CGIAR Advisory Services

CGIAR Research Program 2020 Reviews: MAIZE

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This evaluation was prepared by a team led by Michel Ragot, providing subject matter expertise, and the evaluation techniques implemented under the authority of Rachel Percy.

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CAS Disclaimer

By design, the CGIAR Results Dashboard was a key source of data for the 2020 CRP Reviews. During the pilot phase of the CRP Reviews, issues with interoperability and resulting data quality between the management information systems (CLARISA and the Dashboard) and extracts from CRP systems (MARLO and MEL) were discovered. For harmonization, CAS engaged with the MARLO team and the CRP MEL focal points to conduct data cleaning and pre-analysis for CRP review teams. This exercise revealed the limitations of CGIAR's reporting/repository systems for evaluation purposes; these limitations were mostly due to changing reporting requirements and discrepancies in whether CRPs adopted MARLO or MEL systems. Moreover, in the case of peer-reviewed journal articles, the protocol used by the CRP review teams to identify relevant publications differed from the guidance applied by CRPs (the CRP review teams' bibliometric analysis used only publications indexed by International Scientific Indexing [ISI], available through Web of Science). Therefore, CAS acknowledges discrepancies between the CGIAR Results Dashboard, and the data provided to the Review teams for their analysis, which should not be seen as a factor having influenced the analysis by the CRP review teams.

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Table of Acronyms

AR	annual report
BMGF	Bill and Melinda Gates Foundation
BMS	Breeding Management Software
CAS	CGIAR Advisory Services
CC	climate change
CD	capacity development
CIAT	Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture)
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo (International Maize and Wheat Improvement Center)
CoP	community of practice
CRP	CGIAR Research Program
DarT	Diversity Arrays Technology
DH	doubled haploid
DMTV	drought-tolerant maize variety
DTMA	Drought Tolerant Maize for Africa
EiB	Excellence in Breeding
EBS	Enterprise Breeding System
EQ	evaluation question
FAW	fall army worm
FP	Flagship Program
GENDER	Generating Evidence and New Directions for Equitable Results
GLS	gray leaf spot
GS	genomic selection
ICARDA	International Center for Agriculture Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDO	Intermediate Development Outcome
IEA	Independent Evaluation Arrangement (CGIAR)
IFAD	International Fund for Agriculture Development
IITA	International Institute of Tropical Agriculture
ILO	International Labor Organization
ILRI	International Livestock Research Institute
ISC	Independent Steering Committee
KALRO	Kenya Agricultural and Livestock Research Organization
KARI	Kenya Agricultural Research Institute
MABC	marker-assisted backcrossing
MARLO	Managing Agricultural Research for Learning and Outcomes
MEL	monitoring, evaluation, and learning
MLN	maize lethal necrosis
MMC	Maize Management Committee
NaCRRI	National Crops Resources Research Institute (Uganda)
NARS	national agricultural research system
NGO	nongovernmental organization
NPPO	national plant protection organization
OICR	Outcome Impact Case Report
PLC	product life cycle
PMU	Program Management Unit
POWB	Plan of Work and Budget
QA	quality assurance
QTL	quantitative trait locus
R&D	research and development
SADER	Secretaría de Agricultura y Desarrollo Rural (Secretary of Agriculture and Rural Development - Mexico)
SDG	Sustainable Development Goal (United Nations)
SFSA	Syngenta Foundation for Sustainable Agriculture
SLO	System Level Outcome
SME	small and medium enterprise
SMO	System Management Office (CGIAR)
SRF	Strategy and Results Framework

STMA	Stress Tolerant Maize for Africa
TLB	turcicum leaf blight
ToC	theory of change
YPARD	Young Professionals in Agricultural Development

Executive Summary

Background and Context on MAIZE

Maize, the world's leading cereal in terms of production, is produced on nearly 200 million hectares across temperate and tropical zones and on all continents. Maize production in tropical and subtropical low- to middle-income countries, on which MAIZE focuses, represents about two-thirds of total maize production and is key to the food security and livelihoods of millions of poor farmers.

The demand for maize is constantly increasing, posing challenges terms of soil erosion, soil fertility loss, land degradation, reliance on fossil fuel–derived energy for synthesis of agricultural inputs, and rural transformation. Climate change brings additional risks and aggravating factors to future crop productivity. The poorest populations will likely be the most impacted.

Viable solutions that involve plant breeding and sustainable intensification can be deployed to meet these significant challenges.

MAIZE implements a strategic international research-for-development (R4D) approach, in collaboration with public and private sector partners worldwide, with the specific goal of increasing incomes and food security for poor maize producers and consumers while enhancing the sustainability of maize-based production systems and the natural resource base.

Purpose and Scope of the CRP 2020 Review

The review's purpose is to assess MAIZE based on its work from 2017 through 2019 with respect to the extent to which it is delivering quality of science, its effectiveness in achieving outputs and outcomes and the importance of those identified results, and the extent to which it is positioned to be effective in the future seen from the perspectives of scientists and of the end users of agricultural research.

The review was designed to deliver top-level findings to its primary audience, the CGIAR System Council, the CGIAR System Organization, the MAIZE CRP management, and the Flagship Program (FP) co-leads, the International Maize and Wheat Improvement Center (CIMMYT) and the International Institute of Tropical Agriculture (IITA).

Approach and Methodology

The two-person team followed a mixed-methods approach, combining quantitative and qualitative evaluation. A utilization-focused approach was also taken in which Program Management Unit members joined several interviews.

In addition to a review of documents and publications and a set of semi-structured interviews, the team carried out in-depth reviews of three CGIAR Research Program (CRP) components (Outcome Impact Case Reports, or OICRs). Qualitative methods were complemented with quantitative bibliometric/Altmetric and performance data analysis. Overall, twenty-four people (21 men and 3 women) were interviewed.

Key Findings and Conclusions

RQ 1: Quality of Science

MAIZE generally operates with satisfactory to very good quality of science. However, objectives, roles, and responsibilities are often not specified in a way that would ensure or maximize success and impact. The existence of market segment prioritizations, product profiles, and a stage-gate system in MAIZE Phase 2 to guide breeding and upstream research efforts represents a clear improvement over MAIZE Phase 1 in spite of insufficient direct involvement of downstream partners in their development or validation. Partnerships are far from equal-to-equal, which creates challenges in terms of flow of information (at both ends of MAIZE activities) and hampers the ability to impact targeted farmers' lives.

Scientific and technology inputs and approaches are generally of high quality, sometimes the world's best, such as in the case of doubled-haploid (DH) production. A few technology choices can be challenged on the basis that they put an unnecessary burden on the working relationship between CIMMYT/IITA and

all other partners. Outputs are also generally of good scientific quality despite some heterogeneity. Communication about outputs emphasizes peer-reviewed publications too heavily at the expense of direct, sufficient, relevant, and tailored communication with next-stage users, in particular NARSs, seed companies, and seed producers. Some valuable technology transfer has taken place in the areas of DH production and stress tolerance phenotyping. More such transfers need to be done in the fields of breeding and breeding-related decision-making.

MAIZE is capable of mobilizing stakeholders, resources, and knowledge to rapidly deliver valuable solutions for a critical need, as illustrated by the work on maize lethal necrosis (MLN).

RQ 2: Effectiveness

Milestone completion indicates a fair level of achievement, the extent of which is difficult to precisely assess given the lack of measurable and specific targets. Over the three reporting years, the CRP had 70 milestones, of which 52 were completed on time and 18 were extended. FP2 and FP4 had the most extended milestones. MAIZE has, overall, made good progress in achieving its outcomes, though this varies within FPs and across geographies. It recognizes that partnerships are essential if its products are to make a difference, in spite of some lack of clarity on the roles, strengths, and responsibilities of MAIZE vis-à-vis key partners such as national agricultural research systems (NARSs) and seed companies. While there was evidence of learning from outcomes, the learning component of monitoring, evaluation, and learning was not formalized, hence not necessarily recorded, or reported on.

MAIZE's management and governance did support its effectiveness. Risk was managed appropriately, but annual uncertainty concerning the amount and timing of W1/W2 funding constrained delivery against planned outcomes. Project leads generally prioritized bilateral project reporting over CRP reporting, which was considered by some project leads to be duplicative and burdensome.

The greatest value of the FPs' theory of change (ToC) was the process followed to develop them along with their underlying assumptions, which enhanced effective collaboration between scientists from different centers and between FPs.

The focus on gender in the capacity development strategy, and the capacity building in gender by both W1/W2 funding led by FP1 and in large projects such as Stress Tolerant Maize for Africa (STMA) are commended, as is the capacity building in project management and aspects of monitoring, evaluation, and learning (MEL). MAIZE has been both proactive and productive in addressing the gender and youth cross-cutting areas.

RQ 3: Future Orientation

MAIZE has established a strong network of partners, including seed companies and NARSs. It generally operates with good science at all levels. Full achievement of its outcomes will be reduced owing to the early ending of the CRP.

Good management and governance practice are a strong foundation for the remainder of the CRP's running. Continued commitment of, and leadership by, the CRP director and FP co-leads is essential to ensure delivery against planned outcomes.

Recommendations

Quality of Science Recommendations

1. Transform relationships with national organizations (NARSs, seed companies, seed producers) into full multidirectional partnership:
    - Involve NARSs, seed companies, and seed producers directly in the drafting or at least the validation of market segments and product profiles (QoS-2).
    - Define the roles and responsibilities of organizations and individuals within organizations to ensure that all organizations and individuals have the capabilities to deliver and provide an objective framework to resolve misunderstandings or disagreements (QoS-3).
    - Implement a product life cycle (PLC) system that covers all stages from upstream research to product retirement, and therefore all partners. Ensure transparency of stage-gate advancement criteria and of corresponding decisions (QoS-7).

- Increase transparency about the science implemented with partners, especially downstream partners, in an attempt to deliver more impact across the entire partnership (QoS-11).
- Promote multidirectional training and capacity building among all partners based on each partner's specific areas of expertise (QoS-6).
- Encourage projects led by NARSs or seed company scientists, support such projects and their leaders, and increase NARS or seed company scientists first-authorship on peer-reviewed publications (QoS-9).

2. Ensure that all projects have specific, measurable, achievable, realistic, and timebound (SMART) objectives, in line with high-level objectives (QoS-1).
3. Improve communication with next-stage users:
   - Adjust practices in terms of peer-reviewed publications and other types of communication, with the central objective of communicating in the most effective way for the intended target audience (QoS-8).
   - Improve the amount, quality, and relevance of variety performance data released to next-stage users so that next-stage users are better able to select those varieties that best fit their sometimes very specific needs (QoS-10).
4. Ensure that technology decisions are made with the best interests of the entire MAIZE community in mind. MAIZE should be able to argue in favor of such technology decisions when pressed otherwise (QoS-4).
5. Identify MAIZE' uniqueness vis à vis national partners going forward, reflecting on the ability of MAIZE to rapidly identify a critical need, mobilize stakeholders, and execute and deliver clear value-added products (QoS-5).

Effectiveness Recommendations

1. MAIZE should reflect on and draw on its experience of working with partners to identify how best to attain impact.
   - MAIZE should carefully consider how its expertise in CGIAR can work with NARSs, seed companies, and other key partners (already identified in the FPs' ToC) to best attain adoption and impact on the ground and in an inclusive manner (EFF-1).
   - MAIZE should examine and learn from the examples of effective partnerships, which allowed for adoption and impact on the ground, provided in all three cases (EFF-3).
2. MAIZE should seek to ensure focus and greater coherence between its many funded projects and look to streamline focus in the future (EFF-2).
3. MAIZE should maintain its present effective management and governance.
   - For the remainder of the CRP, keep the present membership and structure for Maize Management Committee (MMC) and Independent Steering Committee (ISC) meetings and the same Program Management Unit (PMU) staffing. Looking forward, ensure an equal level of "voice" of key actors in management structures, and continue the geographic and sectoral representation in any steering committees that are established (EFF-6).
   - Given that the CRP does not have control over the amount and timing of W1/2 funds it receives or over the MEL requirements of the system, it should continue to use the MMC (with ISC guidance where needed) to manage risk and retain the space to respond in a dynamic manner to emerging demands or threats in relation to MAIZE in a similar way to its response to the rise of fall army worm (FAW) and MLN (EFF-7).
   - CRP and FP co-leads should do their best to maintain their present levels of passion, commitment, and collaboration to ensure the best possible outcomes for MAIZE by the end of 2021 (EFF-13).
4. MAIZE should give more attention to recording learning both within and across FPs and projects so that the CRP and other stakeholders can learn from this record (EFF-5).
5. MAIZE should continue to use ToC thinking at different levels. ToC thinking will remain relevant to MAIZE's positioning in One CGIAR. Capacity should be further built in how to use ToC approaches both at the high level and particularly at the more granular level of projects. Within some of the projects in MAIZE, there is good experience in using ToC thinking, and this experience could be shared with others. Revisiting assumptions and, for granular project-level ToC, conducting contribution analysis on relevant impact pathways can greatly support ongoing implementation as

well as provide good evidence for monitoring and evaluation (M&E). MAIZE should consider budgeting for participatory ToC workshops involving both CGIAR and key partners, ideally at the project design phase (EFF-8).

6. MAIZE should continue and build on its existing cross-cutting work with regard to capacity development (CD), climate change (CC), gender, and youth.
    - MAIZE should continue and build on its existing gender and youth work until the end of the CRP. MAIZE should consider positioning its research in relation to gender, youth, social inclusion, and the "leave no one behind" frame of intersectionality, drawing on CGIAR's existing work in this area. This work includes a 2018 webinar on the subject (CGIAR Gender Platform, 2018), and papers from different CRPs that pave the way for MAIZE to start framing its work similarly (see, for example, Tavenner and Crane 2019) (EFF-12).
    - MAIZE, or the projects within the Centers that are carrying out CD activities, should follow up to assess the outcomes of provided training and/or training manuals (EFF-9).
    - MAIZE should give more attention to how cross-cutting areas are tagged in reporting and OICRs (EFF-4).
    - While CC is the basis of much of the CRP's research, MAIZE's role in addressing climate resilience and its focus on this area should be given more attention (EFF-11).
    - Tagging of CC should become the norm for the remainder of the CRP and beyond, as it is for the other cross-cutting areas (EFF-10).

CGIAR System-Level Recommendations

1. The CGIAR System Management Office (SMO) should consider mainstreaming ToC approaches and thinking across CGIAR's research for development design and MEL. This will require further CD and ensuring that there are opportunities for participatory design workshops at the start of any new, large projects. These workshops can include the drawing up of ToCs and consideration of the assumptions behind them by both CGIAR and key partners in a facilitated participatory process. Thinking carefully through the often-unspoken assumptions behind a planned project will allow for questioning of these assumptions and for consensus. Having theories of change in place will allow for theory-based evaluation where that is needed and will provide scope for contribution analysis of particular causal pathways within any one ToC. The assumptions can also be revisited at times and, if incorrect, can be adjusted to allow for changes in project activities or priorities to ensure that the project is on track to achieve its anticipated outcomes (CG-1).
2. The SMO should continue to streamline monitoring and reporting processes as far as possible, building the utility of Managing Agricultural Research for Learning and Outcomes (MARLO) for learning as well as accountability, and investing in ongoing capacity building of staff in using MARLO for reporting, learning, and planning. This effort should include continued capacity building of staff in relation to reporting on policies and innovations and moving toward SMART indicators at least at the output level (CG-2).
3. The SMO should consider, in collaboration with the Generating Evidence and New Directions for Equitable Results (GENDER) platform hosted by the International Livestock Research Institute (ILRI), whether the recommendation made in section 3.3 for MAIZE to consider framing future youth, gender, and social inclusion within an understanding of intersectionality may be relevant for CGIAR as a whole (CG-3).
4. CGIAR should reflect on how it can make the most of its unique ability to rapidly mobilize all necessary high-quality science to attain impact by ensuring that partners in turn can deliver downstream (CG-4).

1 Background to the CRP 2020 Review

1.1 Purpose and Target Audience of the Review

The primary purpose of the MAIZE CRP 2020 review is to assess the extent to which MAIZE is delivering quality of science and demonstrating effectiveness in relation to its theories of change (and other planning documents) (see original TORs in Annex 1 [CoI CRP2020 Reviews and Addendum]). Within that primary purpose, the objectives of the independent MAIZE review are:

- To fulfill CGIAR's obligations around accountability regarding the use of public funds and donor support for international agricultural research.
- To assess the effectiveness and evolution of research programs' work under CRP 2017–2021.
- To provide an opportunity for MAIZE to generate insights about its research contexts and programs of work, including lessons for future CGIAR research modalities.

The target audiences of the review are the CGIAR System Council, the CGIAR System Organization, the MAIZE CRP management, and the Flagship Program (FP) co-leads, the International Maize and Wheat Improvement Center (CIMMYT) and the International Institute of Tropical Agriculture (IITA). The review should also be of use, between now and the end of 2021 when the CRP closes, to the CRP's Management Committee and Independent Steering Committee (ISC).

1.2 Overview of the MAIZE CRP and Its Context in Research for Development

Maize is the leading cereal in terms of production, with about 1 billion metric tons produced on close to 200 million hectares. It is produced across temperate and tropical zones, on all continents. Maize production in tropical and subtropical low- to middle-income countries, on which MAIZE focuses, represents about two-thirds of total maize production. More important, it is key to the food security and livelihoods of millions of poor farmers.

The demand for maize is constantly increasing, posing challenges to the global capacity to sustainably supply the volumes needed, particularly in low- and middle-income countries. Crop area extension and intensification create concerns in relation to soil erosion, soil fertility loss, land degradation, reliance on fossil fuel–derived energy for synthesis of agricultural inputs, and rural transformation. Climate change brings additional risks and aggravating factors to future crop productivity. The poorest populations will likely be the most impacted.

Viable solutions can be deployed to meet these significant challenges. Plant breeding and sustainable intensification have the potential to raise and stabilize yields, specifically through the development of varieties that demand fewer inputs and are more tolerant of increasing abiotic and biotic stresses, and through more efficient cultivation of these varieties with regard to inputs and environmental impact.

MAIZE implements a strategic international research-for-development (R4D) approach in collaboration with public and private sector partners worldwide, with the specific goal of increasing incomes and food security for poor maize producers and consumers while enhancing the sustainability of maize-based production systems and the natural resource base. It achieves this goal by developing, testing, and deploying technological and institutional innovations that enable profitable and equitable integration of small-scale maize producers and processors in the expanding maize value chains.

MAIZE aims to deliver results in 11 sub-IDOs and 6 cross-cutting sub-IDOs of the 2016–2030 CGIAR Strategy and Results Framework (SRF; CGIAR, 2016), namely:

- 1.1.2 Reduced production risk
- 1.3.1 Diversified enterprise opportunities
- 1.3.2 Increased livelihood opportunities
- 1.3.3 Increased value capture by producers
- 1.3.4 More efficient use of inputs
- 1.4.1 Reduced pre- and postharvest losses, including those caused by climate change
- 1.4.2 Closed yield gaps
- 1.4.3 Enhanced genetic gain
- 1.4.4 Increased conservation and use of genetic resources
- 2.1.1 Increased availability of diverse nutrient-rich foods

- 3.2.2 Agricultural systems diversified and intensified in ways that protect soil and water
- A.1.4 Enhanced capacity to deal with climatic risks and extremes
- B.1.2 Technologies that reduce women's labor and energy expenditure developed and disseminated
- B.1.3 Improved capacity of women and young people in decision-making
- C.1.1 increased capacity of beneficiaries to adopt research outputs
- D.1.1. Enhanced institutional capacity of partner research organizations
- D.1.3 Increased capacity for innovation in partner research organizations

In doing so, MAIZE will contribute to CGIAR's 3 System Level Outcomes (SLOs) and through them, to mostly 3 of the 17 United Nations' Sustainable Development Goals (SDGs; United Nations, n.d.): no poverty (SDG1); zero hunger (SDG2); and clean water and sanitation (SDG6), as shown in Table 1.

Table 1: Alignment between MAIZE FPs, CGIAR SRF–SLO 2030 targets, and United Nations SDGs

SRF targets (2030)	Relates to SDG	via MAIZE FP	Relates to CGIAR sub-IDO
SLO1: Reduced poverty	2. Zero hunger	FP1 FP2 FP3 FP4	- Enhanced genetic gain on-farm (1.4.3) - Increased value capture by smallholders (1.3.3) - Reduced production risk and greater input use efficiency (land, labor, purchased inputs, water) (1.1.2) - Reduced pre-, post-production losses (1.4.1) - Diversified enterprise opportunities (1.3.1) - Increased livelihood opportunities (1.3.2) - More efficient use of inputs (1.3.4) - Closed yield gaps (1.4.2Increased conservation and use of genetic resources (1.4.4)
SLO2: Improved food and nutrition security for health	2. Zero hunger	FP1 FP2 FP3 FP4	- Increased availability of diverse nutrient-rich foods (2.1.1) - Reduced pre-, post-production losses (1.4.1) - Closed yield gaps (1.4.2) - Enhanced genetic gain on-farm (1.4.3) - Increased conservation and use of genetic resources (1.4.4)
SLO 3: Improved natural resource systems and ecosystem services	1. No poverty 2. Zero hunger 6. Clean water and sanitation	FP1 FP4	- Agrisystems diversified, intensified in ways that protect soil and water (3.2.2)

Note: Table 1 was compiled by the review team drawing on the MAIZE II Proposal.

MAIZE delivers on its overarching goal through four flagship programs (FPs):

FP1 – Enhancing MAIZE's R4D Strategy for Impact: FP1 focuses on strategically informing and targeting MAIZE research. It coordinates strategic gender research, measures the impact of MAIZE innovations, and informs future investments. It integrates socioeconomic research with all other Flagship Programs.

FP2 – Novel Diversity and Tools for Increasing Genetic Gains: FP2 focuses on characterizing and identifying functional genetic diversity in MAIZE's germplasm collections (including unexploited landraces and wild relatives) for traits of interest and developing enabling tools and technologies for the efficient selection and deployment of these traits of interest. It invests in capacity strengthening of both public and private sector partners in target countries to enhance the utilization of these tools, technologies, and germplasm resources.

FP3 – Stress Tolerant and Nutritious Maize; FP3 uses outputs from FP2 to develop agroecology-specific, high-yielding, stress-tolerant, healthy, nutritious (and more) maize varieties that meet market demand (market being poor farmers). FP3 also supports the maize seed system (especially small and medium enterprise [SME] seed companies and community-based seed producers) in target markets. It aims to

demonstrate agility as needed to tackle new or evolving threats, such as diseases or climate change–induced stresses.

FP4 – Sustainable Intensification of Maize-based Systems for Improved Smallholder Livelihoods: FP4 focuses on the sustainable intensification of maize-based farming systems. It generates and tests sustainable intensification alternatives that have the potential to improve farm livelihoods in maize agri-food systems with high poverty concentration. It aims to gain a better understanding of scaling (models, partnerships) in order to more effectively scale sustainable intensification practices up and out.

1.3 Scope of the CRP Review and Review Questions

The review covers the work of MAIZE and its FPs, guided by CGIAR's quality of science and effectiveness criteria and the theories of change for MAIZE and its FPs. The emphasis is on the CRP's sphere of control—that is, the quality of inputs, activities, outputs, and influence - that is, short-term and intermediate outcomes that are expected to lead to a development impact. The CGIAR System defines outcome-level changes as Intermediate Development Outcomes (IDOs) and System Level Outcomes (SLOs). It is not expected that all planned outcomes will have been achieved at this time, because this review is conducted after three years of operation on a five-year research program (originally planned for six years). To the extent feasible, this review will assess the likelihood of achieving IDOs and/or sub-IDOs based on the documented performance of MAIZE and its FPs in relation to their theories of change.

Questions for the review were provided by the CGIAR Advisory Services (CAS) and are:

1. Quality of science: To what extent does the CRP deliver quality of science, based on its work from 2017 through 2019?

2. Effectiveness: What outputs and outcomes have been achieved, and what is the importance of those identified results?

3. Future orientation: To what extent is the CRP positioned to be effective in the future, as seen from the perspectives of scientists and of the end users of agricultural research (such as policymakers, practitioners, or market actors)?

1.4 Approach, Methods, and Limitations

The review team followed a mixed-methods approach, combining quantitative and qualitative evaluation approaches. This allowed for triangulation and ensured rigor. A utilization-focused approach was also taken in which the CRP program manager and/or the CRP monitoring, evaluation, and learning (MEL) unit lead joined many of the interviews. This allowed for co-learning for all concerned. The review team members operated in a consultative manner (both within and beyond the review team), were respectful of stakeholders' wishes and their time constraints, and maintained independence. Interviewees included CRP management and staff, partners, next-users, and donors.

The team used the evaluation design matrix provided in the CRP 2020 Review Guidelines. The team combined these into an Excel template in which both document review findings and interview findings were sorted and collated against each evaluation question (EQ), sub-question, and areas of focus. This process ensured that the team remained focused on the specific questions related to quality of science and effectiveness.

After orientations and briefings, the team reviewed documents and, with the help of the CRP, set up interviews. In terms of qualitative methods, in addition to reviewing documents and publications and conducting semi-structured interviews, the team carried out a more focused review (termed "deep dive" in the TORs and falling under EQ2.2 with components also from EQ1.3) and observation. Qualitative methods were complemented by quantitative bibliometric/Altmetric and performance data analysis (drawing also on dashboard data pre-analyzed by CAS for the MAIZE CRP review team). In total 22 respondents were interviewed, including two women. Further details regarding interviews are provided in Annex 2. Approaches, principles, data collection and analysis tools, and the list of interviewees are in Annex 4.

Data collection, analysis, and report development took place from September to November 2020.

The review team found no limitations in terms of accessing documents and interview respondents, owing to the assistance and cooperation of both CAS and MAIZE. The team faced two limitations:

- Assessing effectiveness with precision was challenging given that the templates for the Plans of Work and Budget (POWBs) and annual reports (ARs) continuously evolved between 2017 and 2019, milestones in the 2018 POWB and 2018 AR did not correspond, some milestones were not measurable, and processes for quality assurance (QA) of policies and innovations evolved over the review period. Nevertheless, it remained possible to assess the overall delivery of outcomes.
- The short time period for data collection, analysis, and report drafting meant that it was not possible for the team to revisit all findings in the light of new findings and to enquire further where that might have been helpful. However, having the opportunity to share preliminary findings, conclusions, and recommendations with the CRP, external peer reviewer, and CAS did ensure that there were no major gaps or misunderstandings that may otherwise have been addressed if the team had had more time.

Annex 2 provides more detail on the approaches, principles, and data collection and analysis tools, Annex 3 provides the list of documents and publications reviewed, and Annex 4 provides the list of interviewees.

1.5 Management and Quality Assurance

Within the team, the team leader and quality of science expert led on EQ1, and the evaluation expert led on EQ2, with some collaboration between the two over EQ2.2. Work on future orientation and recommendations was carried out jointly. The two experts conducted all interviews together, which ensured a common understanding of findings, and touched base several times a week throughout the review period. As team members started analyzing findings and drawing up conclusions and recommendations, there was an element of QA within the team where any one of member questioned the other where needed.

CAS led on quality assurance overall, with the team and CAS filling in and talking through a CAS QA checklist at intervals. Preliminary findings were shared first with CAS and an external reviewer and then with CAS and the CRP Program Management Unit (PMU). Review of this draft will also be undertaken by CAS, CRP, and the external peer reviewer.

2 Findings

2.1 Quality of Science

2.1.1 Quality of Research Inputs

CRP and FP objectives

Research is by nature a very open space where curiosity and findings may lead researchers in many directions. Research for development, however, needs some level of direction to ensure impact in the short, medium, and eventually long term. Research objectives are thus a critical research input, as they have the potential to greatly impact the relevance and quality of outputs. MAIZE objectives are therefore the first research inputs that the review team examined.

MAIZE objectives, and to some extent FP objectives, as defined by the SRF Grand Challenges addressed by the MAIZE CRP- or FP-level theories of change (ToCs) and impact pathways (IPs), are very high level (adoption of improved varieties and/or improved management practices by farm households; increase in people exiting poverty; improved rate of yield increase; increase in people meeting minimum dietary energy requirements; people, of whom 50% are women, without deficiencies in one or more of certain essential micronutrients; increase in water and nutrient use efficiency in agroecosystems, including through recycling and reuse; reduction in agriculture-related greenhouse gas emissions). Their realization often falls outside the space controlled or influenced by the CRP. As several interviewees put it, these objectives are mostly aspirational rather than specific, measurable, achievable, realistic, or timebound. The aspirational nature of these objectives, however, provides a clear understanding of the societal mission and context of MAIZE.

However, MAIZE annually reports IDOs and impacts against SLO targets, broken down to the FP/cluster of activity (CoA) level in the MAIZE W1&2 workplan. Similarly, bilateral projects pursue specific multiyear and annual objectives, managed by the relevant project lead.

Market knowledge and breeding objectives

MAIZE mostly revolves around the delivery and deployment of improved maize varieties to its target populations (market). The level of market understanding and the translation of this understanding into product and breeding objectives are key inputs that can greatly impact the relevance and quality of MAIZE outputs. Documents describing markets and their relative importance have been produced. Detailed product profiles have been developed for all of the market segments identified.

Market segmentation documents are detailed and provide a clear understanding of the segmentation proposed. Product profile documents are also of good quality. They provide clear and relevant quantitative or qualitative targets for individual traits (product concepts) but do not generally cover relative trait priorities. They also provide detailed data on relevant market benchmark products, which reveal instances where all these benchmark products have been developed by large multinational seed companies such as Bayer, Corteva, or Syngenta, leaving MAIZE with the objective of "beating" private sector product performance (as reported in the minutes of an ISC meeting).

Market segmentation and product profiles have been the topic of a number of workshops organized by MAIZE in East Africa, Southern Africa, South Asia, and Latin America. While these workshops involved many stakeholders, including marketing functions from seed companies, they mostly consisted of high-level discussions about the concepts and benefits of market segmentation and product profiles rather than market segment–based small-group working sessions aimed at developing or validating market data and/or product profiles. The product profile documents to which we have had access list contributors as being 100% CGIAR individuals, most of whom are breeding-related scientists, in line with findings from workshops on product profile-based breeding.

Although market segmentation documents and product profiles have been developed to provide clear and needed information, the process by which they have been informed does not ensure a high enough quality of content or a good match between supply and demand (Almekinders et al., 2019). Indeed, direct involvement of next-stage users (including but not limited to national agricultural research systems (NARSs), seed companies, or seed producers) in their drafting or validation seems to be minimal or missing. One illustration of the absence of that direct involvement is the fact that seed production traits are missing from all product profiles except those for Asia, in spite of being absolutely critical to seed companies and renewal of varieties in farmers' fields.

People and organizations

Based on their previous outputs, in particular those from the first phase of MAIZE (2012–2016), individuals and organizations are generally adequately skilled and capable of delivering project outputs. Some can even be classified as extremely skilled and capable. This is a favorable situation, despite MAIZE's limited ability to decide which organizations or individuals take part in its activities. Decisions about organizations, especially for applied research (starting with breeding and all the way to farmers' fields) are often linked to the geographic focus of projects. Decisions about individuals are generally made by their home organizations with no or little input from MAIZE FP leads, for instance. Finally, decisions about participation in W3 or bilaterally funded projects generally lie with leaders of or donors for these projects.

Technical inputs

MAIZE projects are generally based on high-quality science, whether in terms of knowledge, tools, or methods, as demonstrated by documents cited in MAIZE publications. The most significant examples of high-quality technical inputs include CIMMYT's gene bank, access to the University of Hohenheim's haploid inducers, managed stress testing (drought, maize lethal necrosis [MLN], striga), marker-assisted backcrossing (MABC), genomic selection, and genome editing in collaboration with Corteva.

2.1.2 Quality of Process (including Partnerships)

Strategy

Evidence shows that there are effective processes in place to identify strategic value creation opportunities, develop response proposals, and implement them all the way to satisfactory deliverables. MAIZE activities and deliverables around MLN and fall army worm (FAW) are two such examples. Activities on MLN and FAW were launched after the start of MAIZE, as focused, highly relevant

partnerships of motivated and capable organizations and individuals, funded mostly through W1 and W2. W3 and bilateral funding were later secured, allowing both projects to pursue their search for solutions at a larger scale and with expanded resources. In record time those opportunities were turned into valuable outputs of high scientific quality, including containment strategies, partially or fully resistant varieties, and tools and methods to ensure a constant flow of improved solutions.

People and organization management

MAIZE has little ability, if any, to manage its people or partner organizations. MAIZE partners are independent legal entities. Formal assessments of individual performance are limited to the boundaries of each organization. This is the case even for CIMMYT and IITA, even though both are CGIAR centers. There is also no evidence of the existence of any informal performance assessment process where input is provided across organizations' boundaries, even between CIMMYT and IITA and in spite of each FP's having two co-leads, one from CIMMYT and one from IITA. This lack of any CRP-wide performance assessment process represents a risk for MAIZE (actually for all CRPs, although one would have expected MAIZE to be a little better positioned owing to the CIMMYT-IITA co-leadership of all FPs), including the quasi-absence of mitigation opportunities besides capacity development. In extreme cases this limited ability or inability to manage people and organizations has led to extreme measures, such as the exclusion of an organization for a specific part (period or set of tasks) of a project. Significant activity has been undertaken in training and capacity development. Throughout 2017-2019 MAIZE supported the higher education (BSc, MSc, and PhD levels) of scientists from more than 20 countries. In 2019 alone 114 students were funded, 20 at the bachelor's degree level, 35 at the master's degrees level, 58 at the PhD level, and 1 at the postdoc level. Such capacity development actions (see 2.3.1 for more examples) have the potential to contribute to quality of science, albeit not in the short term (therefore most likely after the end of MAIZE).

Technical project management

MAIZE has been operating with a stage-gate system for germplasm advancement since rather recently, with some support from the Excellence in Breeding (EiB) program. The stage-gate system deals mostly with FP3 activities and to some extent with FP4 activities. It covers all stages from line development through product commercialization but does not provide much (or any) detail about what happens within stages (for instance, line development comprises two stages, Stage I and Stage II, lumped together without any detail about what each stage consists of or how material is promoted from Stage I to Stage II). Similarly, little is known about criteria to promote material beyond Stage II. According to EiB documents, promotion from one stage to the next occurs at advancement meetings. Proposed attendance at these meetings includes CGIAR and NARSs but does not mention any representatives from seed companies.

There is no stage-gate process for activities upstream of breeding such as trait development (FP2) or downstream of breeding such as agronomic innovations. The absence of a stage-gate process for trait development, in particular, has led to a few reported instances of suboptimal transitions between FP2 and FP3. We can speculate that similar challenges have occurred around agronomic innovations and the FP3 to FP4 transition, although this has been neither reported nor investigated. There is no evidence either of any product life cycle (PLC) management process to handle germplasm stages beyond research and development—that is, product launch, deployment, and eventually replacement. Replacement of varieties is, however, a frequently mentioned topic and a kind of tension point between donors, MAIZE, and NARSs or seed companies. The push to replace old varieties, originating with donors and relayed by MAIZE, is often not well understood by seed companies, which are not provided with enough factual information (including product performance, cost of seed) that would justify replacing varieties. Consequently, they sometimes perceive the push for replacement as a somewhat dogmatic position.

2.1.3 Quality of Outputs

Publications

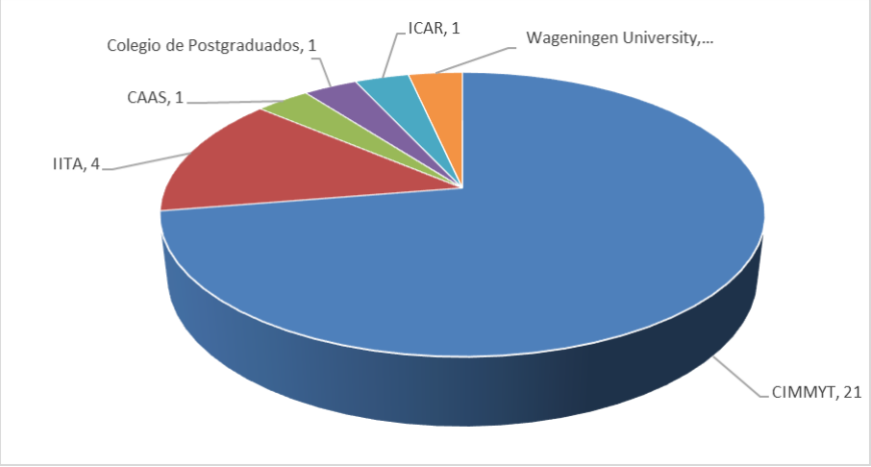
During 2017-2019, MAIZE contributed to 532 peer-reviewed publications. A qualitative analysis of publications shows a number of frequently cited papers, generally published in prestigious peer-reviewed journals. These are high-quality publications reporting on research of equally high scientific quality. The most-cited publication, a review article on a current topic, genomic selection, was cited 187 times. The tenth most-cited publication was cited 44 times (Table 2). Overall, publications have been, to date, cited an average of 8 times, with a median of 4, for an average age of almost two years. This low median value suggests that a large percentage of publications have been published in secondary journals and will likely not impact any further research. The work and results reported in these publications might be

better suited for other types of communication, such as extension-type communication, rather than peer-reviewed publications. The most-cited publications were overwhelmingly authored by CIMMYT researchers (Figure 1).

Table 2: Attributes of 10 most cited articles

First author	Year	Journal	Total citations	Citations per year	Article type
Crossa, J	2017	*Trends in Plant Sciences*	187	46.8	Review/opinion
Araus, JL	2018	*Trends in Plant Sciences*	110	36.7	Review/opinion
Navarro, JAR	2017	*Nature Genetics*	80	20.0	Original research
Koppmair, S	2017	*Public Health Nutrition*	73	18.3	Original research
Ali, A	2017	*Climate Risk Management*	72	18.0	Original research
Hickey, J	2017	*Nature Genetics*	71	17.8	Review/opinion
Gaydon, DS	2017	*Field Crops Research*	61	15.3	Original research
Bukowski, R	2017	*GigaScience*	54	13.5	Original research
Atlin, GN	2017	*Global Food Security*	54	13.5	Review/opinion
Li, H	2018	*Trends in Plant Sciences*	44	14.7	Review/opinion

Figure 1: Organizational affiliation of 30 most-cited authors



Note: CIMMYT = International Maize and Wheat Improvement Center; CAAS = Chinese Academy of Agricultural Sciences; ICAR = Indian Council of Agricultural Research; IITA = International Institution of Tropical Agriculture.

Tangible outputs (germplasm and technologies)

MAIZE has generated large numbers of improved germplasm in the form of lines, F1 hybrids, or open-pollinated varieties (OPVs). Stress Tolerant Maize for Africa (STMA), for example, released 218 new stress-tolerant varieties into the 11 MAIZE breeding pipelines (for which product profiles exist), an average of 20 varieties per market segment over the course of three years (2017-2019). New varieties are generally improved over existing varieties; reports show that the yield advantage of newly developed STMA-derived varieties over cultivated (commercial) varieties ranges from 4% to 150% across on-farm, research, drought-stressed, well-watered, or rainfed trials in Eastern, Western, and Southern Africa

(Amondo et al., 2019; Lunduka et al., 2017; Martey et al., 2020; Rezende et al., 2020; Setimela et al., 2017; Worku et al., 2020).

MAIZE has also generated and transferred to NARSs, seed companies, seed producers, and even farmers a number of improved protocols, including:

- Doubled-haploid (DH) production protocols (and tropical inducer with higher induction frequency)
- Phenotypic data collection protocols based on the use of sensors (plant and ear height, canopy analysis and grain weight) or imaging (ear and kernel traits)
- Biotic or abiotic stress tolerance quantification/characterization protocols (drought, MLN, FAW)
- Agronomic practices (conservation agriculture, intercropping, irrigation)
- Farming mechanization (MasAgro).

MAIZE has also established and transferred operating capacity to NARSs and in some instances seed companies. Examples include a DH production facility established in Kiboko in Kenya, an MLN screening facility in Naivasha, also in Kenya, and a biotic stress phenotyping network for gray leaf spot (GLS), MLN, and turcicum leaf blight (TLB) in East Africa.

Communication with next-stage users

Results, in particular variety performance data, are made available to next-stage users, with a generally satisfactory level of detail. Some reports, however, do not provide the identity of checks used in the trials, making it difficult for next-stage users to fully understand the relevance or quality of the results and varieties.

How communication aimed at next-stage users reaches them is not clear. Data are accessible online, along with applications for allocations and licensing of varieties. There is, however, little to no evidence of direct one-to-one active communication about performance data and new varieties with NARSs or seed companies. General awareness about the improved varieties remains limited and hinders their adoption rate, as reported by a number of interviewees, and discussed by Llewellyn and Brown (2020). Although communication with respect to sustainable intensification outputs is abundant, there have been reports that it is perceived as not sufficiently relevant and aligned with, for instance, cultural or community preferences (see Huesca-Mariño et al., 2019 for a study relative to MasAgro).

2.2 Effectiveness

2.2.1 Achievement of Planned Outputs and Outcomes

Milestones

Over the three reporting years, the CRP had 70 milestones of which 52 were completed on time and 18 were extended. FP2 and FP4 had the most extended milestones (Table 3).

Table 3: Milestones completed or extended (in parenthesis) per FP per year

FP	2017	2018	2019	Total
1	2 (2)	3 (0)	4 (0)	9 (2)
2	3 (1)	3 (1)	1 (6)	7 (8)
3	16 (0)	4 (2)	7 (0)	27 (2)
4	4 (0)	0 (4)	5 (2)	9 (6)

The CRP matched milestones against specific FP ToC outcomes in 2018 and 2019 and against relevant sub-IDOs. Many milestones did not have specific targets. The reason given for this was that when the milestones were set (during drafting of the MAIZE II Proposal), the extent of funding was not known. In addition, there was an awareness that while the CRP could control when a publication was submitted to a journal, they had no control over whether, and by when, it would be accepted.

Those milestones that did not have specific, quantitative values associated with them instead described the delivery of a group of outputs or a qualitative result or deliverable.

Reasons given for the extension of milestones included shortfalls in W3/bilateral money, milestones being met in one geographic location but not another, expansion of milestone-related work to new geographic areas, delays in publication dates, redeployments of staff and resources to address emerging threats such as MLN and FAW, varying levels of achievement among contributions from several funding sources (W3/bilateral-funded projects and W1/2 funding), and the relevance of the milestone for the subsequent year.

Policies

Based on data from ARs, the CRP reported 29 policies over the three-year period: 20 policies in 2017, none in 2018, and 9 in 2019. Policies can arise from the work of more than one FP. In particular, much of any policy work of FP2, FP3, and FP4 is coordinated by FP1. The 2017 policies were present mostly as publications. The System Management Office (SMO) put QA measures in place by 2018, and none of the policies put forward passed. QA measures now follow several steps, from the FP leads to the CRP director and finally the SMO. The 2019 policies were well evidenced in the 2019 report. Some CRP members see reporting on policies as cumbersome and difficult. Interviewees reported that any effects of the CRP's policy work on any policy changes at the national level can take a long time to occur and that attribution is difficult to ascertain. The MEL unit of the PMU is working to build capacity in reporting against policies within the CRP.

Innovations

The CRP reported 29 innovations in each of 2017 and 2018 and 21 in 2019. While innovations are defined in the CGIAR Results Dashboard as "new or significantly improved outputs or groups of outputs including management practices, knowledge of technologies," the review team found no clear consensus among interviewees on what an innovation is and consequently some lack of clarity on how to report an innovation. Interview respondents commented that an innovation would ideally be reported as such at the end of the line (when it "hits the ground") not at stage gates along the way. QA of innovations has increased over the reporting period in line with the QA for reported policies.

Innovations may arise from more than one FP, and social science innovations may be harder to define than breeding innovations. One FP noted that having a record of innovations is useful when developing new research proposals and can inform cross-regional exchanges of experience with regard to innovations, thus contributing to the overall coherence of the FP and CRP work.

Outcome Impact Case Reports (OICRs)

The CRP reported 11 OICRs in 2017, 3 in 2018, and 4 in 2019 (1 of 4 did not pass QA); in total 17 OICRs were produced by the CRP over the reporting period. In 2018, 2 OICRs were level 1, and 1 was level 2. In 2019, 1 OICR was level 2, and 2 were level 3. OICRs are usually identified during Maize Management Committee (MMC) meetings when success stories across the FPs are pinpointed. Level 3 OICRs must be evidenced by publications and can be updated every year with any additional relevant publications.

Overall effectiveness of MAIZE

At a higher level, with regard to the overall effectiveness of the CRP, there is a lack of clarity with regard to the CRP's positioning, strength, and roles in terms of upscaling and achieving impact (in terms of adoption of MAIZE varieties, technologies, and practices arising from its work). It is noted below (under section 2.3.1 on capacity development [CD]) that the IEA independent evaluation of CD in CGIAR questioned the value added of CGIAR's engagement in downstream (extension/farmer groups) CD. However, the CRP still needs to ensure both that the new varieties and technologies it develops are relevant to end users and that they reach and are adopted by them. The CRP is required by donors to demonstrate impact on the ground. There are many steps between the release of a new variety or technology by the CRP and its adoption by farmers. These include national-level trials and adaptation both at NARSs and on farm, licensing, an enabling policy and regulatory environment, seed companies that can access the new varieties and are willing to promote them, effective government, extension by the private sector and nongovernmental organizations (NGOs), and other contextual factors such as market demand and farmer access to finance.

One strong finding from the interviews for this review was that there is presently insufficient clarity regarding the respective roles, strengths, and responsibilities of all partners in this process. While there was good evidence that MAIZE has effective partnerships with seed companies and NARSs (see, for example, section 2.2.2), this is not always the case. Several interview respondents perceived that MAIZE on occasion treats NARS partners either as technicians or as competitors rather than equal partners. They expressed the view that MAIZE needs to do more to understand the role of the private sector (seed companies) and to work with them. The review team believes that MAIZE can apply what they have learned in achieving effective partnerships in all contexts in which they are operating.

A second factor that may hinder the CRP's overall effectiveness is one observed by the review team and also raised by one respondent. This concerns the scattered nature of what the CRP does. This is an inevitable result of having so many different projects funded by W3/bilateral funds. The respondent was of the view that, owing to the need for funding, the CRP takes on a wide variety of projects when they may be better off saying, "This is what we are doing, this is what is critical to what we are focused on, and all this other stuff we are not going to do."

2.2.2 Demonstrated Importance of Outcomes (Focused Reviews of Selected OICRs/Projects)

Section 1.4 and Annex 2.2 ("Data collection and analysis methods and tools") make reference to the focused reviews (or deep dives, as they are referred to in the CRP review TORs) that were conducted as part of the CRP 2020 Reviews. In the case of MAIZE, two OICRs were selected for focused review. In addition, MAIZE's response to the emergence of MLN was reviewed. Annex 6 contains the completed OICR templates for the two OICRs. Annex 7 contains the full evaluator review of each of the OICRs and the MLN response. This section draws on the content of both Annex 6 ("OICR Template") and Annex 7 ("Focused Review of OICRs/Projects") and examines the three cases together in relation to EQ2.2 and EQ1.3.

The three cases

OICR 3321: **"**Over 5 million sub-Saharan African households benefit from improved drought tolerant maize varieties." This OICR relates to the Stress Tolerant Maize for Africa (STMA) project, funded by the Bill and Melinda Gate Foundation (BMGF), which ran from 2016 to early 2020. The STMA followed on from several projects, including the Drought Tolerant Maize for Africa (DTMA), which was also funded by BMGF and ran from 2012 to 2016. In turn, DTMA and other projects built on decades of drought-tolerant maize research conducted by both IITA and CIMMYT. The STMA project aimed to develop improved multiple stress-tolerant varieties that effectively addressed emerging and future production challenges, while increasing genetic gains and scaling up and scaling out the products developed, and the knowledge gained. It operated in 12 countries across West, East, and Southern Africa.

OICR 3322: **"**MasAgro project in Mexico: 500,000 farmers improve yields, incomes and food security by growing improved maize varieties and practicing conservation agriculture on 1.3 million hectares." The Sustainable Modernization of Traditional Agriculture (MasAgro) project, a joint initiative between CIMMYT and Mexico's Secretary of Agriculture and Rural Development (SADER), has worked since 2012 to help address maize production, biodiversity conservation, food security, and rural development challenges. It seeks to ensure that improved maize (and wheat) varieties and conservation agriculture techniques reach farmers across Mexico.

MAIZE'S response to MLN: This case is an example of how MAIZE used small amounts of W1/2 money to raise awareness of the MLN threat within and beyond Africa and generate substantive W3/bilateral project support to respond to the threat. In particular, in 2016 BMGF funded a three-year project called Understanding and Preventing Seed Transmission of MLN in Africa, and the US Agency for International Development (USAID) funded four-year project called Diagnostics and Management of MLN from 2015 to 2019.

Partnerships

Both STMA and MasAgro had large numbers of partners. STMA had 50 downstream partners (NARSs and seed companies) and a few upstream partners. By 2019 MasAgro was partnering with 71 seed companies. While partnerships were effective in both projects, the review team assessed MasAgro as having a favorable partnership environment that created value for all partners as well as for smallholder farmers. In STMA downstream partnerships were also generally satisfactory, although they were more like supplier-user relationships than full partnerships. Response to the appearance and spread of MLN involved a large number of diverse local and international partners covering agriculture, seeds, research, and technology, as well as general and policy development support. The number and range of partnerships illustrate the level of network mobilization to contain and mitigate the spread of MLN.

Outcomes and contributions to SRF and IDOs

STMA exceeded its targets. Actual targets for the project period 2016-2020 were to produce and ensure the use of 54,000 metric tons of seed and to reach 5.4 million households with adequate improved seed varieties covering at best 2.2 million hectares. In practice, 97,000 MT were produced, and 6.5 million households adopted the varieties over 3.8 million hectares. Objectives relating to the development of innovative breeding tools and techniques were also generally met. In particular, significant progress was made in the use of DH lines, resulting in an increased rate of genetic gain. Progress was also made in phenotyping of both abiotic and biotic traits. Early efforts toward marker-assisted selection were successful for resistance to diseases, leading to significant marker-based selection implementation in line development or conversion (particularly productive and effective for the deployment of MLN resistance). Marker-assisted efforts were, however, abandoned and replaced with genomic selection for more complex biotic tolerance traits such as drought tolerance.

On average, farmers participating in the MasAgro project in Mexico had 20.5 percent higher maize yields than the average yields achieved in the region where they live, and 23 percent higher average net income. In rain-fed conditions specifically, MasAgro helped participant farmers achieve yields and income gains that were 92 percent and 105 percent higher, respectively. Seed sales of MasAgro Consortium member companies have almost doubled since 2011, from 600,000 bags to 1,100,000. MasAgro has had a positive impact on the lives of more than 500,000 farmers who have adopted conservation agriculture and sustainable farming technologies on more than 1.3 million hectares across Mexico. The innovation hub model it uses has become increasingly demand led, and the project has deployed cutting-edge tools and technologies for farm analysis, farmer support, and MEL.

MLN management has been effectively addressed through several simultaneously implemented strategies, including development and deployment of elite MLN-tolerant/resistant varieties adapted to Africa, coordinated and synergistic multidisciplinary efforts by various national and international institutions engaged in maize R&D in Africa, intensive awareness creation among stakeholders, capacity building of relevant public and private sector institutions on MLN diagnostics and management, creation and implementation of a checklist and standard operating procedures for MLN-free commercial seed production and exchange by the commercial seed sector, and strong engagement of the national plant protection organizations (NPPOs) on MLN surveillance across Sub-Saharan Africa (Prasanna et al. 2010).

The OICR templates (see Annex 6) indicate the contributions each made to the MAIZE SLOs, IDOs, and sub-IDOs. Indeed, in the case of STMA, the review team considers that in addition to those listed in the OICR, IDOs 1.3 (increased income and employment), 1.4 (increased productivity), and 2.1 (improved diets for poor and vulnerable people) will have been met, as well as all four of the cross-cutting IDOs to some extent. The review team considers that MAIZE's response to MLN contributed to IDOs 1.4 (increased productivity) and 2.1 (improved diets for poor and vulnerable people). It also responded to several of the cross-cutting IDOs, including A.1 (mitigation and adaptation achieved), C.1 (enabling environment improved), and D.1 (national partners and beneficiaries enabled).

Cross-cutting areas

Among the cross-cutting areas, the two OICRs indicated only that CC was significant and did not target the other cross-cutting areas (gender, youth, CD). It is the case in fact that CC was integral to both, given their focus on stress-tolerant maize (STMA) and sustainable intensification (MasAgro). While CD was not tagged for either, there was significant and effective CD of partners (NARSs and seed companies) and end users in all three cases (see Annex 7). For example, STMA supported almost 50 NARSs and seed companies through over 100 backstopping visits; MasAgro trained 62 small and medium companies, and over 34,000 farmers participated in workshops and field events in 2018; the MLN bilateral projects trained numbers of plant protection officers, seed company personnel, NARS staff, and seed growers. The establishment of the MLN screening facility at the Kenya Agricultural and Livestock Research Organization (KALRO) Naivasha research station in Kenya's Rift Valley, where MLN incidence is very high, is a strong manifestation of CD in relation to MLN.

While none of the cases focused on youth, gender was a focus for both STMA and MasAgro. STMA had a full-time gender expert on board. Four of the 10 intermediate outcomes under STMA's primary outcome 3 (Increased seed availability and farmer uptake of stress-tolerant maize varieties in target countries) relate to awareness raising and capacity building in gender. A number of publications, guides, and manuals came out of STMA, and product profiling increasingly sought to identify women's preferences. Starting in 2013 MasAgro had a mandate to include poor and marginalized farmers, and much more recently it developed a social inclusion strategy.

Relevance of the outcomes of each case to the CRP and FP ToC

The outcomes of all three cases are relevant to the ToCs of the CRP and of particular FPs. Although STMA did not itself have a ToC, its primary outcomes are well aligned with those of the CRP: primary outcome 1 is aligned with FP2, and primary outcomes 2 and 3 are aligned with FP3. MasAgro developed a ToC similar to that of FP4 (sustainable intensification) as its focus is very much on conservation agriculture and sustainable intensification. MasAgro considered and documented its specific activities, outputs, risks, and assumptions through a facilitated workshop approach, much like those carried out for the development of the CRP's FP ToC. The ToC was an output that could be used as a tool for multiple purposes as well as a process that played an important function in building consensus around the vision of the project and the expected impact pathways (Childs, 2020). In the case of MLN, the review team considers that the reported outcomes relate to three of the CRP FPs (FP1, FP2, and FP3). The response to the MLN threat undertook all but one (3.9) of the 10 outcomes within the FP3 ToC.

FP/CRP/partner learning from the reported outcomes

All three cases led to learning by MAIZE, partners, and other external stakeholders. Publications in scientific journals about all three allow for others to learn from the experience of these projects. For example, at STMA's annual review meetings staff and partners from all 12 countries exchanged experiences and learned from the experiences of the host country. Further, given the size of the STMA project, it is likely that the CRP and FPs learned from the approaches, technologies, and outputs of the project and applied them in other MAIZE work. The technologies developed and used by MasAgro have been shared, used, and acclaimed by others (see Annex 7.2, "OICR 3322 MasAgro"). In the case of MLN, the CRP as a whole learned, both from responding to MLN and from its earlier response to FAW, how best to manage staff and resources to be able to respond to urgent emergent threats.

2.2.3 CRP Management and Governance

Maize Management Committee (MMC)

The MMC met eight times during the review period. The MMC supported MAIZE's effective management by focusing on decision-making around key areas (including budget scenarios, monitoring/MARLO, and, over time, various substantive technical areas).

Clear TORs for the MMC and changes in the membership of the MMC, made early on in the review period, including bringing on board all the FP co-leads, were appropriate. One interviewee noted that having co-leads from each Center on the MMC increased co-leads' respect for each other's expertise, motivated them, and led to good collaboration. Another noted that having the FP leads on the MMC enhances the level of discussion and participation at the MMC level, contributing to effective management of the CRP.

There is evidence that the MMC meetings were professionally run and that they evolved and matured over time. Several ISC members commented on the responsiveness of the CRP director and program manager in terms of ISC guidance. One FP interviewee commented that the MMC is "run professionally with good collaboration between Centers. It does good work looking at priorities on partnership grants and resource allocation. It is a very pleasant environment to discuss the performance and planning of the CRP."

Independent Steering Committee (ISC)

The ISC met annually through the review period. There is representation of the private sector, NARSs, and each of the Centers connected with MAIZE. The MAIZE director acts as the member-secretary and is a non-voting member. The ISC meetings provided a useful space for MAIZE to consider financial concerns and substantive technical issues. Clear TORs are available for the ISC and its membership in terms of scope (with government and private sector representation) and geographic representation (with private sector representation from Latin America, Sub-Saharan Africa, and South Asia). Having both NARSs and private sector representation on the ISC in particular ensures that their voices, positions, and views are heard. Guidance by the ISC supported MAIZE's effective management and governance.

The CRP MEL unit

MAIZE began rolling out the System-wide MEL system—Managing Agricultural Research for Learning and Outcomes (MARLO)—in 2017, and by the end of 2018 the CRP was fully utilizing MARLO. The MAIZE PMU has a MEL adviser/unit that assisted the CRP in this transition.

Interviews revealed that scientists find reporting to MARLO challenging. Those that are leading W3/bilateral-funded projects have to prioritize reporting to their donors using the preferred donor reporting formats and frequencies. In Latin America these reports may be in Spanish. Where these project leads do not have access to any W1/W2 funds, they are sometimes reluctant to input data into MARLO as well, seeing it as double reporting. There was evidence of FP co-leads gathering relevant data from them and entering it into MARLO on their behalf. While respondents on the whole appreciated having a System-wide digitized MEL system, some commented that by its very nature it aggregates data to a high level, making it less useful than the more granular MEL conducted for W3/bilateral projects. For example, while the reporting into MARLO may result in a milestone being rated as extended or completed, project-level reporting can be more nuanced and perhaps show that a milestone has been met in, for example, East Africa but not in West Africa, or in Latin America and Sub-Saharan Africa but not in South Asia (where a project has global coverage).

The MEL unit within the PMU consistently sought to address MEL challenges by supporting not only the CRP's move of MEL into MARLO but also capacity development of CRP members in MEL. The CRP has been represented on the CGIAR MEL community of practice (CoP) Steering Committee for the past three years and has played an active role in shaping and implementing its agenda.

Capacity to meet unaddressed changes in context or other challenges

MAIZE was proactive in responding to emerging needs such as the spread of FAW and MLN despite operating under a constrained financial environment, which involved having to make tough decisions each year about what W1/W2-funded activities should be stopped, reduced, or delayed. Having the FP co-leads on the MMC enhances the level of discussion, participation, and decision-making.

Risk management

MAIZE managed identified risks—namely, insecurity and delayed transfer of W1/W2 funds, unfulfilled obligations by partners related to commissioned and competitive grants, and lack of systematic monitoring and evaluation (M&E) at the outcome level—in an appropriate and consistent manner. Mitigation involved prioritizing multiyear investments but signing just one-year partner contracts so as to manage partner expectations and minimize delays in payment to them, monitoring partners regularly, and strengthening the CRP MEL. Every year the MMC was faced with uncertainty over funding flows for that year. They responded by holding back funding of selected grants and projects and by setting a percentage funding buffer. For example, in June 2017 the MMC agreed to adopt an 80% funding scenario (with a buffer of 20% in case expected funds did not materialize). In August 2017, when funding still looked insecure, the MMC switched to a 60% budget scenario. When funds finally did come through, the MMC was able to increase the budget scenario to 85% when it met in December 2017.

2.2.4 Progress along ToCs (CRP and FPs)

Quality of CRP and FP ToCs

The FP ToCs, given that they are high level and cover all the CoAs of each FP, adequately depict the generic causal pathways through outcomes and how the FPs relate to each other. They describe assumptions, risks, activities, and outputs. The CRP ToC diagram is more an overall framework focusing on the sub-IDOs that the CRP is seeking to reach.

Outcome of processes used to develop the FP ToCs

The FP ToCs were developed during the transition period between MAIZE I and MAIZE II as part of the CRP II proposal-writing process. Typically, scientists and partners for each FP came together for a two- to three-day workshop facilitated by the then director of MEL from CIMMYT. Commonly the FPs of WHEAT and MAIZE worked together on developing each FP ToC as they have similar focuses.

The processes followed to develop the FP ToCs, along with their assumptions, allowed for ToC thinking to become ingrained and embedded among scientists. This subsequently enabled them to apply more granular ToC thinking in the design of projects. One respondent noted: "When you are a breeder you don't do ToC; you just think breeding. But the participatory processes (followed to develop the FP ToC) gave us an understanding of what a ToC is and the importance of considering assumptions."

Contribution of CRP and FP ToC to enhanced collaboration

The process followed to develop the FP ToCs allowed for greater clarity with regard to relationships between the CRPs' two pillars (germplasm and sustainable intensification) and the four FPs. Each of the FP ToCs indicates the connections with the others in the CRP. The ways in which the FP ToCs depict the impact pathways and connections between FPs contributed to the enhanced collaboration between scientists from different Centers afforded by the MAIZE CRP.

Use of the CRP and FP ToC for planning

The FP ToCs have been useful for planning because, among other things, they inform collaboration between FPs, they match milestones against specific outcomes, and they allow for the use of ToC thinking in the design of projects. Respondents noted that they also allow project leads to assess which of their project components are aligned with which FPs. However, the FP ToCs are at a very high level, and some projects also cover a whole continent or continents. In that case generalized assumptions across a whole FP or project are less useful, given the cultural, political, and agroecological variation between and within continents.

Use of ToCs to inform learning and adaptation

In relation to learning and adaptation, there was little evidence that FPs revisit their ToCs and underlying assumptions and risks. While adjustments to FP3 and FP4 ToCs are referred to in 2019 the corresponding diagrams and assumptions have not been changed.

2.3 Cross-cutting Issues

2.3.1 Capacity Development

The MAIZE 2015 IEA evaluation notes that CD in MAIZE I generally met people's needs and that MAIZE made special efforts to include women. The 2017 IEA evaluation of Capacity Development in CGIAR as a whole commented that the Center boards and management had not paid enough attention to CD but that the CD CoP had developed the CapDev framework, which the CRPs were using to draft their proposals. They also said that CD should be incorporated into ToCs. They were not convinced about the value added of CGIAR's engagement in downstream (extension/farmer) CD. The IEA evaluation of CD in CGIAR's third recommendation was that in its CD activities, CGIAR should "aim at taking full advantage of the experience and facilities of the Centers, particularly with regard to their scientific staff and amenities, and training of local end users and communities should be de-emphasized or channeled through more appropriate CD providers to ensure better relevance and focus and greater cost-effectiveness of CGIAR's efforts" This recommendation was accepted by the CapDev CoP. How MAIZE is addressing this recommendation and could do so in the future are discussed below and also in other sections of this report, including in sections 2.1.3 and 2.2.1.

The CRP MAIZE II Proposal has good material on CD in the main text and in the annexed CD strategy. The strategy outlines four key strategic actions: improving MAIZE science capacity; enhancing gender in research design and impact pathways; improving research-based management, governance, learning, and knowledge sharing; and strengthening capacity in technology dissemination and upscaling. The strategy is well considered and provides detail and indicators for each of the four strategic actions.

All the cross-cutting IDOs have one or more sub-IDOs that refer to capacity development. These are:

- A.1.4 Enhanced capacity to deal with climate risks and extremes
- B.1.2 Improved capacity of women and young people to participate in decision-making
- C.1.1 Increased capacity of beneficiaries to adopt research outputs
- D.1.1 Enhanced capacity of partner research organizations
- D.1.3 Increased capacity for innovation in partner research organizations.

All ToCs of FPs include the CD sub-IDOs; FP2 and FP4 specifically build their pathways around CD sub-IDOs.

The 2017 and 2018 POWBs have a little content on CD; the former refers to CD in project management and MEL at the project level, and the 2018 POWB states MAIZE will continue to implement its CD strategy by (1) providing training in collaboration with partners, (2) supporting a culture of learning and collaboration through the CIMMYT Learning Management System (links to this are not working), and (3) funding seminars, learning events, workshops, and projects that develop knowledge and learning resources across the FPs.

Each of the ARs covers CD, with additional information available through links to datasheets on the MAIZE portal in 2018 and 2019 and CIMMYT's Learning Management System. CD was more frequently tagged as 1 (significant) and 2 (principal) than the other three cross-cutting areas in the POWB- and AR-relevant tables. Over the review period MAIZE supported the higher education of scientists in over 20 countries at the bachelor's, master's, and PhD levels. Much of the long-term and short-term CD carried out by the CRP, both long term and short term (e.g., through demonstrations, field days, and training courses) is enabled by large W3/bilateral projects, but W1/2 funds have been used for CD in MEL and gender. The 2018 and 2019 annual reports provide links to comprehensive databases on CD carried out each year. This includes gender-disaggregated charts indicating numbers of men and women trained through conferences, field days, seminars, training, and workshops; participants per country; female participation per training category; maize training duration; training disaggregated by sex and numbers; and sex of students trained at bachelor's, master's, PhD, and postdoc levels. In brief, key data show that in 2019, 20,710 people attended short-term training (4,552 women and 16,158 men); 114 students were being funded (20 at the bachelor's level, 35 at the master's level, 58 at the PhD level, and 1 at the postdoc level); and 67% of MAIZE training was short term and 33% was long term.

With regard to how best MAIZE can respond to the IEA Evaluation of CD in the CGIAR recommendation referred to above, one respondent noted that there are still activities that the CRP can do to support

downstream work such as sharing the CRP's experience and capacity development of partners (NARSs and seed companies for example) in relation to MAIZE's experience in innovation in extension (e.g. farmer decision tools, train-the-trainer concepts, innovation platforms) and technologies and models developed by MAIZE such as business models for service providers and farmer decision support tools.

2.3.2 Climate Change

Climate change (CC) was not identified as a cross-cutting activity when the MAIZE II Proposal was being drafted and so is not referred to as such in the MAIZE II Proposal, in the POWBs, or in the 2017 AR. In the POWBs for 2018 and 2019, however, climate change was added to the other three cross-cutting areas. CC was second most frequently tagged in both of these after CD. In the 2018 AR (but not the 2019 AR), milestones are tagged, and several are rated as significant (1) or principal (2) for CC. The 2019 AR has links to several studies looking at conservation agriculture and how that reduces the risk of impacts of CC. The CRP ToC has one CC-related IDO (A.1: Mitigation and adaptation achieved) and one sub-IDO (A.1.4: Enhanced capacity to deal with climatic risks and extremes).

Even though CC does not feature strongly as a cross-cutting issue, it is in fact central to all that the CRP is doing. FP2 and FP3 together work toward ensuring the availability of germplasm and new varieties that can withstand drought, stress, and other threats stemming from climate change. FP4 addresses CC in its ToC and CoAs, given that it focuses on sustainable intensification. And the foresight and value chain work of FP1 in particular also takes CC into consideration.

2.3.3 Gender

The CRP took good note of the 2013 gender audit of MAIZE, the 2015 independent evaluation of MAIZE, and the 2017 CGIAR-IEA cross-cutting evaluation of gender in research. For example, in the MAIZE 2013 gender audit and Phase I IEA evaluation of MAIZE, the CRP was advised to improve its gender orientation, maintain investments in gender and social inclusion, and sharpen its focus on gender analysis at the project level, all of which it has acted on. Further, MAIZE addressed the shortfalls mentioned on gender in the CGIAR research evaluation by moving to look at youth separate from gender and to consider other inclusion aspects ("leave no one behind.") in line with SDG principles.

The material in the main body of the Phase II MAIZE proposal and the annexed gender strategy is well written and informed, citing good evidence. The CD strategy annexed to the Phase II MAIZE proposal has four key components, one of which concerns enhancing gender in research design and impact pathways. CD activities under this component are:

- Increasing the capacity to analyze the implications of gender for technology adoption, and ensuring feedback from analysis to research
- Conducting strategic gender research for better research prioritization
- Developing quality standards for gender analysis
- Mainstreaming strategic thinking, theories of change, and gender-sensitive approaches
- Increasing the capacity of young women and men to participate in decision-making, and facilitating their access to markets, value chain opportunities, and job opportunities.

MAIZE II has addressed gender proactively. W1/2 funds have been used to support gender strategic research, gender mainstreaming, and capacity building in gender. Many of the large W3/bilateral projects have also incorporated gender, partly owing to donor interest, with some having full-time gender experts on their team, as was the case for STMA. MAIZE, with WHEAT, also documented a gender-specific OICR arising from their work with Gennovate: OICR 2744 ("Uptake and use of gender research approaches and tools from the project 'GENNOVATE' by agriculture researchers worldwide").

One of the CoAs under FP1 focuses on gender and youth. Table 4 provides details on the number of papers produced by FP1 on gender, youth, and social inclusion.

In addition, the CRP has produced gender manuals and guidelines. Some of these have arisen from MAIZE's active involvement in GENNOVATE which was hosted by MAIZE's lead Center, CIMMYT. The chair of GENNOVATE's Executive Committee was also, until recently, the MAIZE gender research coordinator. Other publications, frameworks, manuals, and tools have arisen from work in large projects such as STMA, as noted in section 2.2.2.

Table 4: Number of papers produced under FP1 CoA 1.3 (gender and social inclusiveness, including youth)

Year	Scopus	Non-Scopus	Total
2017	3	5	8
2018	2	13[a]	15
2019	1	13	14

[a] Includes six papers in a GENNOVATE special issue of the *Journal of Gender, Agriculture and Food Security*, a non-Scopus open-access journal.

Despite the focus on gender, it is not frequently cited as a principal or significant focus of research other than in FP1. Of the OICRs in the CGIAR Results Dashboard, gender was not said to be targeted in most of them (even though in fact it was in some cases).

Interviews with FP co-leads confirm the above findings. Donors are keen to see gender addressed in projects, and it is mainstreamed in most large projects. Interviewees noted that in the first phase of MAIZE, it engaged in gender in a very limited way. But since developing the gender strategy, having a gender research coordinator, engaging in the CGIAR gender network, and proactively contributing to GENNOVATE research, the CRP's focus on gender has grown and become embedded. One interviewee noted "Gender has been quite prominent, and we are accepting it as a standard."

While there are not many gender experts among the socioeconomists in the CRP, many of the socioeconomists are also addressing gender. As a result of capacity building of other (biological) scientists in the CRP, gender-related publications are emerging from across the FPs with authorship by both social and biological scientists. One interviewee noted, "The CRP is instrumental in getting out knowledge products and supporting gender mainstreaming, and we have had CD activities across the board, including managers and how to enrich people's thinking on gender." The CRP conducts both gender strategic work (principally focusing on gender aspects of research to development) and gender mainstreaming.

2.3.4 Youth

The IEA Gender in CGIAR research evaluation suggested that youth be considered separately from gender, and the MAIZE II proposal addressed this by having a sound, well-researched Youth Strategy in addition to a Gender Strategy. The 2018 POWB and all three ARs have material on youth. While youth is only infrequently tagged against milestones, policies, and OICRs, it has been a focus of attention by the CRP.

MAIZE ran youth innovator awards in Asia (2018) and in Latin America and Africa (2019). Farmers, change agents, and researchers were eligible to apply. Awardees had the opportunity to present their research and receive their awards at Maize conferences. For example, the call for nominations for the 2018 MAIZE youth innovator awards stated: "The award recipients will be given the opportunity to attend the 13th Asian Maize Conference in Ludhiana, India (October 8–12, 2018) where they will receive the awards in a ceremony on 10th October, and will be given the chance to present their work. The Conference will also present an opportunity for these young innovators to network with MAIZE researchers and partners, and exchange experiences. Award recipients may also get the opportunity to collaborate with MAIZE and its partner scientists in Asia on implementing or furthering their innovations."

Along with Young Professionals in Agricultural Development (YPARD), MAIZE initiated a MAIZE (and WHEAT) youth task force (MYTF) in 2019, developing a network of young professionals in maize-related sectors in Asia and the Pacific to foster communication, research, and dialogue to support CGIAR and other linked international R4D initiatives. The TORs of the task force outline the following objectives: first, to develop a network of young professionals in maize-related industries to foster and catalyze collaboration; second, to foster communication, research, and dialog to support CGIAR and other linked International Agricultural Research for Development (IAR4D) initiatives; third, to develop a youth position paper of foresighting MAIZE trends; and fourth, to popularize MAIZE industry in the world as a feed, food, and fodder source. According to the TORs, it is to have 15 members per year and membership is annual.

The task force's position paper was to be developed by May 2020, but reviews of the July 2020 minutes of the MYTF indicate delays caused by COVID-19 lockdowns. The MYTF intended to complete the position paper by November 2020. The same set of minutes reflects an active, proactive group, working also on blogposts, videos, and a series of webinars.

Led by FP1 and drawing on W1/W2 funding, the CRP has supported research into youth in relation to agricultural research and development. A key publication that arose from this was Ripoli et al. (2017), which considered the role of agricultural research in rural transformation, cereals, and youth in Africa. It proposed a framework in which to analyze young people's economic room to maneuver in different rural contexts and the differential abilities of young people to exploit associated opportunities This paper informed further research, including by other CRPs and IFAD's *2019 Rural Development Report: Creating Opportunities for Rural Youth*. A key finding is that youth cannot be considered in isolation. Ripoli et al. (2017, 175) notes, "People, including young people, have multiple identities shaped by age, gender, class and ethnicity." A paper prepared by Sumberg et al. (2019, 35–36) to inform the IFAD *2019 Rural Development Report* concluded (in part), "As young people are deeply embedded in family and social networks, any strategy or intervention that implies that rural young people are or can be dealt with as isolated economic or social actors must be avoided."

2.4 Future Orientation

Future orientation is mainly addressed under conclusions and recommendations for the CRP and for CGIAR at the System level.

2.4.1 Future Deliverables

MAIZE benefits from a having developed a strong network of partners, including seed companies of all sizes, local seed producers, national research institutes, pioneering universities, and donors. In that network MAIZE sits in a unique position, having a regional role positioned between worldwide upstream resources (germplasm, technologies, knowledge, etc.) and local and national delivery systems. It also benefits from a uniquely rich and diverse germplasm base that is particularly relevant to MAIZE targets.

Full achievement of the CRP's outcomes will be reduced owing to the early ending of the CRP (at the end of 2021 instead of 2022, cutting short the time available to deliver planned milestones and outcomes by one year) and ongoing uncertainty regarding levels of funding and what the future holds for MAIZE, all of which affect staff motivation.

2.4.2 CRP Management and/or Governance

Both the ISC and MMC exhibit good practice and professionalism, which should continue to position the CRP for future effectiveness. Having one program manager for both MAIZE and WHEAT has added to the effectiveness of the MAIZE CRP and created efficiencies and value added in terms of joint learning. Capacity building within the CRP by its MEL unit in terms of monitoring and reporting is valuable and should be continued for the remaining period of the CRP.

3 Conclusions and Recommendations

3.1 Quality of Science

3.1.1 Quality of Research Inputs

Significant and high-value steps have been taken relative to objectives and roles, such as the implementation of market segmentation and product profiles. Direct involvement of downstream partners in their definition or validation is however still insufficient.

The aspirational nature of MAIZE's objectives probably contributes to engaging like-minded individuals with a clear personal willingness to pursue these same objectives. They are, however, not enough to drive deliverables. Specific, measurable, achievable, realistic, and timebound (SMART) objectives at a lower level (for projects and CoAs) should be but are not always available.

The existence of market segment priorities and product profiles to guide breeding and upstream research efforts is to be commended. Such product profiles are clearly based on market knowledge contributed by CIMMYT and IITA experts and collected through their involvement with individual partners and partner organizations such as region-based International Maize Improvement Consortia (IMICs) through workshops and individual conversations. Although knowledge by CIMMYT or IITA staff of the markets and product needs is commendable, it should not preclude direct involvement of the most interested parties in defining or at least validating markets and product profiles. NARSs, private seed companies, and

others in direct contact with farmers, processors, and consumers are the best positioned to provide input into product profiles. Although their demands could be transmitted accurately by CGIAR experts, direct input into or validation of product profiles by NARSs and/or seed companies is likely the most effective approach. It is also an approach that engages those next-stage users more intimately with research and development, strengthens partnerships, increases the matching of supply and demand, and eventually facilitates dissemination of outputs to farmers' fields. Market segments where all benchmark products are hybrids from multinational seed companies raises questions about the need for MAIZE to breed for those segments, which are obviously already well supplied by private breeding efforts.

The CRP's limited or lack of control over organizations or individuals who participate in its activities is not specific to MAIZE. Rather, this lack of control finds its cause in the collaborative nature of the CRP, which spans legally independent entities. It represents a potential risk for the quality of science, and mitigation approaches should be put in place, such as the clear definition of roles and responsibilities for all activities under the MAIZE umbrella.

Knowledge and technologies upon which MAIZE is built are generally of high to very high quality. More attention needs to be paid to benefits and risks across the entire partnership when making or influencing technology decisions.

As mentioned in the findings, scientific and technical inputs into MAIZE are generally satisfactory. Two choices, however, raise questions. The first is the choice of DarT as the major genotyping platform. The second is the choice of EiB's Enterprise Breeding System (EBS) for breeding data management. Such types of decisions, about platforms and services, have been reported to be decisions made by Centers rather than by CRPs. Under such a scenario it would still be expected that, in making such critical decisions, Centers would consult the CRPs they take part in or lead.

The choice of DarT is puzzling because, unlike many orphan crops, maize is a crop where many resources exist, including many different genotyping resources such as SNP arrays and sequence-based genotyping platforms. These genotyping resources are being used by many actors, public and private, across the globe. The choice of DarT for genotyping is likely to reduce or hamper the ability to exchange data, information, or experience with the many partners using other platforms.

The choice of EBS is also puzzling for two reasons. First, EBS is still in development, while other existing data management tools are available either commercially (Prism, Agrobase/Genovix, PhenomeOne, RnDExp) or gratis (or almost) to non-for-profit research institutions in the developing world (BMS – a CGIAR Challenge Program initiative), and have been satisfactorily and successfully adopted and implemented by many breeding organizations across the world (Rathore et al., 2017). Second, one platform, BMS from the Integrated Breeding Platform (IBP), has been adopted by and implemented at many CGIAR Centers (AfricaRice, CIAT, ICARDA, ICRISAT, IITA) and many NARSs and seed companies partnering with MAIZE CRP (KALRO, NaCRRI, Seed Co, etc.). It seems that the value of being able to implement the same data management platform as many partners immediately may have more than compensated for the cost of not having a perfectly tailored platform (assuming that this is what EBS will deliver).

In addition, developing breeding management software is a very significant undertaking that is rarely, if ever, completed within allocated timeframes and budgets. Had a decision been made to deploy one of the existing breeding data management platforms available a few years ago, MAIZE would not be handling most or all of its data with spreadsheet software nor devoting the precious time of its scientists to the development of functionalities that have already been developed. We believe that the decision to adopt EBS has been a burden for MAIZE, CIMMYT, and IITA and has been and will remain an obstacle in its ability to strengthen partnerships, particularly with downstream national partners, especially those that have adopted other breeding data management systems.

The technical choices of DarT and EBS are at odds with MAIZE's ability to connect with, support, and capacitate local partners. Both decisions are probably reversible at a cost, as unlikely and probably undesirable as it may be at this point in time.

Recommendations

QoS-1 MAIZE should ensure that all projects have specific, measurable, achievable, realistic, and timebound (SMART) objectives, in line with the CRP's high-level objectives.

QoS-2 NARS, seed companies, and seed producers should be directly involved with drafting or at least validating market segments and product profiles. Evidence of this direct involvement should be recorded and available to whomever may request it.

QoS-3 Roles and responsibilities of organizations and individuals within organizations should be defined as precisely as possible to (1) ensure that all organizations and individuals contributing to MAIZE endeavors have the capabilities to deliver, and (2) provide an objective framework for conversations among partners about individuals in case of misunderstandings or disagreements.

QoS-4 Technology decisions made by MAIZE partners, in particular CIMMYT and IITA (since they are the partners making most of those decisions) should be made with the best interests of the entire MAIZE community in mind. MAIZE should be able to argue in favor of such technology decisions when pressed otherwise.

3.1.2 Quality of Process (including Partnerships)

MAIZE has effective processes in place to deliver quality of science in spite of a challenging situation with respect to its ability to manage people or organizations.

MAIZE has high-quality, effective processes in place that allow it to successfully complete all the steps from idea (need, opportunity) to products, effectively mobilizing stakeholders and creating significant value for its targeted farmer population (and beyond). MLN and FAW are two examples that clearly demonstrate this ability. The case of MLN particularly illustrates how internal review and decision processes led to the engagement of W1/W2 funds to launch preliminary work while searching for W3/bilateral funds to scale activities. Not all projects follow that model. Quite a large number of projects are actually designed outside of MAIZE, in particular by donors with their own particular agendas.

In terms of project management and its human component, the CRP is a typical matrix organization where individuals functionally report (through projects) to others who are outside of their line management group. In that respect the CRP is not aligned with the current ways of working at Centers (here CIMMYT and IITA), where people management happens strictly within the boundaries of each organization. Yet it is important that individual and organizational contributions be recognized or sanctioned. MAIZE only has limited ability to do so, although attempts have been made through the attribution of non-monetary awards, including to young scientists. The dual leadership of FPs is one step toward allowing non-hierarchical, functional management of individuals across CIMMYT and IITA, yet currently very much dependent on the personal relationships between FP co-leads in the absence of a formal process. Clarity of objectives and roles, as mentioned earlier, can contribute to building trust among individuals and across organizational boundaries and lead to a situation where co-leadership of FPs may not be necessary to ensure seamless people management across CIMMYT and IITA. Mentoring and capacity development can also play a significant role in mitigating risks associated with individual and organizational performance. Most if not all of the mentoring and capacity development has been from CIMMYT and IITA toward other partners, in what could be described as a unidirectional pattern. It might be desirable for other training and capacity development patterns to emerge in the future, where "trainers" are NARSs or seed companies (for example, around technologies and processes implemented at DH production or MLN screening facilities). Such multidirectional training and capacity development patterns would likely reinforce relationships among all partners and have a positive impact on the ability to manage the human component of projects and MAIZE.

MAIZE operates with a stage-gate system for its breeding activities. How scientific or product development decisions are made is, however, still not transparent enough and too isolated from (mostly downstream) partner involvement.

Despite the implementation of product profiles and a stage-gate system, it is not clear how product specifications in product profiles drive breeding decisions at each stage. Product profiles do not provide relative priorities among traits. No information is available about the criteria used for advancement of products from one stage to the next in the stage-gate system. Selection indices are used in a number of breeding programs, but the mere fact of using selection indices does not provide clarity or transparency about how selection decisions are made. The CIMMYT and IITA maize-breeding programs have recently moved from breeding for specific traits to breeding for wholistic trait "packages," yet no information is available about how this is actually done in terms of breeding decisions, when this necessarily has to do with breeding decisions.

Breeding programs would probably benefit significantly from describing how they operate (in particular with respect to product profiles and stage-gate advancements) to their immediate next-stage users, NARSs and seed companies. Doing so would help engage downstream actors, giving them a platform to provide input or ask questions and allowing them to foresee what the short-term future might look like in

terms of varieties and traits. Lack of engagement of downstream actors is a real issue that hinders farmers' ability to benefit from realized genetic gains.

Relating breeding decisions to product profiles and stage-gate advancement criteria basically consists of describing the scientific process of breeding. An immediate benefit of doing so is the ability to transfer breeding skills across individuals and organizations—to teach the science of breeding, not as found in textbooks but as practiced on the ground for a specific goal. According to some interviewees, maize is the crop where private seed companies should progressively engage more and more in internal breeding efforts, starting with assembling hybrids from licensed-in lines and later moving toward line breeding.

The use of a stage-gate system is often related to breeding and product development. It also, however, applies to activities that take place upstream of breeding, including trait discovery and pre-breeding. The development and implementation of a stage-gate system for these activities would facilitate their alignment with MAIZE objectives and product profiles and facilitate the integration of their outputs into the next stages. An additional benefit would be the ability to explain to the respective individuals how these upstream activities contribute to the same objective as their downstream (breeding) colleagues.

Recommendations

QoS-5 The ability of MAIZE to rapidly identify a critical need, mobilize stakeholders, and execute and deliver clear value-added products, as illustrated by the work on MLN, should be a starting point for MAIZE, and CGIAR more broadly, to reflect their uniqueness moving forward.

QoS-6 MAIZE should promote multidirectional training and capacity building among all partners, based on each partner's specific area of expertise, rather than the current mostly unidirectional pattern, from CIMMYT and IITA toward other partners.

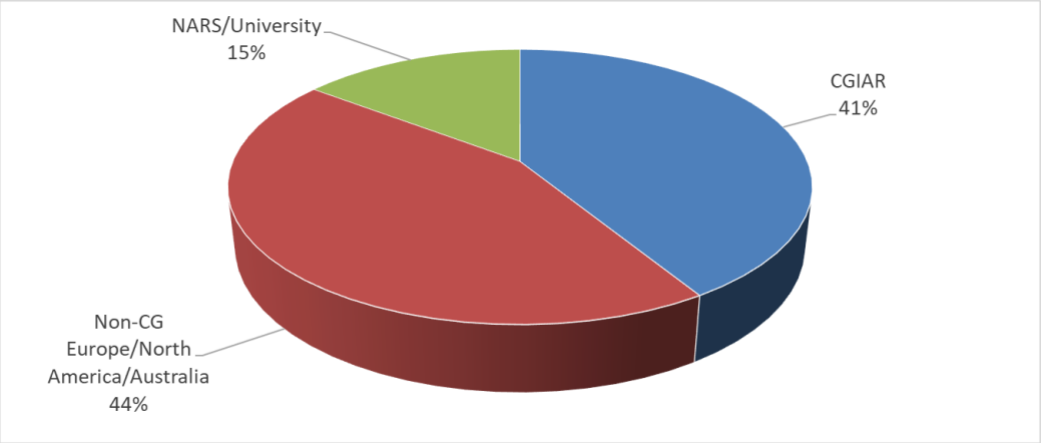
QoS-7 PLC and stage-gate advancement criteria should be described and shared among partners. How product profile specifications and stage-gate advancement criteria determine selection decisions at each stage should also be transparent and described in sufficient detail. These two recommendations would likely benefit MAIZE in two ways: by engaging downstream partners more closely in the processes, and by developing the capacity of NARS and seed company breeders.

3.1.3 Quality of Outputs

MAIZE creates and publishes large amounts of knowledge. Knowledge dissemination may be too heavily focused on scientific publications and too little on tailored communication targeting multiple layers of next-stage(s) users.

Knowledge is disseminated through peer-reviewed and non-peer-reviewed publications. While a significant number of peer-reviewed publications are of high scientific quality, it appears from bibliometric analyses that many (half or more) will never impact any other research. It seems fair, therefore, to ask whether peer-reviewed publications are the best way to disseminate the knowledge described in them. Our view, based on bibliometric analyses, is that the importance given to peer-reviewed publications is probably too high and comes at the expense of other forms of communication that would reach their intended target audience more effectively. It is also worth noting that, of the 10 most-cited publications, none is first-authored by a NARS scientist. Similarly, only 15% of first authors of the 10% most cited peer-reviewed publications are affiliated with NARSs or universities in Africa, Asia, or Latin America (Figure 2). Finally, only 4 of the 30 most productive authors, who contributed to 8 to 32 publications each, were not affiliated with CIMMYT or IITA: one was affiliated with the University of Wageningen, one with CAAS, one with ICAR, and one with the Colegio de Postgraduados. This huge gap between CIMMYT and IITA on the one hand and other MAIZE partners on the other hand should be resolved, at least partially, to ensure the longevity and productivity of the partnership.

Figure 2. Organization affiliation of first authors of the 10% most cited peer-reviewed publications for 2017-2019



Note: NARS/University are meant as located in Africa, Asia or Latin America; Non-CG Europe/North America/Australia are non-CGIAR organizations (public or private) located in Europe, North America (United States or Canada) and Australia

MAIZE has developed significantly improved germplasm and valuable technologies. Communication about these outputs may not always be sufficient or relevant enough to create the necessary pull from next-stage users.

The establishment of fee-based facilities is a tangible expression of sustainable technology transfer to local organizations. The opening of these facilities to non-MAIZE users (especially private companies, including large ones), by allowing them to be in direct contact with markets, puts them in an excellent position to continuously learn from those markets (needs, constraints) and to evolve to serve them better. The development and transfer of phenotyping protocols are also tangible expressions of sustainable technology transfer to local organizations. In the previous section we suggested that describing how selection decisions relate to product profile specifications could be the first step in yet another technology transfer to local organizations: breeding protocols (or the science of practical breeding).

Through MAIZE, a large number of lines and varieties have been developed and released to local partners. Performance of the released varieties is generally high, at least based on on-station trial data. A number of studies of stress-tolerant varieties, however, show that the yield advantage of newly developed stress-tolerant varieties over cultivated (commercial) varieties ranges from 4% to 150% across on-farm, research, drought-stressed, well-watered, or rainfed trials across East, West, and Southern Africa (Amondo et al., 2019; Lunduka et al., 2017; Martey et al., 2020; Rezende et al., 2020; Setimela et al., 2017; Worku et al., 2020). A performance advantage of 4% is likely not perceptible for any smallholder farmer and therefore is basically equivalent to no advantage. For a seed company, taking on such a variety from MAIZE would represent an investment failure, which many small seed companies cannot afford. Unless data are available for their specific target agroecologies, such a range of variation in relative performance makes it very challenging for small local seed companies to select new candidate varieties for further investment and development.

More relevant, seed companies generally need high-quality data to be able to confidently and rapidly invest in new varieties, and to test, produce, and market them. Such data are lacking according to a number of interviewees and documents consulted. Here again, transparency should be the rule. Providing data about a restricted number of varieties to downstream partners, in particular seed companies, weakens the relationship, potentially giving those partners the impression that they are incapable of making their own informed decisions. Providing data on many potentially interesting varieties, even with recommendations for their specific agroecologies, lets them make their own decisions while feeling that their needs are being understood through the list of recommended varieties.

Recommendations

QoS-8 Adjust practices in terms of peer-reviewed publications and other types of communication, with the objective of communicating in the most effective way for the intended target audience.

QoS-9 Encourage partners to have projects led by NARS or seed company scientists, who should have corresponding first-authorship on peer-reviewed publications.

QoS-10 Improve the amount, quality, and relevance of variety performance data released to next-stage users so that they can select those varieties that best fit their sometimes very specific needs.

3.2 Effectiveness

3.2.1 Achievement of Planned Outputs and Outcomes

MAIZE has made good progress in achieving its outcomes, though this varies by FP and geography. Management of partnerships to ensure greater impact requires further thought, drawing on experience to date.

Given that there are few measurable and specific targets for outcome milestones, it is difficult to precisely assess the extent of achievement of outcomes, though the fact that more than 50 of the 70 CRP milestones were completed indicates a fair level of achievement. Assessing detailed achievement would involve going to a more granular project level. The CRP is certainly achieving much across and between the FPs, and while the achievements do fall within the CRP's two pillars (germplasm development and sustainable intensification) and four FPs, they are rather scattered in nature owing to the many different W3/bilateral projects. This point is picked up again below under the last conclusion for this section.

The identification of innovations, policies, and OICRs is evolving, aided by the QA process in place and the gradual building of capacity of staff by the CRP and Center MEL units in how to identify, define, categories, and substantiate these. While MARLO has a channel to ascribe policies, innovations, and OICRs to particular FPs, many necessarily stem from the efforts of more than one FP. Reporting against milestones, policies, and innovations at the CRP level is improving, but there remain challenges in reporting and in the interpretation and use of what is reported.

Given the constraints faced by the CRP, some beyond its control, MAIZE has overall made good progress in achieving its outcomes, though this does vary within each FP and across geographies.

However, effectiveness is best indicated beyond the outcome level, based on the difference the CRP's work makes on the ground. The CRP has unique strengths in terms of the biological and social sciences underpinning germplasm development and sustainable intensification (its two pillars). It also recognizes that partnerships (with both the private sector like seed companies and government bodies like NARSs) are essential if its products are to make a difference. But given the lack of clarity on the roles, strengths, and responsibilities of NARSs and private sector partners, more work is needed on how best to manage these partnerships so that all partners are effective and draw on their strengths. Also, because of how W3/bilateral funding streams reach the CRP, while its research generally falls within the CRP and FP ToCs, it may not be as focused as it could be, which could hinder overall effectiveness.

Recommendations

EFF-1 MAIZE should carefully consider how its expertise in CGIAR can work with NARSs, seed companies, and other key partners (already identified in the FP ToCs) to best attain adoption and impact on the ground in an inclusive manner.

EFF-2 MAIZE should seek to ensure focus and greater coherence between its many funded projects and look to streamline focus in the future.

3.2.2 Demonstrated importance of outcomes

The three cases showed the importance of effective partnerships, mainstreaming of cross-cutting areas, and application of theory of change thinking. Learning from OICRs and successful projects could be enhanced.

The three cases reviewed indicate the importance of partnerships. There was evidence of effective partnerships, which is relevant for the CRP as a whole. While the conclusions regarding the CRP as a whole saw the achievement of outcomes as fair and progress toward outcomes as good, outcomes from the three cases have been good to excellent. STMA exceeded its targets, MasAgro reached farmers and seed companies across Mexico, and MAIZE's response to MLN, with the help of donors, succeeded in containing MLN incidences and spread. All three contributed to CRP SLOs and IDOs.

The two OICRs reflected a wider finding (see section 3.3) that some work taking place in cross-cutting areas is not tagged as such. Both OICRs covered in this review tagged only CC as significant, whereas gender and especially capacity development were important components in the related projects (STMA and MasAgro). While MasAgro looked at social inclusion (which can imply youth as well as gender), youth was not a focus for any of the cases, and this is also reflected more widely in the CRP (see section 3.3).

The outcomes of all three cases are relevant to the CRP and particularly to certain FP ToCs. Even where the case did not have a ToC, it was clear how the project logic and planned outcomes fit with one or more of the CRP FPs. The use of ToC thinking by MasAgro was useful in the same way as indicated in broader findings regarding ToC (see 3.2.4). We conclude that using a participatory ToC approach with staff and partners is beneficial, even if this is not done at the start of the project. It helps build consensus, provides a visualization that can help external stakeholders understand what the project is doing and how its impact pathways are connected, and serves as a tool for later reflection on impact pathways and the assumptions behind them.

While there was evidence of learning from outcomes by the CRP and external partners, the learning component of monitoring, evaluation, and learning was not formalized in any of the cases. This meant that while valuable learning did take place, it was not necessarily recorded or reported on.

Recommendations

EFF-3 MAIZE should examine and learn from the examples of effective partnerships in all three cases, which allowed for adoption and impact on the ground.

EFF-4 MAIZE should give more attention to how cross-cutting areas are tagged in reporting and OICRs.

EFF-5 MAIZE should give more attention to recording learning within and across both FPs and projects, so that the CRP and other stakeholders can in turn learn from this record.

3.2.3 CRP Management and Governance

MAIZE management and governance were good, allowing for good collaboration between scientists from CIMMYT and IITA and effective decision-making.

MAIZE's management and governance supported its effectiveness. MMC and ISC meetings were constructive, practical, and useful, allowing for decision-making and planning around key management and technical issues.

MAIZE managed risk appropriately, but annual uncertainty concerning the amount and timing of W1/W2 funding constrained delivery against planned outcomes as the CRP held back W1/2 money each year until they were sure of the timing and amount of funding. Nevertheless, spending decisions were made in an informed manner, and the CRP exhibited flexibility in terms of responding to emerging needs.

Although MARLO is essential for CRP reporting, for many scientists who implement W3/bilaterally funded projects, it comes second place after project-level reporting to donors. Ways in which it can be used by CRP staff for review of progress and for learning are not yet fully understood or utilized. As noted in section 1.4, the POWB and AR templates changed almost annually through the review period. Further, as noted in section 2.2.1, how to identify and report policies and innovations also changed through the review period as a guidance and quality assurance for this was gradually established. (See section 3.5 for recommendations related to this conclusion.)

Recommendations

EFF-6 For the remainder of the CRP, keep to the present membership and structure for MMC and ISC meetings and the same PMU staffing. Looking forward, ensure an equal level of "voice" of key actors in management structures, and continue the geographic and sectoral representation in any steering committee that is established.

EFF-7 Given that the CRP does not have control over the amount and timing of W1/2 funds it receives or over the MEL requirements of the system, it should continue to use the MMC (with ISC guidance where needed) to manage risk and retain the space to respond in a dynamic manner to emerging demands and threats in a similar way to how it responded to the rise of FAW and MLN.

3.2.4 Progress along ToCs (CRP and FPs)

The increased awareness of ToC thinking among scientists is of greater import than the actual ToCs themselves in terms of their use for planning, learning, and monitoring.

The high-level FP ToCs, particularly for FP1 and FP4, are more a description of the landscape in which the FP is operating and the expectations of different stakeholders than a depiction of causal pathways. However, the ToCs do depict the work of each FP and clearly indicate how the FPs intersect.

The greatest value of the FP ToCs was the process followed to develop them, along with their underlying assumptions. The focused review of MasAgro also indicated the value of following a participatory process, ideally with partners as well as staff, to develop theories of change (see sections 2.2.2 and 3.2.2).

While progress against the defined impact pathways is difficult to assess given that they are high level and not in all cases causal pathways, the ToCs did, and for some still do, provide a framework or guide regarding the responsibilities of each FP and the boundaries between FPs. The focused review of MasAgro described how a ToC can provide a visualization of the planned outcomes of a project, which can be useful to inform external stakeholders.

The nature of the FP ToCs, the process used to develop them, and the presence of co-leads from each Center for each FP enhanced collaboration between scientists from different Centers and between FPs. At the same time, there is little evidence that the FPs have revisited their ToCs for planning, learning, or adaptation purposes. The FPs do report on their milestones against selected FP outcomes.

Recommendations

EFF-8 MAIZE should continue to use ToC thinking at different levels. ToC thinking will remain relevant to MAIZE's positioning in One CGIAR. Capacity should be further built in how to use ToC approaches at a high level and particularly at the more granular level of projects. Within some of the projects in MAIZE, there is good experience in using ToC thinking, and this experience could be shared with others. Revisiting assumptions, and, for granular project-level ToCs, conducting contribution analysis on relevant impact pathways, can greatly support ongoing implementation as well as provide good evidence for M&E. MAIZE should consider budgeting for participatory ToC workshops involving both CG and key partners, ideally at the project design phase (see also section 3.5).

3.3 Cross-cutting Issues

The work of the MAIZE CRP in relation to gender and youth is commendable. CD carried out by the CRP itself (WI/W2 funding) is relevant, and CC is integral to the MAIZE ToC.

While much of the CD work of MAIZE is managed by IITA, CIMMYT, and the large W3/bilateral projects under them rather than by the CRP, overall, the CD of both staff and partners is wide ranging. The focus on gender in the capacity development strategy, and the capacity building on gender through W1/W2 funding led by FP1 and in large projects such as STMA, is commended, as is the capacity building on project management and aspects of MEL, including how to input into MARLO.

The CRP responses to CC are reflected in the FP ToC, the SLOs, and the IDOs, but reporting on CC has not been as consistent as on the other cross-cutting issues, as it was not identified as a cross-cutting issue at time the CRP II proposal was drafted. The fact of CC is, however, central to all that the CRP is doing.

The CRP took note of recommendations regarding gender and youth in earlier evaluations of MAIZE, gender, and capacity development. It benefited from CIMMYT's hosting of GENNOVATE. The CRP, with the encouragement of donors, has been both proactive and productive in addressing the gender and youth cross-cutting issues. It has worked well with others in these areas—for example, under Gennovate with regard to gender and with YPARD with regard to youth. The OICRs examined in section 2.2.2 focused on gender to some extent but not youth, and research arising from MAIZE's FP1 indicates that focusing on youth in isolation should be avoided.

Recommendations

EFF-9 MAIZE, or the projects within the Centers that are carrying out CD activities, should follow up to assess the outcomes from the training and/or training manuals provided.

EFF-10 Tagging of CC should become the norm for the remainder of the CRP and beyond, as it is for the other cross-cutting issues.

EFF-11 While CC is the basis of much of the CRP's research, the role of MAIZE in addressing climate resilience, and the CRP's focus on this, should be given more attention.

EFF-12 MAIZE should continue and build on its existing gender and youth work until the end of the CRP. MAIZE should consider positioning its research in relation to gender, youth, social inclusion, and the "leave no one behind" frame of intersectionality, drawing on CGIAR's existing work in this area. This work includes a 2018 webinar on the subject (CGIAR Gender Platform, 2018), and papers from different CRPs that pave the way for MAIZE to start framing its work similarly (see, for example, Tavenner and Crane 2019).

3.4 Future Orientation

As noted in section 2.4, conclusions and recommendations regarding the future are covered mostly under other evaluation questions. Those below draw on the specific findings listed in section 2.4.

In the short term, continued commitment of the CRP director and FP co-leads is essential to ensure delivery of outcomes, particularly in the reduced time frame with the CRP closing at the end of 2021. In the longer term, MAIZE uniquely fills a gap at the global and regional level, positioning it to continue catalyzing good science across borders.

MAIZE generally operates with good science at all levels: inputs, processes, and outputs. MAIZE also operates regionally and thereby uniquely fills a gap that cannot be easily addressed by its multiple national partners, whether public or private. MAIZE is therefore in a position to act as a facilitator or catalyst to leverage good science across borders. The establishment of a DH production facility with KALRO in Kenya is a good example of how effective MAIZE can be in that unique role. In that example, a technology was brought from one of the best universities in Germany to East Africa, tweaked to meet regional needs (transferring DH induction into tropical germplasm), and made available to regional actors.

Good management and governance practices are a strong foundation for the remainder of the CRP's running. Continued commitment of and leadership by the CRP director and FP co-leads are essential to ensure delivery against planned outcomes as far as possible, given the reduced time frame.

Recommendations

QoS-11 Increase sharing and transparency about the science with partners, especially downstream partners, to strengthen relationships, motivate and engage more intensely, and eventually deliver more impact.

EFF-13 CRP and FP co-leads should do their best to maintain their present levels of passion, commitment, and collaboration to ensure the best possible outcomes for MAIZE by the end of 2021.

3.5 CGIAR System-Level Recommendations

The following recommendations stemming from the MAIZE 2020 review are pertinent to the wider CGIAR:

CG-1 The CGIAR SMO should consider mainstreaming ToC approaches and thinking across CGIAR's research for development design and MEL. This will require further CD and opportunities for participatory design workshops at the start of any new large projects. These workshops can include the drawing up of ToCs and consideration of the assumptions behind them by both CGIAR and key partners in a facilitated participatory process. Thinking carefully through the often-unspoken assumptions behind a planned project allows participants to question these assumptions and achieve consensus. Having theories of change in place will allow for theory-based evaluation where that is needed and will provide scope for contribution analysis of particular causal pathways within any one ToC. The assumptions can also be revisited at times and, if incorrect, can be adjusted to allow for changes in project activities or priorities to ensure that the project is on track to achieve its anticipated outcomes.

CG-2 The SMO should continue to streamline monitoring and reporting processes as far as possible, building the utility of MARLO for learning as well as accountability, and investing in ongoing capacity building of staff in using MARLO for reporting, learning, and planning. This includes continued capacity building of staff in relation to reporting on policies and innovations, and moving toward specific, measurable, achievable, relevant, and time-bound (SMART) indicators at least at the output level.

CG-3 The SMO should consider, in collaboration with the Generating Evidence and New Directions for Equitable Results (GENDER) platform hosted by ILRI, whether the recommendation made in section 3.3 for MAIZE to consider framing future work on youth, gender, and social inclusion within an understanding of intersectionality may be relevant for CGIAR as a whole.

CG-4 The recommendation that MAIZE further consider its roles vis-à-vis those of NARSs, seed companies, and other key partners in terms of attaining impact on the ground is likely relevant to other CRPs as well. Thought needs to be given to how CGIAR can make the most of its unique position—its ability to rapidly mobilize all necessary high-quality science—to attain impact by ensuring that partners in turn can deliver downstream.

4 Annexes

Find the Annexes and Brief here:

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