crosses identified, enough seed multiplied and shared with partners in Bangladesh (BARI and BRAC) for on-farm multilocation evaluation.	Centro Internacional de Mejoramiento de Maíz y Trigo	ICBA - International Center for Biosaline Agriculture	**Regional** Southern Asia
351 - Intercropping with green manure cover crops (GMCC)	Production systems and Management practices	Stage 1: discovery/ proof of concept (PC)	So far we have tried them in clustered research trials on-farm and have extended them to 1000 baby trials	Centro Internacional de Mejoramiento de Maíz y Trigo	CRS - Catholic Relief Services	**National** Zimbabwe

Title of innovation	Innovation type	Stage of innovation	Description of Stage reached	Lead organization	Top five contributing partners	Geographic Scope
441 - Maize genotypes resistant to the devastating Corn Stunt Complex disease	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	The new lines that are resistant to Corn Stunt Complex are ready for distribution to interested partners.	Centro Internacional de Mejoramiento de Maíz y Trigo	CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo	**Global**
442 - Biological control product for controlling aflatoxin contamination in maize grain	Ag. Practices)	Stage 3: available/ ready for uptake (AV);	Technology is ready to be adopted at any and all locations.	Centro Internacional de Mejoramiento de Maíz y Trigo	CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo	**Global**
449 - Fine mapping of resistance against maize lethal necrosis (MLN)	Genetic (varieties and breeds)	Stage 1: discovery/ proof of concept (PC - end of research phase)	Gene candidate for MLN resistance identified. Editing in susceptible lines underway.	Centro Internacional de Mejoramiento de Maíz y Trigo	*Not defined*	**Regional** Sub-Saharan Africa / Eastern Africa Sub-Saharan Africa / Middle Africa Northern Africa
475 - New maize breeding objectives based on a comprehensive	Social Science	Stage 3: available/ ready for	The research has led to a major publication in Global Food Security	Wageningen University and Research Centre	• CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo	**Regional** Sub-Saharan Africa

Title of innovation	Innovation type	Stage of innovation	Description of Stage reached	Lead organization	Top five contributing partners	Geographic Scope
understanding of users' preferences for maize products in Africa		uptake (AV);			• WUR - Wageningen University and Research Centre	
478 - Determinants of maize cultivation in a land-scarce rice-based economy in Bangladesh	Social Science	Stage 3: available/ ready for uptake (AV);	peer reviewed journal article available highlighting key results	Centro Internacional de Mejoramiento de Maíz y Trigo	CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo	**National** Bangladesh
485 - New Varieties adopted: Mayi Plus 1 FP3	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Mayi Plus 1 and Mayi Plus 2 were the varieties selected from trials established over the last 2 years across many areas of Haiti. In 2018, seed increases have already been carried out. Haitian farmers are producing and disseminating their own improved seed..	Centro Internacional de Mejoramiento de Maíz y Trigo	• ORE - Organization for the Rehabilitation of the Environment • AUC - American University of the Caribbean School of Medicine	**Sub-national** Haiti
485 –a- New Varieties adopted: Mayi Plus 2 FP3	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Mayi Plus 1 and Mayi Plus 2 were the varieties selected from trials established over the last 2 years across many areas of Haiti. In 2018, seed increases have already been carried out. Haitian farmers are producing and disseminating their own improved seed..	Centro Internacional de Mejoramiento de Maíz y Trigo	• ORE - Organization for the Rehabilitation of the Environment • AUC - American University of the Caribbean School of Medicine	**Sub-national** Haiti

Title of innovation	Innovation type	Stage of innovation	Description of Stage reached	Lead organization	Top five contributing partners	Geographic Scope
492 - Scaling conservation agriculture-based sustainable intensification systems in Ethiopia	Production systems and Management practices	Stage 4: uptake by next user (USE)	The Ethiopian Ministry of Agriculture has adopted conservation agriculture based sustainable extension package and cascade it to regional agriculture bureaus for implementation starting the small rainy season of 2019. A manual that guides the implementation of CA-based sustainable intensification is developed and distributed in local language.	Centro Internacional de Mejoramiento de Maíz y Trigo	• MoANR - Ministry of Agriculture and Natural Resources (Ethiopia) • EIAR - Ethiopian Institute of Agricultural Research	**National** Ethiopia
493 - Use of high-throughput color sorting technology to enrich source breeding populations for deep orange color required for maize varieties containing high pro-vitamin A content.	Methodological/tools	Stage 1: discovery/ proof of concept (PC - end of research phase)	We have established partners for the collaboration proof-of-concept.	Centro Internacional de Mejoramiento de Maíz y Trigo	• Bayer Crop Science • Purdue University	**Global**
494 - Seed Production Technology	Genetic (varieties and breeds)	Stage 2: successful piloting (PIL - end of piloting phase)	The SPT technology system is based on a gene, Ms44, which has been tested in African adapted hybrids in African conditions both on farm and on station. The hybrid concept consistently gives a 4 to 5 percent yield advantage over near isogenic comparison hybrids.	Pioneer Overseas Pvt Ltd	• CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo • KALRO - Kenya Agricultural and Livestock Research Organization	**Regional** Sub-Saharan Africa

Title of innovation	Innovation type	Stage of innovation	Description of Stage reached	Lead organization	Top five contributing partners	Geographic Scope
					• ARC - Agricultural Research Council	
498 - Foresight for Maize and Wheat	Social Science	Stage 1: discovery/ proof of concept (PC - end of research phase)	As part of the work to derive a strategy for foresight and ex-ante impact assessment presentations on the topic are given at relevant forums.	Centro Internacional de Mejoramiento de Maíz y Trigo	• CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo • IITA • ICARDA	**Global**
540 - The Scaling Scan	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	The tool "The Scaling Scan" is available and ready for uptake by CIMMYT staff, partners and general public. First, it was proofed and then it was piloted in different projects.	Centro Internacional de Mejoramiento de Maíz y Trigo	SNV - Netherlands Development Organisation	**Global**
549 - molecular purity test of seed	Methodological/tools	Stage 3: available/ ready for uptake (AV);	The objective of introducing molecular seed quality test to the seed companies is to increase the awareness about the importance of quality seed for seed business and increasing productivity of maize in Africa.	Centro Internacional de Mejoramiento de Maíz y Trigo	• KALRO - Kenya Agricultural and Livestock Research Organization • NARO - National Agricultural Research Organisation	**Regional** Sub-Saharan Africa / Eastern Africa
574 - Customized GS training set development	Methodological/tools	Stage 1: discovery/ proof of concept	Proof of concept completed and method appears promising.	Centro Internacional de Mejoramiento de Maíz y Trigo	Cornell University	**Global**

Title of innovation	Innovation type	Stage of innovation	Description of Stage reached	Lead organization	Top five contributing partners	Geographic Scope
		(PC - end of research phase)				
575 - High value markers linked to major gene for MLN tolerance in maize.	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	High value, high quality markers have been deployed for use for breeding for MLN tolerance in maize. The markers have been made available for use through the HTPG project of EiB and have been successfully used by the CIMMYT GMP team in east Africa.	Centro Internacional de Mejoramiento de Maíz y Trigo	• Corteva • OSU - The Ohio State University	**Regional** Sub-Saharan Africa
577 - Precision fertilizer application for smallholders	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Advanced stage in India, semi-advanced in Nepal, still in research stage in Bangladesh	Nepal Agricultural Research Council	• BARI - Bangladesh Agricultural Research Institute • CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo • ICAR - Indian Council of Agricultural Research • NARC - Nepal Agricultural Research Council	**Regional** South-Eastern Asia
579 - Integrated weed management (IWM) complex weed flora in rice, maize, and wheat	Production systems and Management practices	Stage 2: successful piloting (PIL - end	Details are available in annual reports found here: https://csisa.org/annual-reports/	Bangladesh Rice Research Insitute	• NARC - Nepal Agricultural Research Council • CIMMYT - Centro Internacional de	**National** Bangladesh

Title of innovation	Innovation type	Stage of innovation	Description of Stage reached	Lead organization	Top five contributing partners	Geographic Scope
		of piloting phase)			Mejoramiento de Maíz y Trigo	
581 - Multiple disease management innovations	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	Details are available in annual reports found here:https://csisa.org/annual-reports/	Nepal Agricultural Research Council	• CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo • BARI - Bangladesh Agricultural Research Institute • DAE - Department of Agriculture Extension (Bangladesh) • ICAR - Indian Council of Agricultural Research	**Regional** South-Eastern Asia
582 - Scale-appropriate mechanization innovations (Multiple)	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Details are available in annual reports found here:https://csisa.org/annual-reports/	International Development Enterprise	• ICAR - Indian Council of Agricultural Research • BARI - Bangladesh Agricultural Research Institute • BRRI - Bangladesh Rice Research Insitute • CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo • IDE - IDE Nepal	**Regional** South-Eastern Asia

Table 5: Summary of status of Planned Outcomes and Milestones (Sphere of Influence-Control)

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
FP1	FP1 Outcome: 1.8 National and regional policy makers improved policy-making and increased investment based on evidence **CC** Increase capacity of beneficiaries to	Highlights foresight/targeting studies to inform policy: -abiotic stresses (drought/heat), weather risk and climate change implications for maize in Africa and South Asia -maize lethal necrosis ex ante analysis of agronomic and genetic interventions Africa	2018 - Targeting incorporates competition for land and spatial dimensions of soil & water degradation	Complete	Published 7 papers 2018 -CSA and targeting DiP https://doi.org/10.1080/09614524.2018.1492516 -Weather risk and innovation benefits SSA AgEcon https://onlinelibrary.wiley.com/doi/abs/10.11... -MLN ex ante AS https://www.sciencedirect.com/science/article... -Potential benefits drought/heat tolerant maize	0	0	1	1

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
	adopt research outputs	-Market potential & targeting biofortified maize in Mexico -review of potential of crop modelling in crop research -synergies between MAIZE foresight/targeting and CRP PIM and Big Data			CRM http://www.sciencedirect.com/science/article/... -drought Ethiopia IJCCSM https://doi.org/10.1108/IJCCSM-12-2016-0179 -crop modelling Agronomy http://www.mdpi.com/2073-4395/8/12/291 -Market potential & targeting biofortified maize Mexico RFM 41, 327-337				
	FP1 Outcome: 1.10 Farmers have greater awareness and access to, and increased adoption and adaptation of improved technologies	Highlights studies to enhance adoption/impact and gender/social-inclusiveness: -MAIZE Impact assessment strategy developed and pragmatically and strategically operationalized; with various 2018 adoptions studies on germplasm and	2018 - Adoption and impact studies on technologies rolling plan based on progress of technologies along the theory of change	Complete	Published 17 papers 2018 9 adoption/impact papers -3xCA: Malawi-IJAS-https://doi.org/10.1080/14735903.2018.1472411; 2xAfrica-LUP-https://www.sciencedirect.com/science/article..., JAEE-https://doi.org/10.1080/1389224X.2018.1429283 -5x maize: 3xEthiopia-JAE-http://dx.doi.org/10.1111/1477-	1	1	1	1

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
	CC Increase capacity of beneficiaries to adopt research outputs	sustainable intensification/CSA innovations. -reviews of remote sensing opportunities for monitoring adoption dynamics -Potential of DNA fingerprinting in Ethiopia for adoption studies. -MAIZE supported gender cross-CRP flagship project (GENNOVATE) brought to completion, with release special issue (Agri-Gender-JGAFS3(1)) and resource materials. -gender research and mainstreaming position created and recruited in S Asia - including linkage with CCAFS.			9552.12221; FS-https://doi.org/10.1007/s12571-017-0759-y; LUP-https://www.sciencedirect.com/science/article...; Nigeria-FS-https://doi.org/10.1007/s12571-018-0772-9; India-AR-https://doi.org/10.1007/s40003-018-0330-x -QPM-Child nutrition Ethiopia-Nutrients-http://www.mdpi.com/2072-6643/10/11/1776 8 gender papers -6x GENNOVATE special issue JGAFShttp://agrigender.net/views/insights-from-wom...;http://agrigender.net/views/collaborative-res...;http://agrigender.net/views/gendered-aspirati...; http://agrigender.net/views/the-GENNOVATE-				

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
					fie...;http://agrigender.net/views/local-normative-c...;http://agrigender.net/views/community-typolog... -Gender-Innovation Platforms Rwanda CP https://doi.org/10.1080/15575330.2018.1496465 -Land-youth Tanzania LE https://uwpress.wisc.edu/journals/journals/le...				
	FP1 Outcome: 1.9 Last mile provider (extension partners, farmer organization, community-based organizations, private sector) increased access and promotion of technologies to	Highlights markets/value chain studies to enhance last mile linkages: -value-chain opportunities in relation to seed systems; mechanization; VC development; innovation; storage - Maize production dynamics and	2018 - Rapid value chain assessments with proper gender lens conducted in selected countries to identify opportunities and bottlenecks in MAIZE	Complete	2018 Published 17 papers Maize Bangladesh-JCI-https://doi.org/10.1080/15427528.2018.1446375 -cereal markets–JADEE-https://doi.org/10.1108/JADEE-09-2017-0088 -review gender-equitable value-chain development guides DiP-https://doi.org/10.1080/09614524.2018.1447550	1	0	1	0

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
	farmers **CC** Increase capacity of beneficiaries to adopt research outputs	opportunities in Bangladesh - Nutritional opportunities MAIZE-AFS, including maize-based foods. Analysis in various countries using secondary data including evolving diets and food security implications. Visiting fellow identified but only available in 2019 Q4. Nutrition and food systems task force initiated at CIMMYT in 2019 building on earlier preparatory work in 2018 (science week; Nutrition Learning Initiative).			-3xValue-chain development JADEEhttps://www.emeraldinsight.com/doi/abs/10.110...; JADEE-http://www.emeraldinsight.com/doi/abs/10.1108...; JADEE-https://www.emeraldinsight.com/doi/abs/10.110... -2xSeed systems – Africa-IFAMR-https://doi.org/10.22434/IFAMR2016.0086; global FS- https://doi.org/10.1007/s12571-018-0825-0 -2xInnovation capacity: ESA-JAEE-https://doi.org/10.1080/1389224X.2018.1439758; LAC-CCTA-http://revista.corpoica.org.co/index.php/revi... -2xMechanization: Kenya-AMAALA49:20-32; ESA-JDS-http://dx.doi.org/10.1080/00220388.2017.13295... -native value chains Mexico-JRS-http://www.sciencedirect.com/science/article/...				

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
					-foods Africa-GFS-https://www.sciencedirect.com/science/article... -storage Benin-AE https://onlinelibrary.wiley.com/doi/abs/10.11... -2xWTP Pakistan-GMCF-https://doi.org/10.1080/21645698.2018.1544831; Ghana-CJAE http://dx.doi.org/10.1111/cjag.12147				
FP2	FP2 Outcome: 2.4 Crop researchers world-wide increased use of novel germplasm and tools for validation, refinement and development of products	Important sets of pre-bred lines and source germplasm was made available for drought tolerance, tar spot disease resistance and maize lethal necrosis tolerance. In addition, progress was made in developing and/or validating novel tools for: 1) discovery and	2018 - Tools and protocols adopted for enhanced efficiency and lower cost of maize doubled haploid (DH) line development in tropical germplasm and environments	Extended	Novel methods to shorten the time required to identify haploid embryos were developed and will be validated and deployed in 2019. These will reduce the cost and/or time of producing DH lines for breeding programs. the discovery research was completed and validation initiated in 2018. Validation and deployment will be completed in 2019.	N/A	N/A	2	2

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
	Adoption of CGIAR materials with enhanced genetic gains	use of novel diversity from germplasm accessions, and 2) enhancing the efficiency of doubled haploid technologies to accelerate breeding progress. Formal capacity development activities, e.g. student thesis projects and formal workshops, are not highlighted in this report, but were/are an important component of FP2 strategy to enhance the effectiveness of MAIZE researchers worldwide.	2018 - Novel alleles, haplotypes and landrace donors identified for at least three priority traits (MLN, TSC and drought) and moved into pre-breeding and/or breeding pipeline	Complete	68 ears from 4 large landrace-based genomic selection pre-breeding populations selected for potential tolerance to drought, heat and low soil nitrogen based on calculated genomic estimate of breeding values - evidenced by breeding trial and analysis files in institutional data repositories. 524 landrace accessions identified using GIS selection with potential for salinity tolerance - evidenced by analysis files in institutional data repositories. Novel allele contributing to drought tolerance identified in landrace germplasm and validated through *in-silico*analysis of trial and expression data - evidenced via draft publication held in internal institutional repository. These landrace donors for MLN, TSC and Drought are listed in the SeeD Product Catalog and are available on	N/A	N/A	2	2

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
					request: https://seedsofdiscovery.org/catalogue/ **MLN:** 13 landraces out of 1000 evaluated were identified as having superior tolerance to MCMV virus, the major component virus of MLN. **TSC:** 2 landraces and 4 CIMMYT populations have been identified with good resistance to Tar Spot Complex. **Drought:** 52 landraces identified as donors for resistance to drought out of over 600 evaluated.				
			2018 - At least 15 early generation pre-bred lines available for TSC and drought, incorporating useful genetic diversity from selected landraces into elite or semi-elite backgrounds	Complete	**Drought:** 32 lines are listed in the SeeD Product Catalog (https://seedsofdiscovery.org/catalogue/) and are available for distribution. These lines were evaluated as testcrosses in multi-year, multi-location trials under managed drought conditions as well as under normal conditions (with irrigation or rain-fed).	0	0	2	2

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
					TSC: 54 lines are listed in the SeeD Product Catalog and are available for distribution. These lines have been screened per se for TSC resistance and evaluated as testcrosses in multi-year, multi-location trials for yield.				
	FP2 Outcome: 2.5 Breeders develop improved varieties more efficiently through greater access and use of documented germplasm and tools Adoption of CGIAR materials with enhanced genetic gains	Strong progress was made in development of improved data management tools for breeding. Genetic markers for use in routine breeding were also deployed during 2018, and a full pipeline of development and validation of additional markers is in progress.	2018 - Established tools and methods that enable more efficient management and utilization of data and knowledge implemented and used by all MAIZE breeders	Complete	Comparison of approaches for genotype driven germplasm selection from germplasm banks for primary phenotypic evaluation for traits of interest conducted and documented, evidenced by a draft publication in internal institutional repository. Release of enhanced Germinate data warehouse (3.4) with new within and cross trial data query capacities, evidenced byhttp://germinate.seedsofdiscovery.org/maize/. Development of a new version of Germinate data warehouse (3.5) facilitating the integration of and query across data from projects subject to different data licensing	N/A	N/A	2	1

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
					terms, evidenced by institutional installation in an internal staging pre-deployment environment Good progress was made in design and development of an enterprise breeding system software for management of breeding programs, integrating use of "big" genomic data. Breeder-ready markers were developed for turcicum leaf blight and maize streak virus. Markers are under development or validation for several additional traits, mainly important diseases.				
FP 3	FP3 Outcome: 3.1 Improved exchange and utilization of germplasm and data by MAIZE partner breeding	Four new MAIZE-derived maize lethal necrosis (MLN) tolerant maize hybrids were released in 2018 in Kenya. 537 tons of certified drought tolerant (DT)+ MLN tolerant maize	2018 - Multiple stress tolerant MAIZE hybrids (with MLN resistance) replace at least 5 dominant but 15+ year old maize varieties in MLN-endemic countries in	Extended	Replacement of 15+ year old maize varieties in MLN-endemic countries in eastern Africa is work in progress. However, 20% yield advantage under heat stress in stage 4 hybrids cohort has been achieved.	0	0	1	0

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
	teams **CC** Increased capacity for innovations in partner research organizations	hybrids were commercialized in eastern Africa. Four new CIMMYT heat-tolerant (HT) maize hybrids allocated to three seed company partners, based on yield advantage of 1.5 tons under heat stress over popular commercial maize hybrid checks in South Asia in Stage 4 trials Three CIMMYT HT maize hybrids released in India in 2018. Nine HT maize hybrids under commercialization in Bangladesh, India and Nepal 70 tons of certified maize seed produced and sold to farmers	eastern Africa; At least 20% yield advantage under heat stress in Stage 4 hybrids cohort relative to popular commercial hybrids grown in the spring season in South Asia.						

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
	FP3 Outcome: 3.2 Effective pest/disease surveillance, monitoring and diagnostics protocols/procedures for controlling the spread and impact of existing/emerging threats Reduce pre- and post-harvest losses, including those caused by climate change	MLN Information Portal and MLN Phytosanitary Community of Practice, established by CIMMYT 242 NPPO staff across 8 countries in ESA trained on MLN diagnostics and surveillance MLN-free seed production and exchange SOPs/Check-lists are presently implemented by 45 seed companies across Eastern Africa A comprehensive IPM manual on FAW published; the manual was further translated into French and Portuguese versions and released in Sept-Oct 2018. FAW R4D International Conference organized in Addis, jointly by CIMMYT,	2018 - A dedicated MAIZE pathogen/pest/parasitic weed web portal and data management system (toolbox) with core databases, established under MAIZE Atlas; Reliable and cost-effective diagnostic protocols for curbing the spread of pathogens (e.g., MCMV) through seed implemented by NPPOs and commercial seed companies in ESA.	Complete	Portal established for MLN, but not FAW- FAO and CABI have separately established Web Portals for Fall Armyworm management, and therefore, not replicated under MAIZE.	0	0	2	0

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
		IITA, CABI, ICIPE, USAID, AUC, FAO, and AGRA FAW R4D International Consortium established jointly by CIMMYT and IITA, with membership of nearly 45 institutions							
	FP3 Outcome: 3.3 Partner breeding teams access and adopt improved breeding processes, including new technologies, methodologies, approaches and genetic resources **CC** Increased capacity for innovations in	Ongoing activities under IMIC-Africa, Asia, LAC (e.g. PPP) and bilateral breeding research collaborations. Doubled haploid(DH) technology optimized and deployed in Sub Saharan Africa, reducing time taken to develop parental lines.	2018 - Precision phenotyping sites, including well-equipped benchmark phenotyping sites and complementary satellite phenotyping sites, established in SSA and South Asia in partnership with public and private sector partners.	Complete	Asia: large heat-stress phenotyping network, 23 sites, 4 Asian countries established. Since 2009, ESA abiotic/biotic screening network expanded to 59 locations across 11 countries. Expanded for managed drought, low nitrogen stress screening. Regional testing network allowed greater selection intensity for stress tolerance, maximized benefits of limited resources.	0	0	1	1

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
	partner research organizations								
	FP3 Outcome: 3.4 Increased deployment of improved MAIZE varieties by seed companies in target agro-ecologies Closed yield gaps through improved agronomic and animal husbandry practices	Approx. 6 tons of breeder, pre-basic and basic seed of CIMMYT maize lines produced in Zimbabwe and Kenya; Approx. 2.2 tons of NPT/hybrid demo seed produced and shared with public/private sector partners in 16 countries across SSA.	2018 - Seed production studies across a range of target seed production environments in collaboration with public/private sector partners; Research into the economics of seed production of single-cross and three-way cross hybrids in SSA.	Complete	Seed production research undertaken on 421 CIMMYT maize parental lines (236 in southern Africa; 185 in eastern Africa), besides more than 50 parental single-crosses, and relevant information shared with seed company partners.	1	0	0	1
	FP3 Outcome: 3.9 Increased availability of nutritious maize with desirable end use quality	A total of 20 MAIZE-derived nutritious maize varieties were released by NARS/seed enterprises, including 7 Provitamin A-enriched varieties (Malawi	2018 - Donor germplasm with kernel carotenoid stability and processing properties identified and shared	Complete	*Prefilled by Flagship*	2	1	1	0

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
	traits to farmers, food and feed producers, and processors Increased availability of diverse nutrient-rich foods	and Cameroon); 6 QPM varieties (Cameroon and Nepal); 6 QPM + high Zn varieties (Guatemala, Nicaragua, Colombia); and 1 high Zn variety in Guatemala. A total of 81 MAIZE varieties (with trait combinations relevant to smallholders in Africa, Asia and Latin America) were released. More than 2 tons of breeder and pre-basic seed of CIMMYT parental lines of commercial climate-resilient hybrids produced and supplied to a basic seed provider for promoting sustainable and quality basic seed to seed companies in ESA	with partners in target countries						
			2018 - Sustainable early-generation seed (breeder, pre-basic, and foundation seed) supply systems promoted, especially in SSA; Deployment of a new seed system management software in regional hubs, linked to institutional phenotypic and genotypic databases, to streamline inventory management, routine QC/QA operations, phytosanitary regulation	Extended	The seed system management software will be developed in 2019, to streamline product flow, inventory management, routine QC/QA operations, phytosanitary regulation compliance, and shipment tracking.	0	0	1	0

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
			compliance, and shipment tracking.						
FP4	FP4 Outcome: 4.9 Smallholder farmers increased their capacity to adopt and adapt SI practices and products (associated with cross-cutting sub-IDO) Increased access to productive assets, including natural resources	Major progress in scaling SI practices have been achieved across the regions (Latin America, Eastern and Southern Africa, South Asia). Detailed progress on the outcome can be found in individual project reports (mainly CSISA, SRFSI, MasAgro, Buena Milpa, TAMASA, SIMLESA). The capacity to adopt is not only through direct interaction with smallholder but through collaboration with a range of stakeholder	2018 - Existing scaling approaches including public/ private partnership and context specific business models evaluated in target geographies leading to improve scaling models and critical scaling factors defined	Extended	See publication list for MAIZE in 2018 plus capcity development/training documents	0	0	1	1
			2018 - adapt precision water mgmt practices w/ use of remote, proximal sensing info	Extended	Prototype application developed for smartphone (PANI) in Bangladesh. Scaling still needs to take place	0	0	1	1
			2018 - optimisation of cropping systems	Extended	More resilient cropping systems in SSA (ESA) through CA based	0	0	1	1

FP	Outcome	Outcome Progress	Milestone	Status	Milestone Evidence	Cross-Cutting Markers			
						Gender	Youth	Cap Dev	Climate Change
			support adaptation to climate change validated in specific MAIZE target geographies		approaches and diversification. Range of Farming Systems analysis tools developed and tested to target specific interventions according to agroecologies and farm types				
	FP4 Outcome: 4.6 Private sector (and public sector) increased provision of services to smallholder farmers to increased their ability to adopt SI practices and products **CC** Increase capacity of beneficiaries to adopt research outputs	Responsible sourcing strategies for various agro-ecologies in Mexico developed and tested. Significant scaling of mechanization option through service provision in Bangladesh and India. Progress on service provision in Eastern and Southern Africa (FACASI)	2018 - Better understand scaling up processes in multi-actor innovation networks, to ensure sustainability of institutional mechanisms, structures	Extended	Needs further scaling in Mexico and other regions where CIMMYT works. CSISA-MI phase funder for further scaling of mech. business model. See reports of GIZ projects in Ethiopia, FACASI in ESA, CSISA and CSISA-MI in South Asia	0	1	1	0

Table 6: Numbers of peer-reviewed publications from current reporting period (Sphere of control)

CIMMYT/IITA pubs list currently includes 172 entries for MAIZE or MAIZE + another CRP or Platform. Please Click Here to see a detailed analysis.

	Number	Percent
Peer-Reviewed publications	172	100%
Open Access	106	62%
ISI	133	77%

Table 7: Participants in CapDev Activities

Please list CapDev activities and participants, following updated guidance.

Please Click Here to see a detailed analysis of MAIZE Cap-Dev Activities.

Column 1	Column 2	Column 3
Number of trainees	**Female**	**Male**
In short-term programs facilitated by CRP	6,562	14,979
In long-term programs facilitated by CRP	77	143

Table 8: Key external partnerships

Please list up to five important partnerships for 2018 for each flagship, using the following table

Lead FP	**Brief description of partnership aims (30 words)**	**List of key partners in partnership. Do not use acronyms.**	**Main area of partnership** dropdown: Research/Delivery/Policy/Capacity Development/Other, please specify _
FP1-4	Fall armyworm Consortium; develop and implement a unified plan to fight this plant pest on the ground in Africa and South Asia	35 organizations, among them CIMMYT, IITA, AGRA, CABI, FAO, icipe, FAO, USAID and the African Union Commission	Research coordination / delivery / policy
FP2-3	Multi-location precision phenotyping platform network for different traits in S. Asia	DMR - ICAR-Indian Institute of Maize Research, BARI - Bangladesh Agricultural Research Institute; MRI - Maize Research Institute of Vietnam, AAU - Anand Agricultural University Bioseed Research India Pvt. Ltd, Bisco Bio Sciences Pvt Ltd, Ajeet Seeds Ltd, Rasi Seeds, IAHS - Indo-American Hybrid Seeds	Research / Cap Dev
	Biological Nitrification Inhibition (BNI) Consortium Global coordination of and implementation of joint research projects focused on BNI, across crops, cropping systems and scientific disciplines. 3rd symposium held in 2018. MAIZE joined in 2018.	Japan International Research Center for Agricultural Sciences (JIRCAS) is lead coordinator. 3 CGIAR Centers (CIAT, ICRISAT, and CIMMYT), collaborating on BNI research. In 2018, total of 13 members, including Chinese Institute of Soil Science (CAAS), Nanjing Agricultural University, Japanese National Agricultural Research Organization (NARO), Texas A&M University, University of Hohenheim, University of Vienna.	Research
	Methods, tools, data storage genetic discovery, genotypic data linked to new breeding management software	Earlham Institute, James Hutton Institute, Cornell University	Cap Dev

FP3	International Maize Improvement Consortium – Africa (IMIC-Africa); enhance members' capacity for germplasm development in their own breeding programs & subsequent multi-location testing of elite pre-commercial maize hybrids throughout sub-Saharan Africa	25 private and public sector seed companies joined for far, to get early access to highly developed material. SeedAssure, a digital platform that gives automatic feedback on compliance and seed production management, along with remedy options.	Delivery / Cap Dev /
	High-throughput genotyping and phenotyping projects partners	USDA, Cornell Uninversity, InterTek, TraitGenetics	Research
FP4	Piloting nutrient management app with farmers	SAA - Sasakawa Africa Association MoANR - Ministry of Agriculture and Natural Resources (Ethiopia) Ministry of Agriculture Livestock and Fisheries (United Republic of Tanzania) IPNI - International Plant Nutrition Institute Fondation OCP, Morocco	Delivery
	Consolidation as a strategic partner, to promote a sustainable intensification in Latin America that promotes combining adequate germplasm, productive practices and management & more direct and reliable relationships between producers and agro-industry.	GRUMA foods company	Delivery

Table 9: Internal Cross-CGIAR Collaborations

Brief description of the collaboration	**Name(s) of collaborating Platform(s), Platform(s) or Center(s)**	**Optional: Value added, in a few words** e.g. scientific or efficiency benefits
High zinc maize for better nutrition (with support from HarvestPlus)	Agriculture for Nutrition and Health (A4NH), Guatemala's Institute for Agricultural Science and Technology (ICTA), , Semilla Nueva	More nutritious diets; biofortified zinc maize hybrid contains 6-12ppm more zinc and 2.5 times more quality protein compared to conventional maize varieties
BPAT, Crops to End Hunger Initiative	EiB and other AFS-CRPs	Cross-crop collaboration on breeding research
Approach to foresight	PIM, other CRPs	Build critical mass, deploy scares resources, joint partnering
Led set-up of International Consortium on FAW to connect research with practical field solutions against FAW; globally roll out a sustainable integrated Fall Armyworm management program, 35 organizations have united their efforts.	CIMMYT and IITA	Capacity building, knowledge exchange

Table 10: Monitoring, Evaluation, Learning and Impact Assessment (MELIA)

Studies/learning exercises planned for this year (from POWB)	Status	Type of study or activity	Comments
S1281 - Strategic research expansion, partner engagement and resource mobilization plan (South East Asia, SEA) (From Project P1072) FP4	On Going	Other	N/A
S1351 - Report on global MAIZE germplasm impact (From Project P969) FP1	On Going	Adoption study: Ex-post adoption survey (at scale)	Completed the first draft and it is under review with the management for dissemination. Most likely by the end of 2019, it will be widely shared and also submitted to a journal for publication
S1601 - Maize variety adoptions through DNA technology in Ethiopia (From Project P857) FP1	On Going	Adoption study: Ex-post adoption survey (at scale)	The project is still on-going but we expect that we will have results on variety adoption soon that will inform breeding and seed systems.
S1611 - The endline survey of maize producers in Ghana (From Project P975) FP1	On Going	Adoption study: Ex-post adoption survey (at scale)	N/A

Studies/learning exercises planned for this year (from POWB)	Status	Type of study or activity	Comments
S1641 - Adoptions and impact of sustainable intensification in maize-legume cropping systems in eastern and southern Africa (From Project P853) FP1FP4	On Going	Adoption study: Ex-post adoption survey (at scale)	N/A
New S2650 - Adoption study: ex post sales survey (From Project P1461) FP3	Complete	Other	In 2018, the seed companies affiliated to the MasAgro Maize project had an impact of 1,023,197 hectares (Mexican market), with a 52% of CIMMYT germplasm.
Ex ante, Bhutan: 6 to 9% poverty levels reduced due to livelihood diversification into non-farm activities. Note: Bhutan has 61,400 farming households (2016, government statistics), growing maize on 23,000 ha. 80% of Bhutan's 0.8 million people engage in agriculture.	Complete	Other	Not a poverty target, but a pathway out of poverty. Multinomial estimation shows that education, asset endowment, labor availability, and sex (male/female) of the household head play vital role in livelihood diversification into non-agricultural sectors. Propensity score matching estimates illustrate that rural households diversifying outside agriculture have higher income and lower poverty levels compared to households pursuing only farming for their livelihoods.

Studies/learning exercises planned for this year (from POWB)	Status	Type of study or activity	Comments
Ex ante: Building pathways out of poverty through climate smart agriculture. Effective targeting of Climate-smart agricultural technologies and practices (CSA) interventions will contribute to poverty reduction by linking smallholder agricultures with alternative interventions, such as social protection.	Complete	Other	Ex ante that shows pathways, potential impact of technologies combinations.
Targeting, value chains, impact pathways: Ghana: Kenkey made with nutritious maize, biofortified with vitamin A with distinct orange color; Study compared estimated willingness-to-pay (WTP) across three mechanisms and how these vary by participation fee: Found no evidence of economically meaningful differences in WTP across elicitation mechanisms, or by	Complete	Other	Example of impact pathway learning.

Studies/learning exercises planned for this year (from POWB)	Status	Type of study or activity	Comments
participation fee. Secondary finding: Providing nutrition information positively and significantly affects the marginal WTP for the new maize.			
Targeting, impact pathway impact assessment: Associations among high-quality protein and energy intake, serum transthyretin, serum amino acids and linear growth of children in Ethiopia: Linear growth failure in Ethiopian children is likely associated with low quality protein intake and inadequate energy intake. Researchers conclude that besides consumption of high quality protein enriched complementary foods, other factors related to health and hygiene or child caregiving	Complete	Other	Example of learning about malnutrition impact pathway

Studies/learning exercises planned for this year (from POWB)	Status	Type of study or activity	Comments
practices and resources, should be taken into consideration. Further longitudinal intervention studies needed, including about whether consumption of high-quality protein enriched complementary foods, such as cereals with increased protein quality (e.g., quality protein maize), increase serum transthyretin and serum amino acid status, which in turn may lead to better linear growth.			
Ex post, IA: Nitrogen Index Tier Zero tool, Zambia: Empirical results suggest that farmers practicing Conservation Agriculture (CA) are environmentally more efficient than conventional farmers. Environmental efficiency is significantly influenced by access to credit, farming	Complete	Other	example of learning about farmer typologies

Studies/learning exercises planned for this year (from POWB)	Status	Type of study or activity	Comments
experience and years of schooling of household head, land ownership and distance to markets. Farmers practising CA are technically more efficient than those using the conventional technology.			

Table 11: Update on Actions Taken in Response to Relevant Evaluations

Not applicable. Tracking of 2014/15 Evaluations closed.

Table 12: Examples of W1/2 Use in this reporting period (2018)

	Strategic, longer-term research, seed invests	Rapid response (incl flexibility)	Cross-Portfolio, -CRP learning for impact	CRP Gov. & Mgmt.
FP1 See pp 5-6	Conduct survey on adoption of improved maize, Ghana; DNA fingerprinting based of varietal identification in farmers's fields, Nigeria	MLN and FAW-related activities: Stakeholder interactions, ex ante impact assessments	Implications of technological, environmental and dietary changes in MAIZE AFS Diversify, strengthen strategic thematic areas for MAIOZE Agrifood Systems (e.g. political Economy, Nutrition, remote sensing opportunities for monitoring dynamics) w/ sabatical visiting scientist	MAIZE-ISC MAIZE-MC SMB CRPs Rep support CGIAR CoPs participation
FP2 See pp 6-7	Provide data curation, data standard development, and database user support towards ensuring FAIR sharing of MAIZE data Phenotype lines selected through high throughput MSV genotyping with artificaial MSV infection	MLN and FAW-related activities: Find novel genetic diversity, gene editing		
FP3 See pp 7-8	Breeding for resistance to key diseases, salinity tolerance, cold stress tolerance, in Asia-adapted maize germplasm Testing of experimental materials and disease screening nurseries, collect information on gains due to genetic improvement in many traits, improved germplasm, improved hybrids, training on yield assessment methods Document genetic gains in hybrids released since 2000	MLN and FAW-related activities: Breeding research	Exploring incorporation of gender-responsive traits in maize breeding and seed systems in ESA Develop capacity for generating field-based multi-location precision phenotyping data for drought/heat stress	
FP4 See p.8 & 10	Develop MAIZE research agenda in South East Asia (partnership resource mobilization strategy/plan) Gain insights on farmers' decision-making related to sustainable intensification Complete evaluation for release of drought tolerant QPM maize	MLN and FAW-related activities: Validate, scale IPM, other agronomic approaches	Rethinking adoption and adoption research (New) Use field data to validate the potential application of CERES-Maize model	

Table 13: CRP Financial Report

	Planned budget 2018			Actual expenditure 2018*			Difference		
	W1/2	W3/bilateral	Total	W1/2	W3/bilateral	Total	W1/2	W3/bilateral	Total
FP1-Enhancing Maize's R4D Strategy for impact	1,405,862	3,509,098	4,914,959	1,384,020	4,135,817	5,519,837	21,841	(626,719)	(604,878)
FP2-Novel Diversity and Tools for increasing Genetic Gains	1,952,893	5,888,123	7,841,016	1,952,374	6,022,054	7,974,428	520	(133,931)	(133,412)
FP3-Stress Tolerance and Nutritious Maize	2,839,856	19,715,955	22,555,812	2,514,207	20,199,618	22,713,825	325,650	(483,663)	(158,013)
FP4-Sustainable Intensification of Maize- Systems for better livelihoods of SH	2,347,056	22,377,397	24,724,453	1,935,874	21,653,748	23,589,622	411,182	723,649	1,134,831
CRP Mgmt & Support Cost	1,493,182	-	1,493,182	755,980	-	755,980	737,202	-	737,202
TOTAL	**10,038,849**	**51,490,573**	**61,529,422**	**8,542,455**	**52,011,237**	**60,553,692**	**1,496,394**	**(520,664)**	**975,730**

* Memo: Actual expenses does not include Carryover & IFRS impact (Deferred Dep´n)