Stakeholders Meeting
S. Mugo, D. Poland, H. De Groote and D. Hoisington - Editors
Panafric Hotel, Nairobi, Kenya,
March 3 2000
IRMA Project Document No. 2
Stakeholders Meeting:
Insect Resistant Maize for Africa (IRMA) Project

Held at the Panafric Hotel, Nairobi, Kenya
March 3, 2000

S. Mugo, D. Poland, H. De Groote, and D. Hoisington, Editors

The views expressed in this paper are the authors' and do not necessarily reflect the positions or policies of their respective institutions.

Design and layout by Grace Kimani. Cover photo: Stakeholders Meeting participants.

IRMA PROJECT DOCUMENT NO. 2
© Copyright International Maize and Wheat Improvement Center
The Kenya Agricultural Research Institute (KARI) was established in 1979 with the express mission of increasing sustainable agricultural production by generating appropriate technologies through research, and disseminating these to the farming community. Inherent to this mission is the protection, conservation, and improvement of the basic resources, both natural and human. Such resources are critical for Kenya's agricultural development and expansion of the nation's scientific and technological capacity. KARI has an extensive history of productive collaborators with national and international institutes and universities, as well as with the private sector.

CIMMYT® (www.cimmyt.cgiar.org) is an internationally funded, nonprofit scientific research and training organization. Headquartered in Mexico, the Center works with agricultural research institutions worldwide to improve the productivity, profitability, and sustainability of maize and wheat systems for poor farmers in developing countries. It is one of 16 similar centers supported by the Consultative Group on International Agricultural Research (CGIAR, www.cgiar.org). The CGIAR comprises about 60 partner countries, international and regional organizations, and private foundations. It is co-sponsored by the Food and Agriculture Organization (FAO) of the United Nations, the International Bank for Reconstruction and Development (World Bank), the United Nations Development Programme (UNDP), and the United Nations Environment Programme (UNEP). Financial support for CIMMYT's research agenda also comes from many other sources, including foundations, development banks, and public and private agencies.

CIMMYT supports Future Harvest,® a public awareness campaign that builds understanding about the importance of agricultural issues and international agricultural research. Future Harvest links respected research institutions, influential public figures, and leading agricultural scientists to underscore the wider social benefits of improved agriculture—peace, prosperity, environmental renewal, health, and the alleviation of human suffering (www.futureharvest.org).

The Novartis Foundation for Sustainable Development provides major funding for the project. The Foundation is dedicated to fostering sustainable development in poor countries of the South through its support of programs and projects in the areas of sustainable agriculture, health, and social development. It is also an active player in development policy debate through its preparation and dissemination of research analysis. Further information about the Foundation may be found at its web site (www.foundation.novartis.com).

The Insect Resistant Maize for Africa (IRMA) Project was launched in 1999 as a collaborative effort between CIMMYT and KARI. Its primary goal is to increase maize production and food security for African farmers through the development and deployment of maize that offers resistance to destructive insect especially stem borers. To achieve this goal, project scientists will identify conventional and novel sources of resistance to stem borers and incorporate them into maize varieties that are both well-adapted to Kenya's various agroecological zones and well-accepted by its farmers and consumers. Varieties and technologies that are appropriate for other African nations may be extended to them for their use.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table of contents</td>
<td>3</td>
</tr>
<tr>
<td>Vote of thanks</td>
<td>4</td>
</tr>
<tr>
<td>Way forward</td>
<td>5</td>
</tr>
<tr>
<td>Program</td>
<td>6</td>
</tr>
<tr>
<td>Summary</td>
<td>7</td>
</tr>
<tr>
<td>Introduction</td>
<td>8</td>
</tr>
<tr>
<td>Remarks by Director of Agriculture, Prof. Wilfred Mwangi</td>
<td>11</td>
</tr>
<tr>
<td>Speech by Minister for Agriculture, Hon. Christopher Obure</td>
<td>13</td>
</tr>
<tr>
<td>Speech by Director of KARI, Dr. Cyrus Ndiritu</td>
<td>16</td>
</tr>
<tr>
<td>Project presentation by IRMA Project Coordinator, Dr. Stephen Mugo</td>
<td>19</td>
</tr>
<tr>
<td>Speech by Director General of CIMMYT, Prof. Timothy Reeves (Read by Dr. David Hoisington)</td>
<td>31</td>
</tr>
<tr>
<td>Speech by Executive Director, Novartis Foundation for Sustainable Development, Dr. Klaus Leisinger</td>
<td>34</td>
</tr>
<tr>
<td>Question and answer session</td>
<td>37</td>
</tr>
<tr>
<td>List of participants</td>
<td>40</td>
</tr>
<tr>
<td>List of press package and background articles</td>
<td>44</td>
</tr>
<tr>
<td>Selected press articles</td>
<td>45</td>
</tr>
<tr>
<td>List of stakeholders invited to the stakeholders’ meeting</td>
<td>46</td>
</tr>
</tbody>
</table>
Vote of Thanks

Many people contributed to the success of this important meeting. The Minister for Agriculture, Hon. Christopher Obure left his other pressing activities to come and open the meeting officially. Prof. Wilfred Mwangi chaired the meeting throughout the presentation and question and answers sessions. Dr. Cyrus Ndiritu, Director of KARI presented a moving account of the project and participated actively in the ensuing question and answer session. Dr. Klaus Leisinger, the executive Director of the Novartis Foundation for Sustainable Development was the benefactor of the meeting, who strongly encouraged those of us in IRMA to run the project in the most transparent and interactive manner possible. Dr. David Hoisington contributed immensely to all aspects of this meeting. Dr. David Poland, Editor, CIMMYT-Mexico, contributed through his writing and editorial efforts and his work with the press. Dr. John. Wafuba, Assistant Director, KARI and Ms. Grace Kimani, Information Officer, KARI provided substantive logistical support. To all I say thank you.

I would like to thank my colleagues in the CIMMYT Nairobi office, Dr. Alpha Diallo, Dr. Dennis Friesen, Dr. Hugo DeGroote, Mrs. Ebby Irungu, Mr. Alfred Imbai, Mr. Joseph Waweru, and Mr. Isaac Mutabai, who all contributed in many ways towards the success of the meeting.

Finally, it was the stakeholders in general who made the greatest contributions of all.

Stephen Mugo
Coordinator, IRMA Project, CIMMYT, Kenya

The Minister for Agriculture and Livestock Hon. C. Obure (right), has a word with Dr. S. Mugo (partly hidden), Dr. W. Mwangi, Dr. C. Ndiritu, and Dr. D. Hoisington, after officially opening the Stakeholders Meeting held at Panafric Hotel on 3rd March 2000.
Way forward

The message from the stakeholders was loud and clear: “to bring Bt maize into the country for evaluation in a responsible manner”, strictly following the Kenyan national rules and regulations. Upon receiving permission to import Bt maize leaves into the country, transgenes that are effective against Kenyan borers will be identified and suitable constructs made. An application for field testing will be made when laboratory, greenhouse, and field sites will have been developed. Finally, upon identification of suitable target germplasm, backcrosses will be made that will subsequently allow testing on farmers’ fields. All these will be undertaken simultaneously with research on potential and actual impacts. The stakeholders and the media will be invited to visit ongoing experiments and results at all stages of development.
Insect Resistant Maize for Africa (IRMA) Project Stakeholders Meeting
Panafirc Hotel, Nairobi, March 3 2000

Program

Chairman: Prof. W. Mwangi – Deputy PS and Director of Agriculture
Rapporteurs: Dr. J.O. Ochieng, Dr. J. Songa, and Dr. B. Odhiambo

Official opening:
09.00 - 09.05 Remarks by the Director of Agriculture
Prof. Wilfred Mwangi, Deputy PS Ministry of Agriculture and Livestock Development and Director of Agriculture

09.05 - 09.25 Official Opening – Minister of Agriculture
Hon. Christopher M. Obure, EGH., MP. Minister for Agriculture

Key roles and the IRMA project
09.25 - 09.40 Remarks by Director, KARI - Dr. Cyrus Ndiritu, EBS Director, KARI

09.40 - 10.10 Insect Resistant Maize for Africa project
Dr. Stephen Mugo, Coordinator IRMA Project

10.10 - 10.25 Role of CIMMYT
Dr. David Hoisington, Director, ABC and Bioinformatics, CIMMYT

10.25 - 10.40 Role of the Novartis Foundation
Dr. Klaus Leisinger, Executive Director, Novartis Foundation for Sustainable Development

Questions and answers
10.30 Stakeholders

Insect Resistant Maize for Africa (IRMA) Stakeholders Meeting held at Panafirc Hotel, from left, Dr. Stephen Mugo, CIMMYT, Dr. Klaus M. Leisinger, Novartis Foundation, Dr. Cyrus Ndiritu, KARI and Dr. David Hoisington, CIMMYT.
Summary of the IRMA Project Stakeholders Meeting

The Insect Resistant Maize for Africa (IRMA) Project was publicly launched on March 3 2000 with the convening of a Stakeholders Meeting in Nairobi, Kenya. About seventy six people, representing different stakeholder groups - including farmers' associations, womens' groups, religious organizations, seed producers, regulatory agencies, NGOs, the media, and others - were in attendance. Representatives of the project collaborators, CIMMYT and the Kenyan Agricultural Research Institute (KARI), as well as the primary donor, the Novartis Foundation for Sustainable Development, were also on hand.

The project is aimed at producing maize that is both adapted to various Kenyan agroecological zones and is resistant to key insect pests, primarily stem borers. Both conventional and novel sources of resistance will be examined for their effectiveness against the borers, which incur losses ranging from 15 to 45 percent, depending on the region. Transgenic maize containing *Bacillus thuringenesis* (Bt) is a focal point of the project, prompting project organizers to emphasize public involvement and awareness through events such as the Stakeholders Meeting.

The specific objectives of the Stakeholders Meeting were to

- Introduce the IRMA project to stakeholders
- Create awareness on the economic importance of stem borers in Kenyan agriculture
- Create awareness on the control options for stem borers, including conventional and novel approaches like the Bt-gene technology
- Solicit responses from stakeholders on the need and processes of developing insect resistant maize for Kenya.

The session was chaired by the Deputy Permanent Secretary, Ministry of Agriculture, and Director of Agriculture Prof. Wilfred Mwangi, and was officially opened by the Minister for Agriculture, the Hon. Christopher M. Obure. Dr. Cyrus Ndiritu, Director of KARI and an outspoken proponent for biotechnology and genetic engineering for developing countries, provided some general remarks on the project, while CIMMYT IRMA Project Coordinator Dr. Stephen Mugo gave a more detailed account. A letter on CIMMYT's role in the project from Director General, Prof. Timothy Reeves was read by Dr. David Hoisington, and Dr. Klaus Leisinger gave a short speech on the role of the Novartis Foundation for Sustainable Development.

Following the opening, the stakeholders readily engaged the expert panel in the question and answer period. Because of their intense involvement, the session ran well over its allotted time and was extended to accommodate additional questions and comments. The stakeholders expressed the need to incorporate sound management strategies and to follow the national regulations strictly during introduction and testing of Bt genes in the country. The view shared by almost all was that we can only evaluate Bt genes if they are in the country. Important, Bt maize was viewed as having a high potential for closing the wide and increasing food deficit in Kenya. Media coverage of both the Stakeholders Meeting and the preceding Africa Biotechnology Stakeholders Forum (ABSF) workshop (sponsored by CIMMYT and the Rockefeller Foundation) was extensive and generally positive.
Introduction

The Insect Resistant Maize for Africa (IRMA) Project is a joint project between the International Maize and Wheat Improvement Center (CIMMYT) and the Kenya Agricultural Research Institute (KARI), with financial support from the Novartis Foundation for Sustainable Development. It responds to the need to feed the rapidly increasing population of sub-Saharan Africa by tackling one of the major sources of maize crop losses in Southern and Eastern Africa—stem borers. The project will be implemented initially in Kenya, and extended to other countries in the region that show interest in the approach and technology.

The overall project goal is to increase maize production and food security through the development and deployment of insect resistant maize, in order to reduce losses due to stem borers. It will seek to effectively combine conventional and novel sources of resistance to stem borers in various agroecological zones in Kenya.

The objectives are to:

- Develop insect resistant maize varieties for the major Kenyan production systems and insect pests
- Establish procedures to provide insect resistant maize to resource poor farmers in Kenya
- Assess the impact of insect resistant maize varieties in Kenyan agricultural systems
- Transfer technologies to KARI and Kenya to develop, evaluate, disseminate, and monitor insect resistant maize varieties
- Plan, monitor and document project processes and achievements for dissemination to other developing countries.

Development of insect resistant maize varieties for Kenya involves:

- Development of the infrastructure for screening insect resistant maize germplasm
- Identification of genes active against Kenyan stem borers (*Chilo partellus, Busseolla fusca, Sesamia calamistis, and Eldana saccharina*) among the various Bt gene constructs (cry1Ab, cry1Ac, cry1B, and cry1E) available at CIMMYT
- Development of improved insect resistant maize germplasm
- Identification of target germplasm for transformation and for backcrossing to source germplasm
- Development of transgenic-based insect resistant maize germplasm
- Transformation of Kenyan adapted germplasm with Bt gene constructs
- Backcrossing adapted Kenyan germplasm with transformed CIMMYT germplasm.

Establishment of procedures to provide insect resistant maize germplasm to resource poor farmers in Kenya involves:

- Developing insect resistant management (IRM) strategies
- Agronomic studies of insect-resistant maize
- Seed production strategies to provide the insect-resistant germplasm to farmers.

Impact assessment and socioeconomic analysis involves:

- Assessing the demand for insect resistant maize varieties through studies of the different maize-based farming systems, a survey of farmers’ perceptions and preferences, and of consumers’ preference
- Ensuring that the technology fits within the country’s institutional framework
- Assuring the safety of the technology to the public through continuous dialogue with environmental groups and local research institutes, and private or public seed companies
- Assessment of intellectual property rights' (IPR) implications and costs
- Ensuring that the technology is appropriate and acceptable to farmers through farmer participatory trials
- Comparing the costs of the new technology to the benefits at different levels: the seed company, the maize producer, the consumer, and society as a whole
- Assessing the impact of the research and comparing the benefits to the costs.

The transfer of technologies to KARI and Kenya to develop, evaluate, disseminate, and monitor insect resistant maize varieties entails:

- Establishment of appropriate laboratory and greenhouse facilities in Kenya to develop and evaluate transgenic germplasm
- Development of appropriate field trial locations to evaluate the performance of insect resistant germplasm
- Training in the genetic engineering of maize
- Training in the evaluation of insect resistant germplasm
- Experience in the drafting, submission and conduction of biosafety applications for the importation and laboratory and field evaluation of transgenic materials.

Planning, monitoring, and documenting project processes and achievements for dissemination to other developing countries will involve:

- Numerous planning meetings between CIMMYT and KARI staff
- A stakeholders meeting during the initial stage to openly discuss the proposed project and receive feedback from a wide range of stakeholders
- Development of a Strategic Plan
- Development of the media relations plan and associated documentation
- Development of position statements and public information materials regarding the project and associated science
- Annual planning meetings and progress reports.

The expected outputs and impacts include:

- Maize inbreds, hybrids, and OPVs that incorporate the most effective conventional and transgenic-based insect resistance, tested and released in Kenya
- Protocols developed and KARI scientists trained in the development and evaluation of transgenic maize cultivars at the experimental station level, and in the deployment and monitoring of transgenics in farmers' fields
- Economic analyses to determine likely farm-level profitability for different categories of farmers, to assess farmers' willingness to pay for the technology (strength of market demand) and to assess the overall private and public benefits of the technology
- Insect resistance management strategies developed and implemented in all zones in Kenya where the maize is to be grown
- Practical experience for KARI in biosafety and IPR regulatory procedures in Kenya
- Thorough documentation of all lessons learned during the project, which will be made available to other developing countries interested in promoting similar technology.
The IRMA project is implemented and managed through a steering committee composed of Senior Directors from CIMMYT, KARI, and NF and chaired by the CIMMYT project director (the Director of the Applied Biotechnology Center and Bioinformatics). Co-ordinators for CIMMYT and KARI will provide the operational management of the project with the assistance of a Project Coordination Committee. CIMMYT has based a maize breeder in Kenya to develop suitable maize germplasm through backcrossing of the various insect resistant genes into Kenyan germplasm. A CIMMYT economist, based in Kenya, is implementing the impact assessment activities. As information is a major output of the project, a CIMMYT communication expert has been designated to assist in preparing project documents, mainly related to public education and public/media relations issues. The project is supported at CIMMYT Headquarters by a cell biologist and entomologist, as well as other staff in the Applied Biotechnology Center, Maize Program, Economics Program, and Information Services.
I take this opportunity to welcome you all to the Stakeholders' Meeting of the Insect Resistant Maize for Africa (IRMA) project. The IRMA project is a joint venture of the Kenya Agricultural Research Institute (KARI) and the International Maize and Wheat Improvement Center (CIMMYT), with financial support from the Novartis Foundation for Sustainable Development. The organizers of this meeting have invited a large number of stakeholders with an interest in agricultural research in general and of maize in particular. These include NGOs, farmers' organizations, both print and electronic media, national research institutions, government institutions, international institutions, seed companies, religious organizations and both large- and small-scale farmers. I would like to recognize the presence of these stakeholders in this meeting and look forward to your contribution.

It goes without saying that agriculture plays a very key role in Kenya and other countries in Africa. In addition to providing food and fiber that directly supports our lives, agriculture contributes greatly towards our cash economy in the form of business and as a source of gainful employment. No one can doubt that agriculture is, and will continue to be, the backbone of our economy. It will also lead to our industrialization.

The contribution of maize to Kenyan agriculture and our economy cannot be overstated. Shortages of maize can equate to national famine while good harvests are welcome by all. Kenya has yet to attain self-sufficiency in maize, a goal that remains elusive due to our rapidly growing population and unpredictable weather. But though elusive, by no means have we given up on trying to attain the maize sufficiency goal.

While there is potential for increasing maize production through improved crop management, technologies that come encapsulated in the seed - such as improved cultivars - are often accepted more readily by our farmers.
The IRMA project aims to develop maize cultivars that carry resistance to stem borers, which inflict severe losses on our maize yields.

Agricultural research - such as we will see with this project - has contributed significantly towards development and food production in Kenya. However, the current and future demand for maize in our country will call for evermore concerted efforts, as well as the adaptation of novel technologies. In this regard, biotechnology holds great promise, and I believe agricultural research in Kenya could benefit significantly.

Agricultural development also benefits from the input of groups like this. To put it simply, the role of stakeholders in development and implementation of agricultural programs has been recognized and we value it highly. Through fora like this one, stakeholders can identify positively with a project, and more importantly, contribute towards the project design in a way that ensures success.

This morning we are going to listen to presentations that will explain the goals, objectives, and activities of the IRMA project as well as views of the various project partners. We will then open the floor for a question and discussion session. A panel of scientists and stakeholders will attempt to respond to the questions, though the ideal will be for a discussion by all of those present.

At this time, it is my pleasant duty to invite the Minister for Agriculture, the Honorable Christopher Obure, to open the meeting.
I take this opportunity to welcome you all to this meeting. I especially wish to recognize the presence of Dr. David Hoisington, representative of the Director General, International Maize and Wheat Improvement Center (CIMMYT), and Dr. Klaus Leisinger, the Executive Director of the Novartis Foundation for Sustainable Development.

Ladies and gentlemen, I would like to use this opportunity to reflect on our country’s food situation. The Government of Kenya is committed to ensuring food sufficiency and food security and my Ministry shoulders the bulk of this responsibility. Although Kenya has a high degree of self-sufficiency, in recent years agricultural productivity has not kept up with population growth, and food-security therefore remains a top government priority.

Many factors influence the current situation. Our population is large, and growing rapidly at 3.5 percent per year. Yield increases for food crops have not been able to match this population growth rate, and our arable land is limited, with little scope for expansion. This trend is accentuated by the negative impact of the increasing drought spells of recent years, resulting in an actual decrease of food available per person. The poorer segments of Kenya’s population suffer especially hard. Already, poverty in Kenya is high and poverty alleviation is one of the greatest challenges of our country. The Government has developed a poverty eradication plan, in which increased productivity of small-scale agricultural production plays an important role.

Although Kenya has the capacity to produce sufficient food for her people and even for export, changes are needed in research, extension, and in the institutional environment. The current Food Policy Paper, the Sessional Paper No. 2 of 1994, emphasizes this and states that farmers will be given the necessary incentives to motivate them to increase agricultural production. The Government has in recent years put significant efforts into improving the institutional environment, especially in areas of marketing, pricing and distribution channels. As a result, farmers now have better access to input and output markets. This liberalization, however, has not solved all problems, as our recent workshops on food policy have demonstrated.
Within the proper institutional environment, farmers also need to be provided with appropriate production technologies. This underscores the importance of agricultural research. Research must be tailored to provide quality products that find a market after satisfying farmers' family consumption needs. This research needs to address both producers' and consumers' needs.

A large proportion of Kenya is arid or semi-arid, and arable land is limited. Options for increasing the area under agricultural production are very limited, so emphasis needs to be placed on intensification strategies that increase production per unit area. This intensification is of utmost importance for maize, our most important food crop. Unfortunately, crops under intensification usually face increased pest pressure. In Kenya, striga and stem borers, to name only two, are responsible for massive crop losses each year. Finding ways to decrease those losses would result in an increased and more stable maize production, improving our food security substantially.

We must as a matter of urgency seek to adopt and adapt appropriate technologies already developed elsewhere. At the same time, however, we should not rely exclusively on imported technology. We need to develop our national capacity for designing new technologies, building on our own experience, our indigenous knowledge and our traditional methods.

The Government of Kenya has always emphasized the development of its research and development capacity, and KARI is now the second largest agricultural research institute in sub-Saharan Africa. Its maize breeding research has been particularly successful, and Kenya has one of the highest adoption rates for modern maize varieties in Africa. The development of those high yielding varieties, in combination with crop management technologies and extension methods, has helped to increase food production. However, the challenges of feeding an increasing population call for new and novel ways to ensure higher production and reduced losses after harvest. The new and emerging science of biotechnology is very promising in stepping up food production through safe processes. The high costs of these new developments holds the danger that we become dependent on outside research institutes. Therefore, our scientists and research institutes need to fully take part in the new field of biotechnology, and commit the necessary investments.

In this light, we are happy to gather here today as stakeholders to a new venture, the Insect Resistant Maize for Africa or IRMA project. This project, a collaboration between KARI and CIMMYT, aims to reduce yield losses in maize due to stem borers by combining conventional breeding and biotechnology to develop resistant varieties. Stem borers are a major pest problem of maize, causing estimated losses of 15-45%, with an estimated value of 6.3 billion Kenyan shillings.

In its biotechnological component, the project will develop stem borer resistant maize varieties by incorporating a new DNA gene, commonly called a Bt gene, into the maize genome. This gene synthesizes proteins that kill stem borer larvae feeding on the maize. The technology has been widely used to enhance maize production in the USA since 1996, and has seen the most rapid spread of any new technology in recent agricultural history.

The IRMA project will identify the right genes that are effective against the stem borer species common in Kenya. These specific genes will then be incorporated into maize varieties that are well adapted to Kenya, and have other important characteristics such as tolerance to drought, low nitrogen, and diseases.

In planning and implementing research towards more intensive agricultural production, we must be careful in our use of the environment so that we do not harm human, animal, or plant life. We need to conserve the natural resource base for our future generations, and therefore we must carefully select only those solutions that lead to sustainable production increases.
All new technologies need to be studied for apparent or potential hazards. Some reservations and criticisms directed at the Bt technology are understandable. There is concern about resistance breaking down and of nontarget insects being killed. However, it is the task of scientists and technology developers to study and reduce such risks. We now have in place the “Regulations and Guidelines for Biosafety in Biotechnology for Kenya” (NCST No. 41 Feb. 1998). It is imperative that all those involved in introducing the Bt technology follow the proscribed biosafety and phytosanitary regulations, the Seed Act, intellectual property rights, and other relevant national legislation.

Kenya upholds the right of stakeholders to be involved through all stages of project development and implementation as spelt out in the current Food Policy Paper, the Sessional Paper No. 2 of 1994. Today you all represent major stakeholders in this project. Your opinions are important and will be considered in the IRMA project implementation. I therefore urge you to engage in candid and open discussions by expressing objective and constructive views and opinions.

Finally, I wish to thank CIMMYT for their continued assistance in improved maize and wheat germplasm, research infrastructure development and manpower development. I also thank the Novartis Foundation for Sustainable Development for providing financial assistance for this work.

I wish you all fruitful deliberations.

It is now my singular honor to declare this meeting officially opened.
Between 55 and 60 percent of the rural population in sub-Saharan Africa is absolutely poor, subsisting on less than US $1 per day. More than 200 million people (over one-third of the African population) suffer chronic undernutrition. Infant mortality in Africa is about 103 in every 1,000 births, compared to 8 per 1,000 in high-income countries. Most urban residents spend more than 80 percent of their earning on food. This leaves very little for spending on human welfare including nutrition, education, and public health. About 32 out of 48 low-income countries in the world are in sub-Saharan Africa.

Most African people earn their living from productive agriculture. In sub-Saharan African countries, 50–75 percent of the population and labour force are in agriculture. In 1990, agriculture provided on average, 32 percent of Africa's GDP, 66 percent of employment (for 1987), and about 20 percent of its exports (World Bank 1989, 1992). In this context, agricultural development is critical to present and future economic growth and improvements in the welfare of the people of Africa.

African agricultural growth has, however, been slowing considerably during the last two decades. The annual growth rate fell from 2.3 percent in the 1970s to 2.0 percent from 1980 to 1992. Of the major developing regions of the world, only in sub-Saharan Africa has the per capita food cereals output been declining over the last 30 years. Maize, the most important staple food in most of sub-Saharan Africa, has been seriously affected.

The stagnation of agriculture is due to both internal and external factors. The external constraints include a number of biotic and abiotic factors such as shortage of arable land, poor moisture availability, declining soil fertility, limited access to costly farm inputs, limited technological base, as well as agricultural pests and diseases.
Apparently African rainfall have shown a progressive drying trend and that drought is a common trend over large parts of the continent. Agricultural growth is severely constrained by extensive and severe rainfall shortages. The problem of rainfall shortages in many parts of Africa is enormous, and is often compounded by low soil fertility such as in the semiarid zones, where soils tend to be sandy and prone to soil erosion and degradation. These soils lack important nutrients like sulphur and phosphorous and have low organic matter content. Agricultural production, therefore, requires capital intensive chemical fertilizer inputs.

The devastating effects of pests and diseases in Africa are reflected in the amount of resources spent by farmers on their control. Huge crop and livestock losses are incurred as a result of pre-and post-harvest pest and disease damage. The issue of pest and disease resistance in crops is of crucial significance to Africa.

Although area expansion and use of conventional methods of breeding and agricultural research and development have served African agriculture well in increasing output in the past (for example in Kenya the production of Katumani Mpya maize and Kenya Mtama sorghum), these options can no longer sustain productivity. New intensive production techniques are now needed to augment yields and reduce losses, while conserving the natural resource base. Innovative technologies are urgently needed to transform agricultural growth and development in Africa. Biotechnology offers scope to resolve many of the problems affecting crop production in Africa.

Biotechnology-derived solutions for the biotic and abiotic stresses, if built into African genotypes of plants, could reduce the need for, and the high costs of agrochemicals and water. New solutions could also reduce the deleterious effects of diseases and weeds, thus promoting sustainable agricultural production. In Kenya, for example, DNA-based molecular markers are now applied in various forms to construct linkage maps of different species. This helps locate particular genes of high relevance to rapid improvement in crop breeding. Mapped markers are useful in accelerating selection of traits for use in conventional breeding procedures. These techniques are applicable to many crop improvement programs, such as those seeking to enhance resistance to diseases (for example, maize streak virus) or to generate tolerance to insect pests and drought conditions. Specific programs and capacities in this field have emerged in KARI to address resistance to maize stem borer and drought tolerance.

To counter the effects of maize stem borers through the KARI/CIMMYT insect resistant maize project, we will develop varieties that carry multiple forms of resistance and combinations of Bt genes. In addition, management strategies will be developed together with farmers that maintain populations of nonresistant borers and limit the buildup of resistant populations.

As you can see, there are many aspects to this new technology that we must consider, which we need not consider with more conventional approaches. However, the potential rewards are great. Not just in terms of limiting our crop losses to insects, but in developing the capacity of Kenyan researchers to work in this exciting cutting-edge area of science.

The IRIMA project brings together institutions with proven track records - CIMMYT and KARI - to bring biotechnology and conventional breeding to bear on one of our major maize production problems - stem borer. The project's objectives are clear and well founded. They are:-

- To produce maize with greatly increased insect resistance, using both conventional and biotechnological approaches to crop improvement
- To provide experience in the development and enforcement of a range of regulatory procedures including biosafety protocols and intellectual property rights agreements.
• To assess the potential and actual impacts of insect resistant maize from environmental, economic, agronomic and cultural perspectives.
• And perhaps most important of all, to find ways to help our farmers adopt the improved maize and use it wisely.

We have given ourselves a five-year time frame for the initial phase of this undertaking, which is quite ambitious when you consider how much ground we have to cover.
Good morning ladies and gentlemen, and welcome.

This morning I would like to present you with an overview of the Insect Resistant Maize for Africa project that we call IRMA in short.

I'll present the details of the project a little later on, but let me start by providing a little background on the situation facing us in providing food. I would like to be able to tell you all is well when it comes to feeding future generations of Kenyans and East Africans, but I'm sorry to report that we have a serious challenge on our hands when it comes to providing food for our people, both now and in the coming years.

During the past few decades, Africa has witnessed unprecedented increases in population growth. Thirty years ago, our continent's population was about 200 million, but thanks to a population growth rate in excess of three percent annually, we are now at about 520 million people, a figure that is projected to more than double up to 1.3 billion in roughly 25 years.

This exponential growth makes it difficult to maintain adequate levels of food supplies. Food availability in Europe, for example, is 3,500 calories a day - while in Africa it drops down to 2,100 calories, giving us the lowest per capita food availability in the world. While some say that at the global level the problem is one of distribution, this response trivializes the problem and misleads people into thinking there is a pat answer to our food dilemma. With 55 to 60 percent of the people in sub-Saharan Africa living on less than a dollar a day, where will the money come from to buy this imported food? If it doesn't come from the people, it will have come from the government, which means diverting badly needed funds from social spending on other development priorities such as health and education. Clearly the solution is to produce more food domestically. And indeed, obtaining food self-sufficiency is an urgent part of the development agenda for many countries in sub-Saharan Africa.
Unfortunately, the growth rate in grain production in sub-Saharan Africa is falling at precisely the time we need to see increases (Table 1). Between 1970 and 1985, food production grew at only half the rate of population increase, and since then it has continued to deteriorate.

Table 1: Cereal Production in the developing world 1960 - 1990

The growth rate in crop production during the 1970s was roughly 2.3 percent annually. This fell to 2 percent annually for the period from 1980 to 1992. In fact, of the major developing regions of the world, only sub-Saharan Africa has seen its per capita cereals output actually decline during the past 30 years!

There are a number of reasons for this decline: Inadequate rainfall is a major constraint to our agricultural growth, and indeed CIMMYT and KARI are currently working on developing maize varieties that are more drought tolerant in the African Maize Stress (AMS) project and in the DGIS funded project. Another key factor is that new land for productive agriculture is limited. Intensification of agriculture on our better lands holds out the best hope for providing the higher yields that we need now and in future years, but this intensification, as with most things in nature, comes with a cost—it requires more inputs and it also brings on increased pest and disease pressures. Our farmers are battling to be more productive, but it is difficult. Many Kenyan farmers cannot afford manufactured fertilizers and so low soil fertility has led to declining yields. Using pesticides to combat pests and diseases that take a devastating toll on their yields is also expensive (estimated at 8,500 Ksh per hectare), time consuming, and potentially damaging to the environment as well as human health. Stem borers, in particular, have proven to be especially pernicious and insidious pests.
Stem borer damage to maize

At their initial most destructive stage, the larvae could easily play host to five or six stem borer larvae on the tip of a finger. But though their stature is small, they can readily destroy the productivity of a maize plant, and in greater numbers, rob farmers of a large part of their would-be harvest. It is estimated that in our country stem borers infest up to 87 percent of our maize areas in a given year, leading to losses that range from a low estimate of 15 percent to a high estimate in a particularly bad year of 45 percent. When one considers that Kenya is a maize importing country, these figures take on added significance. One important component of the IRMA project is to more accurately determine exactly what the yield losses are and how these affect both farmers and urban consumers.

Life cycle of a typical borer

Stem borers starts out with the mature insect depositing its eggs on the leaf of the maize plant. These eggs then hatch and the larvae, after feeding on the leaves, head toward the whorl of the maize plant. They feed on the whorl for approximately 10 days, and then move down the stalk of the plant to a point below the foliage. Stem borers often cause dead hearts. The borers tunnel down through the whorl and kills off the growing tissue of the plant, keeping it from further growth and from flowering and producing grain. Plants hit with dead heart are a total loss. They accomplish this either by burrowing down from within the stalk or by migrating on the outside of the stalk and chewing their way into it further down. They then begin to feed and tunnel through the inside of the stalk. This is their most destructive stage. By tunneling through the maize stalk, they severely disrupt the nutrient flow through the plant, often to an extent where the plant cannot produce grain or it dies. This tunneling also leaves the plant very vulnerable to lodging, so that a strong wind can blow over large areas of maize in an infested field. After they finish feeding, they chew an escape hole out of the side of the stalk for later use. They then go into the pupa stage and emerge later as adult moths through the escape hole.

Now one thing to particularly note about the borers mode of action is that at its most destructive tunneling stage, by virtue of it being literally inside the plant, it is very difficult for farmers to detect and it is virtually invulnerable to insecticides applied to the outside of the plant. In a way, the plant becomes its own worst enemy at this stage as it actually serves to protect the borers from birds, parasitoidal insects, or other natural control measures.

In some instances, the borers may attack the maize ears. This usually occurs later in the life of the maize plant. While the actual feeding damage done to the ears by the borers is usually not extensive, the wounds created by the borers leave the plant vulnerable to a range of diseases and cob rots. Aflatoxins, which are dangerous to humans, can be produced, and further deterioration of the crop may occur in storage. We consider this secondary damage, but it nevertheless still hurts farmers ultimate yields and it is something we would like to remedy.

Borer distribution in Africa

The entire African continent is afflicted with *Sesamia calamitis*. Nearly all of sub-Saharan Africa is hit with *Busseolla* and *Eldana* borers, and most of Eastern Africa suffers from infestations of *Chilo*. A very important aspect of the IRMA project is that the work carried out by KARI and CIMMYT will be used to help other African countries in the region combat these stem borers.

We plan to make the experiences and lessons learned - and some of the maize germplasm that we develop in this project - available to those of our neighbours that want to use this technology themselves.
Figure 1: Borer distribution in Kenya.

Stem borers are distributed throughout the major maize growing areas of Kenya (figure 1). Chilo are found mainly in East Kenya, Busseola mainly in West Kenya. Eldana and Sesamia are often found together in “Central” and Western Kenya. The IRMA project will be working in all of these regions to develop maize varieties that both offer resistance to the most important stem borers in a given region and also produce good yields under the growing conditions found there.

**Target stem borers in Kenya**

*Chilo partellus* goes by the common name of spotted stalk borer and is a relatively recent arrival in Africa, being first identified in Malawi in 1932. It is the most destructive pest of maize in warm, low altitude regions of sub-Saharan Africa, however, we’ve recently found it moving into higher elevations and displacing other borers. *Chilo* does not go into a dormant period like our other borers and is able to attack plants at a very early stage, thereby killing the plant’s growing point. This results in dead heart and reductions in plant densities.

*Busseola fusca* is native to Africa and is the major borer pest at elevations above 900 meters above sea level. After emergence, larvae crawl over the plants, congregate in the funnel or whorl, and feed on the rolled leaves. This often results in dead heart. After killing a plant, the larvae move on to new plants and enter them by boring into the stem near the base. Severe damage to plants is inflicted as these borers tunnel throughout the stems and leaves of the plant before entering a dormant stage. Later they emerge from the plants as moths.
Eldana sacharrina goes by the common name of African sugarcane borer. Although this borer tends to prefer wild hosts, it can reduce yields by up to 20 percent in infested maize fields. This borer tends to attack maize ears and stems late in the season, when it feeds on the grain and inside of the stems. The wounds that result from it’s feeding, makes plants very susceptible to rots and to lodging in the field.

Sesamia calamitis or pink stalk borer is often kept in check by biological control agents, which usually, but not always, prevent serious outbreaks. When feeding at the larval stage it can result in dead heart, while at later stages it tunnels and girds maize plants causing the stems to break. It will also feed on the grain, again causing problems with rots in the field and in storage.

Farmer perception of stem borer problem

Figure 2 below shows the results of a farmer survey from Kilifi and Kwale districts, but I suspect we would find similar results elsewhere. Insect pests, specifically stem borers, were ranked as the number one problem facing farmers in those districts, ahead of soil fertility, labor and land shortages, and other pests. In Figure 3 a survey carried out in the major mid and high altitude maize areas, farmers ranked stem borers as their number one concern outside of drought. It is this kind of input - direct from the field level - that has encouraged us to try and tackle this problem. Additional surveys will be conducted by the IRMA project to better document the problem to give us information from the field level that will help us develop technologies that will be well accepted by our farmers.

Control methods for stem borers

Currently, there are a number of control measures, but each comes with its own problems or limitations. I should note at this point however, that for reasons of costs and labor, farmers often resign themselves to using no control measures at all. Essentially we have four general approaches to insect control: Chemical control, by which we mean the application of insecticides; biological control, which means identifying and introducing natural enemies of the pests into an area; crop management, which includes a broad range of field and crop management techniques; and finally, host plant resistance, by which the plant offers its own resistance to the insects.

For farmers that have the resources, chemical insecticides have been their primary choice here in Kenya. Dipterex was recommended quite often in the past, but it along with Furadan are now being pulled off the market. Bulldock is another option being used quite extensively, but it has considerable drawbacks. At a cost of around $120 per hectare for treatment, it remains out of reach for a great many Kenyan farmers. Furthermore, it is very labor intensive. Granules of the product must be applied by hand in each and every hole where a maize plant is going to be planted and then again at a later stage. Imagine doing this for a field of several hectares and you can quickly see why for many farmers, even those with enough money, this approach is not practical. The traditional method of combating stem borers is to put ashes or a mixture of ashes and powdered chili pepper into the whorl of the plant. We have reason to believe that in some instances this approach could provide some beneficial effects, however, its usefulness is probably conditioned on timing applications just right in terms of the stem borers development, and even then its effectiveness is probably somewhat limited.

Then we have the biological option, which often employs integrated pest management techniques and parasitoidal organisms such as other insects that prey on the target pest. Here in Kenya, work is being done with a small wasp called Cotesia flavipes, which attacks the Chilo partellus. We are encouraged, but it is too soon to say how effective it will prove to be in the long run. Such approaches are slow to develop. Great care must also be taken to make sure that the predators do not have adverse effects on non-target plants and animals in the environment.
Figure 2: Constraints perceived by farmers in Kwale and Kilifi Districts of Kenya

![Pest problems](chart1.png)

Figure 3: Constraints perceived by farmers in Embu District, Kenya

![Constraints perceived by farmers](chart2.png)
Crop management also offers some interesting possibilities. Burning the stover has also been recommended in the past. This kills the borers that have gone dormant inside the stalks before they can reemerge. However, many farmers like to use the stover for livestock feed and the burning of the stover also increases erosion problems. A crop management approach that shows potential is based on planting maize together with other plants, usually forage grasses that either attract and distract the borers away from the maize plants or repel them away from the plot where the maize is being grown. This approach is called push-pull in that the farmer grows plants around the border of the field that pull the borers away from the maize, and he or she grows plants among the maize that push away or repel the pests. This approach presents great potential, but also has its limitations—the main one being that the push-pull plants currently being tested require rainfall of at least 1,000 mm annually. And because the push-pull plants are forage grasses, owners of livestock tend to be drawn to the system more than those who do not raise livestock, who tend to be the poorer farmers, although even these farmers can market the grasses. Another constraint to this approach is the lack of and expense of seed for these push-pull plants.

Breeding for plant resistance is great in principle because farmers just have to plant the new seed to reap the benefits as opposed to learning and implementing new technologies. It’s also cheap and easy to distribute such technologies through the established seed distribution system. The problem has been that conventional breeding has been slow in producing varieties that are effective against the borers. And this is where biotechnology offers an answer to us that was not previously available.

**Biotechnology approaches to developing insect resistant maize**

What exactly is biotechnology? Biotechnology is a group of technologies that can be broken down into two fields: molecular genetics and genetic engineering or modification.

Molecular genetics focuses on the use of molecular markers and genetic fingerprinting to allow us to identify the presence of specific genes that govern the traits of interest. Molecular markers can also be used to tell us which varieties may have common genetic backgrounds. This can be extremely useful for plant breeders trying to identify sources of certain traits, say disease resistance. By using these genetic signposts, they can eliminate many breeding cycles and cut years off the time needed to produce and release a plant variety. KARI and CIMMYT are currently involved in a project sponsored by DGIS to establish molecular breeding capacity in KARI for insect resistance and drought tolerance. Training, consulting, and backstopping is provided by CIMMYT and we are quite encouraged by the results to date.

Genetic engineering, on the other hand, involves the insertion of foreign gene(s) into a host organism in order to increase the value or usefulness of the organism. Genetically modified (GM) crops, such as maize are usually designed to do one of two things:

- Lower farm-level production costs by making plants resistant to pests and diseases or
- Enhance product quality by increasing the crop’s appearance, nutritional content, or processing and storage characteristics.

The debate on biotechnology for Africa must be considered in the context of the continent’s need for more food and survival of its people. With respect to the prohibitive costs to farmers of agricultural chemical inputs and yield losses arising from pest and disease damages, the relevance of genetic engineering to produce transgenic crops with resistance to herbicides, insects, and diseases cannot be ignored. The use of high yielding, disease and pest resistant crops would have a direct bearing on improved food security, poverty alleviation and environmental conservation in Africa. Great strides are being made in this field in
Africa especially in Kenya, Egypt, and South Africa. Tangible examples include our virus resistant transgenic sweet potato project, which is under development in conjunction with the Monsanto Company, Egypt's transgenic potato, maize, faba bean and tomato developments, and South Africa's tobacco and cotton varieties with resistance to herbicides.

In the field of livestock improvement, genetically engineered animal vaccines have considerable application in Africa in combating rampant and devastating livestock diseases such as rinderpest and Rift Valley fever. Not only can such vaccines be produced inexpensively, but they also offer the advantages of multiple protections, low costs, as well as allowing the easy distinction between vaccinated and naturally infected animals. This feature is highly desirable in Africa with respect to livestock exports to developed countries and in continental disease eradication crusades.

Genetically modified foods or food ingredients are currently being produced and consumed on a very large scale, and their value to both farmers and consumers is significant. A few diverse examples are cited below:-

- The enzymes used to produce a great portion of the world's cheese are GM products, helping to ensure a consistent and healthy product with valued consumer characteristics.

- In parts of the tropics, papaya fell prey to a virulent virus that destroyed entire groves of this high value fruit. Genetically modified papaya was produced to resist the virus and restore the profitable industry to Hawaii and other Pacific nations.

- And, this one I find most interesting: herbicide resistant soybeans have made South America a major exporter of this valued crop. While one state in Brazil has legislated against its use, the state's own farmers are busy smuggling the GM seed from neighboring Argentina to use in their fields because it allows them to use no till soil practices that not only saves them money, but helps the environment by reducing erosion and requiring less fuel for mechanized cultivation.

In addition, we are seeing a wave of products on the horizon that will directly benefit consumers as well. Rice with high levels of vitamin A and iron has been developed and is now undergoing testing. This GM rice will help reduce blindness caused by vitamin A deficiencies and improve the health of women and children by raising the level of available iron for them in their diets. On another front, bananas that can carry a human vaccine for cholera have been created using genetic engineering techniques. We are seeing the beginning of a new era in which high science directly benefits those on the lowest rungs of the economic ladder. It's an opportunity we need to seize and exploit to the fullest!

Many in the industrialized countries have already embraced these technologies. One of the most rapidly adopted technologies ever deployed is Bt maize in North America. Bt stands for Bacillus thuringiensis, a naturally occurring soil bacterium that is toxic to a range of caterpillar pests, but harmless to most other insects and to animals and humans. In fact, "organic" farmers have used Bt for years because it is natural and safe. Biotechnology has allowed us to take the genes from the bacterium and transfer them into maize and other crops, where they provide protection against many types of insect pests.

Though only on the market for a few short years, today nearly 40 percent of the maize in the Corn Belts of the USA and Canada is planted to Bt maize. And while critics may argue that this is due to marketing by the large seed companies, the fact is the farmers like what it has to offer and so they adopt it. To think otherwise is to greatly underestimate the intelligence and entrepreneurship of some of the most productive farmers in the world.
Concerns on use of genetically modified organisms

As with any new product, proper testing is necessary. We must evaluate the effects of GM foods on human health, on the environment, and on genetic diversity. We are also concerned with the pests building up resistance to the Bt maize and rendering it less effective.

When it comes to food safety, great care should obviously be exercised - and we believe that to date it has been. While the Europeans argue that their regulatory agencies can’t be trusted, we believe that the World Health Organization, the UN’s Food and Agriculture Organization, the United States Department of Agriculture, and others are more than credible when they go on record declaring the GM foods now on the market as safe. These organizations have found that in terms of its food characteristics, there is no difference between Bt maize and conventional maize. Potential problems related to allergens have been voiced by some distinguished scientific bodies as well as critics as having basis on antibiotic resistance. But these problems can be overcome with the product standards we have established for this project.

On environmental impact, we are committed to determining what - if any - effects transgenic maize will have on our precious ecosystems. We plan on carrying out rigorous research to determine the impacts of Bt maize on non-target organisms such as beneficial insects, birds, and other wildlife. We will also examine the potential for the Bt genes to flow to other plants in our ecosystems, such as our wild grasses. However, since maize is not native to Africa, we do not anticipate that this will present the same concerns that it would in areas of the Americas, the center or origin for maize and its wild relatives.

To counter the build-up of resistance by the borers to Bt maize, we will develop varieties that carry multiple forms of resistance - for example multiple Bt genes and combinations of Bt genes and conventional resistance. So a borer population would have to develop multiple resistances rather than a single resistance to the Bt. This should greatly slow the process. In addition, management strategies will be developed together with farmers that maintain populations of non-resistant borers that will breed with potentially resistant borers and limit the buildup of resistant populations.

As you can see, there are many aspects to this new technology that we must consider that are not necessary with more conventional approaches. But the potential rewards are also great, not just in terms of limiting our crop losses to insects, but in developing the capacity of Kenyan researchers to work in this exciting cutting edge area of science.

The IRMA project brings together two institutions with proven track records - CIMMYT and KARI - to bring biotechnology and conventional breeding to bear on one of our major maize production problems - stem borers.

Objectives of IRMA project

- To produce maize with greatly increased insect resistance, using both conventional and biotechnological approaches to crop improvement.
- To provide experience in the development and enforcement of a range of regulatory procedures including biosafety protocols and intellectual property rights agreements.
- To assess the potential and actual impacts of insect resistant maize from environmental, economic, agronomic, and cultural perspectives.
- And perhaps most important of all, finding ways to help our farmers adopt the improved maize and to use it wisely.
We have given ourselves a five-year time frame for the initial phase of this undertaking, which is quite ambitious when you consider how much ground we have to cover.

We’ll be starting by having consultations such as this one here to gather input and feedback from the stakeholders in the project. We’ve already initiated surveys with the farmers to get a better feel for their situations and to gather baseline data so we can later assess the impact of the project.

To develop maize varieties that meet the farmers’ needs, we have developed a plan that will allow us to develop the maize that is resistant to stem borers but also carries other attributes desired by farmers and consumers.

**Varietal development strategy**

- **Identify Bt genes active against Kenyan stem borers**

  Various Bt gene constructs containing *cryIAb*, *cryIAc*, *cryIB* and *cryIE* have been developed by CIMMYT. These genes have also been inserted into tropical maize material; however, aside from the Bt genes, the maize carries the selectable gene(s) and perhaps other plasmid sequences. CIMMYT believes it is better to develop lines that contain only the gene of interest (in this case, the Bt gene) and is currently using this strategy in all of its genetic engineering projects.

  However, screening of the already developed germplasm with Kenyan stem borers would provide information regarding which gene and/or combination of genes are most effective against the targeted stem borers. Screening will be by bioassays with insect larvae of Kenyan stem borers on fresh leaves from maize transformed with these gene constructs.

  Outputs will be Bt gene(s) identified for resistance against *Chilo partellus*, *Busseola fusca*, *Sesamia calamistis*, and *Eldana saccharina*.

- **Develop transgenic maize germplasm**

  Transformation of the highly transformable hybrid CML216 x CML72 will be done initially in Mexico following the strategy by which only the desired gene is found in the final product. Partners from KARI will be trained in transformation technology in Mexico. Following introduction of transgenes in the initial line, putative transformants will be screened and successful ones will be identified for backcrossing into adapted Kenyan germplasm.

- **Identify target germplasm for transformation and for backcrossing to source germplasm**

  Target ecologies will be identified from KARI studies and yield loss assessment trials. Insect resistant germplasm from various sources will be screened for resistance to Kenyan stem borers through leaf toughness measurements and insect feeding in greenhouse and field trials. Further screening will be for ease of growth under greenhouse conditions and for adaptation to target regions in Kenya. Promising germplasm will also be screened for tolerance to on-farm abiotic stresses such as drought and low-nitrogen conditions.
• Evaluate initially resistant germplasm in greenhouse and field trials

All transgenic lines will be first evaluated in the biocontainment greenhouses at CIMMYT-Mexico for their level of protein production, inheritance of the gene and gene expression, and effect on those Lepidopteran insect species routinely reared in Mexico. This will allow the identification of the most promising events from the transformations to be imported into Kenya for further evaluations. It is proposed that the first trials in Kenya should be held in biocontainment greenhouses to simplify the application procedure. Once the lines have been tested for at least one cycle, field trials under controlled conditions will be considered. For all trials in Mexico and Kenya, the required applications will be developed and submitted to the appropriate authorities. No trials will be performed until full support and approval of the national and local authorities have been obtained.

• Backcross adapted Kenyan germplasm with transformed CIMMYT germplasm

Until Kenyan germplasm can be directly transformed, the inserted genes will be transferred by backcrossing already transformed CIMMYT germplasm to adapted Kenyan germplasm. Molecular markers will be used to decrease the time required for the conversions. This work may be done at KARI, if the necessary facilities are established, and/or at CIMMYT’s Applied Biotechnology Center.

• Transform Kenyan-adapted germplasm with Bt gene constructs

Ultimately, it would be desirable to directly transform Kenya’s germplasm especially if KARI is to adopt this activity in its laboratories. The first step will be to screen the selected lines identified in 6.1.4 for their regeneration ability. The lines found to have high levels of regeneration potential will then be screened for the ability to be transformed using a standard marker gene such as bar or gus. The best lines and/or hybrids will then be used for producing insertions of new insect resistant genes at KARI. It is anticipated that most of this work will be done in Kenyan laboratories, with technical backstopping provided by CIMMYT.

• Establish procedures to provide insect resistant maize to resource poor farmers in Kenya

Stem borer resistant maize germplasm is needed by Kenyan farmers to reduce the losses of the already low grain yield potential. Transgenic Bt gene-based insect resistance is a technology encapsulated in the seed, which will come to farmers at no extra cost beyond the cost of seed. This technology will also reduce dependency on pesticides, which small-scale farmers are poorly equipped to handle.

However, like all new technology, management of Bt gene-based insect resistance will require adjustments either in the technology and/or farming systems in Kenya. The three main areas that will require research attention are 1) insect resistance management (IRM); 2) agronomic performance of Bt gene-based insect resistant maize germplasm; and 3) the actual process of deployment of Bt gene-based insect resistant maize germplasm.

I must stress that great attention will be paid to following the prescribed biosafety regulations and protocols and giving our staff the high levels of training needed to conscientiously and effectively carry out these measures. At all stages of the project we will evaluate the impacts of the improved maize on
the environment and on farmers and consumers.

Finally, considerable effort will be devoted to training extension agents and working with farmers to help promote the adoption of insect resistant maize. Much attention will also be devoted to educating the general public on issues related to insect control in general and GM crops and foods in particular. We hope that this project can serve as a positive example to other nations on how we can develop partnerships between projects and institutions in the region to safely and responsibly put this technology to work for the betterment of our people and our nations.

Thank you for your attention and I look forward to hearing your views and questions on this project.
Dear Mr. Minister, Mr. Director, Stakeholders, KARI and CIMMYT scientists,

Allow me to offer my regrets, as I unfortunately cannot attend this important Stakeholders Meeting due to a series of prior commitments. Rest assured though that I recognize the groundbreaking nature of this project, and the significance of today’s meeting in bringing a wide cross section of opinions and perspectives together to discuss this project. I’d like to begin by saying that all of us at CIMMYT are extremely excited about the IRMA project for a number of reasons.

First, it gives us another opportunity to work together again with our colleagues in KARI. CIMMYT and KARI have a long track record of collaboration, including the ongoing African Maize Stress project, which I understand is beginning to produce cultivars that exhibit outstanding yields under low nitrogen and drought conditions.

Second, this is a project with a clear goal that will directly benefit the maize farmers of Kenya and hopefully the entire region, through the production of maize that possesses resistance to stem borers. As you may know, without the use of insecticides, these borers typically cut crop yields by 15 percent in Kenya and severe infestations can devastate entire fields. By developing borer resistant varieties, we put 15 percent more maize into the harvest baskets of those farmers and their families who are too poor to purchase those chemicals. For the farmers who are a bit better off, we save them the considerable time and expense involved with applying insecticides. This is a direct benefit to those who need it most!

Third, this project gives us the opportunity to address some of the persistent concerns - some with scientific merit and others without—about the use of biotechnology for meeting the pressing food demands of the developing world, especially sub-Saharan Africa. Indeed, this is one of the major issues that brings many of you here today. I anticipate a lively and constructive dialogue, and I trust that this will be the beginning of an inclusive partnership that ultimately benefits the small-scale farmers and the poor of Africa. In regards to this particular session, I would again like to emphasize the word constructive.
Today the media and internet are awash with information and misinformation, opinion and demagoguery about genetically modified organisms and the science surrounding them. I cannot help but be struck by how polarized people’s positions have become on this issue. Passions run high on both extremes and often reason gets lost in the heat of these battles. Pro-GMO campaigners call critics of the technology “Luddites” and broadly categorize them as “anti-science.” On the other hand, we have protest groups calling for more studies on the environmental effects of GMOs, while at the same time vandalizing and destroying the very trials that are aimed at investigating such scientific issues.

When we come to the critical question of how we are going to produce more food in the years to come, cooler heads simply must prevail. The lives of countless millions hang in the balance, and should we fail, the price in terms of human suffering will be enormous. Given this weighty responsibility, common sense dictates that we must responsibly explore the most promising options for increasing food production as well as the nutritional quality of food.

There are those that maintain that the food shortages of today and tomorrow are just matters of poverty and distribution. While this argument may hold some statistical merit in today’s world, its mere recitation will not relieve people’s hunger. We at CIMMYT believe the best way to get food to the rural poor is to have them grow it themselves. And the best way to help them out of poverty is to help them produce enough to sell to their urban brethren. Furthermore, in a world where 70 to 80 million people are added daily - the equivalent of two to three times the population of Kenya - current productivity gains will not meet future demand in the developing world. Where then will these gains come from? In the words of my colleague Per Pinstrup Andersen, the director general of the International Food Policy Research Institute, “Modern biotechnology is not a silver bullet for achieving food security, but used in conjunction with traditional or conventional agricultural methods, it can be a powerful tool in the fight against poverty (and hunger) that should be made available to poor farmers and consumers.”

The IRMA project, with its combination of approaches, follows just such a course. The techniques of biotechnology are used to complement those of conventional plant breeding, and extensive socioeconomic analyses will be employed to make sure that we develop a product that truly helps the poor farmers of Africa. Indeed, your input and our dialogue here today will also contribute to this effort.

CIMMYT and KARI are well positioned to take a balanced view and approach toward the potential benefits and risks of the technology and associated issues. We have no profit motive and no interest in promoting a technology for technology’s sake. We are; however, keen to carry out the impact research that the community is seeking.

To help us focus our later discussions, it might be useful to let you know exactly what CIMMYT’s role is in this project and also about some positions CIMMYT has already taken regarding GMOs.

Though this project is a true partnership, the responsibility for individual activities will vary between CIMMYT and KARI. In many instances CIMMYT will work hand and hand with KARI as equal partners, for instance on identifying germplasm which is well suited to Kenyan conditions, to use as the basis for insect resistant varieties. Much of CIMMYT’s contribution will come in terms of training. KARI staff will receive training in the development and evaluation of insect resistant maize at the laboratory, greenhouse, experiment station, and farmers’ field levels. Biosafety will be another key area of training as will seed production.

CIMMYT will play more of a backstopping role in other aspects of the project such as strengthening and implementing regulations and protocols for biosafety and intellectual property rights. Such backstopping will also be provided for the development of deployment strategies and associated training/extension materials. Finally, CIMMYT will take the lead in socioeconomic impacts and assessment work and in genetic transformation activities in the lab.
In regards to CIMMYT’s positions:

First, in accord with the policy of the CG system, we do not support the deployment of the so-called “terminator” gene or technology.

Second, concerns have been raised about the use of antibiotic genes in the development of transgenic products. Though most of the scientific community does not believe these pose a significant risk to either humans or the environment, this is not a unanimous view. CIMMYT is committed to the development of “clean genes” that carry only the trait of interest. Put bluntly, no transgenic produced by CIMMYT that reaches a farmer’s field will carry an antibiotic resistant gene.

A third concern is that transgenics can carry allergens to unsuspecting consumers. In reality, the natural world offers up an abundance of allergens and outright toxins that consumers unknowingly encounter. Nonetheless, our commitment to clean genes helps eliminate the possibility of such allergens being carried in our maize varieties.

In terms of human health concerns, we closely monitor the news on this front, and have found nothing to supplant the stated views of the World Health Organization, the United Nations Food and Agriculture Organization, the United States Department of Agriculture and many other reputable organizations—that these foods are safe for human consumption. If someone can offer authoritative evidence to the contrary, we will of course be anxious to review it.

In so far as the buildup of insect resistance, CIMMYT’s approach is to counter this by pyramiding resistance genes and mechanisms in the maize plant and to develop management strategies, including integrated pest management, to accompany and enhance the control strategy. Such an approach relies on getting an accurate read on farmers’ situations and practices and indeed this is a major part of this project.

Finally, CIMMYT is unswerving in its commitment to developing and implementing biosafety procedures and policies that safeguard the environment and the nation’s agriculture. There will be no concessions on this front as doing so would ultimately compromise our mission to help the resource poor in Kenya, East Africa, and the developing world.

Do questions and issues remain? Of course they do. But the partners on this project are committed to asking the right questions and undertaking the exhaustive research needed to provide solid scientific answers to address these concerns. We owe this to you the stakeholders and most of all, we owe it to the current and future generations of African farmers. I wish you the best in your discussions and look forward to reviewing the discourse.

Yours Sincerely,
Timothy Reeves,
Director General, CIMMYT
We are here to inform a wider public about details of a research joint venture between KARI, CIMMYT, and the Novartis Foundation for Sustainable Development. You have heard about the agricultural and scientific background of this project from my colleagues. I will use the next three minutes to describe why Novartis is supporting CIMMYT and KARI to implement this project. The rest of my speaking time will be devoted to some remarks about the lack of societal acceptance of genetic engineering in Europe and the possible consequences for public research devoted to the problems of resource-poor farmers in the developing world.

- **Why is the Novartis Foundation for Sustainable Development spending more than $6 million to support this project?**

The answer is quite simple: It is the mission of our foundation “to foster sustainable development in developing countries through the support of programs and projects in the areas of sustainable agriculture, health and social development.”

We are doing this through conceptual research and practical programs, in particular by strengthening development capacities, supporting self-help efforts, and developing and implementing innovative strategies for improving the effectiveness of programs and projects. Agriculture plays the leading role in development. As a result of continually high rates of population growth, agricultural development programmes face one of the major challenges of the coming decades – namely, the challenge of producing enough food for steadily growing populations while also conserving natural resources.

When CIMMYT asked us whether we would support the “Insect Resistance Maize for Africa Project”, we agreed for the following reasons:
- CIMMYT is an excellent research institution with a world-wide reputation for practicing good science and we are pleased to cooperate with such a partner.
- The problem to overcome - damage to the maize harvest inflicted by insects - is acknowledged, and innovative solutions are available but not yet accessible in sub-Saharan Africa.
- We do not believe in scientific apartheid and do not want to exclude countries in sub-Saharan Africa from cutting-edge research. We therefore support scientific capacity building and transfer of technology, including on biosafety.
- To the best of present judgement, nobody has demonstrated, that genetically modified organisms have any substantial, long-term health hazards for humans or animals -- neither is there any empirical proof of danger to the environment in millions of hectares planted with GMOs so far.

There is neither a commercial interest nor a hidden political agenda behind this project. We are supporting KARI and CIMMYT to use state-of-the-art methods of preparing and implementing this project, and prefer to invest more in preparation rather than leaving important questions open. We are convinced that there can be no double standards with regard to quality of research, quality of fieldwork, and quality of safety of all kinds.

As there is nothing to hide, we also encouraged today's conference in order to give all stakeholders the opportunity to ask questions to the different project partners rather than relying on insinuations or - even worse - rumours.

- Societal acceptance, funds for public research, and sustainable agricultural progress

You all are aware that in some European countries a kind of bio-McCarthyism is taking place, leading to slandering and vilification of anybody who sees genetic engineering and green biotechnology as anything but a nail in the coffin of modern society. in this climate, risks of field trials of genetically modified organisms (GMOs) are compared with the impact of nuclear disasters such as Hiroshima or Chernobyl. Activists who are spreading hitherto unfounded rumors that GMOs are dangerous are creating an atmosphere of violence and call for the destruction of field trials that would prove the safety of GMOs. Northern NGOs are trying to export this distorted view to the developing world, insinuating that they know best what is good for the developing countries and its scientific community.

Whenever risks with extremely low likelihood are blown up through worst-case scenarios to become monstrous "Bio-twisters", something has gone terribly wrong. Web sites are calling for vandalism and destruction as well as attacks on research facilities and corporate headquarters - all this, by the way, in the name of helping the people in the developing world. As the media is more likely to take up wild stories about the creation of monsters than stories about slow but steady progress toward better crop varieties for resource-poor farmers, a certain kind of semantics and argumentation has direct relevance for societal perception of a technology.

While I agree that we should not deny or belittle potential risks and not be arrogant towards those who do not share our points of view, or even discredit them as stupid or liars, I am at a loss to explain how one can have a dialogue with people who have made up their minds before we discuss facts and figures.

We from the Novartis Foundation want to go on record for taking opposing views seriously and engaging in an ongoing stakeholder dialogue. We believe in the necessity and value of benefit/risk analyses and support consistency in standards as well as communication. We know that there are no simple solutions to complex issues and therefore invite different parties with different values and differing interests to find common solutions.

Having said this, I want to remind you, however, of the background of all endeavors in agricultural research: This is no playground for politics and it is no stage for boosting NGO-portfolios. The United
Nations observed October 12, 1999, as the day of Six Billion - the world's population had doubled since 1960. Most population experts share the expectation that the world's population will probably grow by another 50 percent - in absolute numbers, by nearly three billion by the year 2050. Almost all this population growth will happen in the less developed regions. This is the part of the world where today an estimated 800 million people do not have enough to eat, and countless children die from nutritional deficiencies or grow up with reduced physical or intellectual abilities. More food will have to be produced with fewer resources.

Available knowledge suggests, that water, the source of all life, is going to become even scarcer: More than a quarter of the world's population, or a third of the population in developing countries, live in regions that will experience severe water scarcity. There is growing concern that the developing world is facing a decline in long-term productivity of agricultural soil resources. Already today, the area of degraded soils is extensive and the effects of soil degradation on food consumption by the rural poor, on agricultural markets, and hence on farm incomes are significant.

With land becoming less abundant, increases in cultivated area are expected to contribute only to a small extent to increased food production. Hence higher production quantities to feed a growing world population will have to come predominantly from yield increases. The annual growth of cereal yields from conventional breeding, however, has diminished substantially since the period 1967 - 1982 and is expected to diminish further. At the same time, funding for yield-increasing public crop research is - due to the negative discussion about the Green Revolution - at best stagnating, if not declining. A continuous negative discussion in the terms described before will accelerate the drop of funds for public research, because politicians will try to close their budget gaps in areas that have drawn controversy and in which there is support for zero funding.

Agricultural development that raises productivity and incomes either directly or indirectly for the poor is still an eminent precondition for other development processes to be initiated - it is certainly a precondition for alleviating absolute poverty. To initiate such a development in a sustainable way involves many political and social changes. But modern inputs such as genetically modified seeds that bring good yields on marginal land, are tolerant to pests as well as other stress factors, and deliver food in good quality can be an important help for resource-poor small farmers.

Many concerned citizens worry today that biotechnological research is too concentrated in the private sector, and that its results are patented and hence may prove to be too sophisticated or expensive for resource-poor farmers. The worry is justified: When research priorities are determined by the financial return on investment, the needs of those who have the purchasing power are likely to have higher priority than the poverty eradication needs of small farmers. For this reason public research must be strengthened, because its fruits can be passed on to small farmers at cost or, via government channels, even free of charge.

To accelerate progress, there must be more and more-intensive public-private partnerships. The special knowledge and know-how and the different experience - and patented intellectual property - at the disposal of the private sector but used only selectively for lucrative markets in industrial countries could be passed on via donated transfers or very favorable licensing terms to public research institutes in developing countries. The feasibility of this has already been demonstrated by a number of concrete examples, with Novartis having been one of the first on record.

Let us all work together to make this project a pilot for excellent partnership and co-operation. Let us all work together to make this project one that others can learn from and will refer to. It can be done - and if we all want it, it will be done.
Question and Answer Session

Question: Are we addressing the market too? What if other countries reject maize imports from Kenya?
Answer: Yes, concern for the market is apt; but first we need food for our people.
Comment: An emphasis that biological control is not an expensive method. How expensive depends on the means to be used to achieve control. The only bio-control method that is expensive is the pathogens that need to be applied repeatedly to achieve control. Otherwise, most parasites and predators, once established in the environment, continue to multiply and do their job and the farmer does not need to use any money—the biocontrol agents continue doing their job. While we develop this project, we need data on the effects of the Bt toxin on beneficial insects such as biocontrol agents and other beneficial nontarget organisms. The idea is that the transgene maize technology complements the existing operating effective cheap control methods.

Question: How will extension work with research on this project?
Answer: Agricultural extension is very ready to go.
Comment: Farmers in Kakamega are ready for new technologies, as witnessed by recent high harvest of maize thanks to striga weed “control”.

Question: What is the status of land available for research?
Answer: The principle is that now all research land must be protected. The commissioner of lands has ordered that all KARI land be registered and for the Director of KARI to hold titles to such land.

Question: What is the relationship between the Novartis Foundation for Sustainable Development, the Novartis Corporation, and the technology?
Answer: Biotechnology is important for agriculture and pharmaceuticals. Novartis Foundation does not have a commercial interest in promoting Novartis Company products.
Comment: Apologizes for the absence of the Director General of ICIPE. ICIPE has taken a very neutral and balanced position on GM crops, but stressed the need to seriously address, through research, issues related to potential environmental consequences of the introduction of GM crops into Africa.
Response: ICIPE holds a middle-of-the-road view that new technology, including GM food, is good for Africa: why test the consequences, e.g., effect on the environment (such as possible effect of Bt on biological control agents).

Question: What legislation or strategies exist to combat invasion of foreign strains of pests?
Answer: There are quarantine requirements to prevent unauthorized imports into Kenya. Importation into Kenya is also subject to reputation. There are regulatory and phytosanitary inspections. There is a Committee in place to vet all foreign importation of agricultural and other commodities. However, cross-border pest infection is difficult for control.
Question: Could this project find ways and means to support the support groups such as the regulatory bodies, e.g., National Biosafety Committee (NBS) and improve their inventory, evaluation and information sharing among the stakeholders?

Answer: Yes, these bodies need to be supported, depending on what is needed. These concerns about NBS are genuine as they require support and such support needs to be built into new projects.

Question: How will we tell whether an import of maize is carrying the Bt gene?

Answer: Declaration form, labeling, policing at the port.

Comment: It is imperative that the use of this technology, as indeed others, be undertaken closely by extension and the scientists.

Response: Agreed. The Ministry of Agriculture and KARI have the research-extension links. This linkage may not have excelled but partners are doing their best.

Comment: A draft ABSF statement on Biotechnology. After ABSF, more people now have a positive attitude towards biotechnology. There are noteworthy examples of countries using biotechnology products today, in particular China, which is going ahead with GMOs as a major part of their food production policy.

Comment: The Rockefeller Foundation (RF) representative has seen a rare opportunity to be visionary and practical at the same time. The RF is working in partnership with others to bring an agricultural revolution to Africa.

Comment: Commendation to CIMMYT/KARI/RF. Noted it is not easy to balance what you need to do (help poor countries) while satisfying shareholders. Stem borers are biggest problem, but termites are also important. Expressed need to look into other crop production problems from IPM approach. Need to educate farmers on various technologies.

Comment: Convinced we should move ahead on new Bt maize. Will we look into consumer acceptability aspects (e.g., taste) when Bt maize is deployed?

Response: We are looking into this, including the marketing aspects. We will seek experts in the country, especially from the National Universities.

Comment: Cost of technology: current hybrids package is too expensive, which leads to problems in adoption of hybrid maize. Farmers are increasingly using their own seeds. Will there be a premium on Bt maize?

Response: Cost of seed is a factor, but competition could bring down the price of seed to a reasonable level. This technology will not be monopolized. However, you cannot get something for nothing—higher outputs should allow more funds for input.

Question: What are the likely effects on the ecosystem of the GMOs on our farms?

Answer: These issues will be areas of experimentation in the process of implementation. KARI and CIMMYT need suggestions as to what should be done.

Question: What are we doing about other constraints facing farmers?

Answer: The economy does not allow for all issues to be addressed right now; we have to prioritize.

Comment: Indicate the farmers' role in the biotechnology research cycle. The need to improve the traditional seed varieties. Look at the issue of benefit sharing between the farmers and the private sector. There is need to conserve traditional biodiversity of crop varieties.
Comment:  KNFU has educated its farmers not to listen to all negative comments on new technologies; we need more food to keep away hunger. KNFU is very encouraged by MoA move in the right direction. There is need to disseminate new information to our farmers more effectively. What happens when we have the eco-balance disturbed when we deploy the Bt maize? Kenyan farmers need support, e.g., credit to do more effective farming.

Response:  We need strong farmer institutions, but with the present state of the economy, we must prioritize. Yes, we need to study the consequences of ecosystem imbalance. There is need to educate other stakeholders to take this technology on board. Solve problems through scientific pluralism, if one method does not work, we look into another. We accept proposals and ideas on how to undertake studies to answer questions related to the deployment of the technology in Africa.

Comment:  IP issues are worrying from the perspective of the National Environment Secretariat. How will benefits be shared? Who will benefit? Are the MOUs among KARI/CIMMYT/NF? If there are, shouldn’t farmers be included too? There is need to conserve biological diversity and to preserve the indigenous varieties as you deploy this new technology.

Response:  There is no MOU with Novartis Foundation as the foundation has no interest in IPR on the Bt technology. The alliance and product is between KARI and CIMMYT, and not KARI and NF.

Question:  It is possible that NGOs can link KARI with farmers in the dissemination of the Bt technology. Technology should also target OPVs so that farmers who use their own seed can also benefit. Will open pollinated varieties (OPVs) also be considered when implementing the technology?

Answer:  KARI can also work closely with other partners such as NGOs, women groups, and church groups to strengthen extension. KARI works very closely with Agricultural Extension, even in the face of serious resource constraints; now we do not even have an MOU but KARI and Ag. Extension are in the same ministry (Ministry of Agriculture). Agricultural extension now goes beyond MoA; NGOs are also involved. We’ll work with honest NGOs carefully, as some NGOs lack background knowledge on the technology. The project recognizes the need to develop OPVs carrying the Bt gene so that more farmers can benefit.
List of Participants KARI/CIMMYT IRMA Project Stakeholders Meeting, 3 March 2000, Panafic Hotel, Nairobi, Kenya

- Achieng Judith - IPS (inter Press Service) Box 42005 Nairobi, Tel: 240951 Fax: 240951 Email: ipsnrb@iconnect.co.ke
- Akanga Laban - Farmer - Box 70 Kipkarren River Lugari
- Ayiecho P.O. - UoN Dept of Crop Science - Box 29053 Nairobi, Tel: 631277 Fax: 336885 Email: phealth@nbnet.co.ke
- De Groote Bugo - CIMMYT - Box 25171 Nairobi, Tel: 524600 Fax: 522879
- DeVries D. Joseph - The Rockefeller Foundation - Box 47543 Nairobi, Tel: 228061 Fax: 218840 Email: jdevries@rockefeller.or.ke
- Diallo A.O. - CIMMYT - Box 25171 Nairobi, Tel: 552278 Fax: 522879
- Fitzhugh Hank - ILRI - Box 30709,Nairobi, Tel: 630743; Email: h.fitzhugh@cgiar.org
- Frei Jost - Novartis Foundation for Sustainable Development Box 14002 Basel Switzerland Tel: 41-61-6977200, Fax: 41-61-6977104; Email: jost.frei@novartis.group.com
- Friesen Dennis - CIMMYT - Box 25171 Nairobi, Tel: 524607 Fax: 52287 Email: d.friesen@cgiar.org
- Gachi Macharia - KARI RRC Embu - Box 27 Embu, Tel: 0161-20116 Fax: 30064, Email: icraf_emb@cgiar.org
- Gogo Barack - Picasso Production - Box 49030 Nairobi, Tel:335252 Fax: 338002
- Hoisington David - CIMMYT APDO POSATAL 6-641,06600 Mexico
- Jetzer Alexander F. - Novartis Foundation for Sustainable Development - P.O Box CH4002 Basel Tel: 41-61-6970403 Fax: 41-61-6970416 - Email: Alexandre.jexter@novartis.group.com
- Jurg Burgi - Journalist - Box 425 CH400J Basel
- Kanampiu Fred - CIMMYT - Box 25171 Nairobi
- Karanja Mercy - Kenya National Farmers Union - Box 43481 Nairobi, Tel: 608324 Fax: 608325 Email: knfu@arce.or.ke
- Kataka Peter - Farmer, Kakamega Box 27 Khwisero
- Kedera Chagema - KEPHIS Box 49592 Nairobi, Tel: 440087 Fax: 448940 Email: kephis@nbnt.co.ke
• Keino Alexander - Farmer, Box 1990 Kitale, Tel: 0325-552446
• Kimani Grace - KARI Box 57811 Nairobi, Tel: 583301-20; Email: gkimani@kari.org
• Kimenye N. Lydia - UoN, Dept of Agri. Economics Box 29053 Nairobi, Tel: 632150 Fax: 631815 Email: kimenye@form-net.com
• Kiome M. Romano - KARI - Box 57811, Tel: 583301-20 Fax: 583344
• Kituyi Evans - ACTS - Box 45917 Nairobi, Tel: 524711 Fax; 522987; Email: e.kituyi@cgiar.org
• Lago Daniel - Maoni Network (The Scholar) Box 66247 Nairobi, Tel: 211752
• Leisinger Klaus - Novartis Foundation for Sustainable Development
• Mailu M. Andrew - KARI, Box 57811 Nairobi, Tel: 583299
• Maina Henry - Action Aid/AWC Box 21561 Nairobi, Tel: 247393
• Mathai Charles - Kenya Times Box 30958 Nairobi, Tel: 241763
• Mbaya J.S.K. - NCST Box 30623 Nairobi, Tel: 336173, Email: nest@insightkenya.com
• Muchendu N. Eliud - Ministry of Agriculture Box 30228 Nairobi, Tel: 632161/340081 ext. 448
• Mugera S. K. - NES 67839 Nairobi, Tel: 242569 Fax: 248851; Email: mec@nairobi.net.or.ke
• Mugo Stephen - CIMMYT Box 25171 Nairobi, Email: s.mugo@cgiar.org
• Mungai Kure Naftali - The People Newspaper - Box 48647 Nairobi, Tel: 253166/8/9 Fax: 225334 E-mail: nmungai@people.co.ke
• Mutemi Tabitha - Broadbase Promotions Box 74624 Nairobi, Tel: 212945 Fax: 242066
• Muthoni Agatha - Farmer Box 183, Embu
• Munyao Nguta Edward - Farmer/KABP - Box 36 Kithimani, Yatta, Machakos Phone: 0158-55221 (c/o Mr. Andrew Munyao)
• Mwangi Wilfred - Ministry of Agriculture Box 30028 Nairobi, Tel: 725723
• Ndambuki M. Francis - Kenya Seed Box 553 Kitale, Tel: 0325-20941
• Ndiritu G. Cyrus - KARI, Box 57811 Nairobi, Tel: 583291
• Ngaruiya W. Ruth - Farmer, Box 470 Githunguri
• Ngeno J.K. - Ministry of Agriculture, Box 30028 Nairobi, Tel: 729562 Fax: 729619
• Njeru Kenneth - Farmer Box 555 Embu
• Njoroge Kiarie - KARI Katumani - Phone: 0145-21122

• Nyambati Mbogah - Association of Food and Agriculture Journalists (AFAJ) Box 45837 Nairobi
  Tel: 224495/337755 Fax: 215807

• Nzioka Betty - Dept of Resource Survey and Remote Sensing (DRSRS) Box 47146 Nairobi
  Tel: 502223-6 Fax: 504777 - Email: bettynzioka@yahoo.com

• Obure Christopher - Minister for Agriculture

• Ochanda James - UoN, Dept of Biochemistry Box 30197 Nairobi,
  Tel: 442534/445694 Fax: 442841, Email: jochandy@healthnet.or.ke

• Ochieng A.W. Joseph - KARI - Box 57811 Nairobi, Tel: 583301-20

• Odhiambo Benjamin - KARI - Box 57811 Nairobi, Tel: 440113, Email: bodhiambo@arcc.or.ke

• Odongo M. Omari - KARI Box 169 Kakamega, Tel: 0331-30062 Fax 30049

• Ogoyi D. - UoN - Box 30197 Nairobi

• Okech Arnold - KARI, Box 57811, Nairobi

• Okeno E. Drecky - Farmer Kakamega - Box 125 Butere

• Okong’o Paul - Farmer Kakamega, Tatro Central Farmers’ Group, - Box 34, Yala

• Okore George - Central Africa News Agency Box 4705 Nairobi, Tel: 2472546 Fax: 247246
  Email: okore@studio.Africaonline.com

• Okwemba Arthur - African Women and Children Features Services - Box 48197 Nairobi
  Tel: 718469, 720554, 724756 Fax: 718469; Email: awcin@kenyaonline.com

• Olembo Norah - KIPO, Box 51648 Nairobi, Tel: 219430/244821 Fax: 219430; Email: kipo@arcc.or.ke

• Omondi Alfred - Association of Food and Agriculture Journalists (AFAJ) - Box 45837 Nairobi
  Tel: 606071 Fax: 211996; Email: strucap@icconnect.co.ke

• Oundo Geoffrey - Insight Media Consultant’s Box 63487 Nairobi, Tel: 823716/17

• Overholt William - ICIPE - Box 30772 Nairobi, Tel: 802501 Fax: 803360; Email: woverholt@icipe.org

• Owour Otula - Africa Sciences Box 76336 Nairobi, Tel: 577935 Fax: 250330
  Email: dataease@swiftglobal.com

• Poland David - CIMMYT, Mexico APDO POSATAL 6-641,06600 Mexico, Email: dpoland@cgiar.org

• Rangi Dennis - CAB International - Box 633 Nairobi
• Rwambo Paul - Biosystems Resource Management, Box 18052 Nairobi, Tel: 530312 Fax; 584585 Email: biosystems@iconnet.co.ke
• Seyfu Ketema - Ethiopian Agricultural Organization - Box 2003 Addis Ababa Ethiopia Tel: 251 1 612572 Fax 251 1 611222
• Siambi Moses - KARI Katumani - Tel: 0145-20403, Fax; 0145 – 20403
• Songa Josphine - KARI - NDFRC Katumani - Tel: 0145 21146
• Songa Wilson - KEPHIS - Box 49592 Nairobi, Tel: 440087 Fax: 448940, Email: kephis@nbnt.co.ke
• Strano Mike - Aventis Cropscience Box 30438 Nairobi, Tel: 447356 Fax; 445458 Email: mike.strano@aventis.com
• Von Kaufmann Ralph - ILRI Box 30709 Nairobi, Tel: 630743 Fax; 631499
• Wabomba Janet - Central Africa News Agency Box 4705 Nairobi, Tel: 2472546 Fax: 247246
• Wafula John - KARI - Tel: 583343
• Wambuugo Florence - ISAAA Africentre Box 25171 Nairobi, Tel: 632054 Fax: 631599
• Waswa Simon - Photojournalist Box 21903 Nairobi, Tel: 717717/578000 pager No. 4478
• Wekundah Joseph - KABP/ETC EA, Tel:4454212/3 Fax: 445424, Email: etc@africaonline.co.ke
• Wondera James - The People Newspaper, Tel: 253166/8/9, Email: jwodera@people.co.ke
Press Package Background Articles


- Nature 401. *Developing Countries Look for Guidance in GM Crops Debate* by Colin MacIlwain

- Center for International Development at Harvard University (CID). *Learning from crisis: How (not) to read the GM food controversy* by Prof. Sheila Jasanoff.


- Independent (London) October 11. The study that sparked the furore over genetically modified food has failed the ultimate test of scientific credibility.

- Agriculture Online. *Anti-GMO sentiments will fade shortly, says Nobel winner* by Dan Looker, Business Editor, Successful Farming.


**Background Articles - (distributed to all stakeholders at meeting)**

- FAO Press Release. Biotechnology can help feed an increasing world population—its positive and negative aspects need to be balanced.


List of Invited Stakeholders for the Insect Resistance Maize for Africa (IRMA) Project Stakeholders Meeting (March 3 2000)

Participants:

KARI scientists

CIMMYT scientists

Director of Agriculture, Ministry of Agriculture and Rural Development

Directors of all interested NGOs (Green peace and Greenbelt movement)

Chairman, Kenya Agricultural Biotechnology Platform

Chairman KARI Biosafety Committee

Chairman, National Biosafety Committee

Director, KEPHIS

Director, Kenya Industrial Property Office (KIPO)

Managing directors of seed companies dealing with maize in Kenya

Representatives of three small- and three large-scale farmer groups

Leaders of two womens’ groups working with KARI

Churches (two representatives involved in agricultural projects)

Managing Director, Kenya National Farmers Union

Farmers’ cooperatives (two representatives)

Journalists (editors of all major newspapers)

Secretary, National Council for Science and Technology

Director, Kenya Bureau of Standards

Director, Novartis Foundation

The Rockefeller Foundation

Director, ACTS

ISAAA Afri-Center Director

Director, ICIPE

Director, UNEP

Chairmen, UON Agricultural Economics and Crop Science Departments

Representatives of food processors
The Kenya Agricultural Research Institute (KARI) was established in 1979 with the express mission of increasing sustainable agricultural production by generating appropriate technologies through research, and disseminating these to the farming community. Inherent to this mission is the protection, conservation, and improvement of the basic resources, both natural and human. Such resources are critical for Kenya’s agricultural development and expansion of the nation’s scientific and technological capacity. KARI has an extensive history of productive collaborators with national and international institutes and universities, as well as with the private sector.

CIMMYT® (www.cimmyt.cgiar.org) is an internationally funded, nonprofit scientific research and training organization. Headquartered in Mexico, the Center works with agricultural research institutions worldwide to improve the productivity, profitability, and sustainability of maize and wheat systems for poor farmers in developing countries. It is one of 16 similar centers supported by the Consultative Group on International Agricultural Research (CGIAR, www.cgiar.org). The CGIAR comprises about 60 partner countries, international and regional organizations, and private foundations. It is co-sponsored by the Food and Agriculture Organization (FAO) of the United Nations, the International Bank for Reconstruction and Development (World Bank), the United Nations Development Programme (UNDP), and the United Nations Environment Programme (UNEP). Financial support for CIMMYT’s research agenda also comes from many other sources, including foundations, development banks, and public and private agencies.

CIMMYT supports Future Harvest,® a public awareness campaign that builds understanding about the importance of agricultural issues and international agricultural research. Future Harvest links respected research institutions, influential public figures, and leading agricultural scientists to underscore the wider social benefits of improved agriculture—peace, prosperity, environmental renewal, health, and the alleviation of human suffering (www.futureharvest.org).

The Novartis Foundation for Sustainable Development provides major funding for the project. The Foundation is dedicated to fostering sustainable development in poor countries of the South through its support of programs and projects in the areas of sustainable agriculture, health, and social development. It is also an active player in development policy debate through its preparation and dissemination of research analysis. Further information about the Foundation may be found at its web site (www.foundation.novartis.com).

The Insect Resistant Maize for Africa (IRMA) Project was launched in 1999 as a collaborative effort between CIMMYT and KARI. Its primary goal is to increase maize production and food security for African farmers through the development and deployment of maize that offers resistance to destructive insect especially stem borers. To achieve this goal, project scientists will identify conventional and novel sources of resistance to stem borers and incorporate them into maize varieties that are both well-adapted to Kenya’s various agroecological zones and well-accepted by its farmers and consumers. Varieties and technologies that are appropriate for other African nations may be extended to them for their use.