

# CIMMYT

**CENTRE COMMISSIONED EXTERNAL REVIEW  
OF  
CIMMYT's MAIZE IMPROVEMENT PROGRAMS IN SUB SAHARAN AFRICA**

**May 2004**

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**CENTRE COMMISSIONED EXTERNAL REVIEW  
OF  
CIMMYT's MAIZE IMPROVEMENT PROGRAMS IN SUB SAHARAN AFRICA  
May 2004**

**EXECUTIVE SUMMARY**

CIMMYT has made important contributions to the livelihoods of resource poor maize producers and to Africa's maize industry since it based staff in the region in the mid 70s. In addition to its germplasm CIMMYT has provided essential support in programme design, breeding methodology, trait characterisation, trial evaluation, staff training and capacity strengthening. CIMMYT's research on soil fertility is in early stages of testing 'Best-Bets' to get feedback and promotion through farmer groups, extension services and NGOs. In addition to addressing drought, low soil pH, CIMMYT is engaged in research on quality protein maize, Bt maize and associated technologies for controlling Stem Borer and Striga and resistance to weevil and Larger Grain Borer. CIMMYT has also developed regional capacity for participatory research and socio-economics.

Following an extensive review in 2002, CIMMYT developed a new strategy with a focus on people and livelihoods with a new innovation agenda that emphasizes global and eco-regional priorities, responsive partnerships and networks for innovation and impact, and a commitment to sharing and using knowledge for innovation across scientific, institutional and national boundaries. Within this livelihoods approach CIMMYT will need to empower people to meet their basic needs for maize, and to make maize production more profitable and suited to mixed-farming livelihood strategies. In addition to addressing the biotic and abiotic stresses the new technologies will have to cope with market failures, increased pressure on natural resources, and adverse demographic trends including the devastation of HIV/AIDS.

CIMMYT has set itself comprehensive and ambitious 10 year targets ranging from adoption of biotic and abiotic stress tolerant technologies to strengthening collaboration, contributing to policies and documenting impact. However, it will not have sufficient funding to meet all the demands placed upon its limited human and financial resources and it has limited discretionary funding. To make the research possible there are many essential non-scientific tasks that require resources. Setting the priorities and balancing the conflicting demands will be best accomplished by encouraging project leaders to engage fully in the Centre's budgeting processes and to accept responsibility for spending on their projects. Staff locations and the balance between scientific and support staff will need to be reviewed to ensure the quality of science and the productivity of the scientists. Leadership and resources are required to sustain the excellent partnerships, improve awareness and engage more effectively with decision makers in national, regional institutions such as the SROs and NEPAD and donors. Linkages with other CGIAR centres should aim at maximising overall impact through realisation of comparative advantages. Multi-institutional programmes, especially in natural resource management and capacity building offer opportunities for improved efficiencies and accessing new and more sustainable funding.

## **PANEL RECOMMENDATIONS**

### **1. Improving livelihoods and measuring impact**

CIMMYT should develop a conceptual livelihoods framework for identifying where and how its interventions will impact on livelihoods. Both technical and social scientists should participate in developing and implementing the framework, which will have an “Impact Pathway” with key milestones to facilitate regular reviews using quantitative and qualitative information to trace the impact of new maize germplasm and natural resource management interventions on people’s livelihoods, especially of the poor. CIMMYT should hire a social scientist (anthropologist or social scientist) to assist in designing and carrying out livelihood studies in cooperation with economists and members of the maize and natural resources management team.

### **2: Improving maize germplasm and breeding**

CIMMYT should seek opportunities to improve dialogue and collaboration with other CGIAR centres and partners that have overlapping maize germplasm development responsibilities across Africa. CIMMYT should work with private as well as public partners in developing adapted germplasm and facilitate improvements in seed production and distribution to help smallholder seed multiplication. CIMMYT should advocate standardized/harmonized trait priorities that breeding programs could use across sub Saharan Africa.

Future directions for CIMMYT should include exploration of the potential for increasing levels of QPM in base genetics and enhancing the effectiveness of its Mother-Baby trial approach aligning these closely with advances in integrated natural resource management.

### **3. Improving crop, soil and water management**

CIMMYT should instigate a CGIAR-wide initiative to rationalize and coordinate the activities of the large number of institutions involved in natural resource management research in Africa.

CIMMYT should strengthen its capacity for supporting farmer participation in its natural resource management research and development activities, ensuring that such work is assessed on criteria farmers consider important.

CIMMYT’s research should be informed by the forecast impacts of climate change on maize production systems and producers’ livelihoods.

### **4. Economics and policy issues**

CIMMYT should develop a joint Inter-Center Research Program with ICRISAT on fertilizer and seed marketing in Eastern and Southern Africa.

CIMMYT should undertake limited policy studies that emerge from the introduction and scaling up of new maize technology. Rather than taking a proactive role and building policy research capacity, CIMMYT can develop partnerships with IFPRI, ICRISAT and other regional policy research institutes.

CIMMYT should undertake an economic analysis, of all best-bet soil fertility options promoted, together with adoption to date and impact on crop productivity and livelihoods of adopting farmer households. The review should provide a framework against which to review ongoing and proposed technical research activities

## **5. Capacity strengthening**

**CIMMYT should develop a ten year plan for its contribution to capacity strengthening in region that is consistent with its mandate and funding opportunities and which will ensure that the Centre is a player in the global and regional programmes that are concentrating donor funding for capacity strengthening.**

## **6. Improving partnerships**

**CIMMYT should increase its interaction with regional universities and strengthen multi-institutional collaboration with CGIAR and other advanced institutions. This will require the appointment of a senior scientist familiar with donors, national, subregional and regional agencies to develop and manage an efficient partnerships programme that embraces research partners, investors and policy makers.**

## **7. Organisation and resource mobilisation**

**CIMMYT's African Livelihoods Program should develop a pragmatic business plan which will relate the budgets for proposed research to the actions required to realise the funding. This will recognise that priority long-term research, such as germplasm improvement, must be suitably buffered from the consequences of short-term project funding and the need to retain flexibility, within the business plan, to be able to deploy staff to where they can most effectively accomplish the highest priority tasks.**

**Field staff should be given more autonomy in determining how resources related to their programme and projects are allocated. This would include input to a review of CIMMYT's communication and logistic support to achieve optimal arrangements for accomplishing essential non-scientific tasks.**

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## **1. INTRODUCTION**

The first and foremost function of CIMMYT's Maize Improvement Programme in sub Saharan Africa is to generate knowledge that will improve the livelihoods of resource-poor maize producers who, because of their poverty, cannot attract privately-funded research. To do that, CIMMYT must be constantly aware of its stakeholders' circumstances, demands and knowledge systems and be capable of applying the latest advances in science in their cause. External reviews are one means of assessing if this complex of challenges is being met successfully and helping make the Centre even more effective.

In March 2003, CIMMYT's Board of Trustees agreed that Senior Management should contract two Centre Commissioned External Reviews (CCERs) to assist in the evaluation and planning of CIMMYT's research and to inform CIMMYT's 5<sup>th</sup> External Program and Management Review (EPMR) scheduled for late 2004/early 2005. The first review focused on CIMMYT's wheat improvement programme. The second review, to which this report relates, focused on CIMMYT's Maize Improvement Program in sub Saharan Africa.

### **1.1 Terms of reference**

The CCER was commissioned to examine the effectiveness and efficiency of CIMMYT's maize improvement efforts in sub Saharan Africa with a particular focus on the impact of stress tolerant maize germplasm and related crop and natural resource management systems on smallholder, subsistence farmers' livelihoods (Annex 1).

### **1.2 CIMMYT Maize Improvement Program External Review Panel**

The External Review Panel was comprised of:

- Dr. Monty Jones, Executive Secretary of the Forum for Agricultural Research in Africa chaired the Panel and took particular responsibility for partnerships and organisational aspects
- Dr. Carl K. Eicher, University Distinguished Professor Emeritus Department of Agricultural Economics, Michigan State University, USA took particular responsibility for economics and capacity strengthening aspects
- Dr. Jim Ellis Jones, Farming Systems Economist, International development Group, Silsoe Research Institute UK took particular responsibility for farming systems and crop production aspects.
- Dr. Peter Freymark, Research Coordinator Mexico and Africa, Crop Genetics Research and Development, Pioneer Hi-Bred International Inc. took particular responsibility for plant breeding and germplasm aspects
- Mr. Ralph von Kaufmann, FARA Senior Resource Person served as a resource person to the Panel.

### **1.3 Framing questions from CIMMYT's Programme Committee**

The Programme Committee of CIMMYT's Board of Trustees provided the External Review Panel (hereinafter referred to as the Panel) with a set of questions as a reference frame for the review (Annex 2). These focused on four main areas: 1. Socio-economics and impact assessment; 2. Partnerships and methods; 3. Training; and 4. Strategic issues. The questions drew

the Panel's attention to key issues affecting the impact of CIMMYT's Maize Improvement Programme on the livelihoods of resource-poor African smallholders with a view to finding ways to improve the targeting and effectiveness of the Programme. The Board sought the Panel's views on the possibilities of improving CIMMYT's partnerships by using alternative providers and ensuring that the Centre's dissemination strategy gave due credit to all partners in the region.

The framing questions on partnerships and methods sought the Panel's views on the advantages and constraints of the collaborative arrangements that CIMMYT's Africa Teams have with a wide range of partners including CIMMYT headquarters, regional official and non-official organisations and, not least, with farmers and seed producers.

In regard to capacity strengthening, the Panel's attention was drawn to issues of how training is conducted and how future needs can be identified and met.

The strategic issues set out in the framing questions ranged from aspects of resource mobilisation to issues related to synchronising CIMMYT's maize improvement programs with the Centre's new *African Livelihoods Programme*.

#### **1.4 Methodology and Programme for the review**

In keeping with its terms of reference and the framing questions, the Panel undertook to review the research and capacity strengthening components of *CIMMYT's Maize Improvement Programme in sub Saharan Africa* and the way that they were prioritised, organised and resourced.

The Panel endeavoured to get the views of as many CIMMYT staff, collaborators and stakeholders, including government officials and farmers as possible in the time available and adopted an open and flexible approach to interacting with them. Panel members occasionally separated to cover more ground. This process was greatly facilitated by the professionalism and collegiality of all CIMMYT staff. At no time did the Panel sense any restriction or withholding of materials and all requests for information were honoured willingly and promptly. The Panel appreciated the help and guidance provided by Dr. John Witcombe, Chair CIMMYT's Programme Committee at the outset of the review in Zimbabwe. The Panel gratefully acknowledges the careful prior preparation of briefing notes and comprehensive presentations by CIMMYT staff and collaborators and access to more than adequate documentation.

The Panel's field visits started in Zimbabwe on Wednesday 14 April with presentations by the CIMMYT Harare-based team. The presentations opened with an overview of maize systems and their past and future trends. This was followed by presentations on maize breeding and seed issues, soil fertility and risk management strategies and site visits. Similar programmes were arranged for Malawi and Kenya though there was no field visit in Kenya. The Panel's programme up to Saturday 24 April is provided in Annex 3.

#### **1.5 Structure of the report**

This report starts with essential information on the origin and evolution of *CIMMYT's Maize Improvement Programme in sub Saharan Africa* and an assessment of the Programme's achievements. However, its main emphasis is on looking ahead in the context of CIMMYT's new *African Livelihoods Programme*, which includes maize breeding, crop soil and water management and the economics of maize-based systems for improved livelihoods. After reviewing the Centre's research activities the report provides the Panel's perspective on capacity strengthening, partnerships, and resource allocation and mobilisation.

## **2. BACKGROUND TO THE CCER**

### **2.1 The origins and evolution of CIMMYT's Maize programme**

Maize is the major staple food crop produced and consumed in Eastern and Southern Africa and is a cornerstone of the region's food security and economic stability (Byerlee and Eicher 1997). Hence CIMMYT has posted staff to sub Saharan Africa since the mid-1970s to develop varieties adapted to the biotic and abiotic stresses that reduce smallholder maize yields. The Programme included complementary research on seed production and distribution systems particularly for smallholders and producers in biophysically and socio-economically marginal circumstances and on soil fertility and risk management.

Since it is the food of choice of hundreds of millions of Africans, the demand for maize will continue to grow but it will be difficult to meet this challenge because yields are constrained by declining soil fertility, increasing incidences of pests such as stem borers and parasitic weeds (*Striga hermonthica* and *S. asiatica*), highly variable rainfall, and climatic change. These risks to farmers' investments have been compounded in recent years by reduced governmental advisory, marketing, and agricultural credit services.

Under CIMMYT's Medium Term Plan (1998 to 2003) most of the Centre's African projects were subsumed into the regional "*Food and Sustainable Livelihoods for Sub-Saharan Africa*" Programme but staffing still came from crop-specific or disciplinary programs for Maize, Biotechnology, Economics, and Natural Resources. The goal of the programme in Eastern and Southern Africa was to enhance the development and deployment of efficient, productive, and sustainable maize and wheat technologies and systems, including germplasm with resistance to pests and diseases and tolerance to environmental stresses, and the development of natural resource management technologies and human capacity. The donor-funded projects were drawn together into an integrated set of research, networking, training, and extension activities with multiple partners to address five aspects of food security and livelihood development:

1. Tracking and understanding biophysical and socioeconomic change in the maize and wheat systems of sub Saharan Africa and formulating strategies to address the implications.
2. Developing and disseminating maize and wheat germplasm that possesses durable resistance to pests and diseases and tolerance to environmental stresses.
3. Developing and promoting more sustainable crop production systems, focusing on soil fertility maintenance and water and pest management, while conserving natural resources and increasing productivity.
4. Formulating policy recommendations and research priorities for improving maize and wheat farming systems in sub Saharan Africa.
5. Building local and national capacities through training and networking to address points 1 to 4 above.

From 1 January 2004, the regional project structure was replaced by a new program structure with staffing and resources for sub Saharan Africa from then on allocated through the new *African Livelihoods Program*, which encompasses all the activities that were conducted within the former CIMMYT regional program.

### **2.2 Current organisation and staffing**

During 2003 CIMMYT undertook an in-depth strategic planning process involving its stakeholders, donors and partners in examining the relevance of its mission, defining how to position the Centre to best meet the needs for agricultural knowledge and technology over the next 10-15 years and to determine the most appropriate organisational arrangements and

operating modalities. In 2003 there were 18 internationally recruited and 60 locally hired staff distributed between its offices in Nairobi; Harare, Addis Ababa and Lilongwe with the latter two each having only one CIMMYT staff member.

In addition to management and administrative support, CIMMYT's headquarters in Mexico provides the Africa-based teams with a range of services from germplasm development to biotechnology and GIS.

### **2.3 Current Research projects**

Most of CIMMYT's research projects involve collaborations with networks of national research institutions. In Eastern Africa, this involves ASARECA's East and Central Africa Maize and Wheat Network (ECAMAW) which is coordinated by staff based at CIMMYT offices at ILRI, Addis Ababa, Ethiopia and ICRAF, Nairobi, Kenya. In Southern Africa, CIMMYT was the implementing agency for the Maize and Wheat Improvement Research Network (MWIRNET) for SADC/FANR from 1995 to 2000 which undertook the SADLF and QPM projects and a maize seed promotion initiative funded by USAID.

Having a regional perspective helped CIMMYT to set priorities, encourage synergies and integration among an array of donors and partners and to disseminate research results to extension services, seed producers and farmers. The Programme functioned through six thematic subprojects with the following focuses:

1. Development of maize germplasm adapted to biotic and abiotic constraints
2. Deployment of maize germplasm adapted to sub Saharan Africa
3. Development and deployment of wheat germplasm
4. Understanding and promoting sustainable maize and wheat-based systems:
5. Enhancing human resources and partnerships devoted to maize and wheat cropping systems
6. Impact assessment and socioeconomic analysis of maize and wheat technology

### **2.4 Funding trends**

The research undertaken by CIMMYT is mostly supported by project funding involving more than 20 special projects supported by about 16 donors and some regionally restricted funds mostly from UK/DFID.

In the briefing notes provided to the Panel, it was estimated that total funding for CIMMYT's research in Africa was a little in excess of US\$15 million. However, in the more detailed analysis provided later total funding for CIMMYT's research in Africa ranged from a peak of US\$ 10,552,553 in 2000 to a trough of US\$ 8,964,961 in 2003. The budget for 2004 was US\$ 10,625,873. In 2004 36% of the funding (US\$ 3,832,368) is expected from CIMMYT's unrestricted funding.

In contrast to trends in other CGIAR centres, restricted project funding declined from US\$ 6.1 million in 1999 to US\$ 5.7 million expected in 2004. This trend was reflected in CIMMYT staff frustration with the unreliability of donors manifest by the inconsistency between donor comments on their 'good' proposals and subsequent decisions not to fund them, despite the recent trend for Africa and agriculture to rise in donor priorities.

### **3. OVERALL ASSESSMENT OF CIMMYT's AFRICA PROGRAMME (1998-2004)**

#### **3.1 Mission and objectives**

CIMMYT's objectives in Eastern and Southern Africa include the regional release, through seed companies and NGOs, of open pollinated varieties (OPVs) and hybrid varieties of maize that are tolerant to the region's abiotic and biotic stresses. The programme also aimed to produce new natural resource management information, particularly about combating soil fertility, weed management, and conservation tillage.

CIMMYT has endeavoured to improve its focus on meeting the needs of resource-poor maize farmers and seed producers and sellers by adopting a poverty focus for all aspects of its work including: maize seed product development and delivery, research on soil fertility management, adoption and impact studies, policy analysis, facilitating private sector support for natural resource management, and strengthening the skills of national scientists in areas such plant breeding and natural resource economics.

#### **3.2 Maize germplasm**

CIMMYT has made very important contributions in improving maize germplasm for sub Saharan Africa. This germplasm is used extensively either *per se* as released hybrids or open pollinated varieties (OPV's), as parental lines in combination with public or propriety germplasm or is recombined to develop new breeding material. Since maize is a staple food, seed and germplasm security is a prerequisite for food security, consequently CIMMYT's germplasm constitutes an enormous contribution to improving livelihoods in the region. It is critical that this focus on key germplasm is maintained.

##### **3.2.1 Perspectives of the National Agricultural Research Systems (NARS)**

The germplasm support is vital for the NARS. While many countries have national germplasm collections, the changing environment presents evolving needs. Maize streak virus tolerance and tolerance to grey leaf spot are examples of diseases which have not been present at adequate levels in some of the national germplasm collections causing delays in responding to changes in disease pressures. CIMMYT germplasm has provided important access to those traits and enabled the national germplasm collections to stay relevant in the changing environment.

In addition to providing germplasm, CIMMYT staff offer vital support in program design, breeding methodology, trait characterization, trial evaluation, staff training and capacity building. While many countries have determined that they will maintain their own national breeding programs, it is evident that this would be much more difficult and probably not possible in some cases without CIMMYT's support. CIMMYT understands well the importance of its role with the NARS and continues to devote considerable time and expertise to assisting these programs. CIMMYT could provide additional help in monitoring the progress individual NARS are making towards ensuring relevant local material is sent to the SADC gene bank to avoid national germplasm losses. There is a concern that some of the national programs may reduce internal funding and become overly reliant on CIMMYT, rather than sustain their own obligations to develop and support their own crop breeding initiatives.

##### **3.2.2 Private Sector perspectives**

The high adoption rates by small and large private sector companies emphasises the important contributions of CIMMYT germplasm. Some members of the private sector also seek CIMMYT's assistance in broader arenas some of which may be beyond CIMMYT's mandate or objectives. This should be reconciled by dialogue to help these companies understand where CIMMYT can help and where they will need to rely on their own or other resources. However,

the requests make the point that CIMMYT, in addition to being the key source of germplasm, is also seen as having a very important advocacy role and being a credible honest-broker. The broader requests that CIMMYT has been asked to assist with or facilitate include:

- Regional registration and seed movement issues:
  - These were listed as one of the areas of highest concern for the Private Sector across the region. Zimbabwe was noted as perhaps the country with the most limiting registration and seed movement issues. Encouragingly some of the Governments are acutely aware of the challenges and are putting together policy documents and position papers aimed at addressing some of these issues and revitalizing their seed sectors. CIMMYT plays an important role facilitating this dialogue. The role of the SADC Regional Seed Security Network (<http://www.sadc-fanr.org.zw/ssn/ssn.htm>) is critical in helping fostering a holistic regional approach to these issues. This initiative needs to be maintained and CIMMYT has an important role in this. Varietal registration and release procedures and requirements (including DUS etc.) and supporting technical information (including production recommendations).
  - Smaller companies lamented that they were not as well placed to generate product characteristic information etc. as required for the varietal registration and release procedures. DUS information is difficult for smaller companies to generate because they are limited by staff and financing. While CIMMYT does provide performance data to support registration and release, they don't provide varietal descriptions like DUS information. There was some discussion about whether this could be provided on a fee/contract basis or outsourced. Smaller companies also asked if more specific production recommendations could be provided when CIMMYT made announcements indicating hybrid and OPV availability. Here again there was discussion of the merits of a fees/contract basis or outsourcing. CIMMYT could help with strengthening the capacity to achieve these needs.
- Market issues including the roles of NGO's and seed "dumping" undermining normal distribution channels
  - Private seed sector participants expressed one of the most disturbing trends was the more recent reallocation of resources into more relief focused activities rather than activities focused on longer term development of the seed sector. There is an urgent need for a better understanding of how NGOs distribute seed in a relief versus longer term scenarios. Local distribution channels, small stockists etc., which are all important to developing infrastructure for seed security and ultimately food security, are very adversely affected when normal distribution channels are by passed. While coupon systems channelled through such stockists have been considered this has not been adequately implemented and the distribution channels remain very fragile. CIMMYT has an important role in promoting better policies and arrangements with the donors individually and in their councils. The current situation is not sustainable over the longer term.

The Panel urges NARS and Governments to put aside individual differences and aspirations for the collective benefit of the region on varietal release and registration issues. While there has been discussion ongoing for many years it is important that this is prioritized and brought to some closure. Regional variety release list issues need to be resolved and implemented and it is critical that seed movement issues are harmonized, particularly in times of shortage – some shortages are due more to logistic challenges than actual seed depletion. CIMMYT has an important role, along with the SADC Regional Seed Security Network, to help see that these issues are resolved.

The donors and NGOs also need to be challenged to find ways of distributing seeds that do not undermine the local distribution systems.

### 3.3 Crop, soil and water management strategies

#### 3.3.1 Soil fertility network

Despite considerable effort, gains in maize systems productivity from improved crop and soil management, although potentially higher, remain below that of improved germplasm. This limited impact has as much to do with structural, policy and socio-economic issues, as it does with biophysical limitations. In addressing these concerns, CIMMYT has developed a collaborative approach involving two regional networks (SoilFertNet in southern Africa and ECAMAW in east and central Africa), much of whose work has been funded by the Rockefeller Foundation.

These initiatives built on farming systems diagnostics work undertaken in the 1980s and early 90s, which helped to identify problems and opportunities related to soil fertility management. At the same time, long-term studies, over 10 years, on productivity of maize-groundnut rotations (Zimbabwe) and maize-pigeon-pea intercropping (Malawi) have provided a better understanding of soil degradation and its impact on crop yields and identified technologies for optimising nutrient use efficiency.

- SoilFertNet (CIMMYT, 2004a, SoilFertNet, 2004) has worked for nine years to maintain and improve soil fertility through the development and promotion of improved soil fertility technologies.
- The ECAMAW network has focused for seven years on strategies to enhance soil fertility and mitigate the effects of drought.

In both networks, focus has been on the use of legumes especially green manures, organic-inorganic mixes and participatory technology testing (Table 1)

**Table 1:** Main crop management and soil fertility initiatives (1994-2004)

Southern Africa	East and Central Africa
<ul style="list-style-type: none"> <li>◆ Long term trials</li> <li>◆ Best bets (SoilFertNet)               <ul style="list-style-type: none"> <li>- Green manures</li> <li>- Grain legume intercrops</li> <li>- Rotations</li> <li>- Agro forestry</li> <li>- Targeted use of organic and chemical fertilisers</li> </ul> </li> <li>◆ Risk Management and crop modelling               <ul style="list-style-type: none"> <li>- Low fertility, climatic variability, risky environments</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>◆ Integrated Striga control</li> <li>◆ Best bets (ECAMAW)               <ul style="list-style-type: none"> <li>- Legumes</li> <li>- Animal manures</li> <li>- Low rates of inorganic fertilisers</li> <li>- Organic and inorganic mixes</li> <li>- Rainwater harvesting</li> </ul> </li> <li>- Tied ridges/ potholing</li> </ul>

SoilFertNet and ECAMAW collaborators have conducted extensive on-farm research of many soil fertility and *Striga* control options as well as evaluation of stress tolerant germplasm (drought and N-use efficient maize). Most emphasis has been placed on identifying organic sources of N, especially legumes, both as green manures and grain, either in rotation or as intercrops. While legumes in rotation increased subsequent maize yields, inter and relay cropping of legumes with maize have been less effective. From this work “best-bets” were identified for widespread testing through a mother-baby approach that has provided farmer feedback and assisted promotion

through partnerships with farmer groups, government extension services and NGOs. Work on this is ongoing and farmer involvement is still at an early stage in some countries.

### 3.3.2 The Risk Management Project

CIMMYT’s Risk Management Project arose from the challenges to researchers of undertaking experimentation into soil fertility that adequately represents the diversity of conditions found in smallholder maize systems. A modelling approach was taken to help address questions relating to the sustainability and the longer-term riskiness of certain production practices, particularly drought and declining soil fertility

Funded by AusAID, the project has combined crop simulation modelling with farmer participatory research. The context is that farmers’ management, including soil nutrient management, involves a complex set of decisions made each season that are both location and time specific (Shamudzarira, 2004). The project has sought to understand these decisions through farmer participatory research, participatory resource flow mapping, constructing a set of more common scenarios used by different categories of farmer, and modelling the risks of these over a longer time period. This was helped through a partnership with ICRISAT in Malawi involving on-farm trials, using the “mother-baby” approach, which is now providing a focal point for engaging with farmers and collecting contextual information with which to build maize management scenarios.

### 3.3.3 Lessons learnt

There are many strengths in CIMMYT’s work on soil fertility in the region but there are also a number of weaknesses that need to be addressed (Table 2).

**Table 2:** Summary strengths and weaknesses of CIMMYT’s work on soil fertility management.

<b>Strengths</b>	<b>Weaknesses</b>
<p>CIMMYT’s focus on soil fertility management is fully justified as rural livelihoods in sub Saharan Africa centre on low input agriculture</p> <p>Programmes have succeeded in:</p> <ul style="list-style-type: none"> <li>- Combining technical research with resource-poor farmer orientation</li> <li>- Linking key stakeholders and developing their capacities</li> <li>- Developing some extension material to assist in promoting best bets</li> </ul> <p>Modelling soil management scenarios has the potential to inform predictions and policy on the sustainability of soil fertility management options. Information could be used in a soil fertility management to SFM.</p>	<p>Uptake of the technologies has been limited</p> <p>Areas that require strengthening include:</p> <ul style="list-style-type: none"> <li>- Economic assessment of the best bets</li> <li>- Lessons learnt on best bets need to be more widely shared to provide improved access by extension agencies and farmers to information</li> <li>- Farmer participation in the research activities</li> </ul> <p>Capacity building amongst partners and extension agencies</p> <p>Research results to date have not influenced policy makers and decision makers</p> <p>The impact of the research on productivity and poverty alleviation has not been adequately identified or documented</p>

Current information is mainly based on the working knowledge of SoilFertNet members, their field observations during experimentation and on feedback from farmers and extension staff. There is little indication that the research has used information collected by other agencies on

livelihood trends, rural poverty and its causes, in order to set their current programme activities within a livelihoods context (Sutherland and Tripp, 2001). However, the *Risk Management Project* has added to this understanding in the selected operational areas, although project experiences is still being documented, analysed and presented in a way that provides a basis for assessing the relevance for resource poor farmers.

### **3.4 Impact Highlights of CIMMYT Sub Saharan Africa Programme**

#### **3.4.1 Drought, low N and low pH tolerant maize varieties**

CIMMYT has made a major impact in moving abiotic stress tolerance into OPVs and hybrids (Diallo et al 2001). Widespread adoption of improved varieties, often OPVs, through close work with seed companies and farming communities has resulted in over 250,000 ha being planted in Southern Africa with sales quadrupling over each of the past four years. In Eastern Africa, private seed companies reported sales of 93 tons of CIMMYT hybrids and 11 tons of OPVs in 2003. This is projected to rise to 630 and 175 tons in 2004, respectively, partly resulting from the distribution of demonstrations and promotion packs. More than 100,000 farmers were exposed in Western Kenya in 2003 and it is anticipated that 32,000 ha will be planted to stress tolerant maize in 2004. Ongoing breeding is further increasing the penetration of stress tolerant germplasm.

#### **3.4.2 Quality Protein Maize (QPM) for local conditions and preferences**

Quality Protein Maize (QPM) can benefit farmers' households' food security and livelihoods by providing a more complete protein dietary complement than normal maize (CIMMYT 2003). This can improve the nutrition of those consuming it and raise incomes through its use as a high quality feed for poultry or pigs. However, experience shows that nutritional characteristics alone are not enough to stimulate wide-scale farmer adoption because consumer preferences are influenced by yield, taste and cooking qualities. So, it is necessary to move the QPM trait into varieties as an added value to the preferred characteristics. This is now CIMMYT's main efforts in this area with many products being in the pre-release/release pipeline. For instance, two QPM hybrids have been released in Kenya, one in Ethiopia. Tanzania has released three QPM varieties. Obatampa (Ghana QPM OPV) has been released in Mozambique, South Africa and Zimbabwe; Uganda has released a QPM OPV, locally known as Nalongo. This attracted the interest of the World Food Program (WFP) which has encouraged local farmers to grow it for emergency food rations.

#### **3.4.3 Bt maize moving forward in East Africa**

The *Insect Resistant Maize for Africa* (IRMA) project is charged with developing maize with either conventional or Bt resistance to stem borers. Varieties with conventional resistance have now begun to enter the National Performance Trials (NPT) process and the Bt maize research has produced groundbreaking outputs that are likely to influence the course of GM technology in East Africa and very possibly sub Saharan Africa as a whole. "First's" include:

- the development of insect resistance management strategies for smallholder farmers; extensive pre-release studies on the non-target and beneficial organisms in African maize cropping systems;
- development of marker-free Bt constructs for use in the African varieties; construction of a bio-safety greenhouse (first in sub Saharan Africa outside of South Africa) to international standards and a team trained to run it;
- support for capacity strengthening in bio-safety regulation and review.

This project was launched with the express idea that the lessons learned along the way could be employed by other nations in the region exploring the use of GM maize and other GM crops.

#### **3.4.4 Resistance to diseases and field and storage pests**

Many national and private sector breeding programs have been using a very narrow germplasm base and the resulting maize varieties were known to be susceptible to Maize Streak Virus (MSV) and showed poor processing and storage characteristics. This hindered the adoption of improved maize germplasm. Between 1996 and 1998, most maize in Eastern and Southern Africa was hit by a severe epidemic of Grey leaf Spot (GLS) which further highlighted the lack of genetic diversity among released maize varieties. Since then an increasing number of maize varieties with increased resistance to MSV, GLS and northern leaf blight, and improved storability due to better husk cover and hard endosperm grain texture are entering the market in Eastern and Southern Africa. Many of these traits, indeed 55% of all new releases, contain CIMMYT germplasm derived from 2,500 seed samples provided annually on request to breeding programs in sub Saharan Africa by CIMMYT as the steward for the World's maize genetic resources.

#### **3.4.5 Weevil and larger grain borer resistance**

Weevils, a longstanding storage pest, and the Larger Grain Borer (LGB), which is a recent introduction, cause significant maize storage losses. Following farmer surveys that indicated the importance of controlling these post harvest losses, CIMMYT initiated research aimed at producing grain that resists the major storage pests. Establishing inexpensive and rapid testing protocols has been a major thrust of this work. A "weevil warehouse" technology has been developed which replicates the storage conditions of farmers, and promotes rapid and extensive screening. A rapid visual scale was also developed to rate damage to maize ears with and without the husk, thereby facilitating the screening of 1,500 genotypes per season, and enabling breeders to make evaluations prior to subsequent planting seasons. Eight synthetics with moderate weevil resistance have now been developed. For the LGB, CIMMYT has now identified a Caribbean accession from its gene bank which has moderate levels of resistance though with poor agronomic characteristics. A structured breeding program is now underway to move the LGB resistance into African germplasm.

#### **3.4.6 Striga resistance and control**

*Striga* is responsible for, conservatively, more than US\$1 billion in maize losses annually in sub Saharan Africa (reasonably reliable figures indicate \$2.7 billion in losses, with some published estimates as high as \$7 billion). More than 100 million people, mostly resource poor, are affected. CIMMYT and Israel's Weizman Institute have developed a technology based on coating herbicide resistant seeds with a herbicide that not only offers *Striga* resistance, but also lowers the seed bank of the parasitic weed in the soil. Sixty late maturing and 22 early-maturing OPVs for the mid-altitudes; 10 OPVs for the lowlands; 30 new inbreds and 12 CMLs have been converted to herbicide resistance. The best varieties will be evaluated in trials across sub Saharan African countries where *Striga* is a problem. Five hybrids were nominated for the Kenya National Performance Trials (NPTs) and three were pre-released. In 2005, 21,000 farmers will grow IR maize in on-farm demonstrations. In addition, screening continues for increasing *Striga* resistance/tolerance in maize.

#### **3.4.7 Regional approach to soil fertility research and diffusion**

CIMMYT played coordinating and facilitating roles in the formation of the SoilFertNet and the soon to be launched Soil Fertility Consortium (SoilConsort) which will directly serve four countries in Southern Africa, and nine countries indirectly through the ECAMAW network. Given the scarcity of soil scientists in the region, the potential impact of fertilizer and/or improved soil fertility, and the need to reverse the deterioration of the natural resource base, such networks are expected to be in the forefront of soil fertility research and development

#### **3.4.8 Mother-Baby participatory research and diffusion**

Participatory research is now a major component of CIMMYT's research both in maize breeding and soil fertility management. Mother-baby trials, a farmer-centered approach to variety testing and selection, have been promoted by CIMMYT in both Southern and Eastern Africa and much of the success in developing drought tolerant varieties can be attributed to this approach. Mother-baby trials are now used in 12 African countries, Afghanistan, Nepal, India and East Timor. In Africa, they involve over 100 partner organizations and 240 farming communities and have resulted in more effective collaboration among research, extension, NGOs, farming communities and the private seed sector. The system has influenced variety releases, scaling-up of seed production, and identification of farmer selected breeding priorities. In soil fertility research they give opportunity to farmers to select those options that best suit their conditions.

#### **3.4.9 Socio-economics**

The CIMMYT Economics program has been active in Africa since the 1970s. It was instrumental in developing Farming Systems Research (FSR), which has been a key link in bringing agricultural research closer to farmers. Participatory research methods such as PRAs and PVS were developed, and are now routinely used in conjunction with mother-baby trials. In East Africa, CIMMYT economists have organized farm surveys, including 22 adoption studies that provide the basis of most of the quantitative analysis on maize systems available today. Further, most agricultural economists in the region have benefited from CIMMYT training and collaborative research. CIMMYT's economics capacity in Southern Africa was strengthened in 1998 and since then has contributed to biophysical research activities, including impact assessments of maize breeding research, coordinated capacity building/training in socio economics and on-farm research methodologies (specifically, MWIRNET-RSA-1999-2001). A regional EPWG has undertaken studies on benefits/returns in Zimbabwe, Malawi, Zambia, and Mozambique, and initiated policy advocacy for soil fertility management by interacting with and organizing workshops for policymakers in Zimbabwe, Malawi, and Zambia.

#### **3.4.10 Training and capacity building**

Shortages of trained staff, exacerbated by rapid attrition, pose serious constraints to public sector agricultural research in sub Saharan Africa. Between 1998 and 2004 CIMMYT either sponsored or coordinated more than 150 training events ranging from PhD committee membership to GMO awareness programs for parliamentarians and farmer participatory research workshops. Approximately 2,500 individual training opportunities were realized by regional participants (some trainees participated in more than one opportunity) facilitated and/or supported by CIMMYT Africa. Many of African scientists have also participated in extended basic and advanced breeding courses offered at CIMMYT-Mexico.

#### **3.4.11 Impact on poverty alleviation and livelihood improvement**

Impact assessment studies (Hassan *et al.*, 2001; Doss *et al.*, 2003) have largely concentrated on identifying the impact of CIMMYT's work on policy reform, private sector participation in the maize seed industry, adoption of improved maize varieties (in terms of land area or numbers of adopting farmers) and use by other researchers of CIMMYT germplasm. While the results are impressive, there is no indication how this has impacted on the lives of poor people. This will require addressing in CIMMYT's new strategy.

#### **4. LOOKING AHEAD: ENHANCING CIMMYT's EFFECTIVENESS**

During the 1990s overall investment in agriculture by donors and national governments halved, while the number of people in need of food aid doubled (FAO, 2001, World Bank 2003). With the most severe and intractable poverty in the world being in sub Saharan Africa nearly half of the people live in absolute poverty subsisting on incomes of less than a dollar a day. Unfortunately, while most governments recognize the critical importance of agriculture this is not matched by budget allocations to the agricultural sector nor by inclusion of agricultural research and development in their national Poverty Reduction Strategy Papers (PRSPs) that determine donor funding priorities (World Bank, 2003). On present trends, two of the fundamental Millennium Development Goals set by the United Nations, i.e., halving the number of people living in absolute poverty and halving the proportion of people suffering from hunger will not be met in sub Saharan Africa by the target year of 2015. To reverse this disaster the focus of development in sub Saharan Africa must be on the rural areas where three quarters of the people live and are dependant on agriculture for their primary livelihood source (FAO, 2004). In these areas tackling poverty means boosting smallholder agriculture and recognising that this is the best way of driving broad-based economic growth and poverty reduction.

Achieving smallholder agricultural growth will not be easy. Small scale farmers continue to face a host of problems including: poor access to markets and to the financial, extension and research services needed to help them work in difficult conditions of limited resources and high exposure to price and production risks. These difficulties are compounded by the impact of HIV/AIDS on individuals, households and communities. Unless these constraints are addressed by national governments and international organisations the prospects for sub Saharan Africa remain bleak.

##### **4.1 New directions for CIMMYT<sup>1</sup>**

In 2002 CIMMYT's Board of Trustees decided to conduct a thorough wide ranging evaluation of the Centre's mission and if necessary to undertake a structural transformation to achieve its strategic goals (CIMMYT, 2004a). In developing this strategy CIMMYT sought to examine the continuing relevance of its mission, define how to position itself to meet the needs for agricultural knowledge and technology over the next 10-15 years, and determine the most appropriate organizational structure and operating modalities.

###### **4.1.1 Mission statement**

As a result, CIMMYT has revised its mission statement to acknowledge the people, who are central to its mission, notably the poor for whom maize and wheat offer paths out of poverty and environmental degradation.

*"CIMMYT acts as a catalyst and leader in global maize and wheat innovation network that serves the poor in developing countries. Drawing on strong science and effective partnerships we create, share and use knowledge and technology to increase food security, improve the productivity and profitability of farming systems and sustain natural resources."*

###### **4.1.2 Key elements of CIMMYT's strategy**

To achieve its mission CIMMYT will rely on four sources or "seeds of innovation":

1. A focus on people and livelihoods
2. A new innovation agenda that emphasizes global and eco-regional priorities
3. Responsive partnerships and networks for innovation and impact

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<sup>1</sup> Much of this section is derived from CIMMYT, 2004b. Seeds of Innovation: CIMMYT's strategy for helping to reduce poverty and hunger by 2020. Mexico, DF: CIMMYT.

4. A commitment to sharing and using knowledge for innovation across scientific, institutional and national boundaries

#### **4.1.3 A focus on peoples and livelihoods**

In taking a holistic approach to its research in maize and wheat cropping systems CIMMYT proposes to adopt a conceptual livelihoods framework to organize this research, which will be driven by two livelihood systems, where maize and wheat:

- provide food and nutritional security to rural households
- generate income, foster growth and alleviate poverty

Although these two systems are not mutually exclusive, a mix of research strategies and partnerships is required to respond to the challenges in different settings. CIMMYT will need to empower people to choose to remain in maize or wheat to meet their basic needs, to make it more profitable, to incorporate maize and wheat into other livelihood strategies or to diversify out of maize and wheat if this becomes viable.

The Panel supports the proposal for an inter-centre workshop on livelihood assessment to be held in August 2004 at which both technical and social scientists will jointly develop a conceptual framework that can guide future research and can be used to identify quantitative and qualitative information needed for tracing the impact of new maize and natural resource management interventions on the livelihoods of the poor. A social scientist (anthropologist or rural sociologist) should be hired to assist in developing the conceptual framework for the livelihood studies and carrying out qualitative and quantitative studies of how CIMMYT's technology is impacting on the lives of the poor, on gender and on the families affected by HIV/AIDS.

#### ***Research agenda and structure in sub Saharan Africa***

Of all regions of the developing world, sub Saharan Africa poses the greatest challenge for sustained improvement of rural livelihoods and agricultural productivity. A combination of uncertain and variable rainfall, poor soils, insect pests, Striga and poorly developed markets and infrastructure has stalled efforts to improve agro-ecosystem productivity and sustainability. In some countries conflict, deteriorating macro-economic and agricultural policies and a high incidence of HIV/AIDS have exacerbated these problems and debilitating malnutrition is common, especially amongst women and children.

Farm households mainly grow maize, the most important staple, in rotation or association with groundnuts, beans or other legume or sometimes cash crops such as cotton or tobacco. Livelihood strategies often feature a close integration of crops and livestock as well as reliance on migration and remittances. Farm households need production systems that reduce losses in bad seasons (drought), are substantially more productive in good seasons, improve labour productivity to compensate for loss of family labour due to migration or HIV/AIDS, can exploit environmental niches, use scarce and expensive inputs (especially fertilizer) efficiently, take advantage of locally available inputs (such as manure, and leaf litter) to maintain soil fertility and foster market development to reduce input prices and improve farm-gate product prices.

#### ***Project impact***

CIMMYT has set it self some ambitious 10-year targets for sub Saharan Africa (primarily Eastern and Southern). These include:

- i) Ensuring that 20% of farm households/families grow maize varieties that better withstand drought and low soil fertility
- ii) Developing and promoting effective techniques to combat *Striga*, maize field and grain storage pests

- iii) Developing and promoting decision aids that match resource-conserving practices with land types and farmer categories
- iv) Strengthening collaboration among partners to address development concerns more effectively
- v) Fostering market development and better integrate smallholder cropping systems into national markets.
- vi) Contributing to the debate on policy and institutional issues affecting the agricultural sector
- vii) Documenting impacts of improved practices on incomes, livelihood, soil and water resources and the environment.

A well focused and concerted programme will be required to achieve these targets.

**Recommendation 1: Improving livelihoods and measuring impact**

**CIMMYT should develop a conceptual livelihoods framework for identifying where and how its interventions will impact on livelihoods. Both technical and social scientists should participate in developing and implementing the framework, which should have an “Impact Pathway” with key milestones to facilitate regular reviews using both quantitative and qualitative information to trace the impact of new maize germplasm and natural resource management interventions on people’s livelihoods, especially of the poor. CIMMYT should hire a social scientists (anthropologist or social scientist) to assist in designing and carrying out livelihood studies in cooperation with economists and members of the maize and natural resources management team.**

**5. LOOKING AHEAD: MAIZE BREEDING**

In view of the importance of maize breeding and the amount of work that has to be done, ways need to be sought to keep channels of communications open between the CGIAR centres. Otherwise tight funding, which increases competition within the CGIAR system, may be detrimental to their collaboration. In this regard there appear to be mutually beneficial options for CGIAR centres and their partners to consider for focusing on their respective areas of excellence across the continent. To determine these, opportunities need to be sought to bring about better dialogue amongst institutions that have overlapping maize germplasm development (breeding) responsibilities across Africa. For centres/institutions the desired outcome would be to identify key strengths, leverage them better and reduce overlap. There is opportunity to review the relative strengths of various groups/centres and consider in more depth the potential to allow one CGIAR Centre to assume the overall mandate for maize development (breeding) for Africa. Partners including the NARS should be encouraged to consider their current activities versus outcomes needed 5 to 10 years from now in a more liberalized seed industry so that they can position themselves better to meet the new challenges.

**5.1 Participatory research**

Participatory research is a major component of CIMMYT's maize breeding programme. Mother-baby trials are a key pillar of this approach. In Africa, they now involve over 100 partner organizations and 240 farming communities and have resulted in more effective collaboration among research, extension, NGOs, farming communities and the private seed sector. This valuable effort needs to be continued but there is an opportunity to refine the structure and layout of the mother–baby trials. In order to enhance their effectiveness a dual season approach should be considered along with some revision of the entries. Such a revised program might entail:

- Dual season approach: Summer 1 -- mother trial. Summer 2 -- baby trials consisting of 2 or 3 farmer chosen entries as well as 2 or 3 randomized entries. (Seed and logistic

- implications will need to be carefully considered). Farmers currently do not choose the entries in baby trials rather they participate by growing a pre-determined set of entries – allowing more customization will increase participation and effectiveness.
- Refining trial placement and size by limiting entries as much as possible to areas of adaptation.
  - Restrictions should be encouraged in baby trials to the two most appropriate maturity bands. If broader maturity ranges need to be demonstrated, it would be more appropriate to do so in the mother trials and nest entries by maturity to show farmers the relative advantages and disadvantages.
  - Moving more quickly to improved releases and not continue to trial varieties which have been replaced (OPV's for example).
  - Ensuring the design and placement of mother baby trials aligns closely with advances in natural resource management and that varieties are tested under conditions representative of the circumstances of resource-poor farmers.

## **5.2 Breeding approaches and trait priorities**

The CIMMYT sub Saharan Africa maize breeding staff have recently had fairly extensive reviews of components of their breeding methodologies and the resultant recommendations have been well noted. There is considerable complexity given the range of breeding material, its diversity, and the multiple trait priorities across geographies for a continent that spans an area more than three and half times the area of the continental USA. In that light, over simplifications and generalizations are not appropriate and the breeding schemes were generally well thought out and considerable depth was evident in answering questions from the Panel on the various approaches. There may, however, be opportunity to move to earlier generations of top crossing and testing – but that will need to be considered on a case by case basis depending on the relevant starting population and trait focus. There is opportunity to standardize/harmonize trait priorities that breeding programs use across sub Saharan Africa and CIMMYT is making progress already in this direction.

CIMMYT should continue to seek ways to standardize/harmonize trait priorities that breeding programs use across sub Saharan Africa and ensure that these efforts are shared with the NARS. These efforts should:

- Ensure that trait priorities and their relative weightings are clearly understood and easily communicated.
- Keep this information current each season by making that part of a formal meeting agenda and ensure that these priorities are used for optimizing resource allocations. Stakeholder/partner participation in setting and reviewing these trait priorities and relative weightings is essential.
- Consider the opportunity to further expand and clarify some of the more complex traits (for example ear molds, and poundability)
- Harmonize where possible with individual NARS.

## **5.3 Quality Protein Maize**

The importance and relevance of QPM for sub Saharan Africa is broadly acknowledged and the increasing focus on it now accounts for probably 40% of CIMMYT's sub Saharan Africa overall germplasm work. There is opportunity to explore the potential to move to increased levels of QPM incorporation – to a point where QPM might be part of CIMMYT's base genetics for most inbreds, hybrids or OPV's. This is a complex issue given the recessive gene action and importance of modifiers to maintain grain acceptance for consumers and industry. Such an approach carries with it some cautions and must address knowledge gaps. To incorporate more

QPM into base genetics currently would potentially involve narrowing genetic diversity as large segments of chromosome 7 are involved spanning the opaque 2 gene and modifiers. However, there may be opportunity for changing the mode of gene action for QPM, for example, through a transgenic strategy which may allow the gene to be inserted into germplasm carrying the modifiers but without conserving such large segments of chromosome 7. If a transgene strategy is pursued there may be opportunity to tie this with other genes of interest from either the public sector or through public/private sector collaborations (for example mycotoxin degradation) or bio-fortification or other health/nutrition opportunities. This could also be linked through the Health and Nutrition Challenge Program and links with the African Agriculture Technology Foundation (AATF) and other partners.

There is also need for additional consideration to be given to the likelihood and potential effects of inadvertent cross-pollination of current QPM varieties in smallholder seed production (should appropriate isolations not be possible) and in farmer-saved seed scenarios. Any reversions to undesirable grain texture, expressed in the absence of the modifiers, could be detrimental to the longer-term promotion and adoption of QPM. The potential for any such effects, as well as changes in protein levels, need to be better quantified and understood first. More stringent production requirements or seed replenishing scenarios may need to be recommended specifically for QPM hybrids or OPV's for example.

There also is ongoing need to critically compare/contrast the QPM approach with other methods of elevating levels of limiting amino acids as may be evolving. A small team from CIMMYT could be tasked to approach the private sector to see what new approaches may be developing that the private sector could consider for potential knowledge sharing or collaborations.

#### **5.4 *Striga* control**

CIMMYT has submitted a proposal to NEPAD through FARA for *Disseminating an Herbicide Seed-dressing Technology for Controlling Striga in Maize to Enhance Food Security in Africa*, which build on successes achieved in Kenya during the past seven years where CIMMYT has developed and demonstrated technology with potential for high and immediate impact in controlling *Striga*.

The programme will be composed of two companion projects, one focusing on proprietary issues in *Commercialisation of the IR-maize Striga control technology* and the other addressing technology development and extension in *Disseminating adapted IR-maize germplasm to the major Striga-infested areas of Africa*. Both projects involve a wide group of public and private partners.

#### **5.5 Overall perspective**

As highlighted in the paragraphs above, CIMMYT plays an important role in assisting varietal registration and release, as well as in seed movement. Other valuable initiatives that will also positively impact production and distribution include partnering and supporting small seed multiplication groups that are important in local seed distribution. This recognises that groups like ASSMAG (Association of Smallholder Seed Multiplication Action Groups) are producing important quantities of seed, not just maize in the face of the complexities and challenges of relying on smallholder farmers, with limited capital and inadequate infrastructure for conditioning and treating the seed.

This could be an area where the more established private sector seed companies could help smallholder farmers in sub Saharan Africa to gain better access to agricultural technologies to help improve seed availability and thereby improve food security and reduce poverty. To promote this CIMMYT should continue with efforts in fostering improvements in seed

production and distribution and seek ways to facilitate private and public partner collaborations to help with smallholder seed multiplication issues. Some ways to achieve this could be to:

- Provide valuable support for groups like ASSMAG
- Consider ways to help beneficiaries better understand relevant strengths and weakness of such approaches and adjust as necessary (seed quality, planting rates and germination limitations, logistic limitations).
- Work with private and/or public partnerships to transfer appropriate technology to assist groups like ASSMAG and ultimately expand the seed sector and improve maize adoption rates.
- For maximum impact this work needs to be coordinated with research into seed marketing in smallholder environments and take into account prior learning from community based seed systems (see section 7.2).

### **Panel Recommendation 2: Improving maize germplasm and breeding**

**CIMMYT should seek opportunities to improve dialogue and collaboration with other CGIAR centres and partners that have overlapping maize germplasm development responsibilities across Africa. CIMMYT should work with private as well as public partners in developing adapted germplasm and facilitate improvements in seed production and distribution to help smallholder seed multiplication CIMMYT should advocate standardized/harmonized trait priorities that breeding programs could use across sub Saharan Africa.**

**Future directions for CIMMYT should include exploration of the potential for increasing levels of QPM in base genetics and enhancing the effectiveness of its Mother-Baby trial approach testing new varieties, aligning these closely with advances in natural resource management.**

## **6. LOOKING AHEAD: CROP, SOIL AND WATER MANAGEMENT**

### **6.1 Coordinating crop management, soil & water, and Conservation Agriculture work**

Agro-ecosystems in sub Saharan Africa are very varied with a high proportion of land constrained by low soil fertility and erratic and changing climatic conditions. Such conditions demand a range of technological solution, even across small areas. Although basic yield enhancing technologies are available for most crops, including maize, further research is needed to adapt them to local conditions and ensure that they are economically and environmentally sustainable. The best way to achieve this is through farmer-led research because when many farmers are involved in setting the research agenda and in monitoring and evaluating different technologies and crop varieties there is greater assurance of uptake (Peacock *et al.*, 2004). Farmers have their own criteria for assessing crop performance often looking to minimise risks rather than maximising yields. Many farmers are natural innovators who are adept at experimenting in their own fields and observing the results but they need support in this process as well as access to new ideas and crop varieties to work with. It is, therefore, essential that CIMMYT and its partners expand their involvement with small farmers at all stages from defining priorities to assessing results. This will facilitate scaling-up when viable innovations have been identified.

While the Panel was impressed with the new soil fertility initiatives it was concerned about the multiple players involved in such work including conservation agriculture. At a regional level this includes not only CIMMYT, ICRAF, CIAT (with TSBF and a new African Network for Soil Biology and Fertility-Afnet), ICRISAT and IITA, who sometimes work together, some times in parallel and at other times in competition with each other, but also multiple NARES who often

work separately with different CGIAR centers in the same country often even on similar programmes. SoilConsort and SWMNet are means of bringing some coordination but they have not overcome the fragmentation of effort. To address this CIMMYT should instigate a CGIAR-wide initiative to rationalize and coordinate the activities of the large number of institutions involved in crop soil and water management research in the region.

However, the changes needed to address future needs will concern SoilConsort and ECAMAW/SWMNet stakeholder groups, as much, if not more than CIMMYT and the recommended changes will require support from the range of partner organisations. No radical shift of current priorities is expected but rather increased emphasis on pro-poor growth and poverty concerns. Additional human and financial resources will be required for implementing the scale of actions required to achieve significant impact.

## **6.2 Future direction for crop, soil and water management**

Presently CIMMYT's soil fertility activities are at a crossroads in the Southern, and Eastern and Central African regions. In Southern Africa SoilFertNet will shortly cease operations and a new Soil Fertility Consortium (SoilConsort) will be launched funded initially by the Rockefeller Foundation, at least for one year. In Eastern and Central Africa, ASARECA has recently established a new network for Soil and Water Management Research (SWMnet), which has a vision for ensuring land and water resources are utilized sustainably to reduce poverty through profitable agriculture, and CIAT has formed Afnet as part of TSBF.

SoilFertNet evolved successfully from a network of soil scientists and agronomists to include farmer participatory extensionists, agricultural economists and policy analysts with regional theme leaders, country groups and facilitators with a direct flow of funds from donors (mainly Rockefeller Foundation) and member institutions. SoilConsort has been under development since mid 2003 and is intended to build on SoilFertNet's operations and include more partners (from Zambia, Malawi, Mozambique and Zimbabwe) and partnerships with a broader range of agro-ecologies and farming systems. As such SoilConsort is now expected to provide:

- Improved research and development efficiency for food security and economic growth
- Improved access to and collaboration with policy advisors in both public and private sectors
- Improved participation and ownership by NARES
- Increased funding opportunities for soil fertility research with funding from more donors.

Both SoilConsort and SWMnet have similar goals and purposes and planned outputs or theme areas (Table 3).

SoilConsort and ECAWAM/SWMnet will continue to have important roles in mobilising and focusing the region's available expertise on relevant soil fertility and crop management research. Key components should include:

- Early effort to acquire buy-in from stakeholders including different donors
- Building on existing partnerships and building capacity, for raising both the quantity and the quality of participation by key stakeholders in both research and extension activities. This may involve researchers handing over leadership on some components of the research to extension agencies and farmer organisations.
- Empowering partners particularly extension staff, private sector partners and farmers with knowledge arising from ongoing research to draw them into the research and extension process.

- Adopting a policy to improve farmer participatory approaches that target poorer farmers. This will include targeting areas, soil and land types with large numbers of poorer households and more likely to be used by poorer households.

**Table 3:** Theme areas for SoilConsort and Planned Outputs for SWMnet.

<b>SoilConsort theme areas</b>	<b>SWMnet planned outputs</b>
<ul style="list-style-type: none"> <li>• Characterization of soil fertility problems</li> <li>• Biophysical process research</li> <li>• Participatory technology development and integration into farming systems</li> <li>• Scaling up and strengthening linkages with markets</li> <li>• Fertilizer market development</li> <li>• Regional capacity building and soil fertility management and policy</li> </ul>	<ul style="list-style-type: none"> <li>• Demand driven new knowledge information and technology for S&amp;WM</li> <li>• Enhanced brokering, sharing and utilization of SWM knowledge, information and technologies across ECA</li> <li>• Strengthened capacity of NARES for R&amp;D in integrated soil and water resources</li> <li>• Effective regional coordination and collaboration mechanism for S&amp;WM in ECA.</li> </ul>

- Addressing policy issues which facilitate or hinder development and adoption of improved crop and soil management strategies.
- Improving research continuity. Agricultural research in SSA raises concerns about sustainability of the human and financial resource base. It will be necessary to foster greater local ownership and accountability and at the same time seek to expand its range of funding sources, if possible bringing in interested private sector players. At the same time CIMMYT should consider increasing CIMMYT's budget allocated to natural resource management in line with potential productivity gains with core budget allocations for carryover between projects.
- Adopting an integrated approach to reducing land degradation. Whilst CIMMYT activities focus on plot and field levels, little consideration has been given to natural resource management at a wider landscape level. This is not considered a priority area for CIMMYT's future activities, but it does need to be addressed either through partners in SoilConsort or through a wider CGIAR initiative.
- Focusing on scaling-up and assessing impact should increase the understanding of partners in farmer adoption and adaptation of the best bet technologies, which types of farmer take up which types of practices and how farmer to farmer extension can be improved. At the same time the need to prove positive impact is needed not only to justify continued funding, but also that such studies are used to improve research and development focus.

### 6.3 Pilot studies for Conservation Agriculture

As SoilConsort starts its activities, a new initiative on conservation agriculture is being launched with funding from BMZ Germany, which is part of a wider initiative funded by BMZ including

the African Conservation Tillage (ACT) Network managed from the University of Zimbabwe. Other donors are also promoting Conservation Agriculture in the Region<sup>2</sup>.

Conservation Agriculture is a suite of technologies that encompass surface crop residue retention, minimal soil movement, crop rotations and possibly use of green manure cover crops. However, there are many versions of Conservation Agriculture because while the principles appear to have wide application, their applications are very site specific. This makes it difficult to develop “packages” for different agro-ecologies and farmer situations. Proponents of Conservation Agriculture state that Conservation Agriculture involves a change in the agricultural system and in the way agricultural research, extension and development is conducted (Wall, 2004). CIMMYT’s new Conservation Agriculture initiative aims to facilitate accelerated adoption in both Eastern and Southern Africa through synthesis of past experience, participatory adaptive research and scaling-up of Conservation Agriculture practices, many of which come from south and central America. Activities will be largely based on-farm with opportunities for research and demonstration, farmer experimentation and community learning in clearly defined domains. This will involve a wide range of stakeholders with emphasis on capacity strengthening with and farmer-to-farmer extension. Problems envisaged include competition for crop residues (both animals and termites), equipment for planting and weed control, nitrogen fertilization, creating awareness, knowledge dissemination and changing traditional agricultural habits.

Future soils research should be undertaken in close collaboration with farmers and farmers groups encompassing soil fertility, soil and water management and conservation agriculture and place emphasis on criteria they consider important. This is likely to include risk reduction, multi-use technologies, sustainability, minimising the effects of HIV/Aids and maximising economic returns over a short to medium timescale (1-3 years). Best-bets from SoilFertNet and ECAMAW should be integrated into new SoilConsort and SWMnet activities.

#### **6.4 Crop management germplasm interface**

CIMMYT needs to ensure that its germplasm and the resulting varieties are tested under conditions representative of the circumstances of resource-poor farmers. Although considerable effort is already devoted to this through the “mother-baby” approach, it is important that partners responsible for such activities are reminded of this so that the “babies” are not distorted by superimposition of improved management practices. It is essential that new varieties are tested under normal farmer practices, which may include: late planting, no fertiliser, intercropping and off season production (in irrigated gardens or wetlands/*vleis/dambos/dimbos*). This will require on-going training of partner organisations in site selection and trial management. Only after “best-bet” soil fertility and conservation agriculture management options have been identified and widely adopted by farmers should they be included as farmer management practices in mother-baby variety trials.

#### **6.5 Strengthening farmer participation in research and development**

More open-ended and participatory approaches to technology evaluation are needed, which involve farmers in generating criteria and assessing technology together with researchers. For instance *ex-ante* assessment of potential impact of the best-bets would be useful in terms of anticipating their potential for widespread uptake. This could be done with groups of farmers who have worked with the technologies and involve a simple scoring mechanism, based on local knowledge, of probable impacts on farmer identified criteria, which may include female and male labour, cash income allocation, food security and nutrition. At the same time an assessment

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<sup>2</sup> For instance DFID is now keen to promote Conservation Agriculture as part of the new agricultural recovery programme in Zimbabwe.

should be made of which extension strategies are best suited to each technology, particularly those able to reach the poorer farmers.

There are opportunities for strengthening farmer participation in the research processes, for instance mother-baby trials can be used, not only for research, but also as demonstrations and joint farmer/extension/scientist learning centres. There are opportunities to expand their use by allowing best-bets to be identified by all stakeholders and to include traditional technologies and farmer innovations in the testing processes. The choices could be widened by increasing the number of informal exploratory trials with a wider range of technology options to be experimented with and narrowed down by farmers learning from their adaptations. Clearly, this will require capacity strengthening for all partners in farmer participatory research and extension. SoilConsort and ECAMAW should seek to draw in extra resources for this task, and, where possible, should offer ideas and practical help. This will not only accelerate technology adoption but it will also inform future reach and extension initiatives.

Opportunities for partnering farmer associations could be explored. Although such partnerships often involve better-off farmers they can be justified on the basis that better off farmers provide employment opportunities. Implementing these measures will require CIMMYT to strengthen its capacity for supporting farmer participation in its research and development activities.

## **6.6 Addressing climatic change**

Climate change adds significantly to the challenges of ensuring food security and reducing poverty and this is likely to be most significant in the tropics and subtropics especially in Africa where most households depend on agriculture and have few alternatives (IPCC, 2001). Process modelling and mapping indicate that although the overall impact of climate change on maize production in both Africa and Latin America will be only a 10% yield reduction (Jones and Thornton, 2003) which could be compensated for by plant breeding and crop management improvements, the aggregate losses hide enormous variability. In some areas maize production is predicted to benefit, sometimes up to 100% from climatic change allowing increased intensification and raising rural wealth. However in other areas maize yields may decline drastically bringing considerable disruption to rural life. Major changes may have to be made to the agricultural systems and human populations may even be displaced. A comprehensive systems analysis should be undertaken at regional, country and household level to identify possible consequences for maize production and producers' livelihoods in order to identify appropriate adaptation strategies. Although CIMMYT is unlikely to have the resources to undertake such studies, they should be informed by them.

## **6.7 The Limpopo Project of the Water and Food Challenge Programme**

A new project funded under the CGIAR Water and Food Challenge Programme, entitled "*Increased food security and income in the Limpopo basin through integrated crop, water and soil fertility options and public private partnerships*" is a potential opportunity for CIMMYT to act on several of the Panel's recommendations. The project is likely to be funded from late 2004 and will involve provinces of three countries (Mozambique, South Africa and Zimbabwe) where problems of food security, poverty and ill-health are widespread (Waddington, 2004). Many parts of the Limpopo basin routinely face food deficits and are dependent on food aid. Droughts and cyclones are common which in the past two years have caused deaths from starvation in basin areas of Mozambique and Zimbabwe. Local economies which depend on rainfed agricultural systems are characterized by low productivity, vulnerability to frequent drought and occasional flooding, poor adoption of improved technologies and management practices, poorly developed input and output markets and diminishing farm labour due to out-migration and HIV/AIDS.

The project involves at least 11 participating institutions from the three countries in delivering six outputs over a three-year period

1. Identifying constraints to farm productivity in the cereal-based smallholder sector.
2. Verified and promoting improved drought tolerant crops and varieties integrated with improved soil, water and crop management technologies appropriate to smallholder agriculture
3. Evaluating and promoting alternative farmer-market linkage models that provide incentives to improved crop, soil and water management options.
4. Identifying and addressing training and information needs of technical collaborators and farming communities.
5. Assessing impact of drought tolerant crops, new high value crops and soil, water and crop productivity enhancing technologies
6. Developing policy recommendations.

This project should provide opportunity for CIMMYT to test a new and integrated approach to breeding, variety selection and improved crop management technologies and at the same time developing market linkages, assessing impact and developing policy recommendations, which could provide a model for integrated research for development. Lessons learnt will be invaluable for informing future research activities.

### **Recommendation 3: Improving crop, soil and water management**

**CIMMYT should instigate a CGIAR-wide initiative to rationalize and coordinate the activities of the large number of institutions involved in natural resource management research in Africa.**

**CIMMYT should strengthen its capacity for supporting farmer participation in its natural resource management research and development activities, ensuring that such work is assessed on criteria farmers consider important. CIMMYT's research should be informed by the forecast impacts of climate change on maize production systems and producers' livelihoods.**

## **7. LOOKING AHEAD: ECONOMICS OF MAIZE-BASED SYSTEMS**

### **7.1 Demographic Pressure and the Need for Pro-Poor Agricultural Growth**

The starting point of CIMMYT's Africa strategy is to look ahead and come to some agreement on demographic trends and the future demand for maize--the main political crop and food staple in Eastern and Southern Africa. A few years ago, Alex McCalla (1998) posed the question: why is there so much agreement among food policy experts on the future demand for food and so little agreement on the ease or difficulty of meeting these requirements? When McCalla asked that, population and income growth were assumed to be the major determinants of food demand and it was relatively easy for forecasters to come to broad agreement on future food demand. Based on these demand estimates, McCalla argued that food and agricultural production must be accelerated because twenty years from now there would be another 1.8 billion people in the world to feed. The FAO recently forecasted that the population of sub Saharan Africa will increase by a billion or from 700 million today and 1.7 billion by 2050 (Bruinsma 2004). More startling is Ethiopia's predicament where its population is projected to almost triple from 70 million today to 186 million by 2050. However, without even thinking about these future food needs, one may pose the burning question: who will feed Ethiopia's five million destitute tomorrow and the day after tomorrow?

The forecasting world was jarred a few years ago when the HIV/AIDS pandemic started to invade Africa and demographers were challenged to rethink their assumptions and population projections. A recent study of HIV/AIDS has reported that five countries in Eastern and Southern Africa will be experiencing negative population growth rates by the year 2010 (Jayne *et al* 2004). But numbers do not adequately reflect the demographic consequences of the loss of working adults, the increasing numbers of women- and children-headed households and the depletion of both financial and social capital of rural households.

No one has a good grip on the demographic implications of AIDS because of the uncertainty of how many countries will be able to follow Uganda's lead and cut the incidence so quickly. Jayne *et al* (2004) recently concluded that "The most effective strategic response to the ravages of AIDS in Eastern and Southern Africa is to promote agricultural growth because it contributes to economic growth and reduces the cost of food which is the greatest expenditure of the rural and urban poor. McCalla was ahead of his time on the livelihood debate when he concluded back in 1998 "increased productivity in subsistence and smallholder agriculture is a powerful engine of labor-intensive growth, income improvement and better access to food" (p.52).

The theme of pro-poor growth and poverty alleviation has resonated with the pleas of NEPAD and many African political leaders who have pledged to increase their investment in agriculture. The African Heads of state meeting in Maputo in July 2003 pledged to raise public investment in agriculture to 10 percent of their government budgets. President Museveni of Uganda recently reported that his government raised its support to agriculture from 1 percent to 3 percent in 2003 and it plans to increase it in the future. A World Bank economist, Karen Brooks, recently reported, "In the 1990's there was a belief that more emphasis on the social sectors would address poverty effectively. Now there is recognition that increased investment in the social sectors is not sufficient to bring growth, especially income growth" (Brooks 2004). This fact of life helps explain why the Bank and many other donors have put agriculture back on the agenda.

Now that there is agreement that pro-poor agricultural growth is central to economic growth, food security, poverty alleviation and coping strategies of victims of HIV/AIDS, the challenge for CIMMYT/Africa is to work with African governments, NARS and donors to develop maize strategies that contribute to pro-poor agricultural growth and food security (Dorward *et al* 2004; Fan *et al* 2004).

## **7.2 Input Markets**

Looking back to the late eighties and early nineties, there was optimism in the air about the ability of market reforms to liberalize agricultural input and output markets, and the privatization of government grain boards. During this heady period, it was assumed that the private sector would be able to perform marketing functions more effectively. But the reality is that after 15 years, market reform has not brought about the expected improvements in the livelihoods of the rural poor nor has it reduced maize seed prices. How does one explain why the introduction of three new seed companies in Kenya has led to higher prices that farmers pay for maize seed?

A study of input markets is timely. Although the economic reform process was initiated in the 1980s, it has reduced the role of the state and increased the role of the private sector in input delivery and grain marketing and storage. But Kelly, Adesina and Gordon (2003) report that with the exception of improved maize varieties (58 percent for Eastern and Southern Africa) the "vast majority of African smallholders rarely use modern inputs, particularly farmers living in remote areas". Clearly the private sector has not met the expectations of the proponents of structural adjustment and liberalization.

What is a feasible research program for CIMMYT/Africa on input markets? The answer to this question must be couched in strategic terms because CIMMYT's small team of socio-economists

is stretched in serving a large number of CMMYTs' special projects (more than 20 today) that are spread over a land area (Eastern and Southern Africa) that is larger than the United States. We can rule out research on land because of its political nature. Likewise because of the failure of government-run credit programs (30–40 percent repayment rate in Zambia in 2002), no donor will come forward with a credit project in Zambia. This explains why research on credit is of low priority at this time.

Simple arithmetic explains the importance of gaining a better understanding of what drives fertilizer and seed markets. A recent study of fertilizer market development in Ethiopia, Kenya and Zambia by Jayne et al (2003) revealed that 50 percent or more of the farm gate (delivered) price of fertilizer was accounted for by domestic marketing costs. CIMMYT should explore mobilizing support for research on fertilizer and seed markets from the recently launched Rockefeller (Nairobi) program "*Markets to Raise Incomes of Poor Farmers*". This project has awarded \$1.8 million of grants for research in 2003 that promotes "grantee partnerships" in solving marketing problems in Kenya and Uganda.

Research on fertilizer and seed are the two key inputs that CIMMYT's social scientists should study as part of the maize-based cropping systems. Fertilizer subsidy is a hot button topic because of the growing awareness that subsidies may help smallholders increase the rate of technology adoption just like they did in India in the early decades of the Green Revolution (the sixties and seventies). A recent study by Fan et al (2004) reports that India's experience reveals that initial subsidies in credit; fertilizer<sup>3</sup> and irrigation for small farms were "crucial" for small farms in India. In the absence of subsidies, small farms lagged in adopting the new technologies because they were often losers in the initial stage of a new technology because agricultural prices typically fell following the expansion of output by large farms that had adopted the new technology. The big question about India's use of input subsidies in the sixties and seventies is whether India's experience is relevant for Africa at this time. For example, most African countries have much lower levels of physical infrastructure (e.g. roads), and generally weaker extension and research systems. Further they lack buffer stock schemes that India used to manage food price risks during the spread of the Green Revolution (Kelly et al. 2003).

Turning to fertilizer, CIMMYT's social scientists should examine ICRISAT's research on small packs (1 kg) for fertilizer and the Rockefeller- financed Farm Input Promotion program in Kenya that provides a mini-pack of 150g (worth KSh 20) of an improved maize variety free of charge to every farmer purchasing a 1 kg pack of *MAVUNO* fertilizer. To summarize, since ICRISAT and CIMMYT are addressing the same problems of fertilizer use for small-scale farms, it seems logical for CIMMYT/ICRISAT to launch a joint research programs on input markets and rural poverty.

ICRISAT has studied seed marketing problems over the past seven years (Rohrbach, Minde and Howard (2003). CGIAR research on seed marketing problems in ESA is reported in the summary of an Inter-Center Seed Workshop in Nairobi in June 2002 (CGIAR 2002). However, the Centers in ESA have still not developed a joint research program to address the following issues:

- how do farmers acquire information on new varieties that have been developed by public and private researchers
- Institutional innovations to reduce transaction costs and seed prices
- Market constraints that prevent poor households from acquiring commercial maize seed
- How to develop sustainable seed delivery systems for smallholders and

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<sup>3</sup> The fertilizer subsidy is defined as the difference between the farm gate cost of imported fertilizers and the price actually charged to smallholders.

- How to deliver seed to the rural poor in emergency relief situations without hampering the sale of seed by private seed companies and the emergence of private seed markets.

Research is not recommended on community seed systems because ICRISAT has studied this topic for the past seven years and in every case the schemes collapsed after the withdrawal of donor support. Currently a CIMMYT agricultural economist is carrying out field surveys of 900 farm households in Malawi, Mozambique, Zambia and Zimbabwe with an aim to identify seed marketing constraints that prevent poor households from acquiring seed. CIMMYT and ICRISAT should develop a joint Inter-Center Research Program on fertilizer and seed marketing in Eastern and Southern Africa. Special attention should be given to on-going studies of input markets by other centers and agencies in Eastern and Southern Africa<sup>4</sup>

### 7.3 Policy Issues

This topic was discussed at length by members of the Panel because a number of burning policy issues are impeding the uptake of both maize technologies and natural resource management practices. Two examples illustrate the policy issues affecting maize adoption and the livelihoods of the poor that require debate and further study.

The first concerns the pricing policy of the GMB (Grain Marketing Board) of Zimbabwe. The GMB initially set the 2004 buying price for maize at US\$60 per ton and then raised it to US\$150 per ton. Nevertheless farmers in the Chihota Communal Area reported that they will still sell their maize locally and revert to subsistence levels of production. Besides, farmers in the Chitoha communal area reported that the nearest GMB buying depot was some 30 km away. Post liberalization grain policies represent an important research topic but other research teams have a comparative advantage and are already pursuing research on this topic.

The second policy issue is price risk management of food staples. This topic has emerged as an important applied research topic for social scientists because of the problems that African and Asian countries are experiencing in managing price spikes and collapses in markets for staple foods. This topic is important for CIMMYT and NARS researchers who are trying to achieve higher adoption rates of new maize varieties. This topic is also of critical importance for the poor because they are vulnerable to food price fluctuations and because food accounts for a large share (50 to 70 percent) of smallholder incomes. Finally, many African and Asian governments are struggling with this issue because governments perceive it to be politically risky to leave prices of staple foods to the whims of the markets.

Two examples from Eastern and Southern Africa illustrate the sense of urgency in carrying out research on price risk management. First, Uganda has experienced maize production surges and collapsing prices three times over the 1980-2000 periods. The second country is Ethiopia where government-guaranteed credit contributed to the rapid spread of improved maize technologies in 2000 and 2001 by the Sasakwa-Global 2000 program. But the 80 percent collapse of maize prices in Ethiopia in 2002 has shifted the maize policy debate from production expansion to food price stabilization schemes.

What should CIMMYT/Africa do? Clearly with 3.5 person years of social science talent, CIMMYT is not in a position to reallocate staff or hire new staff to take on the price risk management project. But the World Bank's Agriculture and Rural Development Department is launching a study on this topic in June 2004 that will include conceptual work and case studies, including tentatively Ethiopia and Malawi. The World Bank team will study Asia's long

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<sup>4</sup> These include the Africa Center for Fertilizer Development in Harare. (Kachere et al. 2004), the USAID financed study of agricultural input markets in Malawi and studies supported by the Rockefeller Foundation .

experience with price risk management and the history of regional grain reserves in Africa in the seventies and eighties.

The Panel Proposes that CIMMYT/Africa seek an active but low profile role in the Bank's Price Risk Management study and offer to be of help in developing the methodology to ensure that livelihood issues are an integral part of the studies in Eastern and Southern African countries that are ultimately chosen for case studies. Turning to other policy research topics, CIMMYT should, in the foreseeable future, undertake limited policy studies that emerge from the introduction and scaling up of new maize technology rather than taking a proactive role and building policy research capacity. CIMMYT can develop partnerships with IFPRI, ICRISAT and the numerous policy research institutes in Eastern and Southern Africa (Kenya has three such institutes). Several years down the road after CIMMYT's social scientists have gained experience in carrying out studies of livelihood issues, they can revisit the question of hiring additional staff members to pursue more policy research.

#### **7.4 Economics of Natural Resource Management and Soil Fertility**

Several studies have been conducted by SoilFertNet's economics and policy workgroup in Malawi, Zimbabwe, Zambia and Mozambique (Mekuria and Siziba 2003; Mekuria and Waddington, 2002 and Kamanga *et al.*, 2003.) to understand the profitability, adoption benefits, constraints and challenges facing farmers in taking up new soil fertility management systems. However the many different economists involved have used different approaches to their work, with sometimes different interpretations of the results. Consequently, it is often difficult to discern the profitability of the alternative best bets for different agro-ecological zones and different wealth categories of farmers. In ECAMAW, similar studies have been undertaken but with little consideration of the profitability of the best-bets.

Notwithstanding, a picture emerges that pay-offs to investing in green manures are small and increase risk, whether they are grown in rotation or as an intercrop. Similarly returns to investments in soil and water conservation appear low. On the other hand maize grown in conjunction with groundnuts, soyabean and pigeon pea has shown high net benefits and marginal rates of return. At the same time gross-margin analysis comparing returns to low, medium and high rates of inorganic fertiliser applications have shown highest gross-margins for highest rates of application. However high rates incur high risk and in fact returns to investment in fertiliser, excluding household supplied resources were highest for low and medium applications especially when manure was also added. This supports findings from ICRISAT's work on mini and precision dosing of N fertilisers that very small applications have considerable benefit in marginal maize growing areas and for poorest households.

It is however be noted that although some SFMTs offer significant yield increases, when they are combined with other risk management practices and current pricing policies, their impact on farm income remains can be very limited.

Profitability of introducing legumes into a maize-system is largely dependent on the opportunity cost of land and other household supplied resources, especially labour. As a result households with more land, more cattle and other physical assets, more experience and knowledge and who belong to groups with whom the extension service is linking are more likely to adopt fertiliser enhancing options. This means that poorer households with no links to extension are likely to loose out.

This was reinforced by farmers' views during a visit to Chihota, Zimbabwe (on 16 April) who stated that maize was not a profitable crop and they only grew sufficient for themselves. Interestingly at the time of our visit the Government GMB control price was approximately \$60 (Z\$300,000) per tonne, against a local selling price of over \$200 per tonne (Z\$1 million).

Subsequent to our visit the Government control price for maize was increased by 150% to \$150 (Z\$750,000) per tonne although still less than local selling prices. Farmers elsewhere report that low producer prices discourage them from investing in SFMTs, contributing to low yields reduced maize production and household/national food insecurity.

The impact studies that have occurred reveal that despite the many SFT options available for farmers, as well as efforts to popularise and promote them, their use and adoption has been very slow and their future is uncertain. The studies reveal lack of farmer knowledge about the technologies, modest and sometimes negative returns, non availability of inputs, non-affordability, no access to credit and lack of output marketing opportunity are constraints to adoption. At the same time that farmers are required have considerable knowledge of sometimes complex management requirements, they are also required to invest in land, capital and labour with considerable time lag before benefits accrue. It is therefore hardly surprising that adoption of the best bets has been low.

CIMMYT should undertake a critical assessment with emphasis on economic analysis of all best bet soil fertility options promoted, together with adoption to date and impact on crop productivity and livelihoods of adopting farmer households. This would include a review of qualitative data on local perceptions of soil fertility trends, household decision making on soil and its management and how this is influenced by access to key assets such as land, labour, cash, seed, fertiliser, technical knowledge, tools and credit. The review would provide a framework against which to review proposed and ongoing technical research activities by SoilConsort and EACMAW. This should assist in establishing a common vision of conservation agriculture agreeing a range of options suitable for different micro-environments, cropping systems and proximity to market.

#### **Recommendation 4: Economics and policy issues**

**CIMMYT should develop a joint inter-center research program with ICRISAT on fertilizer and seed marketing in Eastern and Southern Africa.**

**CIMMYT should undertake limited policy studies that emerge from the introduction and scaling up of new maize technology. Rather than taking a proactive role and building policy research capacity, CIMMYT can develop partnerships with IFPRI, ICRISAT, policy research institutes in Eastern and Southern Africa, and with local and overseas research institutes.**

**CIMMYT should undertake an economic analysis, of all best-bet soil fertility options promoted, together with adoption to date and impact on crop productivity and livelihoods of adopting farmer households. The review should provide a framework against which to review ongoing and proposed technical research projects.**

## **8. LOOKING AHEAD: CAPACITY STRENGTHENING**

### **8.1 Background**

Human capital improvement is the lifeblood of rapid economic development, a point made by the late Professor Thomas Odhiambo of Kenya more than three decades ago (Odhiambo, 1967). In the sixties and seventies, CIMMYT responded to the human capital challenge and mounted ambitious and focused training programs in Mexico and in Africa. However, in the early nineties, training programs were scaled back in CIMMYT and other CGIAR Centers because of financial cutbacks.

Africa made substantial progress in human capital improvement from the 1960s to the 1990s:

- The percentage of African agricultural researchers in national agricultural research systems increased from 10 in 1960 to 90 percent in 1990.
- There are over 200 universities in Africa of which 87 teach agriculture (Temu, Mwanje and Mogotsi, 2003).
- Zimbabwe is typical of other African countries in having increased its number of universities from one at independence to twelve today (9 public and 3 private, including Africa University, a private university with students from more than 25 African countries).
- Africans head an increasing number of significant NGOs and agricultural production, processing and marketing businesses.

Despite these impressive achievements, CIMMYT Africa reports that its collaborating African institutions are having serious problems in recruiting and retaining plant scientists, agricultural economists and specialists in other disciplines. In fact, CIMMYT reports, “on average 50 percent of all scientists stay for less than three years in NARS maize breeding programs in Southern Africa. This falls far short of the time required to test and release a variety” (CIMMYT, 2004, p39).

But CIMMYT’s problems with rapid staff turnover in national programs are not unusual because there is no longer a simple South /North brain drain. Today, there is a global market for scientific talent and many private seed and chemical companies and developing countries are recruiting scientists from the global market to accelerate technology development. In the same way that India drew on Japan’s agricultural development experience, the government of Vietnam recruited French scientists and a leading Kenyan coffee breeder ten years ago to move to Vietnam and develop the scientific foundation for its bid to become a leader in the global coffee market. A decade ago, Vietnam was the 42<sup>nd</sup> largest coffee exporter in the world. Today, it is the second largest coffee exporter in the world (behind Brazil).

From the 1960s to the 1980s, Africa’s universities performed a valuable service in increasing the output of teachers, researchers and civil servants. But over the past decade, African universities and faculties of agriculture have been especially hard hit as a large percentage of senior academics (the scientists who set the tone, direction and quality of the educational experience and mentor younger scholars) have migrated to NGOs, the private sector and overseas posts. Since the first generation of African scientists, teachers and managers has by-and-large retired, we can pose the question: Who will train the second generation?

Without question, the second-generation crisis in the African scientific community is severe, is not amenable to a quick fix, and bodes ill for the future. African scholars and researchers, with their unacceptably low salaries and inflation-riddled retirement programs, outmoded scientific infrastructure and thin operating budgets, are poorly prepared to train the third generation of agricultural scientists. Africa’s second-generation challenge calls for renewed political commitment to training the next generation. Valuable lessons can be gleaned from human-capital-improvement initiatives that were launched in Malaysia, Brazil, Thailand, Indonesia, and India in the early 1960s and steadfastly implemented for two decades. For example, India sent about 1000 scientists overseas for post-graduate training in the sixties and seventies. To summarize, the severity of the situation requires a “Fast Track Initiative” to develop a human capital strategy for building agricultural science bases and regional knowledge hubs to serve the complex agro-ecologies in a continent of 200 universities, 48 NARS and a land area seven times larger than India (Eicher 2003). To be effective on a scale that will make a meaningful difference across Africa the stakeholders must identify their assets and match their comparative advantages in concerted capacity strengthening programmes with other providers.

The donor pendulum has shifted from overseas training to postgraduate training within Africa because of the growing realization that overseas training is postponing the development of Africa's own postgraduate programs and agricultural science base. The Panel concurs fully with the IAC's (2004) conclusion that local scientific and technological capacity is essential for using and contributing to the world's accumulated knowledge. Relying on benefiting from scientific and technological breakthroughs produced by the industrialized nations is a false hope and the wrong policy for Africa. As stated by the IAC "The tools involved in such breakthroughs are often very sophisticated and their use requires a great deal of knowledge at the local level, as well as an ability to adapt and extend them to meet local needs." This is entirely true of agriculture.

But expanded postgraduate training in Africa must be accompanied by a creative and competitive incentive structure to recruit, promote and retain scientists. CIMMYT's acknowledgment that more than 50 percent of public sector maize breeders in Southern Africa left their NARS within three years reinforces the point that more postgraduate training by itself will not solve the capacity building problem. History provides a valuable perspective on the symbiotic relationship between postgraduate training, incentives, the brain drain, and capacity -building in developing countries. Successful institution-building experiences in Brazil, India, Malaysia, and Chile over the past 30 years reveals that young scientists on overseas graduate-training programs can be attracted to return home and pursue careers in the core agricultural institutions and private sector if they can benefit from research funding, attractive monetary and non-monetary incentives, and most importantly, a viable scientific infrastructure for effective and lasting partnerships. Such infrastructure should include post-degree networking, mentoring, and access to the global scientific literature, sabbatical leaves, and participation in national and regional workshops on development policy, management and research topics.

The quality of post graduate training is to large measure dependent on the quality of MSc and PhD candidates. In this regard, while there are serious difficulties in meeting the demands of growing numbers of students, the greater challenge is to develop and retain staff competent in the range of skills required by graduates in the changing and increasingly globalised world (Fehnel 2003). These skills include problem solving, the ability to produce knowledge in the context of applications in real-life situations, the ability to work comfortably in several disciplines, the ability to manage information, the ability to work in cross-cultural settings and in flexible organisational arrangements, which are as important in agriculture as in any other industry.

To better meet the growing demands more emphasis is being placed on achieving cohesive and complementary actions in African agricultural research and development including capacity strengthening. For example, in the ASARECA sub-region one of the 8 collective priorities accepted by the CGIAR centres, including CIMMYT and other ASARECA stakeholders is to improve learning mechanisms, capacities and the spread of knowledge.

The CGIAR centres are also examining other options for enhancing its contribution to capacity strengthening through electronically-based postgraduate programs for agricultural education. Its objective is to develop a distance education programme into a global open agriculture and food university, that will provide, in partnership with developed and developing country national and regional institutions, high-quality course contents and teaching by international standards to postgraduate students researchers, and professionals through course modules and academic programmes drawing on the collective knowledge of the CGIAR system, its partner and outside experts.

Another trend that will change the allocation of resources and opportunities for collaborative partnerships for strengthening African capacity in upstream research is the formation of centres of excellence as strongly advocated by NEPAD and FARA and endorsed by the recent IAC Report

(IAC 2004). CIMMYT Africa plans to take advantage of the opportunity that is being created at the NEPAD Bioscience facility being established at ILRI in Nairobi.

## **8.2 An assessment of CIMMYT's training and capacity building programs.**

Since the Panel did not have time to study CIMMYT's training programs in biotechnology, plant breeding, natural resource management and impact assessment, its focus is on networking and capacity strengthening. First it is gratifying to note that CIMMYT is proud of its commitment to "helping NARS in sub Saharan Africa strengthen their human and institutional capacities," and that "capacity building is a must". CIMMYT estimates that it is spending 33 percent of its budget on training and networking activities (CIMMYT, 2004, p.vi).

### **8.2.1 CIMMYT's Achievements in capacity Building**

CIMMYT's achievements in training and capacity building are impressive. Here is a brief overview and assessment:

- CIMMYT's maize breeding and natural research management networks in Eastern and Southern Africa have assembled a critical mass of scientists and students to work on critical problems. The technical backstopping of CIMMYT scientists is much appreciated by the NARS and universities. MWIRNET, ECAMAW and SoilFertNet are productive ventures and should be continued, but special efforts are needed to help the NARS attract and retain more maize breeders and agricultural economists, especially in Southern Africa.
- The maize working group approved 78 small grants in 2003. A total of 13 screening sites and 60 testing sites for drought, low nitrogen, and borers have been developed. Over 100 scientists and technicians were trained in stress breeding.
- Training in seed production was offered to 125 national scientists, extension workers, private seed companies and NGOs.
- CIMMYT has made major contributions to formal training (BSc, MSc, and PhD) of African scientists. For example, the maize breeding team of CIMMYT/Zimbabwe is currently supervising 19 thesis projects of African students and over the past ten years, 66 students from sub Saharan Africa acknowledged CIMMYT's financial contributions to their thesis.
- Over the 1998-2004 period CIMMYT has provided funding and support for 38 students completing their MSc and 7 PhDs in disciplines such as plant breeding, agronomy and the social sciences (CIMMYT 2004).
- More than 250 people have benefited from CIMMYT's training programs in Biotechnology and Biosafety with the IRMA Project (Kenya).

### **8.2.2 Challenges Facing CIMMYT's Training and Capacity Building Programs**

Despite notable successes in training and capacity strengthening, CIMMYT is facing the following problems:

- CIMMYT's maize breeding programs in Eastern and Southern Africa are facing a shortage of maize breeders, and agricultural economists, and high staff turnover. The staffing problem is more acute in Southern than Eastern Africa. Three examples illustrate this point. Currently, there are no plant scientists at the University of Zimbabwe. Part-time lecturers in government and the private sector teach undergraduate courses. The University of Zimbabwe's MSc program in plant breeding has been curtailed. Next, the turnover is high as we pointed out above. Newly recruited scientists in NARS rarely overlap with previous position holders because of protracted hiring procedures. Finally,

- few NARS scientists in maize breeding have had recent postgraduate training because of the sharp cutback in donor support (Kaufmann and Temu, 2003).
- SADC's regional MSc program in Crop Science at the University of Zambia turned out 38 MSc degrees over a 14-year period or an average of three per year. The GTZ discontinued this and three other regional MSc programs (agricultural economics, animal science and agricultural engineering) because of thesis supervision problems, smaller than expected student intake and related issues.
  - There is domestic political support to construct new universities rather than strengthening post-graduate programs in the older and more established universities. For example, the number of universities in Zimbabwe has increased from one to twelve in the past decade.

### **8.2.3 Trends in human capital improvement and capacity strengthening**

Many studies have shown that building a sustainable human capital renewal system should be conceptualized as a multi-generational process. The starting point is to look to the future with an eye to learning from CIMMYT's experience in Africa over the past three decades. Three trends are visible as one examines capacity strengthening and human capital renewal in Eastern and Southern Africa in historical perspective.

- Simple attrition is taking its toll on the agricultural science capacity in Eastern and Southern Africa. Many African scientists trained in the U.S. and Europe during the past 20 to 30 years are rapidly approaching retirement. There is also a striking absence of young scientists to take their place. For example, both Tanzania and Uganda froze the size of their NARS staff from the early nineties for more than a decade because of pressure of liberalization programs to cut the size of the government staff. Finally, the HIV/AIDs pandemic has taken its toll on the pool of agricultural scientists in Eastern and Southern Africa.
- The sharp cutback in donor support for training and capacity building has forced some CGIAR centers to slash their training programs and the number of scholarships for advanced study abroad. For example, the World Bank reviewed its expenditure of US \$4.8 billion of global investments on agricultural research, extension and higher education over the 1987-97 period and found that 2 percent of the total was spent on agricultural higher education and 98 percent on research and extension. Moreover, during this 10-year period, the Bank made only three loans to African agricultural education (Willett, 1998).
- The emergence of new problems, disciplines and changing technology has led not only to a notable shortage of scientists in biotechnology, applied social science (especially in rural poverty alleviation), WTO rules and regulations and the impact of supermarkets on smallholders in Africa. Many of the graduates are also lacking in the new skills and techniques required to take full advantage of developments in agricultural sciences and innovation systems.

To summarize, these three trends in human capital improvement and capacity building should be addressed by CIMMYT as part and parcel of a CIMMYT capacity Strengthening Plan, which should itself be part of a concerted regional programme.

### **8.2.4 CIMMYT's 10 year capacity strengthening plan**

The time is ripe for CIMMYT to prepare a ten year capacity Strengthening Plan. The preparation of such a plan is timely because of the new approaches to strengthening capacity that are being formulated and the renewed commitment by a number of donors and foundations to increase their support for capacity strengthening in Africa. The plan, which may be prepared by a task force, should be consistent with CIMMYT's mandate and its complementarities with other providers and emerging funding opportunities that are coming on stream as part of the renewal of interest

among donors in capacity strengthening. However, the first step for CIMMYT Africa would be to carry out a tracer study of the 38 MS and 7 PhDs in order to analyze their career pathways with emphasis on why so many of them left public research careers to pursue other opportunities. The second CIMMYT task is to position itself in concert with other providers to tap the new funding opportunities described below.

### **8.2.5 New Capacity Strengthening Initiatives**

In 2002, four major U.S. foundations (Ford, Rockefeller, Carnegie and MCArthur) formed a Partnership for Higher Education in Africa and pooled \$100 million to help rebuild the capacity of universities in six initial countries in Africa. In each country, the Partnership provided grants to the targeted universities to enable local scholars to prepare self-assessments and a business plan. In 2002 and 2003, the Foundations allocated \$64 million to African Universities. The self-studies and business plans are available for Uganda (Musisi and Muwanga 2003), Tanzania (Mkudu et al 2003) and Mozambique (Mario et al 2003).

FARA is facilitating the development of a multi-institutional program called BASIC (Building Africa's Scientific and Institutional capacity) that plans to improve human and institutional capacity through partnerships with three groups of partners: African universities, northern Universities and the CGIAR Centers (Kaufmann and Temu, 2003). The focus of BASIC is on raising the quality of tertiary agricultural BSc level training.

In 2003, USAID accepted the recommendation of a report by BIFAD (2003) to renew its long term support for postgraduate training in food and agriculture in African and American Universities.

NEPAD has formed a task force to develop capacity building proposals.

The Africa Capacity Building Foundation based in Harare has recently decided to support the new collaborative MSc Program in Agricultural Economics. (Until recently, the Foundation offered support only for policy research institutes in Africa that were specialized in studying structural adjustment and liberalization).

In 1992, the Rockefeller Foundation initiated a program called the Forum on Agricultural Resource Husbandry. Annual disbursements under the Forum averaged around \$1.4 million with a high of almost 3 million in the year 2002. Many students and researchers in NARS, universities and CIMMYT scientists have applauded the program. The Foundation recently decided to add US \$ 3.5 million dollars to the effort to help train new scientists. Based on an outstanding report by a team of evaluators, the Forum has recently moved its headquarters to Makerere University and a new Executive Director (Professor Adipala Ekwamu) was appointed in April 2004. Sida has identified the Forum as one of the most effective regional capacity building initiatives in Africa. It is assumed that Sida, USAID and possibly the Dutch and NORAD will support the Forum.

The Rockefeller Foundations' new program "Markets to Raise Incomes of Poor Farmers in Africa" recently held a highly successful workshop in Nairobi on April 5-8, 2004. The Advisory Board endorsed the outstanding work of the leader of the markets program, Akin Adesina. The Foundation will be making grants of around \$2 million for market research in Eastern and Southern Africa in 2004/2005.

Because of the shortage of agricultural economists, especially at the MSc level, an African-led Agricultural Economics Board (AEEB) representing 16 universities in 12 countries in Eastern and Southern Africa spent the past year developing a proposal for a large-scale professional Master's degree program in agricultural and applied economics. The program consists of five semesters over 20 to 24 months and it will be launched in September 2005. Students will take two semesters of course work in their home universities, one semester at the University of Pretoria followed by

two semesters of field research for their MSc thesis research and write-up. Successful candidates will be awarded the MSc by their home university in one of the following fields of specialization:

- Agricultural and Rural Development
- Agricultural Policy and Trade
- Agribusiness Management
- Environment and Natural Resource Management

### **8.2.6 The Big Picture**

Human capital improvement can occur in formal training and in informal groups such as community seed banks, networks, and mother-baby trials. Drawing on the experience of Africa, Latin America and Asia, there is broad agreement that capacity strengthening is an accretionary and virtually invisible process that unfolds over decades through investments in training, mentoring and by a learning-by-doing approach to strengthening human, financial and managerial capacity.

CIMMYT's research networks, partnerships with NARS and supervision of post-graduate students from universities in Eastern and Southern Africa are commendable "bread and butter" approaches to developing a sustainable and indigenous human capital renewal system. Because a number of countries in Africa have more PhDs in faculties and universities of agriculture than in the government agricultural research system, it follows that CIMMYT'S competitive grants and small grants programs are cost effective ways of mobilizing academic staff and post-graduate students to carry out research and help build university research capacity.

The time is ripe for CIMMYT to participate in a CGIAR led review of capacity strengthening in Eastern and Southern Africa. The Panel was impressed with the dedication and commitment of CIMMYT'S staff to training and capacity strengthening. Without question, the Panel meetings, field trips and discussions with NARS, universities and government officials lend support for the view that CIMMYT's training programs should be supplemented with expanded capacity strengthening programs. However, the demand for capacity strengthening in agriculture and natural resource management far exceeds the resources and mandate of CIMMYT. There is therefore a need for a systems (CGIAR view) appraisal of how the Centres including CIMMYT can best contribute to capacity strengthening in agriculture in Eastern and Southern Africa. The CGIAR-led appraisal should be carried out in close cooperation with NEPAD's and FARA's capacity building initiatives as well as those of ANAFE, BASIC, EU-ACP Secretariat, NATURA, USAID, the U.S. Foundations Partnership for Higher Education in Africa and the World Bank.

#### **Recommendation 5. Capacity strengthening**

**CIMMYT should develop a ten year plan for its contribution to capacity strengthening in the region that is consistent with its mandate and funding opportunities and which will ensure that the Centre is a player in the global and regional programmes that are concentrating donor funding for capacity strengthening.**

## **9. LOOKING AHEAD: PARTNERSHIPS**

CIMMYT has exemplary relationships with its national partners that stem from the quality of its products and the pragmatic and flexible approach that the scientists have adopted in their collaborations. This has enabled them to functioning below capacity because of the shortage of local researchers. For example, CIMMYT's collaboration in Zimbabwe is dependent on only one B.Sc level plant breeder and one local agricultural economist serving five Southern African countries in SoilFertNet.

### **9.1 Strengthening existing partnerships**

In the face of such enormous challenges, CIMMYT's chances of achieving meaningful impact is entirely dependent on the scale and quality of the partnerships it is able to forge to allow it to focus on the activities for which it has the greatest comparative advantages. CIMMYT's scientists recognise this but weaknesses amongst their potential partners create demands for their involvement in activities such as university teaching that ideally should be left to others. CIMMYT should engage with the proponents of the various capacity strengthening programmes outlined in section 8 to find ways out of this dilemma.

CIMMYT has considerable assets to bring to multi-institutional programmes including a strong corporate memory of trends in farming systems and maize breeding, strong links with the NARS providing good opportunities for research in landscape and farm contexts.

### **9.2 Synergies with universities**

As noted in section 8.5 the universities comparative depth in numbers of qualified staff suggests that CIMMYT should seek greater synergies with them. However, the Panel recognises the realities that CIMMYT teams are bound to work with their primary host institutions, which are usually the national agricultural research institutions

Where there are staff shortages especially of plant breeders the universities such as the University of Zimbabwe will be very keen to engage CIMMYT staff in lecturing and research supervision. Recognising that these demands far exceed CIMMYT's capacity and the potential for multi-institutional actions, CIMMYT should continue to ensure that staff engage in activities that are closely related to CIMMYT's programme priorities and which are mutually beneficial.

### **9.3 Strengthening inter-centre partnerships**

Owing to the focus on plant breeding CIMMYT's teams in Africa have not been at the forefront of inter-centre collaboration but this will need to change as CIMMYT seeks greater impact especially in natural resource management and capacity building. It was noted in section 3.3.1, improvements in crop husbandry probably have greater potential for impact than plant breeding which implies that with farmers typically engaged in multiple cropping and mixed crop-livestock farming CIMMYT could gain a lot from strengthened collaboration with other centres in the CGIAR system in maize development, soil fertility, and seed and fertiliser marketing.

### **9.4 Building new partnerships with the advanced institutes**

The African Union with NEPAD and FARA is promoting the concept of establishing specialised centres of excellence in Africa. This concept was strongly endorsed by the Inter-Academy Council which advocated "action to develop, use and adapt knowledge and techniques to enhance local, national, subregional, regional centres of excellence for education, research and training in order to strengthen the knowledge capacity of developing countries". The first NEPAD-sponsored centre of excellence to be established is the Bioscience Facility for East and Central Africa. Such centres will expand the possibilities for CIMMYT to build local capacity for the application of cutting edge science to development.

### **9.5 Linkages with regional and sub-regional organisations**

The African Union's commitment, endorsed by the major donors to NEPAD and the Comprehensive African Agricultural Development Programme (CAADP), has important implications in regard to CIMMYT's purpose of being a source of international public goods and its commitment to finding ways and means of maximising its impact regionally. This requires proactive engagement with sub regional organisations such as ASARECA and SADC/FANR and

the regional economic communities (RECs) such as COMESA, SADC and IGAD and the continental institutions such as NEPAD and FARA to increase awareness of CIMMYT's outputs amongst key decision makers and helps disseminate them.

**Recommendation 6: Improving partnerships**

**CIMMYT should increase its interaction with regional universities and strengthen multi-institutional collaboration with CGIAR and other advanced institutions. This will require the appointment of a senior scientist familiar with donors, national, subregional and regional agencies to develop and manage an efficient partnerships programme that embraces research partners and investors and policy makers.**

## **10 LOOKING AHEAD: ORGANISATION AND RESOURCES**

### **10.1 Programme organisation**

#### **10.1.1 CIMMYT Africa offices**

There are many ways in which CIMMYT's African Livelihoods Programme could be organized and in the rapidly changing circumstances for agricultural research and development in sub Saharan Africa this should be kept under constant review. However, the Panel is necessarily cautious in its recommendations because, in the limited time available, it only had a snapshot view of CIMMYT's operations.

The Panel recognizes that the allegiances that CIMMYT staff have developed diligently over many years are valuable assets in enabling their work to progress smoothly. The transaction costs that have been paid in establishing working relationships are valuable investments. The good relationships with institutions such as the University of Zimbabwe, Chidetze Research Station in Malawi and the Kenya Agricultural Research Institute attest to that.

The CIMMYT teams made the case for keeping the status quo of two major offices in Harare and Nairobi and smaller presences in Addis Ababa (Annex 6). They noted ecological, organizational, logistical and funding reasons for this. However, they also noted that other countries are requesting CIMMYT to post staff with them. How CIMMYT will respond must ultimately be determined by the resources available and the critical mass required for achieving the target outcomes.

In chapter 5 it is proposed that there should be dialogue on the potential for a single CGIAR institute to lead maize breeding in sub Saharan Africa. If that is accepted and if it were to be CIMMYT there would be important resource and geographical implications for both taking on new tasks and for divesting old ones. In the meantime while the two principle office arrangement appears appropriate to present circumstances, CIMMYT should retain flexibility and position itself to be able to deploy staff to where they can most effectively accomplish the highest priority tasks as they emerge.

#### **10.1.2 Communication and logistical support**

The CIMMYT staff are well trained, very accomplished and apply considerable excellence to their breeding and support activities. The activity this success generates and need for interaction and dissemination of information with donors, policy makers, research and extension staff, reporters and the wider community inadvertently brings about challenges that can impair their ability to maintain focus on the scientific aspects. Without adequate support scientists can become too distracted from the scientific discovery process and too involved in routine logistics and

communications that could perhaps be better served by trained media and communication personnel.

## **10.2 Budgeting, sourcing and use of funds**

The Africa-based teams were not fully aware of how their budgets were constructed. They were aware that a portion of funding that was restricted to sub Saharan Africa had been allocated to cover headquarters expenses but were not sure what those expenses related to. This made it difficult to reconcile the tight restrictions placed on the African-based teams in respect of engaging support staff with the more generous support provided to headquarters-based scientists. To encourage commitment to most efficient use of funds the CIMMYT field staff should be given more autonomy in determining how resources related to their programme and projects are allocated. This will require more ready access to budgetary information.

CIMMYT should address the proportionate levels of funding across Research and Administration. Currently CIMMYT Africa Maize support appears 65% research and 35% external administration and support – the latter seems to be quite high in proportion. It might be more cost effective to have some administrative and support facilities offered by private firms within Eastern and Southern Africa.

### **10.2.1 Allocating unrestricted and restricted funds**

Almost 95 percent of the current funding for CIMMYT/Africa comes in through special projects but this heavy reliance on restricted special project funding can adversely affect the execution of longer-term projects. However, finding the appropriate mix of funding is complex because some projects by their nature are less able to attract project funding. Maize germplasm development, for example, is at risk because it is apparently not attractive to donors. This makes the balance between restricted and unrestricted funding a sensitive issue for CIMMYT because continuity is essential for germplasm development and changes/impact are best measured in terms of multiple years (4 to 5 minimum). To reduce the perpetual competition for scarce unrestricted funding germplasm improvement would benefit from an endowment or similar non-project funding to smooth the short cycles of project funding.

Despite its problems restricted funding will continue to be the main source of CIMMYT's funds and CIMMYT should constantly seek new sources of such funding. For example, CIMMYT is accessing bilateral funding but only in one instance where the donor has been prepared to fund the centre directly. There should be opportunities for more support from bilateral sources because CIMMYT's work contributes directly to the goals and objectives of national governments in a very visible way.

CIMMYT along with the other CGIAR centres has the constant dilemma of having to source funds for its partners, so that they can fulfil their roles in the collaborations, at the same time as meeting its own needs. It is appropriate for CIMMYT in such instances to help NARS attract the necessary funding directly or as flow-through money and this should be clearly distinguished from funds granted to CIMMYT for its own specified purposes.

### **10.2.3 The potential for establishing an endowment fund**

The Panel was informed that CIMMYT is giving thought to the possibility of establishing an endowment fund. With hindsight this is something that CIMMYT should have done in the early years of the Green Revolution when donors were much more liberal but it could still be a possibility if, for example, a person of the stature of Dr. Norman Borlaug were to endorse it. In advancing this CIMMYT should learn from the other funds such as the Global Conservation Trust and ASARECA endowment fund which relate to CIMMYT in different ways and be sensitive about areas where it might create unhelpful competition.

### **10.3 Public awareness and interacting with CIMMYT's donors**

The CIMMYT scientist exhibited considerable frustration with the difficulty of attracting and sustaining funding for their research. The frustration was heightened by the scientists' belief that the donor representatives apparently did not live up to their assurances that CIMMYT was doing good work and had submitted fundable proposals.

However, CIMMYT staff recognises that there is a general lack of awareness about their activities in the region and that this is costing them support amongst key policy makers and donors. Since publications are costly in time and materials they have to be as carefully targeted as the research on which they are based. There is also evidence that donors and decision makers are impressed most by material that is directly understandable and useful to them in their work such as IFPRI's policy briefs that are eagerly sought after as sources of information that can be directly incorporated into reports and position papers. CIMMYT has the raw material for similar material which should be tailored for the needs of different stakeholders.

The Panel considers that CIMMYT's *African Livelihoods Programme* requires a senior level scientist to lead its partnership and resource mobilisation strategies. Such a person on a half time basis should be capable of interacting with decision makers at the highest level and representing the Programme in the forums in which resource allocations are determined.

### **10.4 Developing a business plan for resource mobilisation**

The current level of frustration amongst CIMMYT staff caused by the failure of donors to continue funding projects that have good products and to fund new proposals about which they are very complementary is distracting and counter productive. More importantly it appears to be unnecessary since CIMMYT's work is greatly appreciated by the target beneficiaries of donor programmes in Eastern and Southern Africa. However, the Panel is unable to provide detailed advice because there was no resource mobilisation plan or record of activities on which it could advise. The African Livelihoods Program should, therefore, develop a pragmatic business plan which will relate the proposed research programme to the funding required and the actions required to raise the funds. This will require iteration to match the desired livelihoods programme to funding realities.

- Projects should be budgeted on a whole cost basis to ensure the costs not covered by projected-restricted funds do not detract from higher priority research.
- The highest priority research for which project funding cannot be obtained should be the most eligible for unrestricted funding. Funding for activities that are not priorities should be rejected.
- Individuals in the Harare and Nairobi teams should have identified responsibility with timelines for specific actions in the business plan and this should be part of their annual work programmes with due credit being accorded to them.
- In view of the universal trend for donors to delegate authority to outposted field staff CIMMYT should take steps to keep local donor representatives informed and involved in activities in their areas of responsibility.
- CIMMYT should capitalise on its outstanding relationships with the NARS to access bilateral funding for joint activities. By providing the potential for raising the capacity to absorb funds effectively CIMMYT should be able to help the NARS leverage greater funding and thereby its access to bilateral funds should not be perceived as competition by the NARS. This will, however require careful articulation.

Though undoubtedly important, maize is seldom sole cropped and the farmers have a host of issues to deal with in addition to the quality of maize germplasm. Even where farmers are growing maize it is not necessarily what they should be growing, as reported in Malawi. This presents good opportunities for tapping diverse sources to raise additional funding.

## **10.5 Sub Saharan Africa Challenge Programme**

The extensive consultation process that culminated in development of the Sub Saharan Africa Challenge Programme identified the following three issues as the most significant constraints to reviving agriculture in the region: 1. failures of agricultural markets; 2. inappropriate policies; and 3. natural resource degradation.

It also concluded that addressing these constraints in isolation will not solve the problem. The consensus is that the traditional fragmented and reductionist approach to agricultural research and development has been largely ineffective in dealing with the complex conditions in the countryside. A new paradigm is called for that can foster synergies among disciplines and institutions, along with a renewed commitment to change at all levels from farmers to national and international policy makers. The proposed Sub-Saharan Africa Challenge Programme (SSACP) is based on such a paradigm, entitled “Integrated Agriculture for Development” (IAR4D).

The IAR4D paradigm draws heavily on successful experiences in Africa with Integrated Natural Resource Management (INRM), which takes a systems approach to managing the interactions between soils, water, pests, and human interventions in agriculture. IAR4D goes beyond INRM, however, to encompass as well the domains of policies and markets, and the effects that these have on the productivity, profitability, and sustainability of agriculture. Taking all these factors into account, the research and development agenda of IAR4D will focus on four overall objectives:

- To improve the accessibility and efficiency of markets for smallholder and pastoral products;
- To develop technologies for sustainably intensifying subsistence oriented farming systems;
- To develop smallholder production systems that are compatible with sound natural resource management; and
- To catalyze the formulation and adoption of policies that will encourage innovation to improve the livelihoods of smallholders and pastoralists.

Integrating research and action on these four dimensions already represents an improvement on current practice, but the IAR4D approach calls for an even broader scope of work. There have in fact been countless success stories in agricultural research and development in the region, but few have had sufficient impact to reverse the decline of the sector. Four additional mechanisms or “support pillars” are required to foster internalisation of a new way of doing business, and the “out-scaling” and “up-scaling” of programme outcomes – out-scaling to neighbouring villages or similar agro-ecosystems elsewhere on the continent, and up-scaling to connect with local, national and international governments and institutions and the private sector. The four support pillars of IAR4D are:

1. Promotion of organizational and institutional change to enable cross-disciplinary research and development and multi-institutional collaboration;
2. Capacity building for project teams, farmers, and scientists in African institutions;
3. Information and knowledge management (including documentation of new methodologies developed) to disseminate widely the findings of IAR4D work; and
4. Ongoing monitoring and evaluation, and a systemic approach to impact assessment, to track Programme progress towards overall goals, signal the need for mid-course adjustments, and document the returns on investment in the Challenge Programme.

CIMMYT should continue to be a major player in the development and implementation of the Sub Saharan Africa Challenge Programme as a means of accelerating sustainable uptake of its improved technologies and policy outputs.

**Recommendation 7: Organisation and resource mobilisation**

**CIMMYT's African Livelihoods Program should develop a pragmatic business plan which will relate the budgets for proposed research to the actions required to realise the funding. This will recognise that priority long-term research, such as germplasm improvement, must be suitably buffered from the consequences of short-term project funding and the need to retain flexibility, within the business plan, to be able to deploy staff to where they can most effectively accomplish the highest priority tasks.**

**Field staff should be given more autonomy in determining how resources related to their programme and projects are allocated. This would include input to a review of CIMMYT's communication and logistic support to achieve optimal arrangements for accomplishing essential non-scientific tasks.**

## **11. CONCLUSION**

CIMMYT Africa is doing excellent work but there are many unmet demands for further research in maize breeding, for backstopping NARS maize breeding programmes, rationalizing natural resource management research and for contributing to undergraduate and postgraduate training. In this scenario the programme's greatest threat is of being stretched too thin and that, in response to the demand and the lack of alternative providers the research programme will loose focus and critical mass. The Centre's careful preparation for this review and its openness to new ideas assures the Panel that it will continue to find the critical resources required to make its vital contributions to improving the livelihoods of African smallholder maize producers.

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## ACRONYMS

AATF – African Agriculture Technology Foundation  
ACT – African Conservation Tillage network  
AEEB - African Agricultural Economics Board  
ANAFE- African Network for Agriculture, Forestry and Environment  
ASARECA – Association for Strengthening Agricultural Research in East and Central  
Afnet African tropical soil and biology fertility network (initiated by TSBF, which is part of CIAT)  
ASSMAG - Association of Smallholder Seed Multiplication Action Groups  
AusAID – Australian Agency for International Development  
BASIC – Building African Scientific and Institutional Capacity  
BIFAD – Board for Food and International Agricultural Development  
BMZ – Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung  
Bt – Bacillus thuriangiensis  
CAADP Comprehensive African Agriculture Development programme  
CCER - Centre Commissioned External Review  
CGIAR – Consultative Group on International Agricultural Research  
CIAT International Centre for Tropical Agriculture  
CIMMYT – International Maize and Wheat Improvement Centre  
CAADP – Comprehensive African Agricultural Development Programme  
CA Conservation Agriculture  
COMESA- Common Market for Eastern and Southern Africa  
DFID Department for International Development (of the UK Government)  
DUS - Distinct, Uniform and Stable : requirements as part of varietal registration and release procedures  
ECAMAW - East and Central Africa Maize and Wheat Network  
EPMR – External Programme and Management Review  
ESA - Eastern and Southern Africa  
EU – ACP European Union African, Caribbean and Pacific  
FAO – Food and Agriculture Organisation of the United Nations  
FARA – Forum for Agricultural Research in Africa  
FANR – Food Agriculture and Natural Resources  
FSR Farming Systems Research  
GLS – Grey Leaf Spot  
GM – Genetically Modified  
GMB – Grain Marketing Board of Zimbabwe  
GMO Genetically Modified Organism  
GTZ – Gesellschaft für Technische Zusammenarbeit, Germany  
HIV/AIDS - Human Immunodeficiency Virus / Auto Immune Dysfunction Syndrome  
IAC – Inter Academy Council  
IAR4D – Integrated Agricultural Research for Development  
ICRAF – International Centre for Research on Agroforestry The World Agroforestry Centre  
ICRISAT – International Centre for Research In the Semi Arid Tropics  
IFPRI – International Food Policy Research Institute  
IGAD – Inter Governmental Authority for Development

ILRI – International Livestock Research Institute  
 IITA – International Institute for Tropical Agriculture  
 INRM – Integrated Natural Resource Management  
 IPCC – Intergovernmental Panel on Climatic Change.  
 IR - Imidazolinone resistant  
 IRMA- Insect Resistant Maize for Africa project  
 LGB – Larger Grain Borer  
 MSV – Maize Streak Virus  
 MWIRNET - Maize and Wheat Improvement Research Network  
 NARS – National Agricultural Research Systems  
 NATURA – Network of European Agricultural and Tropicallly and Subtropically oriented  
     Universities and Scientific Complexes Related with Agricultural Development  
 NARES – National Agricultural Research and Extension Systems  
 NEPAD – New Partnership for Africa’s Development  
 NGO – Non Governmental Organisation  
 NPT – National Performance Trials for crop varieties  
 NRM – Natural Resource Management  
 OPV – Open Pollinated Variety  
 PRA – Participatory Rapid Appraisal  
 PRSP - Poverty Reduction Strategy Paper  
 PVS – Participatory Varietal Selection  
 QPM - Quality Protein Maize  
 R&D - Research and Development  
 RSA – Republic of South Africa  
 REC – Regional Economic Community  
 SADC/FANR – Southern African Development Community Food Agriculture and  
 Natural Resources department  
 Sida – Swedish International Development Agency  
 SADLF – Southern African Drought and Low Fertility project  
 SoilFertNet – Soil fertility network  
 SoilConsort – Soil Consortium  
 SWMnet – Soil and Water Management Network  
 SRO –Sub Regional Organisation for agricultural research  
 SSA CP - Sub Saharan Africa Challenge Programme  
 SWMNET – Soil and Water Management Network  
 S&WM – Soil and water management  
 TSBF – Tropical Soil Biology and Fertility network (part of CIAT)  
 UK/DFID – United Kingdom Department for International Development  
 USAID – United States Agency for International Development  
 WFP – World Food Programme

## **Annex 1 TERMS OF REFERENCE CENTRE COMMISSIONED EXTERNAL REVIEW OF CIMMYT'S MAIZE IMPROVEMENT PROGRAMS IN SUB SAHARAN AFRICA**

### **Terms of Reference**

#### **Context**

In March 2003, CIMMYT's Board of Trustees agreed that senior management should proceed to undertake two (2) Centre Commissioned External Reviews (CCERs) to assist in the evaluation and planning of CIMMYT's research and to inform the 5<sup>th</sup> External Program and Management Review (EPMR) scheduled for late 2004/early 2005. One of the CCERs will examine the effectiveness and efficiency of CIMMYT's maize improvement efforts in Sub Saharan Africa with a particular focus on the impact of stress tolerant maize germplasm and related crop and natural resource management systems on small holder, subsistence farmers' livelihoods in the region. The Terms of Reference of the CCER were approved by CIMMYT's Board of Trustees at its October '03 meeting.

#### **Objectives and Scope**

The CCER will assess the effectiveness and efficiency of CIMMYT's maize improvement approaches; specifically, the CCER panel will assess the following:

- The quality and relevance of CIMMYT's work in maize germplasm improvement in and for sub Saharan Africa;
- The scope and effectiveness of CIMMYT's maize systems research on crop and natural resource management practices for sub-Saharan Africa.
- The effectiveness of seed production and distribution systems, and CIMMYT's role in fostering improvements in these systems;
- The scope and role of socioeconomics research in support of CIMMYT's efforts in maize improvement and maize systems research, such as participatory needs assessment, targeting and evaluation of technologies and impacts assessment;
- The effectiveness of partnerships with NARS (particularly capacity building), ARIs, NGOs, and the private sector for the development and delivery of technologies and seed that impact on the livelihoods of the resource-poor in Sub Saharan Africa;
- Opportunities to improve the effectiveness and efficiency of the CIMMYT's current research and development work on maize systems;
- The impacts of CIMMYT's work on maize systems research on food security and poverty reduction in Sub Saharan Africa.

The CCER will report both to CIMMYT's Board of Trustees and to CIMMYT's management. The CCER is authorised, as well, to provide a supplemental (self-contained) appendix to its main report, which offers substantive or administrative comments beyond those covered in the above terms of reference especially in the context of implementation of CIMMYT's new strategic plan. There is no presumption by the Board that that this supplemental appendix will be necessary; however, the Board wishes to enable such an outcome should the CCER find it desirable to offer additional commentary about CIMMYT's maize research.

## **Annex 2 FRAMING QUESTIONS FROM THE PROGRAM COMMITTEE FOR THE CCER ON CIMMYT'S MAIZE IMPROVEMENT PROGRAMS IN SUB- SAHARAN**

### **Socio-economics and impact assessment**

1. How can the activities of CIMMYT's maize improvement programs in sub-Saharan Africa (SSA) best contribute to poverty alleviation and improved livelihoods?
2. What methods have the CIMMYT SSA programs used to analyze and target poverty alleviation by improving livelihoods in the region and what should be done in future?
3. What methods have the CIMMYT SSA programs used to address gender issues and what should be done in future?
4. What has CIMMYT done on assessing the impacts of its maize programs in the region and what should it do differently in the future?
5. In CIMMYT's impact assessments in the region what approaches, if any, have been or should be used to apportion the credit for impacts among the partners in the region?
6. In CIMMYT's dissemination strategy what policies and procedures have been adopted to give due credit to all of the partners in the region? How might these policies be improved?
7. What socio-economic input is required in the future in the CIMMYT SSA program? How can CIMMYT cost-effectively manage a high-quality social science input given the alternatives e.g., CIMMYT in-house, NARES, contracted out tasks to ARIs or IFPRI?

### **Partnerships and methods**

8. What are the advantages and the constraints with regard to effective collaboration between CIMMYT's SSA program and:
  - CIMMYT Mexico,
  - other CGIAR Centers in the region, and
  - NARES in the region including NGOs and CBOs?
9. How efficiently is CIMMYT participatory research conducted in terms of both methods and partnerships with NARES in the region and how could effectiveness be improved?
10. Do the target traits prioritized in the breeding program for SSA best reflect how the livelihoods of farming households can be improved? What methods are used to identify and prioritize traits and how might these be improved?

### **Training**

11. How is training currently conducted in SSA? How can future training needs (capacity building) in the region best be identified and met?

### **Strategic issues**

12. How can CIMMYT SSA program contribute best to fund-raising for research and development activities in sub Saharan Africa?
13. How well, according to the observations of the panel, does the existing CIMMYT's program in the region provide a basis for the new strategy for sub Saharan Africa?
14. What are the most important gaps or barriers for CIMMYT's plan for future work in the region? For example, technology, organization, partnerships, or mindsets of CIMMYT and/or NARES? What recommendations does the panel have to fill these gaps and overcome the barriers?

**Annex 3 CCER PROGRAMME ORGANISED BY CIMMYT/AFRICA TEAMS**

Date	Day	Time	Peter Freymark Breeding	Monty Jones Partner Organizations	Carl Eicher Economist	Jim Ellis Jones Farming Systems
14-Apr	Wed	8-9	Welcome and introduction - S. Waddington			
		9-10	Maize systems in sub-Saharan Africa - Past, present and future - S. Pandey			
	Mon	10-11	Maize breeding and seed issues (Banziger, Langyintuo, Mwala, Setimela, Vivek)			
		12-13				
		13-14	Lunch at the CIMMYT station			
	Mon	14-15	Soil fertility and risk management strategies (Mekuria, Shamudzarirai, Waddington)			
		15-16				
	Mon	16-17	General discussion - W. Mwangi			
	Mon	Evening	Welcome cocktail at Monomatapa			
15-Apr	Thu	8-9	Visit to the AREX directorate			
		9-10	Past, present and future in the Zimbabwean Maize Breeding Program			Visit of Domboshawa: SoilFertNet-Long Term Experiments
		12-13	Visit of the Zimbabwe Maize Breeding Program			
		13-14	Past, present and future in the Mozambiquean Maize Breeding Program			
		13-14	Lunch at the CIMMYT station			
	Tue	14-15	Visit of CIMMYT Nurseries	Focus discussion on adoption, sConservation Agriculture scaling-up and policy constraints		
		15-16				
	Tue	16-17				
	Tue	Evening	Dinner			
16-Apr	Fri	8-9	Field trip: Making farmers' voices heard - Farmer-participatory maize variety testing in Zvimba			SoilFert Net- technology integration, promotion and use, Chihota and Chikwaka
			Constraints to extension and input delivery			
			15:30 Focus discussion on the seed sector in Southern Africa: Strength and weaknesses of various partners			
		9-10	At review team's disgression			
17-Apr	Wed	Evening	Follow-up discussion with individual scientists or group of scientists			
	Sat	8-9				
		9-10				
	Thu	10-11	Harare - Blantyre (Air Malawi)	Discussion with Ed Zulu SADC Seed Security Network	Harare - Blantyre (Air Malawi)	
		11-12		Lunch discussion with UZ representatives		
		12-13				
		14-15				

Date	Day	Time	Peter Freymark Breeding	Monty Jones Partner Organizations	Carl Eicher Economist	Jim Ellis Jones Farming Systems
18-Apr	Thu	15-16	Report writing / At review team's disgression			
	Wed	16-17	Report writing / At review team's disgression			
	Sun	Evening	Dinner	At review team's disgression		Dinner
		8-9	Field Visit - Mother-Baby Trials at Senzani and Dedza, Role of NGOs	Harare - Lilongwe (Air Malawi)		Field Visit - Mother-Baby Trials at Senzani and Dedza, Role of NGOs
		9-10	Report writing / At review team's disgression			
		11-12	Report writing / At review team's disgression			
		12-13	Report writing / At review team's disgression			
	Fri	16-17	At review team's disgression			
19-Apr	Wed	Evening	At review team's disgression			
	Mon	8-9	Visit of the Department of Agricultural Research at Chitedzi			
		9-10	Field visit to Chisepo: Farmers' risk management strategies Interaction with NGOs and extension			
	Sat	10-11	Breeding at Chitedze Research Station	Field visit to Chisepo: Farmers' risk management strategies Interaction with NGOs and extension		
		14-15	Visit of Seed Services and Seed- Co	Field visit to Chisepo: Farmers' risk management strategies Interaction with NGOs and extension		
	Sat	16-17	Dinner			
20-Apr	Wed	Evening	Dinner			
	Tue	8-9	Report writing / At review team's discretion	Visit of Bunda College: A. Phiri and V. Kabambe		Report writing
		9-10	Report writing / At review team's discretion			
	Sun	10-11	Report writing / At review team's discretion			
		11-12	Lilongwe - Nairobi (KY)			
		13-14	Lilongwe - Nairobi (KY)			
21-Apr	Wed	Evening	Introduction and overview (S. Pandey and W. Mwangi)			
	Wed	8-9	Introduction and overview (S. Pandey and W. Mwangi)			
		9-10	Biotic constraints (S. Mugo and F. Kanampiu)			
		10-11	Abiotic constraints (A. Diallo and D. Friesen)			
		11-12	Highland maize (T. Afriyie) and Maize nutritional quality (D. Kirubi)			
		12-13	Using biotechnology (D. Hoisington)			
		13-14	Lunch			
		14-15	Visit with Director General of ICRAF			
		15-16	Seed Availability Constraints (S. Mugo)			
		16-17	Constraints in Regional Capacity (Z.O. Mduruma)			
	17-18	Social-economics/Policy Constraints: policy, marketing, IPR issues (Hugo De Groot)				
22-		Evening	Cocktail at the ICRAF campus			
	Thu	8-9	NARS representatives - Presentations and discussions			

<b>Date</b>	<b>Day</b>	<b>Time</b>	<b>Peter Freymark Breeding</b>	<b>Monty Jones Partner Organizations</b>	<b>Carl Eicher Economist</b>	<b>Jim Ellis Jones Farming Systems</b>			
Apr									
		9-10							
	Tue	10-11					Representatives from the private seed sector and NGOs - Presentations and discussions		
	Tue	13-14					Lunch		
		14-15					Visit with Director KARI - Romano Kiome		
		15-16					Visit of KARI Biotech Center - Ben Odhiambo		
	Tue	16-17					Visit of the Rockefeller Foundation - Matlon, DeVries, Lynam, Akin		
	Mon	Evening					Dinner at Angahiti		
23- Apr	Fri	8-9					Report writing / At review team's discretion		
		9-10					Report presentation (Review Team, S. Pandey and W. Mwangi)		
		14-15							