MAIZE (2015 – 2023):

Doubling Maize Productivity through Performance Partnerships
Justification

The increasing cost of food—exacerbated by population growth, volatile energy prices, natural resource depletion, and climate change—continues to threaten the livelihoods of millions of poor people. Together with rice and wheat, maize provides at least 30% of the food calories of more than 4.5 billion people in 94 developing countries. They include 900 million poor consumers for whom maize is the preferred staple, 120-140 million poor farm families and about one-third of all malnourished children. Between now and 2050, the demand for maize in the developing world will double, and by 2025 maize will have become the crop with the greatest production globally and in the developing world. But harvests at current levels of productivity growth will still fall short of demand and millions of farm families will remain in poverty. Unless vigorous measures are taken to stabilize food prices, accelerate yield growth, increase incomes from more productive, sustainable and resilient maize based systems, and give greater opportunities to women and young adults, the outcome will be less affordable food for millions of poor maize consumers, continuing poverty and childhood malnutrition, deforestation, soil degradation, reduced biodiversity, and accelerated depletion of water and fertilizer reserves.

The MAIZE strategy is designed to ensure that publicly-funded international agricultural research helps most effectively to stabilize maize prices and double the productivity of maize-based farming systems, making them more resilient and sustainable and significantly increasing farmers’ income and livelihood opportunities, without using more land and as climates change and fertilizer, water, and labor costs rise. The MAIZE CRP has three principal target groups: 1) Smallholders who live in stress-prone environments and who have poor market access; 2) Market-oriented smallholders in more favorable production areas, and; 3) Poor maize consumers and governments in low and middle income countries affected by maize price fluctuations.

The Vision of Success for MAIZE is:

1. Increasing demands for food are met, and food prices are stabilized at levels that are affordable for poor consumers.
2. Farming systems are more sustainable and resilient, despite the impacts of climate, and their dependence on irrigation and increasingly expensive fertilizers is reduced.
3. Increased production in developing countries is achieved mainly through higher yields, thus lessening pressure on forests, hill slopes, and other crops.
4. Poverty and malnutrition are reduced, especially among women and children, and a greater proportion of women and young adults are able to engage in profitable and environmentally-friendly farming.
5. Developing countries are able to compete more vigorously in export markets and ensure benefits for a wide range of actors in the value chain of major food crops.
6. Disadvantaged farmers and countries gain better access to cutting-edge proprietary technologies through innovative partnerships, in particular with advanced research institutes and the private sector.
7. A new generation of scientists and other professionals is guiding national agricultural research across the developing world and working in partnership with the CGIAR, the private sector, policy makers and other stakeholders to enhance efficiency and impact.
**RESEARCH STRATEGIES AND FLAGSHIP PROJECTS**

The MAIZE Strategy is comprised of three Research Strategies: **Sustainable Intensification and income opportunities for the poor; Maize varieties – stress tolerant, nutritious and safe, and; Integrated Post-Harvest Management.** These Strategies and the associated Intermediate Development Outcomes and System-Level Outcomes to which they contribute to are illustrated in the diagram below.
**Research Strategy - Sustainable Intensification and income opportunities for the poor**

The goal for this Research Strategy is to reduce poverty and hunger through integrated and scalable innovations that improve market access and increase the productivity, sustainability, and resilience of maize-based farming systems. It is estimated that the Research Strategy will reach 25 million people by 2020 and 75 million people by 2030, and lift at least 10 million out of extreme poverty within the first 10 years. The foundation for this change is based on the premise that a network of change agents and modern communication tools empower 20 million smallholders to manage their crops in a more profitable and environmentally friendly manner, thereby providing food for 150 million poor maize consumers while reducing the environmental footprint. Research Strategy 1 is comprised of two Flagship Projects: Sustainable intensification and income opportunities for the poor, and; Smallholder precision agriculture, and is supported by Flagship Project Socioeconomics and policies for maize futures, and cross-cutting gender, capacity-building and knowledge management investments.

The principal outputs for Research Strategy 1 are crop and resource management practices and knowledge. Crop and resource management practices, incorporating improved maize and other high performing adapted crop varieties, are developed with national public and private sector partners to address specific resource constraints and agronomic opportunities present in the MAIZE CRP target areas (outlined below).

If key assumptions hold, the Sustainable Intensification and income opportunities for the poor Research Strategy will lead to two important Intermediate Development Outcomes: IDO1 Increased productivity and stability of farming systems and IDO2 Increased income of smallholder farmers. Performance Indicators for IDO1 include: Increased farm level production; Lower per ha level input use (labour, fossil fuels, fertilizer, pesticides, irrigation water, etc.), and; Improved soil health (SOM, reduced erosion, nutrient depletion). Performance Indicators for IDO2 include: Reduced production costs; Increased profitability of maize production, and; Diversification of income sources.

**Research Strategy - Maize varieties – stress tolerant, nutritious and safe**

The goals for this Research Strategy are to: 1) provide maize food security and reduce production shortfalls for at least 36 million and ideally over 100 million of the poor in Africa, Asia, and Latin America whose crops suffer the effects of an array of abiotic (especially, drought) and biotic stresses, accentuated further by global climate change; 2) Through public–private partnerships, increase maize productivity among smallholders in high-potential areas of Asia, Africa, and Latin America, thereby providing food for 50–170 million poor maize consumers, reducing demands on land and irrigation, increasing the diversity of improved maize varieties grown by farmers and fostering a more competitive maize seed sector; 3) Using native maize genetic diversity and novel tools, develop and disseminate maize varieties that are bio-fortified for pro-vitamin A (pro-V A), zinc, or essential amino acids (quality protein maize—QPM), thereby reducing 10–20% of the life-years that are lost annually to Vitamin A deficiency in five sub-Saharan African countries alone, and benefiting malnourished children who grow up on maize-based diets. Research Strategy 2 is comprised of five Flagship Projects: Stress tolerant maize for the poorest; Towards doubling maize productivity; Nutritious maize; Seeds of discovery, and; New tools & methods for NARS & SMEs, and is supported by Flagship Project Socioeconomics and policies for maize futures, and cross-cutting gender, capacity-building and knowledge management investments.
The principal outputs for Research Strategy 2 are high yielding, stress tolerant and nutrient enhanced maize varieties. New elite maize varieties are developed with national public and private sector partners to meet the specific needs of farmers in the MAIZE CRP target areas (see target geographies below).

If key assumptions hold, the **Maize varieties – stress tolerant, nutritious and safe** Research Strategy will lead to three important Intermediate Development Outcomes: **IDO2** Increased income of small holder farmers; **IDO3**: Increased yields of maize for smallholder farmers, and; **IDO4**: Increased nutritional diet. Performance Indicators for **IDO2** include: Reduced production costs; Increased profitability of maize, and; Increased marketable surplus. Performance Indicators for **IDO3** include: Increased maize yields (t/ha); Reduced vulnerability (risk) from disease and pest attack, and; Area expansion of maize at farm-level. Performance Indicators for **IDO4** include: Increased consumption of bio-fortified maize; and; Increased livestock consumption of high stover quality of maize.

**Research Strategy - Integrated Post-Harvest Management**

The goal for this Research Strategy is to: 1) Improve the food security and safety, health, and marketing options of some 6 million smallholders in 15 countries of Africa, Asia, and Latin America by reducing post-harvest losses and mycotoxin contamination in maize-derived foods. Research Strategy 3 is comprised of one Flagship Project: Integrated Post-harvest management and is supported by Flagship Project Socioeconomics and policies for maize futures, and cross-cutting gender, capacity-building and knowledge management investments.

The principal outputs for Research Strategy 3 are integrated approaches for reducing post-harvest losses and mycotoxin contamination. Integrated Post-Harvest Management approaches are developed with national public and private sector partners to meet the specific needs of farmers in the MAIZE CRP target areas (below).

If key assumptions hold, the **Integrated Post-Harvest Management** Research Strategy will lead to two important Intermediate Development Outcomes: **IDO5** Reduced post-harvest losses, and; **IDO6**: Reduced aflatoxin in maize value chain. Performance Indicators for **IDO5** include: Number of maize silos and bags purchased by farmers, and; Reduced post-harvest losses. Performance Indicators for **IDO6**: include: Quantity of Aflasafe purchased by farmers; Reduced aflatoxin in maize value chain, and; Premium attained for higher quality maize (food and feed).

Success among the concerted investment of partners—at international, regional and bilateral level, and by the public and private sector—will imply that the following **impact targets** are being met:

1. As compared with current trends, boost maize productivity by at least an additional 20% by 2020 and 50% by 2050 in 60 major maize-producing countries of the developing world, thus helping ensure accessible and stable prices for the over 900 million poor maize consumers.
2. Sustainably intensify maize production and ensure stabilization of the total maize area at about 120 million hectares in developing countries, thus avoiding environmental damage.
3. Reduce the frequency of production shortfalls and price volatility in areas and countries where the probability of crop failure in maize-based farming systems is greater than 15%.
4. Diversify maize-based farming systems and enhance their productivity and sustainability, dealing specifically with the systems with the highest poverty concentrations, where over 660 million maize-dependent poor and about 62 million malnourished children live.

5. Ensure that higher rates of maize yield growth are sustained beyond 2020 in the face of climate change impacts, worsening water scarcity, and rising fertilizer prices.

6. Increase opportunities for diverse market participation, including locally emerging companies, women and young adults, and give developing countries access to know-how and technologies comparable to those available in high-income countries.

**GEOGRAPHIC FOCUS**

The MAIZE CRP has a range of geographies predicted to benefit from MAIZE Research Outputs. Uptake Modality One areas (Map 1) represent areas in which NARES, NGOs and private entrepreneurs are expected to independently uptake the agricultural productivity enhancing technologies/approaches, namely; improved maize varieties, improved crop management and maize storage technologies and practices.

Uptake Modality 2 Areas (Map 2) represent areas, in which intensive efforts will continue to steward successful uptake of agricultural the productivity enhancing technologies and approaches described above. The colours indicate geographies where MAIZE and Humid Tropics (red), MAIZE and WHEAT (yellow) and MAIZE and GRiSP (blue) collaborate. Significant input is also received from PIM and LEGUMES & LIVESTOCK, and results feed into CCAFS.

**IMPACT PATHWAYS AND THEORY OF CHANGE**

For each Research Strategy, a generic impact pathway and associated theory of change has been developed. Figure 1 outlines the impact pathway and theory of change for Research Strategy 1. Initial research outputs in this example are crop and resource management practices and knowledge. As long as key assumptions are met (in orange), and external factors are enabling, these practices and knowledge will be taken up by NARES, NGOs and private entrepreneurs (Immediate Outcomes). As long as key assumptions hold (in orange), NARES, NGOs and private entrepreneurs will promote these improved crop and resource management practices and knowledge at the farm-level. Key assumptions holding, farmer uptake of these practices and knowledge are expected to led to improved system productivity and stability and increased income of smallholder farmers (Intermediate Development Outcomes).
Figure 1. Theory of Change for Research Strategy 1: Sustainable Intensification and income opportunities for the poor

System-level Impacts

- Improved Sustainable management of natural resources
- Improved system productivity and resilience and increased income of smallholder farmers
- Profitable, resource efficient maize-based farming systems and value-chain innovations adopted by smallholder farmers
- Profitable, resource efficient maize-based farming systems and value-chain innovations locally adapted by NARES and promoted by public, NGO, and private sector
- Crop and resource management practices and knowledge

External factors

- Natural events, trends

Assumptions

- National government, INGOs and private sector scale-out the practices
- The practice(s) and knowledge work in practice
- There is a willingness to change
- Practice changes not seen as potentially detrimental
- The practices and knowledge address locally important challenges and opportunities
- Farmers, input providers and extensionists are willing and able to support the intervention
- The right people are reached
- The right message is delivered
- The messages are understood

Implementation

- Theory
- Outputs

Programme Theory

Research and Engagement with Policy makers
- New knowledge, tools and methods
- New policies/instruments
- Regional adoption

Research and Engagement with Policy makers Private sector NARS Communities
- Knowledge on socioeconomic dynamics and drivers of agrarian change
- New or better functioning institutions, input markets and maize value chains

Research and Engagement with individuals households
- Household & farm-level data used for targeting innovations
High quality partnerships with a range of research and development actors are critical with regard to defining R4D priorities and achieving both Immediate and Intermediate Development Outcomes and ultimate Impacts.

In the case of Research Strategy 1, partners from Advanced Research Institutions, the private sector and NARES (either managing projects or sub-projects), work together with CIMMYT and IITA to generate a range of resource efficient maize-based farming systems and value-chain innovations. These technologies, approaches and knowledge are promoted via two different modalities. The first modality centers on the direct intervention of the MAIZE CRP through its large bilaterally funded projects. In this modality, different approaches to sustainable intensification and value-chain integration are tested, adapted and the most successful approaches are scaled-up and scaled-out. Regional, sub-regional and national partners on the ground are essential for testing, adaptation and scaling up and scaling-out. The second modality centers directly on the actions of change agents (Policy and development actors, NARES, NGOs, farmers etc.,) independently adapting and scaling-up and scaling-out profitable and locally adapted approaches to sustainable intensification and value-chain integration developed by the MAIZE CRP and partners.

Ultimately, crop and resource management practices and value-chain integration approaches developed by the MAIZE CRP are only adopted if one or more of the following assumptions hold. Research outputs must truly address locally important challenges and opportunities. For example, poor farmers and women benefit from increased productivity, reduced risks, and improved food security, while reducing or reversing negative impacts on soils and the environment. Ultimately, MAIZE partners, change agents in developing countries are better equipped to diagnose maize production problems and give reliable and simple messages to farmers on “best-bet” crop management practices. This includes enhanced capacity of smallholder farmers managing maize-based systems in developing countries to better understand factors that limit maize and system productivity, and the interactions between these factors. Development partners, policy makers, researchers, and change agents are able to identify viable options for rapid and sustainable poverty reduction in maize-based systems. It is only when value-chain actors and service providers benefit from market innovations (developed by MAIZE) that they will take steps to link the poor into markets to access inputs and equipment and to purchase agricultural produce (including maize). Change agents such as NARES, seed companies and NGOs/CBOs are better equipped to catalyze and lead multi-agent innovation systems, as well as to facilitate information/knowledge flows. Finally, there needs to be willingness to change and new practices are not seen as potentially detrimental. Obvious benefits of MAIZE interventions include: reduced soil erosion, siltation, and flash-flooding downstream from agricultural areas, reduced greenhouse gas emissions, especially as a result of reduced fuel use in agriculture, and increased carbon sequestration in agricultural soils, thereby mitigating climate change (often most important at the policy-maker level). Other benefits to partners and beneficiaries include: increased biological control of pests accompanied by a reduction in pesticide use and increased nutrient use efficiency in high productivity maize systems of Asia and Latin America. Farmers alone or with assistance from extension services must be able to see increased productivity and profitability of their maize crops through adopting MAIZE technologies (seed, fertilizer, mechanization) approaches (precision agriculture) knowledge (value chains/innovation platforms). Seed companies and other input supplier and know-how providers must be able to better target their products to particular agro-ecological niches due to research outputs developed by MAIZE.
In the case of Research Strategy 2, partners from Advanced Research Institutions, the private sector and NARES (either managing projects or sub-projects), work together with CIMMYT and IITA to generate high yields, stress tolerant and nutrient enhanced maize varieties. Immediate Outcomes expected are new elite maize varieties are promoted using three modalities. The first modality centers on the provision of technical backstopping to NARS and private seed companies (SMEs). In this modality, the MAIZE CRP provides new elite maize varieties and lines, and technical backstopping, for regional on-station testing. Next, for maize varieties that show significant promise, technical backstopping is provided to NARS and private seed companies for regional on-farm testing; including entry into National Performance Trials (NPT) and for Distinctness, Uniformity and Stability (DUS) trials. In some cases, technical backstopping and financial support are provided to assist SME seed companies in the process of variety registration and to produce breeders and basic seed. The second modality centers on the inclusion of new elite maize varieties in large bilaterally funded sustainable intensification interventions outlined above. The third modality centers on the independent uptake of new elite varieties by NARS and private seed companies.

Ultimately, new elite maize varieties developed by the MAIZE CRP are only adopted if one or more of the following assumptions hold: 1) Public (NARS) and Private (SME seed companies) are willing and able to test new germplasm; 2) Germplasm originating from MAIZE CRP is better than commercial checks; 3) Seed companies & NARS are willing & able to put new maize varieties through NPT testing &/or DUS; 4) Seed companies & NARS have capacity (technical/financial) to produce breeders & basic seed; 5) Farmers’ are convinced of the value of new maize varieties and are willing and able to purchase; 6) Seed companies deliver quality seed, at a competitive price, in a timely manner; 7) New maize varieties are more profitable than existing commercial varieties or confer greater fitness for the farmers’ environment; 8) There is sufficient production increases in stress-prone environments to allow farmers to escape the poverty trap of recurrent failed harvests and enable them to obtain reliable returns on investments in seed, fertilizer, land and labor; 9) There is increased diffusion of improved technologies in stress-prone environments, to the benefit of farmers and local entrepreneurs; 10) There is reduced variation in maize production and more stable grain prices, and; 11) National research systems and seed companies participate in research consortia that empower them to establish and implement an effective collaborative research agenda, including use of new research tools and information.

In the case of Research Strategy 3, partners from Advanced Research Institutions, the private sector and NARES (either managing projects or sub-projects), work together with CIMMYT and IITA to develop Integrated Post-Harvest Management technologies, approaches and knowledge. Immediate Outcomes expected are that technologies, approaches and knowledge are promoted using two modalities. The first modality centers on the inclusion of post-harvest management approaches in small, medium and large budget bilaterally funded projects. The second modality centers on the independent uptake of post-harvest management technologies, approaches and knowledge by NARS, NGOs, and private entrepreneurs. Ultimately, post-harvest management approaches developed by the MAIZE CRP are only adopted if one or more of the following assumptions hold: 1) Farmers and development partners are convinced of the value-added of maize storage technologies and Aflasafe; 2) Private entrepreneurs make profits from the production and distribution/sale of maize storage technologies and/or Aflasafe; 3) Farmers are convinced that they will increase profits through use of maize storage technologies and/or Aflasafe; 4) Farmers are convinced that they will retain a significantly higher proportion of the crop compared to traditional storage methods; 5) Farmers are convinced that they will or improve the quality and health benefits of the stored crop;
6) A premium develops for higher quality/lower aflatoxin maize; 7) Maize storage technologies increase food security and health benefits (perceived and real), and; 8) National government, INGOs and private sector scale-out the post-harvest technologies and/or Aflasafe.

6 DRAFT BUDGET

TOO EARLY IN THE PROCESS TO BE DEFINED