# CIMMYT-Zimbabwe: Summary of Projects



## Mid-Altitude Maize Improvement

**Principal Investigators: D.C. Jewell / K.V. Pixley** (CIMMYT-Zimbabwe)

Specifically, the maize breeding research at CIMMYT-Zimbabwe addresses the issues of increasing yield and yield stability. Important objectives are host plant resistance to maize streak virus, resistance to foliar leaf diseases that are common in the region, and resistance to attack by maize stem borers. Tolerance to drought and improved production under low soil fertility conditions are increasingly important objectives. The breeding research continues to move towards a hybrid-oriented system from which open pollinated products are also generated. A small amount of agronomy research is also financed and is focused on the measurement of crop yield and soil fertility trends in maize dominated cropping systems and the evaluation of technologies that may improve soil fertility. In collaboration with our Kenya office, we have initiated a project focused on the potential use of herbicide resistance to control the parasitic weed *Striga*.

We continue the development of project proposals and donor contact to promote improved awareness and collaboration between technology developers and technology disseminators. This is vital for achieving the more rapid transfer of improved maize technologies (with appropriate characteristics) to the resource poor farmers of the region. Collaborative work on natural resource management is a priority for CIMMYT. We are presently seeking ways to increase our effort in these areas. Work is done directly with the NARS as priority opportunities are identified.

Five-year objectives are:

- Develop and evaluate maize varieties, lines, synthetics and hybrids with improved yield stability when grown under

stress from drought, low soil nitrogen, *Striga*, stem-borer and other priority problems that limit maize production in the region.
- Identify the key components of two heterotic groups in early and late elite germplasm.
- Have in place a systematic strategy for improving the tolerance of each of these heterotic groups to drought and low nitrogen.
- Form 10 new open pollinated varieties, each from inbred lines within the same heterotic group.
- Train NARS personnel in breeding, seed production and related technologies.

The project is expected to lead to and promote increased utilization of genetic diversity and the release of maize cultivars with increased yield stability.

**Donors: DFID and the Republic of South Africa**

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### The Southern African Drought and Low Soil Fertility Project

**Principal Investigator: M. Bänziger (CIMMYT-Zimbabwe)**

The Southern African Drought and Low Soil Fertility Project (SADLF) began on January 1, 1996. The project is a collaborative effort between the International Maize and Wheat Improvement Center (CIMMYT) and the National Agricultural Research Programs of the Southern African Development Community (SADC). A CIMMYT scientist leads activities at CIMMYT-Zimbabwe on breeding for tolerance to drought and low nitrogen (N) and the project coordination. National Program activities are guided by the Steering Committee of the Maize and Wheat Improvement Research Network for SADC (MWIRNET). Individual National Programs assigned maize scientists to become main collaborators to the project. Both National Programs and CIMMYT provide research sites. Established links with soil fertility and on-farm research should enable the testing of project products.

The goals of the project are:

- To enhance the capacity of CIMMYT and the National Programs to improve and disseminate adapted drought- and low nitrogen-tolerant maize germplasm through regional collaboration.
- To develop, within ten years, maize germplasm which has increased yield and yield stability under conditions typical of resource-poor farmers, and to achieve this without further depleting natural resources (water, nutrients, land).

**Donor: Swiss Development Cooperation (SDC)**

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### Estimating the Impact Potential of Drought- and Nitrogen- Stress Tolerant Maize for SADC

**Principal Investigators: J. de Meyer / M. Bänziger** (CIMMYT-Zimbabwe)

Most maize breeding in sub-Saharan Africa is currently done under high-yielding conditions that do not represent the conditions typical for most (resource-poor) farmers. The Southern African Drought and Low Soil Fertility project (SADLF) introduces an innovative breeding approach that could--as extensive studies from CIMMYT-Mexico prove--have a major impact on maize production in stressed environments and thereby on income and food security of households and countries. Different to conventional breeding methodologies, this new approach screens germplasm not only under high-input conditions but as well under the most important stresses present in farmers' fields, drought and low soil fertility.

The Swiss Development Cooperation approved to strengthen SADLF with a PostDoc project that should evaluate the impact potential of drought- and N-stress tolerant germplasm for increasing and stabilizing maize production under conditions typical of resource-poor farmers in SADC. By evaluating the first project products of SADLF through on-farm trials and by extrapolating biophysical, management and socioeconomic data, it is expected that we will develop quantified assessments of the impact potential of stress breeding approaches for the SADC region. The project will be conducted in collaboration with agronomists from the National Program in Zimbabwe and farmers and draws on links established by CIMMYT through its maize breeding program, Soil Fert Net, MWIRNET and SADLF.

The specific goals of the project are:

- Evaluate the first products from SADLF in on-farm and on-station trials against current releases. These trials should be representative of maize growing environments in Zimbabwe and should sample varietal differences along a moisture gradient.
- Evaluate interactions of stress-tolerant maize germplasm with improved agronomic techniques.
- Extrapolate trial results to estimate impact potential in Zimbabwe and the SADC region, using available data on rainfall, crop distribution, and socioeconomic parameters.

**Donor: Swiss Development Cooperation (SDC)**

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### Eastern Africa Regional Maize Nursery

**Principal Investigators: K.V. Pixley** (CIMMYT-Zimbabwe) / **A.O. Diallo** (CIMMYT-Kenya)

A regional nursery is being established to evaluate resistance/tolerance of promising maize lines to endemic diseases and insect pests, as well as to verify their agronomic suitability for use in breeding programs of eastern Africa. Germplasm is initially supplied by CIMMYT and collaborators are being encouraged to contribute much of the nursery during the mid to long term. Reports summarizing disease reaction, insect tolerance, and agronomic traits of the lines will be widely circulated to the NARS annually. Breeding projects will be initiated each year by the nursery coordinator and interested collaborators as a result of data collected from the previous regional evaluation. Funds for regional nursery sites where artificial inoculation or infestation will be performed, as well as essential seed production, distribution, and coordination costs incurred by CIMMYT are provided by the project.

This project will:

- Contribute substantially to regional information and germplasm exchange.
- Assist regional breeders to develop better hybrids and varieties as opposed to simply allowing them to test already-assembled hybrids.
- Provide an environment conducive for breeders, pathologists and entomologists to work together.
- Increase institutional memory by producing and widely distributing annual reports.
- Document differences in disease reaction throughout the region, thereby increasing understanding of range of races or strains of important pathogens.

The project is expected to lead to both increased utilization of genetic diversity and to release of maize cultivars with increased yield stability.

**Donor: The Rockefeller Foundation**

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### Improvement of Grain Weevil Resistance in Maize for Southern Africa

**Principal Contact: Dr. K.V. Pixley** (CIMMYT-Zimbabwe)

The maize grain weevil (*Sitophilus zeamais*) is the most significant post-harvest pest of maize worldwide. Damage by weevils to stored maize is especially important to smallholder farmers who generally store much of their produce for their consumption and for planting their following crop. Weevils not only consume large amounts of stored grain; they also reduce the quality and viability of the grain. Losses of 25 to 40% of stored maize grain are common and grain damage levels in excess of 90% have been reported for grain stored on small farms. There is some evidence that improved varieties and hybrids, although higher yielding than traditional varieties, are generally more vulnerable to damage by weevils. This fact, and farmer concern over storage damage, limits adoption of improved cultivars.

This research project will:

- Develop maize with the combined traits of improved resistance to grain weevils (S. zeamais) and adaptation to the mid-altitude maize producing regions of southern Africa. No such germplasm is currently available for southern Africa. Further, improved cultivars will be tested for resistance before recommendation to national programmes.
- The research of this project will provide the opportunity for two local (or regional) persons to pursue M.Phil. degrees.

**Donor: The Rockefeller Foundation**

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### The Improvement and Promotion of Quality Protein Maize in Selected Developing Countries

**Principal Investigators: H. Cordova** (CIMMYT-Mexico) / **K.V. Pixley** (CIMMYT-Zimbabwe)

Recent estimates by leading development agencies place the number of the world's chronically poor at approximately 1 billion – more that one-fifth of humanity. High on the list of hardships suffered by the poor is malnutrition; those most often undernourished are women and children. Major reasons for the lack of adoption of maize with quality protein include (QPM):

1. General ignorance about the benefits of QPM.
2. Lack of interest on the part of scientists and decision-makers.
3. Lack of promotion of superior varieties and hybrids.
4. Lack of local awareness of the production technologies required for maintaining the quality of the grain.

Participants in the project to address these constraints include CIMMYT and the NARS of Bolivia, Brazil, China, Ethiopia, Ghana, Guatemala, India, Malawi and Mozambique; Sasakawa-Global 2000, the Sasakawa Africa Association, World Vision International. Specifically the CIMMYT-Zimbabwe program is involved in developing and testing QPM and training of National Program maize breeders from the region.

Objectives of the project are to:

- Facilitate accelerated on-farm testing and rapid release and seed multiplication of elite open-pollinated varieties and hybrids developed in the late 1980s.
- Restart QPM research and development using new genetic engineering techniques to speed up the process of converting elite normal maize materials to QPM versions.
- Help selected national agricultural research systems – in countries where maize is the major source of calories for the poor – to increase their own efforts to get support for QPM.

**Donor: The Nippon Foundation**

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### The CIMMYT Maize Micronutrient Project

**Principal Investigator: M. Bänziger** (CIMMYT-Zimbabwe)

The CIMMYT maize micronutrient project is part of the CG center-wide micronutrient project conducted by CIAT, CIMMYT, IFPRI and IRRI. The project aims at evaluating the possibility to alleviate micronutrient deficiencies with humans through staples with an increased micronutrient concentration in the grain. The main focus is on iron, zinc and vitamin A.

CIMMYT chose to locate the maize micronutrient project at CIMMYT-Zimbabwe. Southern Africa is a region where Fe, Zn and

Vitamin A deficiencies are widespread among the population and where maize is the most important staple food. Because consumers strongly prefer maize with white grain, the problem of Vitamin A deficiency has little chance of being addressed in southern Africa through ProVitamin A enriched maize (ProVitamin A levels are much higher in yellow maize). The screening of maize in southern Africa is therefore focused on grain Fe and Zn concentration.

The overall goals of the maize micronutrient project for the period 1994 to 1999 are to:

- Evaluate the genetic variability of grain Fe and Zn concentration in maize with special focus on germplasm adapted to southern Africa.
- Examine the inheritance of grain Fe and Zn concentration.
- Produce experimental germplasm (synthetics/hybrids) with high or low Fe and Zn availability for potential use in plant breeding programs and in impact studies.

**Donor: DANIDA**

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### The Seeds of Freedom (SOF) Project in Angola, Phase II

**Principal Collaborators: D.C. Jewell / M. Mekuria** (CIMMYT-Zimbabwe)

The USAID Global Bureau initiated this project in September 1995. The project was developed collaboratively by the International Agricultural Research Centers (IARCs), the Ministry of Agriculture in Angola (MoA), and non-governmental organizations (NGOs) operating in Angola. From the beginning, this collaborative partnership has been a hallmark of the project. ICRISAT is the lead IARC and CIMMYT is a participant together with CIAT, CIP, and IITA. World Vision Angola is the lead NGO and coordinates the project activities with other NGOs operating in Angola.

The objective of the project is to improve household food security and help to revitalize the agriculture sector in Angola after the war, by ensuring that high-yielding and adapted varieties of important food crops were available to Angolan farmers. This has involved CIMMYT-Zimbabwe in seed multiplication of open pollinated varieties, training of Angolan National Program Staff and in initiating baseline studies in regard to Maize in Angola.

Specific objectives of the program are:

- Production of seed (or plantlets for vegetatively propagated crops) outside Angola, of appropriate improved varieties, and delivery to Angola;
- On-farm testing and verification of the improved varieties, in comparison with local landraces;
- Multiplication of planting materials inside Angola, with special emphasis on vegetatively propagated crops such as cassava and sweet potato; and
- Distribution of planting materials of appropriate varieties to farmers by the MoA and NGOs.

**Donor: USAID**

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### The Maize and Wheat Improvement Research Network for SADC

**Principal Investigators: G. Varughese / B.T. Zambezi / M. Mekuria / M. Bänziger** (CIMMYT-Zimbabwe)

The Maize and Wheat Improvement Research Network for SADC (MWIRNET) aims at developing and facilitating the exchange of improved varieties of Maize and Wheat. It also aims at strengthening the research capabilities of NARS through human resources development and exchange of information. Key partners in this Network facilitated by CIMMYT are Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia, Zimbabwe, and South Africa. South Africa was a late comer to the Network because they were not members of the Lome Convention when this network was initiated.

The Network is coordinated by a Steering Committee consisting of a prominent Maize or Wheat scientist form each of the above 11 countries. SACCAR (the regional body responsible for the coordination of agricultural research and training on behalf

of SADC), the donor agency and the Network Team Leader are also represented on the Steering Committee.

The major activities fall under the following categories:

- Germplasm development and exchange
- Training
- Research support
- Enhanced information exchange and communication

**Donor: European Union**

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### Soil Fertility Network for Smallholder Maize-Based Farming Systems in Malawi and Zimbabwe

**Principal Investigator: S.R. Waddington** (CIMMYT-Zimbabwe)

Soil Fert Net is a grouping of staff from NARS working to help smallholder farmers in Malawi and Zimbabwe produce higher, more sustainable and profitable yields from their maize-based cropping systems through improved soil fertility technology and better management of organic and inorganic fertilizer inputs. The Network is coordinated from CIMMYT-Zimbabwe.

It emphasizes the development of effective, targeted research and extension through joint priority setting, planning and implementation of complementary soil fertility activities across maize-based agro-ecologies by participating organizations. This involves enhanced interaction between research, extension and the farmer. Activities include:

- Research priority setting, planning, proposal development and review, and the sourcing of funds.
- Conduct of priority research and extension.
- Information synthesis and exchange, and training for Network members.
- Distribution and use of output information through links between farmers, research, extension, NGOs and fertilizer input suppliers.

The Soil Fert Net project began in October 1994 and the initial phase is planned to continue until September 1998.

**Donor: The Rockefeller Foundation**

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### Soil Fertility and Agronomy Research for Smallholder Maize-Based Systems in Zimbabwe

**Principal Investigator: S.R. Waddington** (CIMMYT-Zimbabwe)

CIMMYT-Zimbabwe is undertaking research to gauge the productivity and sustainability of smallholder maize-based cropping in Zimbabwe, with emphasis on soil fertility issues. With most of this work we try to fill a gap between basic process research (as practiced by, for example, the Tropical Soil Biology and Fertility Programme, and their cooperators) and shorter term productivity research (conducted by, for example, the Agronomy Institute of DR&SS). This work is done in cooperation with the University of Zimbabwe and is CIMMYT-Zimbabwe's research contribution to Soil Fert Net. Main activities include:

- On-farm trials to measure yield and soil fertility trends in maize-groundnut rotations and intercropping patterns, compared to use of inorganic N and cattle manure on smallholder farms.
- Longer-term evaluations on station of various grain legumes intercropped with maize and cheaper basal fertilizer options for maize.
- Soil Fert Network Trials on cattle manure x inorganic N interactions, and green manures + liming to rehabilitate exhausted maize fields.
- Evaluation of maize response to N fertilizer under smallholder farm soils and management.

Expected outputs are trends in yields and profitability, and soil fertility, with current maize-based cropping systems on smallholder fields, and guidelines on relative benefits from legume rotations, legume intercropping, cattle manure and inorganic fertilizer on-farm. This work started in 1992 and it is hoped to continue until 2000 or beyond.

**Donor: The Rockefeller Foundation and DFID**

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### An Evaluation of Nitrogen Use Efficient and Other Maize Genotypes under Smallholder Soils and Management Conditions

**Principal Investigators: C. Chiduza** (University of Zimbabwe) / **S.R. Waddington / M. Bänziger** (CIMMYT-Zimbabwe)

Most maize in Zimbabwe is produced by smallholder farmers on infertile sandy soils. Given the worsening economics of using N Fertilizer on smallholder maize in Zimbabwe and the declines in soil fertility, it is vital that the available N is used efficiently by the crop. New maize genotypes are under development that produce more grain per unit of N assimilated. Appropriate management of organic inputs with inorganic N can also raise N-use efficiency.

Specific objectives include:

- Conducting several types of on-farm trials in four smallholder areas in sub-humid parts of Zimbabwe over two years.
- The yield response of different maize genotypes to different rates of applied inorganic N will be tested.
- The interaction between applied inorganic N and applied cattle manure will be tested under on-farm conditions and the "real" inorganic N fertilizer response curves will be calculated.
- The research of this project provides a local Zimbabwean person with the opportunity to pursue an M.Phil. degree.

**Donor: The Rockefeller Foundation**

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### Risk Management in Southern African Maize Systems

**Principal Investigators: L. Harrington / P. Grace / J. White** (CIMMYT-Mexico) / **G. Varughese / M. Mekuria / S.R. Waddington** (CIMMYT-Zimbabwe)

**Affiliates:** ***Crop Modeling:*** **Z. Shamudzarira,** Zimbabwe;
***Farmer Participatory Research:*** **B. Kamanga,** Malawi

Climatic risk, primarily resulting from erratic rainfall, is a major constraint to development and adoption of improved technologies for smallholders producing maize in southern Africa. Some 70% of the maize production in the region comes from smallholder farms of less than 5 ha, virtually all of which is rainfed. Beside the constant threat of drought, farmers in the region also face the challenge of rapidly declining soil fertility in an economic environment where external inputs are both costly and risky to use. New productivity-enhancing resource-conserving technologies must not increase risk, but rather help reduce it: In other words, such technologies must be compatible with farmers' broader risk management strategies. The initial emphasis of this project is on soil fertility technologies.

Objectives include:

- Assess the risk associated with alternative maize system management practices under varying climatic and soil conditions.
- Assess the long-term consequences of adoption of maize management practices on system productivity and resource quality.
- Farmer panels will define the categories of production risk, identify farm-level strategies for managing climatic risk and highlight climatic patterns that are difficult to manage. These will be translated into scenarios that can be assessed with models through simulations over multiple cropping seasons.

- The collaborating institutions include the National Programs of Malawi and Zimbabwe, and research institutions in Australia.

**Donor: AusAID**

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### Improvement of Drought Tolerance and Insect Resistance of Zimbabwean Maize Using Biotechnology

**Principal Investigators: J.M. Gopo** (SIRDC) / **D.A.Hoisington** (CIMMYT-Mexico) / **D.C. Jewell / M. Bänziger** (CIMMYT-Zimbabwe)

Communal farmers in Zimbabwe identified drought, poor soil fertility and biotic stresses, especially insect pests, as major constraints for maize production. A collaborative project was agreed on by the Biotechnology Research institute SIRDC, Zimbabwe, the Kenyan Agricultural Research Institute KARI, Kenya, and CIMMYT for the utilization of marker-assisted breeding for drought tolerance and insect resistance in maize. The specific objectives of the project are to develop drought tolerant and insect resistant Zimbabwean and Kenyan maize using molecular marker-assisted breeding, to transfer the technology to Zimbabwe and Kenya and to develop in-country the capacity to use molecular markers in crop improvement. SIRDC is the implementing agency for Zimbabwe. KARI is the implementing agency for Kenya. CIMMYT is sub-contracted to provide the technical expertise in this project.

This project will:

- Develop insect and drought tolerant hybrids for Zimbabwe and Kenya.
- Establish the in-country capacity in molecular breeding for Zimbabwe and Kenya.
- Achieve collaboration among Zimbabwean and Kenyan maize scientists.

CIMMYT-Zimbabwe assists with local project activities including the management of drought screening trials, and in the training of SIRDC personnel.

**Donor: DGIS**

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**Maize in the Developing World**