CRP on Maize: 2011 Annual Progress Report

(Working Document - For Discussion Only)

Document presented for Agenda Item 3:
CRP Portfolio Annual Progress Report, CRP Annual Reports, CRP Financial Reports, and FC Members' Feedback

Submitted by:
CRP on Maize
MAIZE Report by CIMMYT to the Consortium Office of the CGIAR

A. Key messages

a. Synthesis of progress and challenges in implementing the CRP

Notable progress has been made during the first six months of MAIZE implementation, as is evidenced by the large number of MAIZE milestones that were achieved across all Strategic Initiatives (details are provided below). Partner enthusiasm and engagement are high. A cross institutional management committee has been established, and the program is well on its way to transform nine project clusters into nine effective work teams (= the “Strategic Initiatives”) which are aligned towards one common vision of success. Highlights across the program include (i) farming-systems focused innovation platforms are operational and rapidly evolving in Central America, eastern and southern Africa and South Asia (ii) heat tolerant maize is taken up as a new program focus providing insights about more pronounced climate change impact in maize, (iii) the international maize improvement consortium promotes a new approach to engaging and strengthening public-private sector collaboration with local seed companies and is launched in Asia and Latin America; (iv) the combined strengths of CIMMYT (in post harvest pests) and IITA (in post harvest diseases) opens new opportunities for integrated post harvest management in maize, which is a pronounced concern by many governments; (v) in collaboration with CRP4, high Provitamin A varieties are reaching farmers in Zambia; (vi) in collaboration with Mexico and international partners, Seeds of Discovery launches cutting-edge genomic analysis of the untapped wealth contained in the world’s native maize genetic resources; (vii) collaboration with the University of Hohenheim delivers tropically adapted inducer lines that enable NARS and seed companies to implement doubled haploid technology in their own breeding programs. (viii) Overall, MAIZE produced over 100 peer-reviewed journal articles and book chapters (see Annex 1). The MAIZE CRP creates both the context and momentum for greater cooperation and collaboration between CGIAR centers and better alignment of R4D activities between existing programmes within CIMMYT and between CIMMYT, IITA and other CGIAR centers. The MAIZE CRP has also facilitated an even greater results-focused culture; with significant emphasis now being placed on the stewardship of development outcomes. Whilst full integration of CGIAR maize-based system R4D will take time, initial experiences within the MAIZE CRP demonstrate significant promise.

b. Synthesis of the two most significant achievements/success stories in the year

The first success story – of a farmer and program participants - is typical for achievements of the work executed in MAIZE Strategic Initiative 2 Sustainable intensification and income opportunities for the poor. This Strategic Initiative currently works in maize based systems in eastern and southern Africa, Central America and South Asia (in collaboration with GRiSP), covering three of the six priority regions for MAIZE. The second success story is about MAIZE Strategic Initiative 8 Seeds of Discovery. This Strategic Initiative is one of the most cutting-edge endeavors of MAIZE - to analyze and make available the untapped wealth contained in the world’s native maize genetic resources. Seeds of Discovery is funded and implemented in collaboration with Mexico and international partners. It is a tremendous gift to the world.

1. Sustainable intensification of maize-legume cropping systems for food security in eastern and southern Africa
Through their own determination, and with support from researchers in Ethiopia, Kenya, Malawi, Mozambique, South Africa and Tanzania, CIMMYT, ICRISAT, organizations in Australia and ASARECA, Sub-Saharan African farmers are testing and adapting improved maize-legume cropping systems to grow more food, increase incomes and be prepared to face increasingly variable climates. Australian funding enabled and launched this collaborative effort with national agricultural research and extension systems in Ethiopia, Kenya, Tanzania, Malawi, and Mozambique in 2010. MAIZE support will make it stronger. The target is to improve the productivity, resilience and sustainability of a minimum of a 500,000 smallholder farmers deriving their livelihoods from maize-legume cropping systems in eastern and southern Africa. Felista Mateo near the village of Kilima Tembo in Tanzania is one of the participating farmers. In August 2011, her 3- to 4- ton maize plot stood in stark contrast to neighboring fields, which were pocked by brittle, knee-high plants, demonstrating success for her and her research partners. A few years ago, things did not look so promising for Felista. She had separated from her husband and was left alone to care for her four children. Typically, a separated woman is ostracized when she returns to her parents’ home. Felista refused to see her newfound independence as an affliction and Felista set out to acquire a plot from her father. After the elders of the Village Council gave their approval, Felista became an independent farmer. It was this same strength of character that made her the perfect candidate for the newly launched maize-legume cropping systems program. Within one year of inception, she like 214 other farmers have become the pilot testers and centers of local innovation platforms for drought tolerant maize, more productive legume varieties and adapted conservation agriculture practices. Farmers’ active assessment and strong involvement of stakeholders from private seed companies, fertilizer companies, input dealers, local authorities, and extension generate an innovation approach that ensures that productivity-enhancing, risk-averting production practices are linked into stronger value chains and their implementation is hence made sustainable. Through the network of five participating countries, lessons are being scaled out across important maize-legume based systems in eastern and southern Africa. Through integration in MAIZE, lessons from Africa are being exchanged with experiences in Central America and South Asia for more targeted and effective interchange between pilot farmers and researchers to the benefit of 640 million poor living in maize based systems world-wide.

2. A new genomic selection test population: Coaxing maize to unveil its mysteries

Domesticated over millennia from the native plant teosinte, maize is a vital and familiar food crop and, even more, a time-honored cultural artifact of the Americas. Yet beneath the familiar icon of the plant and its fruits lies a large and complex genome which only slowly gives up its inner secrets to science. In particular, as regards the study and use of DNA markers—genetic “signposts” linked to specific traits—crop breeders for tropical maize have been hard-pressed to apply them for dramatic gains. On the one hand, the most important traits of interest—those like yield or drought tolerance—are generally complex: their expression results from the action of many genes acting in tandem and each with relatively small effects. Selection combining so many markers is hopelessly impracticable; using one or two markers for individual genes provides little gain. To make matters worse, markers identified for traits in a particular maize type—say, an inbred line—are not always useful across the broad swath of tropical maize diversity.

To address these issues and uncover the genetic basis of maize diversity, one of the world’s largest genomic selection test populations was formed in a project named “Seeds of Discovery”. Its ambition, “to make the wealth contained in the world’s native maize genetic resources available as an international public good at the price equivalent to developing and commercializing one transgenic”. In its first year of operation, individuals from more than 4,500 tropical, subtropical, and highland maize
landrace seed collections—representing a significant sampling of the diversity of native Latin American maize and a broad cross-section of adaptation, maturity type, and race—were crossed with improved hybrids to study how alleles—different forms of genes—from the landraces would behave in the crosses. The population is comparable in size to a nested association mapping population\(^1\) generated recently in the USA to tackle similar concerns, but is derived from many more, and more diverse maize sources. It is more than 10 times the size of any other maize genotyping population created by a public sector organization in the past.

DNA from the landraces has been isolated to perform high-density genotyping; that is, a very large number of DNA markers will be used in genetic studies to provide new knowledge about the frequency in landraces of particular alleles, about rare alleles that may be associated with important traits, and hopefully large-effect alleles.

In collaboration with Mexican partners, progeny of crosses are being studied in the field—a process known as “phenotyping” and crucial for linking genetic data to actual physical traits in plants—and this work will continue throughout 2012-13. The next challenge is to match genotypic and phenotypic data, and convey insights to the world community. The amount of data generated through high density genotyping requires a paradigm shift in the way data is handled and visualized. Indeed as Seeds of Discovery scientists received their first data files, available computers were unable to open them, the files were simply too large. With that obstacle rapidly overcome, scientists are cruising now towards making the data accessible through simple web based queries that are understandable and implementable by researchers and breeders world-wide, whatever their bandwidth or computer strength.

Seeing the obstacles and challenges overcome in its first year of operation, Seeds of Discovery proved that it is truly the start or seed of discovering a new world, the world of alleles and what explains some—most definitely not all—of the mysteries in maize. This is a story to be continued and watched!

c. **Financial Summary**

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<th>MAIZE</th>
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### Indirect Costs

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### CRP Expenditure Report – Lead Centers

#### CIMMYT CRP EXPENSES (AX) 6 MONTHS

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### CRP Expenditure Report – Lead Centers

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### B. Baseline

Recurrent food price crises—combined with the global financial meltdown, volatile energy prices, natural resource depletion, and climate change—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 consumers with incomes of less that US$ 2 per day 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 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, consisting of nine interrelated Strategic Initiatives each with a well defined product concept, 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 first target group for MAIZE contains smallholders who live in stress-prone environments and who have poor market access (typically both factors go together). This group includes an estimated 640 million poor people who live on USD 2 per day or less; 275 million are maize dependent and 72 million of those are malnourished children. The second target group comprises market-oriented smallholders in more favorable production areas and with great potential to supply markets but who lack access to appropriate technology. This group includes 470 million poor, of whom 367 million are maize dependent and among whom there are at least 49 million malnourished children. The third target group includes poor maize consumers and governments in low and middle income countries affected by maize price fluctuations.

With a targeted annual budget rising to USD 97.8 million—to which the CGIAR currently contributes approximately 19% of the funding through unrestricted support, and bilateral CGIAR and non-CGIAR donors contribute approximately 53% of the funding through over 100 individually designed projects—MAIZE is expected to increase the productivity of the target groups by 7% by 2020 and 33% by 2030, adding an annual value of USD 2.0 billion by 2020 and 8.8 billion by 2030. It will reach 40 million smallholder farm family members by 2020 and 175 million by 2030, and provide enough maize to meet the annual food demand of an additional 135 million consumers by 2020 and 600 million by 2030.

C. Progress in Producing Outputs and Outcomes

Progress is presented viz milestones that were due in 2011 based on the approved MAIZE proposal, and aligned with respective MAIZE outputs.

Strategic Initiative 1 - Socioeconomics and policies for maize futures

Output 1.1 Assessing impact: Impact Assessment [IA] of MAIZE and its nine Strategic Initiatives, including ‘generic’ and thematic impact assessment (eg gender; environmental); Associated tool & method development

2011 Milestone - Household typologies developed for targeting innovations in at least five farming systems with the greatest number of intervention – As part of Strategic Initiative 2,

2 These calculations do not include impacts from pre-MAIZE research.
comprehensive nationally representative plot and household level data were collected, entered and cleaned in maize producing areas of Ethiopia (1,500 sample households and 30 districts) and Malawi (1,015 sample households and 10 districts). A national survey of 1,400 households in Zambia, representative of the major maize production areas, was conducted, analyzed, and reported. A national survey of maize producing areas in Zimbabwe (1,400 farm households and 14 districts) was conducted and cleaned. As part of Strategic Initiative 4, characteristics and poverty profiles of drought prone maize-based systems were reported for Sub-Saharan Africa. For selected countries (Malawi and Nigeria), this was complemented by trait based variety preferences of both male and female farmers exposed to drought tolerant maize varieties. 2011 Milestone - Develop and test tools and instruments for household, market, and farming system surveys – Experimental auctions were conducted in Kenya as one of the target countries for Strategic Initiative 6 and in relation to an aflatoxin control survey. The survey included a representative sample of rural consumers (1,344) in all major maize production zones of Kenya.

Output 1.2 Enhancing impact: Activities to enhance MAIZE impact, including targeting and studies to enhance understanding & foresight in relation to seed systems, production systems, value chains, policy. 2011 Milestone - Ex-ante economic/geospatial analysis of R&D opportunities in sub-Saharan Africa, South Asia, and Central America - A forward looking analysis of maize in Asia was developed and presented in a regional stakeholder meeting in China. The study focuses on the changing maize demands and value chains in the Asia region, including China. In support of Strategic Initiative 7, a more focused ex-ante assessment was made of quality protein maize rich in high methionine for the Indian poultry sector, based on data collected from 185 poultry firms in South India on cost effectiveness of methionine sources. 2011 Milestone - Scoping study on seed and input supply systems and output value chains for maize - A prototype seed market potential index (MPI) was developed in Mexico, based on the need and demand for such tools by seed companies taking part in the International Maize Improvement Consortium (Strategic Initiative 5). The challenges and opportunities of seed industries in Eastern Africa, Southern Africa, and Western Africa were characterized and reported. Targeted at the needs of Strategic Initiative 7, in Zambia the potential of orange, Provitamin A bio-fortified maize was assessed.

Strategic Initiative 2 - Sustainable intensification and income opportunities for the poor

Output 2.1 Geo-spatial information on poverty and socio-economic profiles in target environments: knowledge on livelihood strategies and source of income growth in different maize-based systems. 2011 Milestone - Maize-based system and poverty profiles characterized and constraints mapped using existing information and community surveys – Activities proceeded in all current focal areas of this Strategic Initiative. In Mexico, a study looked inter alia at obstacles to and opportunities for farmer adoption of conservation agriculture options and improved maize seed. Studies were conducted to assess progress towards the sustainable intensification of maize-legume cropping systems in Eastern and Southern Africa. Two contributed papers were presented at the WCCA Conference in Brisbane Australia, 26-29 Sept 2011. Geo-spatial data aggregation for new hub domains in Bangladesh was completed (including soil, climate, socio-economic, and crop yield data layers). Village surveys of production practices and socio-economic characteristics of mixed maize-livestock systems in rain-fed hill ecologies of Nepal were completed. Secondary and tertiary data on (i) area & productivity of principal crops including maize by States of India, (ii) pesticide consumption in India during last five years (2005-2010) and (iii) net irrigated area and area covered by different sources of irrigation in India has compiled and mapped (http://sites.google.com/site/csisaportal/awhere-platform). 2011
Milestone - Household typologies developed for targeting innovations in at least five farming systems with the greatest number of interventions - See Milestone “Household typologies developed for targeting innovations in at least five farming systems with the greatest number of intervention” for output indicators.

2011 Milestone - Develop and test tools and instruments for household, market, and farming system surveys - See Milestone “Develop and test tools and instruments for household, market, and farming system surveys” for output indicators.

Output 2.2 Pro-poor, risk reducing, and income increasing technologies for regions with maize-based systems.

Milestone 2.2.1 Scoping study on seed and input supply systems and output value chains for maize - See earlier Milestone “Scoping study on seed and input supply systems and output value chains for maize” for Output indicators.

Contributions to future milestones: The comparative performance of mechanical, chemical, and conventional weed control methods in rain-fed maize ecologies was evaluated. Precision planting machinery suited to small holder farmers and varied soils and production systems were developed/ fine-tuned under local conditions.

Output 2.8 Through linkages with CRP5 on Soil and Water, gather field data showing the potential district, watershed and regional effects of improved maize-based systems.

2011 Milestone - Promising technologies identified and links established with other institutions with crucial research capacity for complementary crops, trees, or livestock, resulting in an inter-disciplinary, inter-institutional research for development team - Long term field data for southern Africa were collected and analyzed. Four publications are in draft form to be submitted in 2012 to high impact factor peer reviewed journals. A large number of applied research trials on CA based technologies in maize-wheat, rice-maize and maize-legume/vegetable systems prioritized for different geographies of India, Nepal and Bangladesh were conducted and the results were shared with partners. More than 500 farmer participatory trials/demonstrations on prioritized technologies for sustainable intensification of maize systems were conducted in India, Nepal and Bangladesh.

Strategic Initiative 3 - Smallholder precision agriculture

Output 3.1 Information on farmers’ maize yield constraints in different environments, readily available to partners in a geo-referenced database to help target improved technology (links to SI 1).


Output 3.4 Web platform for receiving feedback from development partners, managing trial information and shipments, and sharing best practices.

2011 Milestone - Develop a user-friendly version of the International Crop Improvement System (ICIS) to include agronomy trials - Assessment to be undertaken in 2012. 2011 Milestone - Web platform developed for project management and data sharing - A wiki approach was implemented to enhance transparency, collaboration, and shared learning across MAIZE, and to ensure that documents are easily updated, accessible, and actionable, and duplication of effort is eliminated. Wikis enable program and project staff to easily deposit documents including outreach/extension/training related materials, as well as project meeting minutes, documents being developed collaboratively, presentations, staff contact information with photos, email listserv links to facilitate rapid communication among key groups, and more. Milestone 3.4.3 Regional web platform established - Not yet achieved due to lack of an appropriate IT infrastructure.

Strategic Initiative 4 - Stress tolerant maize for the poorest

Output 4.4 Open-source breeding networks and a set of decentralized phenotyping sites to improve maize for tolerance to drought, nitrogen stress, and heat, using state-of-the-art phenotyping, doubled haploids, and innovative marker-based approaches designed for quantitative trait improvement.

2011 Milestone - Africa: six drought phenotyping sites, six N stress phenotyping sites, one heat phenotyping site, and one acid soil phenotyping site - Significant progress has been made in 2011 in developing breeding and testing networks for abiotic and biotic stresses. Screening capacity for all 4 of the major abiotic stresses; drought, low N, heat, and waterlogging, is now underway. In West Africa, one managed drought and one drought + heat site are operational. In ESA, 6 managed drought and 3 heat screening sites have been developed. A low-N screening network of 14 sites, including private and public-sector partners, was established in 2011; screening 60,000 plots under low N. No acid soil research is currently funded in Africa. 2011 Milestone Asia: four drought phenotyping sites, two heat phenotyping sites, three waterlogging phenotyping sites. Tolerance to combined heat plus drought, and waterlogging plus drought, will be evaluated in at least one site for each combination - 4 drought phenotyping sites established in India (2 with private sector partners), 1 in Thailand, 1 in Vietnam. 2 heat screening sites operating in India, 1 in Pakistan. 3 waterlogging sites established in India, 1 in Bangladesh, and 1 in Vietnam. Two sites each have been established in India for drought + waterlogging and drought + heat phenotyping. 2011 Milestone - Latin America: two drought phenotyping sites, two N stress phenotyping sites, one acid soil phenotyping site. Tolerance to heat plus drought will be evaluated in at least one site - New managed drought phenotyping facilities were developed in collaboration with the Mexican and Peruvian national programs, bringing the total number in the region to 3. Low N screening is conducted at 2 sites in Mexico. Heat + drought screening was initiated at Obregon in Mexico, permitting screening for this combination at 2 sites. 2011 Milestone - Disease and insect pest phenotyping hubs established in key countries in East and West Africa, and in Asia - Misting systems expanding leaf disease screening capacity were expanded in Harare, Zimbabwe, and implemented at two locations in Kenya. Hot-spot disease screening is conducted at two locations in Nigeria. Hot-spot screening sites have been established for fungal diseases at five locations in India and one in Nepal.
Output 4.8 The capacity of NARS and private-sector scientists to conduct biotic stress screening and develop multiple disease- and insect-resistant maize germplasm in their breeding programs will be strengthened

2011 Milestone - Standard biotic stress screening protocols developed and shared with partners - Protocols for foliar diseases completed and materials in production.

Output 4.10 Institutional innovations, seed market information, and policy recommendations that accelerate the diffusion of stress tolerant maize varieties into areas with a weaker private seed sector presence.

2011 Milestone - Target regions with the greatest potential return to investment in drought/heat tolerance breeding defined, based on available GIS data - Potential changes in temperature in SSA were identified using the outputs of 19 global climate models at the mega-environment level within each country (Cairns et al., submitted 2012).

Strategic Initiative 5 - Towards doubling maize productivity

Output 5.2 Formal International Maize Improvement Consortium (IMIC)

2011 Milestone 5.2.1 Collaborative development of business plans, terms of interaction with research for development partners, and refined specification of germplasm requirements - Terms of interaction with research for development partners, and refined specification of germplasm requirements have been developed with partners in Africa, Asia and Latin America. No collaborative business plans have yet been developed because change envisioned with such large numbers of partners needs more time to be internalized by these partners. 2011 Milestone - International Maize Improvement Consortium (IMIC) established in Asia, Africa, and Latin America and web platform established - IMIC-Asia and IMIC-LA have been launched. Interactions with Africa resident seed companies are strong and on-going without the formalization of IMIC as evidenced by more than 20,000 tons of drought tolerant maize annually being deployed in Africa.

Output 5.4 A web-based platform for development partners' feedback and for management of germplasm information and shipments.

2011 Milestone - Geographic information systems and client feedback used to better define undersupplied markets and relative priorities - Achievement of milestone scheduled for 2012.

Output 5.12 Foundation seed production units in cooperation with NARSs and SMEs in Latin America, sub-Saharan Africa, South Asia, and Southeast Asia for a consistent local source for breeding lines.


Strategic Initiative 6 - Integrated postharvest management

Output 6.1 Documented knowledge of the magnitude and impact of post-harvest grain losses, mycotoxin contamination, risk maps, and prediction tools for target regions.
2011 Milestone - Extent and intensity of post-harvest losses and mycotoxin contamination along maize value chains determined - A total of 1300 samples were tested for aflatoxin and fumonisin from validation trials across different agro-ecologies in Mexico. This is likely the greatest validation trial ever undertaken in Mexico for mycotoxin contamination which is an important partner country for this Strategic Initiative.

Output 6.3 Promising post-harvest storage technologies identified and tested.


Output 6.5 Genetics and mechanisms of resistance to post-harvest pests and diseases identified.


Strategic Initiative 7 - Nutritious maize

Output 7.9 Maize varieties, lines, hybrids, and source materials with desirable characteristics for stover production identified/developed.

2011 Milestone - At least five donor lines identified for each of the important nutrients in tropical and subtropical germplasm - Donors of different adaptation and maturity have been identified for the following traits: provitamin A, oil, zinc and tryptophan. Seed has been distributed to several partners in India, Egypt, Zambia, USA. Pixley, K., Palacios-Rojas, N., Glahn, R. 2011. The usefulness of iron bioavailability as a target trait for breeding maize (Zea mays L.) with enhanced nutritional value. Field Crops Res. 123:153-160. Book chapter accepted for


Strategic Initiative 8 - Seeds of discovery

Output 8.2 Seed from global maize diversity collections is made more easily accessible to maize researchers, breeders and farmers worldwide. 2011 Milestone - Business plan and terms of engagement developed for research partners - A draft business plan was formed for Seeds of Discovery and terms of engagement were discussed, defined and documented. Research partners have been engaged for initial phenotypic collaborations, and research partnership agreements and sub-contracts were formed. Accessions for phase 1 phenotyping were agreed upon, and discussions about phase 2 accessions have been initiated. Given rapid progress, a first revision of the initial strategy component is currently taking place. 2011 Milestone - Global Maize Phenotyping Network formed; priority traits, methods, research partners, and accessions to be characterized agreed upon – A series of priority traits for global, regional and Mexican maize growing areas has been established for initial project phenotyping. In addition to the vast phenotyping capacities described in Strategic Initiative 4, the Mexican phenotyping network has been greatly strengthened given its environmental diversity, the strength of partners and closeness to the next generation genotyping hub. Methods and approaches for phase 1 phenotyping were established, with 2012 activities focused on further documenting and rationalizing these. 2011 Milestone - Decisions taken about which databases, seed bank management systems and web portals to build upon, and on the kind of IT expertise required to implement the SI - SeeD entered partnership arrangements with the bioinformatics group at the James Hutton Institute (JHI) and Diversity Arrays Technology P/L (DArT PL) to jointly develop an Open Source software platform for data management and dissemination. A comprehensive strategy was developed to
build upon and integrate existing database and user applications (GrinGlobal, Germinate, IBP Fieldbook, Flapjack), with databases and tools under development (KDDart, DataKapture) while developing and adding new components as required (e.g., a database for ultra-high-throughput genotyping-by-sequence (GBS) data. The system to be assembled will have a three-tiered structure with a data-access layer separating backend databases and user applications/interfaces to enable the separate ‘evolution’ and replacement of individual modules in the future. **2011 Milestone - Legal and publicity arrangements for creating a pre-competitive “Commons” domain for data delivery validated by legal and public-relations experts** - A workshop, bringing together research partners from NARs, CIMMYT, ARIs and the private sector, was held to discuss IP-related issues within Seeds of Discovery. General guidelines for the formulation of a “single-click” license to access data on the future Seeds of Discovery web portal were developed to “level the playing field” for users with different capacities and to discourage IP protection of Seeds of Discovery outputs *per se*. The workshop also tackled the complex situation in the area of access and benefit-sharing mechanisms for national germplasm that are the center of origin but not regulated by the ITPGRFA. The guidelines developed during the workshop are being incorporated into the business plan. **2011 Milestone - Genomic selection (GS) initiated in at least five pre-breeding populations to sample under-utilized maize races** - What is likely the world’s largest genomic selection training populations was formed in 2011. In excess of 4500 maize landrace accessions from tropical, sub-tropical and highland adaptations representing the diversity of Latin American landraces were used to develop testcrosses with adapted materials to form a GS training population. This population is comparable in size to the nested association mapping (NAM) population generated in the US but is derived from many more founder materials than the 25 employed in NAM. The population is more than 10 times larger than other publically generated population and represents a very broad set of materials in terms of adaptation, maturity and race. DNA from the founder accession has been isolated in preparation for genotyping by sequencing (GBS), and phenotyping of the test cross progeny was initiated in 2011 in collaboration with Mexican partners and will continue into 2012 and 2013.

**Strategic Initiative 9 - New tools and methods for NARS and SMEs**

**Output 9.5** CIMMYT’s association mapping panels, consisting of 500 inbred lines with adaptation to all major tropical and subtropical target mega-environments, assembled into a single, large, publicly available panel and genotyped at high density using both the new SNP50 array and the Cornell GBS platform; genotypic and phenotypic data assembled into a single public database, with seed and data freely available to the international maize research community for further phenotyping and client-specific gene discovery.


**2011 Milestone - Seed increased and single database established** - Seeds (inbreds and testcrosses with CML539 as the common tester) and available to partners. Phenotypic data from all entries available in the IMIS database. **2011 Milestone - Multi-parent synthetics initiated for GS proof-of-concept experiments** - Synthetics from both A and B heterotic groups developed for GBS in Latin America and Eastern Africa.
Output 9.7 “Open-source” breeding models that link breeding programs of national systems and small- and medium-sized seed companies with CIMMYT and IITA phenotyping and genomic selection networks for the delivery of proprietary DH lines, genotypic information, and predictions of performance under local conditions.


Progress in Outcome Assessment

Due to the short operational (ie funded) timeframe, an outcome-oriented monitoring and evaluation framework was still under development by the end of 2011. Outcomes are taking place on a daily basis, more than we can capture! Due to the fragmented funding of MAIZE (low proportion of W1&W2 funding), it is a significant challenge to align project-specific outcomes with MAIZE outcomes in a manner that does not double our reporting commitments. Also, a systematic outcome measuring framework will need to be discussed and institutionalized with the various Strategic Initiative Teams and their partners. This is a significant challenge given the large collaborative nature of MAIZE.

In autumn 2011, CIMMYT hired a gender specialist to mainstream gender in both the WHEAT and MAIZE CRPs. The gender specialist is working with the MAIZE CRP Program Manager and counterpart in IITA to develop a Gender Strategy for MAIZE; one that demonstrates integration of gender into the main research process. In 2012, an independent gender audit of MAIZE will take place.

D. Risk Management

a. In spite of the efforts of many, the inception of MAIZE was delayed by almost six months after its official launch at the beginning of July 2011. The Program Implementation Agreement for MAIZE was signed on the 17th of November, 2011, and MAIZE funds were released on the 19th of December, 2011, ie almost at the end of this first reporting period. As a result, sub-contracts to partners and hiring of crucial members of the Program Management Unit were delayed. The first international partner meeting could only be held in January 2012. Bilateral funding support enabled MAIZE activities to proceed; many staff carried double work-load and double reporting load. We are confident that these problems will no longer occur in future.

b. The summary description of milestone achievements in its first six months of operation shows MAIZE as a strong on-going program. With the high level of bilateral funding/low level of Window 1 & 2 funding (only 19% of the targeted budget coming from W1&W2 funding), one of the most significant challenge to, and opportunity of MAIZE is to successfully transform nine project clusters into nine effective work teams which are aligned towards one common vision of success. On the funding side, MAIZE has been very successful in aligning the content of significant bilateral projects with its overall strategy; eg the Mexico Government funds the entity of Strategic Initiative 8. MAIZE provides the opportunity for donors to support MAIZE, an individual MAIZE Strategic Initiative, or an individual MAIZE Strategic Initiative in a particular region.

c. Due to limited funds and, in some instances, operational complexities, MAIZE Strategic Initiative 2 at this stage only works in three of the six targeted maize-based farming systems. Funds will be sought from an expanded range of bilateral donors to bolster mainstream efforts of MAIZE to ensure sustainable intensification of farming systems and enhanced income earning opportunities for the
poor in the six designated maize-based hot spots. At the CGIAR systems level, greater synergies could be fostered by a clear definition of the regional targets of various CGIAR Research Programs using one common language, *the FAO farming systems classification*. To a similar extent, a mapping of the geographic focus of innovation platforms in individual CGIAR Research Programs could facilitate the exchange of lessons learned across diverse production conditions, farming systems, and socio-economic circumstances in the various target regions.

d. Due to the high investment costs and the limited availability of funds, MAIZE will not be able to facilitate the establishment of seed production and product supply chains to farmers, which is critical to several Strategic Initiatives and to attain the vision of success of MAIZE. Links will be initiated or strengthened with on-going value-chain initiatives to enhance delivery of products emanating from the MAIZE.

e. First indications are that the Program Implementation Agreement of the CGIAR may impede partner involvement, in particular among partners in the developing world who are intimidated by such lengthy and complex agreements.

E. **Lessons Learnt**

a. **Variance from MAIZE proposal and its impact pathways**

Within the first six months of operation, there has been no significant variance from the MAIZE proposal and its impact pathways.

b. **Effectiveness of the partnership strategy of the CRP**

The execution of the MAIZE partnership strategy has been delayed due to late availability of W1&W2 funds. The following gives a foresight of 2012 activities.

- MAIZE was launched with international partners in January 2012
- During the international launch of MAIZE, priority areas of research were identified jointly with partners to identify and fill gaps in the various Strategic Initiatives. Competitive grants are being launched to identify and engage partners with complementary strengths in filling these gaps.
- Strong working partnerships have already been developed with advanced research institutes, particularly Cornell University (GBS and genomic selection) and the University of Hohenheim to develop doubled haploids. Cornell University is providing all routine high-density genotyping to MAIZE on a cost recovery basis, and is providing significant support on bioinformatics.
- The Maize Management Committee Team has met face-to-face on two occasions and all primary research partners have confirmed their participation.
- A systematic priority setting approach among research and development partners has been conceptualized and will be launched in May 2012.
- Linkages with several other CGIAR Research Programs have been strengthened. MAIZE Strategic Initiative 1 has close linkages and collaborations with CRP 2. CRP7 is building up on MAIZE Strategic Initiative 2 and 4 outputs. MAIZE Strategic Initiative 7 has strong collaborations with CRP 4 especially through the HarvestPlus Program.