CIMMYT's Formal Training Activities:

Perceptions of Impact from Former Trainees, NARS Research Leaders, and CIMMYT Scientists

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CIMMYT

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CIMMYT® (www.cimmyt.org) is an international, not-for-profit organization that conducts research and training related to maize and wheat throughout the developing world. Drawing on strong science and effective partnerships, CIMMYT works to create, share, and use knowledge and technology to increase food security, improve the productivity and profitability of farming systems, and sustain natural resources. CIMMYT is one of 15 Future Harvest Centers of the Consultative Group on International Agricultural Research (CGIAR) (www.cgiar.org). Financial support for CIMMYT's work comes from the members of the CGIAR, national governments, foundations, development banks, and other public and private agencies.

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Abstract: This report provides information on the impact of CIMMYT training, based on a set of background interviews with center staff, reviews of relevant data and documents provided by CIMMYT, and two surveys: one of research leaders in trainees' countries of origin and one of participants in CIMMYT courses on maize and wheat improvement, quality protein maize, soil-borne pathogens of cereals, and maize stress breeding during 2002-04. Evidence indicates that training provided by CIMMYT not only furnishes new knowledge and skills, but results in new ways of thinking about research and new research partnerships, is often shared within trainees' home institutions, and changes the way the institutions work. The evidence in this study establishes the existence of impact but does not support conclusions about its extent.

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1. Executive Summary

The International Maize and Wheat Improvement Center (CIMMYT) allocates approximately 5% of its operating budget to training and professional development. This report addresses the need for current information about the impact of CIMMYT training. It opens by providing background information: an overview of center training activities and past studies on training at CIMMYT. The actual study is based on a set of background interviews with center staff, reviews of relevant data and documents provided by CIMMYT, and two surveys: one of former trainees and one of research leaders in the trainees' countries of origin. It focuses on formal group training activities; it does not address other CIMMYT capacity-building activities such as collaborative research, visiting scientist appointments, doctoral and post-doctoral fellowships, or support for thesis research, to name several. We interviewed participants in courses on maize and wheat improvement, quality protein maize, soil-borne pathogens of cereals, and maize stress breeding held at CIMMYT-Mexico and in India and Turkey during 2002-04.

All sources of evidence indicate that training provided by CIMMYT achieves many of its goals. For the individual trainee, it not only furnishes new knowledge and skills, but results in new ways of thinking about research and new research partnerships. The individual trainee often shares his or her knowledge with colleagues and brings new research materials and approaches to his or her institution. In time, these new materials and approaches can create changes in agricultural practices, such as enabling farmers to be more involved in the development of new varieties, increasing productivity in dry areas, or improving the quality of seed. According to CIMMYT scientists and research leaders in developing nations, CIMMYT training integrates new knowledge with hands-on practice and the dissemination of new materials, as well as creating collaborative relationships that facilitate work toward CIMMYT's mission.

The evidence in this study establishes the existence of impact but does not support conclusions about its extent.

2. Introduction and Overview

Building the capacity of developing nations to conduct research for the improvement of maize and wheat and related cropping systems is a part of CIMMYT's mandate and heritage. Training, which is just one kind of capacity building, has been at the core of CIMMYT's work. Since 1966, more than 3,000 people have participated in its training activities. In addition, more than 4,000 have worked as visiting scientists to learn about the center's facilities and interact one-on-one with its scientists. As these figures indicate, CIMMYT has made a huge investment in training and related activities over the years. For the past several years, the center has dedicated around 15% of its budget to activities intended to strengthen the capacity of national agricultural research systems (NARSs) in developing nations. Of this, approximately 5-7% is spent specifically on training and professional development. In its medium-term plan for 2005-2007, CIMMYT continues this pattern, allocating approximately 5% of its operating budget each year to training and professional development. This kind of investment warrants a systematic review of the impact of CIMMYT training.

There has not been an overarching assessment of CIMMYT's training activities since 1983, when a survey of past trainees was conducted.[1] This report addresses the need for current information about the impact of CIMMYT training. In the context of the long history and large scope of CIMMYT training activities, the study described here is limited. It consisted of a set of background interviews with CIMMYT staff, reviews of relevant data and documents provided by CIMMYT, and two surveys—one of former trainees and one of research leaders in developing nations that have sent scientists to CIMMYT for training. One of the major limitations of the study is its focus on formal group training activities. Information on visiting scientists, doctoral and post-doctoral fellows, and other one-on-one kinds of training is not included, except where it emerged in data collected on the group training activities. The report is organized in four sections. The rest of this section provides an overview of CIMMYT training, outlines its key principles and expected outcomes, summarizes previous evaluations of the impact of CIMMYT training, and briefly describes the two surveys. Section 3 presents the results of the trainee survey, and Section 4 describes the findings from the survey of research leaders. The final section discusses the results of the two surveys in light of the strengths and weaknesses of the study and considers implications for CIMMYT's plans for training in the future.

Overview of CIMMYT training

This overview describes the CIMMYT training program, drawing on a database of training activities from 1991-2001 compiled for a system-wide study of training by the Consultative Group on International Agricultural Research (CGIAR), a catalogue of MSc theses and doctoral dissertations compiled by the CIMMYT library, and recent medium-term plans.[2] The two data sets are not comparable. The 1991-2001 data are limited to

[1] The survey findings are summarized in "A Partial Analysis: CIMMYT In-Service Trainee Questionnaire, " September 8, 1983, available in the CIMMYT library. An external review commissioned in 1984 did not look at impact, focusing instead on implementation issues.

[2] A database of training and other professional development activities in 2003 was compiled by CIMMYT's training coordinator in early 2004. This database was not used because it included all kinds of training, including field days and visiting scientists and students supervised by CIMMYT scientists, and thus was not comparable to the 1991-2001 data reported to the Science Council Secretariat.

formal courses and may under-report those (Appendix A provides tables detailing the 1991-2001 data by year). As a result of a strategic planning process in 2003 and staff turnover, the structure of CIMMYT's training program is in transition, so the description provided here may not be relevant to the current or future training program.

Training and other capacity-building activities. Table 1 lists the activities through which CIMMYT builds NARSs' capacity. As shown, these activities have different levels of intensity and vary in location.

As mentioned earlier, this report will focus on the formal training courses described in the first two rows of the table. However, much of CIMMYT's capacity-building takes place through one-on-one mentoring and other kinds of support. In 2003, CIMMYT scientists supervised 60 PhD and 30 MSc students, and hosted 77 visiting scientists. From 1993 to 2003, CIMMYT hosted over 1,100 visiting scientists, with the largest numbers coming from China (154), Mexico (109), India (98), the United States (47), and Kenya (44). Looking even farther back, CIMMYT librarian John Woolston has compiled a list of 768 theses and dissertations published since 1966 and representing the work of 708 scientists from 74 countries, developing and developed.[3]

In a database provided to the CGIAR Technical Advisory Council (now the Science Council) in 2002, 184 courses were recorded during 1991-2001. Figure 1 shows the number of courses offered each year.

Course topics. CIMMYT has offered two kinds of courses: long courses focused on basic and advanced skills in maize and wheat breeding and on crop management, and shorter courses focused on specialized topics, including but not limited to experiment station management, analysis of nutrient response trials, wheat diseases and their control, molecular markers in breeding, scientific writing, gender analysis, and socio-economic analysis. The most commonly offered courses are listed in Table 2. These make up more than half of the courses listed in the 1991-2001 data set.

Table 1. CIMMYT's capacity-building activities by length and location.

Capacity-building activity	Length	Location
Long courses	3-9 months	Mexico
Short courses (includes workshops and conferences)	1 day-2 months	Mexico and regions
Mentoring and support of scientists and technicians who are visiting CIMMYT	Variable	Mexico
Mentoring and support of scientists and technicians by going to national programs	Variable	Regional
Mentoring and support of students	Variable	Mexico and regions
Facilitation of networks	Ongoing	Regional
Publications	Ongoing	Available worldwide

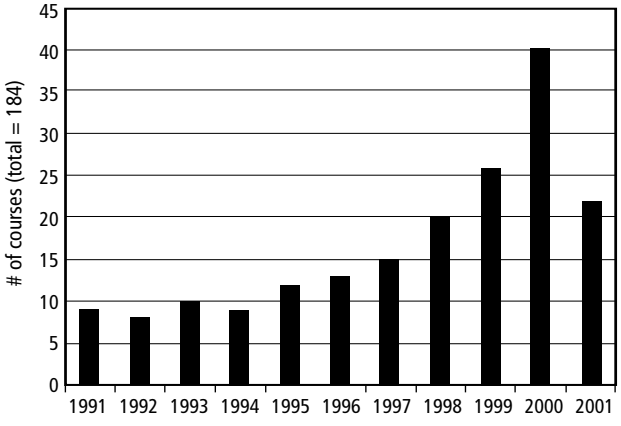


Figure 1. Number of formal training courses, 1991-2001.

[3] The criteria for inclusion in this list were:
"CIMMYT must be named, and its support - either financial or through the use of its research resources - must be recorded in the thesis itself or in a journal article based on the thesis. An acknowledgement to CIMMYT for the use of its seeds or its library is not sufficient to make a thesis eligible; nor is an acknowledgment to a member of CIMMYT's staff, whether for scientific counseling, for moral support, or for serving on the thesis committee." The list can be found at: http://www.CIMMYT.org/libtools/thesis.htm

Data on the distribution of courses by thematic area and by the research program responsible are presented in Figures 2 and 3. The accuracy of the data is uncertain, so the figures provide an approximate picture of the distribution of courses across the different topics and programs. It should also be noted that CIMMYT has changed its organization in recent years, so the programs/units named here may not reflect those which actually exist today.

Table 2. Courses offered 5 or more times, 1991-2001.*

Course title	# of times offered	Locations
Maize Crop Management Research	20	Brazil, Kenya, Mexico, Thailand
Maize Improvement (basic & advanced)	20	Mexico
Hybrid Maize Seed Production/Maize Seed Production	16	Bangladesh, Brazil, Colombia, India, Kenya, Nepal, Peru, Philippines, Thailand, Trinidad & Tobago, Uganda, Venezuela, Zimbabwe
Wheat Improvement (basic & advanced)	16	Mexico
Wheat Industrial Quality (cycle A & B)	15	Mexico
Wheat Crop Management	6	Argentina, Mexico
Breeding for Drought and Low N Tolerance in Maize	6	Kenya, Tanzania, Zimbabwe

* These courses account for 99 (54%) of the 184 training activities listed in the data set.

Location of training. Training activities are offered in Mexico at CIMMYT headquarters or organized by staff in regional offices. The long basic and advanced breeding and crop improvement courses are located in Mexico. In the past, these courses have been managed by training coordinators under the maize and wheat research programs. According to CIMMYT staff, the advantages of training programs in Mexico include having the infrastructure to house and feed trainees for longer courses, the opportunity to interact with many scientists and other visitors, and seeing how a large-scale research organization is organized and equipped.

Regional offices organize their own courses, develop their own training materials, and provide support to advanced degree students without direct assistance from headquarters training staff. Advantages of regional training reported by some CIMMYT staff include the ability to tailor the training to specific regions, an increased opportunity for trainees to participate in the training process, and a greater use of non-CIMMYT instructors. Some CIMMYT staff indicated that regional offices show more sophistication about training. Specific examples were the use of participatory methods and the quality of the

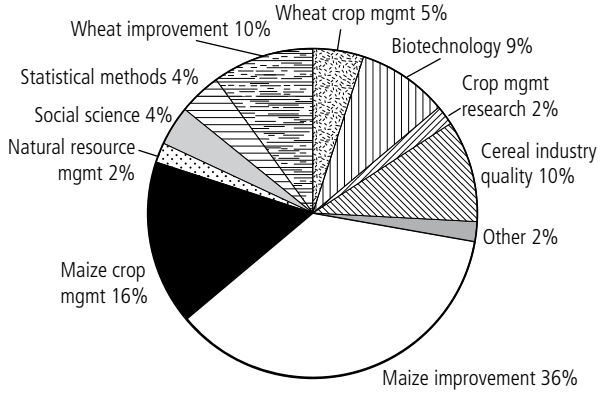


Figure 2. Distribution of courses by thematic area, 1991-2001.

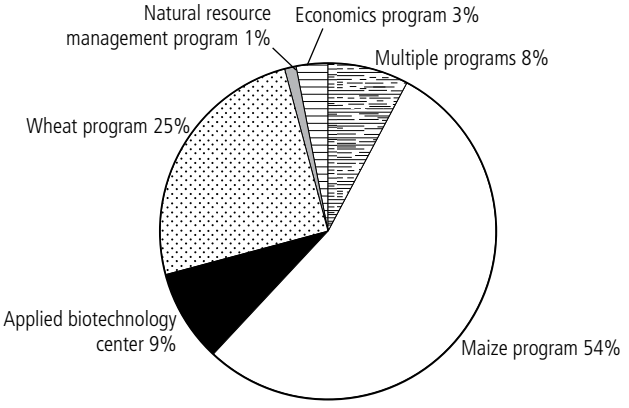


Figure 3. Distribution of courses by organizing program.

training materials. As CIMMYT decentralizes its management structure, the amount of training in the regional offices may increase. Figure 4 shows the regional distribution of the courses listed in the 1991-2001 database.

Target audience. Traditionally, CIMMYT capacity building activities have focused on the professional development of scientists and technicians involved in maize and wheat improvement. Recently CIMMYT training has expanded to serve a variety of stakeholders, including extension workers, farmers and farming families, managers and scientists in private industry, policy-makers, journalists, and other people in the media. For example, for the 156 training events recorded in the 2003 database (see footnote 2, p.3), CIMMYT reports that it served 5,276 scientists and 5,330 extension officers and farmers, for a total of 10,606 participants.

Investment in training. In the past, CIMMYT headquarters has had two or more training coordinators—a minimum of one each for the maize and wheat programs. The coordinators were primarily responsible for organizing the long courses offered in Mexico, including developing training materials, evaluating training activities, and providing support to the students. Currently, CIMMYT has a single training coordinator.

Based on figures from the medium-term plan for 2003-2005, CIMMYT spent US $5.5 million on training in 2001. The estimated costs for 2002 were just under US $4.8 million, a decrease of US $700,000. The planned expenditures for 2003-2005 show a further decrease of US$ 647,000 to US $4.2 million. The overall decrease in training allocations from 2001 to 2003 was US $1.4 million. (See Appendix B for the detail on specific project sources for training support.)

Previous evaluations of training

CIMMYT does not have an evaluation system for its overall training program. Occasional studies have looked at the cumulative impact of CIMMYT training, either in general or specific to the maize or wheat programs. In addition, individual training courses sometimes conduct evaluations of their effectiveness. This section first describes previous studies that assessed the impact of training programs (not just individual courses), and then provides two examples of approaches used to evaluate specific courses.

Studies of the cumulative impact of CIMMYT training. Ad hoc studies have been conducted since the early 1970s (Table 3). Note that all relied on surveys of trainees.[4] The information available on the surveys identified in Table 3 is incomplete; however some pattern to the results can be

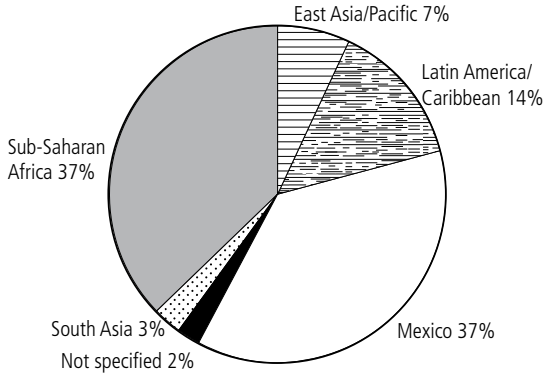


Figure 4. Location of CIMMYT courses, 1991-2001.

[4] Despite requests made to CIMMYT librarians, discussions with other CIMMYT staff, and Internet literature searches at the time of this study, no other evaluations were identified. However, reviewers of this report stated that a 1999 report, "CIMMYT's Human Resource Development Initiatives: Objectives, Structure, Content, and Impacts," should also have been included. While the inability to identify this report during the time of the present study indicates an inadequate search on the part of the report authors, it also adds to the evidence that CIMMYT 's knowledge of its training activities is fragmented in a way that continues to limit a cumulative assessment of training impact.

discerned. The studies indicate that around half of the people who responded to the surveys were able to use the training they received to a great extent. The survey for which we have more detail (1983) shows that more than 85% of the respondents reported being able to use CIMMYT training to at least a moderate extent when they first returned home, and 81% reported that they were still using CIMMYT training to at least a moderate extent at the time of the survey. The other kinds of impact reported in the 1983 survey include subsequent interaction with CIMMYT scientists, use of modern varieties, and increased yields in breeding materials. Two of the surveys also asked whether the respondents had or knew of other sources of training comparable to that which they received from CIMMYT. Fewer than 25% of the 1983 survey respondents reported that their home country provided comparable training. Fewer than 40% of the respondents in the 1995 Bangladesh survey reported the existence of other sources.

Some respondents to the surveys added comments. Negative comments focused on logistical issues, such as language difficulties or the balance of practice and lecture. The latter set of comments included requests for more time in the field and more practice to build computer skills. The positive comments emphasized the knowledge of the presenters, the value of the materials received, and the excellent organization of the course by the training program staff.

Table 3. Description of previous evaluations of CIMMYT training.

Source	Respondents	Response rate	Evidence of use	Evidence of other impact	Other sources oftraining
1972 wheat program survey*	Wheat program trainees, 1960-1971.	130/183 = 73%	46% reported they were able to make full use of the training they had received.	————	————
1983 survey**	Maize, wheat, and economics trainees, 1977-1983.	211/650 = 32%	When you returned home [and today], how much of your CIMMYT training were [are] you able to make use of: Most: 52% [47%] Moderate: 35% [34%] Little: 11% [15%] None: 1% [2%].	58% communicated with CIMMYT scientists on a regular basis. 62% visited CIMMYT at least once.	Today, does your home country's national crop research program offer in-service training programs which accomplish the same purposes as CIMMYT's in-service training programs: Yes: 23%; No: 73%.
1995 Bangladesh survey***	Bangladeshi scientists who participated in training courses at IRRI and/or CIMMYT, 1968-1995.	61/100 = 60% (41% for CIMMYT courses, or a total of 24 former CIMMYT trainees).	61% used upon return.	From 1968-1992, yield increased from 125 K tons to 1,125 K tons. BARI released over 16 varieties; all wheat hectares are sown to modern varieties[5].	39% said there are other sources.
2002 maize program survey+	Maize trainees, 1966-1996.	39 responses; denominator not provided.	54% very useful (average response).	————	————

* Described in "CIMMYT's Training Programs: Scope and Future Directions," Internal Discussion Draft, Revised September 8, 1983.
** Described in "A Partial Analysis: CIMMYT In-Service Trainee Questionnaire," September 8, 1983.
*** Described in "Impact of CGIAR Training in the Developing World: Bangladesh, a Case Study." Wheat Program Special Report by C. A. Meisner, October 1997.
\+ Data provided by former maize training program coordinator

[5] Reviewers of a draft of this report questioned the statement about the increase in yield. However, the claim is made in the survey report. The authors of this report are not in a position to verify its accuracy.

Approaches to evaluating individual courses. In addition to the general surveys described above, individual courses are often evaluated. The following examples illustrate two approaches to evaluating individual training courses. The first model, represented by the evaluation of the Wheat Improvement courses, is one of an ongoing, internal evaluation system in which consistent assessment tools are used across different iterations of a course. The evaluation of the "Soil-borne Pathogens of Cereals" course, offered recently by one of the regional offices, illustrates an ad hoc model in which evaluation tools are tailored to an individual course that may or may not be regularly offered by CIMMYT. Both evaluations were implemented internally by CIMMYT staff.

The Wheat Improvement Course was evaluated using pre and post tests of trainees' perceptions of the importance of the topics covered in the course and their competence in each topic. In addition, the trainees' knowledge and skills were assessed with pre- and post-course written theoretical and practical tests. A third component of the evaluation was a questionnaire asking trainees to rate course organization, methods and materials, the usefulness of topics covered, the appropriateness of emphasis given to topics, and the resources, services, and facilities available to the trainees. Trainees were also invited to comment on what they liked or disliked about the course. In addition to assessing trainees' knowledge and opinions, the training program coordinator documented the materials distributed to trainees. For example, the 2002 evaluation report identifies several publications given to trainees and also reports that more than 80,000 F2 plants were selected and more than 100,000 spikes were harvested.[6]

While pre-post approaches to evaluating training have some limitations, their findings can still indicate short-term change. In addition to trying to control for pre-training differences among the trainees through the pretest, the Wheat Improvement Course evaluation model has other advantages. The combination of written and practical tests allows program organizers to assess the kinds of knowledge targeted by the course and thus furnishes a multidimensional understanding of the course's short-term effectiveness. The information about the process (organization, materials, etc.), helps organizers to improve the course. Finally, by documenting the materials received, this evaluation approach also lays the groundwork for future studies regarding subsequent use of the materials.

The Soil-borne Pathogens course offered in Turkey in 2003 included lecture sessions, practical sessions in the laboratory and field, and group presentations. The short-term effectiveness of the course was assessed with a participant questionnaire that asked respondents to rate the extent to which they had increased their knowledge, the quality of the facilities and materials, and other aspects of the classes. The evaluation report indicated that the most important aspects of the course for participants were meeting other scientists with similar interests and participating in the discussion groups, lectures, and laboratory sessions. The interaction with internationally recognized teaching personnel and other participants was viewed as providing direct linkages to a future network. The participants gave good reviews to the training manual and the training facilities. In general, participants (including already trained pathologists) reported having greatly increased their knowledge.

[6] These figures are reported in the 2002 evaluation report as part of the materials that trainees took home with them from their CIMMYT training. The authors of this study are not in a position to verify this claim.

An end-of-session questionnaire is not sufficient to understand the effectiveness of a training course. The Soil-borne Pathogens course supplemented the questionnaire with a sort of take-home assignment for the participants. During the course, the participants developed case study reports that provided background on the cereal production system in their country or region, identified key problems that affect yield, described the current research program, and presented a research plan for the control of soil borne pathogens of cereals over the next five years. The case studies were reviewed by the training personnel and, after the course, the course organizers and participants continued to interact as the participants followed through on the application of the plans. In this model, two methods of evaluation were used: a self-assessment questionnaire and an assignment that required participants to apply the knowledge they gained. The methods provided complementary information about the implementation and effectiveness of the training. Another advantage of this approach was that the assignment assessed knowledge gained, reinforced the skills taught, and helped the training participant take the next step on the impact pathway toward applying the knowledge.

Methodology of current study

As the previous section shows, there is some information about the effectiveness of individual courses, but no recent data on the overall impact of CIMMYT training. The present study is similarly limited by the absence of a coordinated database of CIMMYT training participants. Such a database would allow a random sample of former trainees to be surveyed and, thereby, estimates of the extent to which different kinds of impact had been achieved. Without a random sample of former training participants, estimates of the extent to which CIMMYT training has achieved its desired effects are not appropriate. Instead, this study describes the nature of the impact and the extent to which those impacts have been achieved among participants from selected courses. In addition, to provide a more complete picture of impact, data from multiple sources have been collected. Specifically, key informant interviews were conducted with CIMMYT scientists and staff involved in training and capacity-building; and participants in selected training courses and research leaders from countries that have sent scientists to CIMMYT training programs were surveyed. The next three chapters present the findings of the interviews and surveys. This section briefly describes the three data collection activities.

Key informant interviews with CIMMYT scientists. In May 2004, we conducted 25 interviews with CIMMYT staff, including the Director General, scientists in the Maize Program, the Wheat Program, the Applied Biotechnology Center, the Economics Program, and staff in the administrative offices that support training and capacity building activities (such as Visitor Services and the Library). In addition to the interviews at the center's headquarters outside Mexico City and at its research station near Ciudad Obregón, Sonora state, Mexico, we interviewed scientists in two offices outside of Mexico, via teleconference. Respondents were asked to describe their role in CIMMYT training, the goals of CIMMYT training programs, and their perceptions of the impact of CIMMYT training on trainees and their institutions. Respondents were also asked for their recommendations for improving CIMMYT training in the future.

Training survey. In the summer of 2004, participants from several recent CIMMYT training activities were surveyed to learn about the utility and impact of the training. The survey collected background information on the kind of work the respondents performed, the kind of institution they worked for, the number of people they supervised, and the crops they worked on. Other questions focused on the extent to which respondents had used the training

and materials they received. Respondents were also asked about specific barriers they faced to using what they had learned. Questions about "impact" addressed personal impact, such as changes in salary or job type, and organizational and national impact, including changes in research areas and agricultural practices. A final set of questions elicited information about the availability of other sources of training. (A copy of the survey is available in Appendix C.)

The survey sample consisted of participants from five training courses. The courses were selected to ensure variation in two factors: location (regional or headquarters) and crop focus. In addition, the sample was limited to training programs for which participant contact information was readily available. The events meeting these criteria were:

- Course on quality protein maize, Mexico, 2002, 4 weeks, 25 participants.
- Wheat Improvement Training Course, Mexico, 2002, 6 months, 24 participants.
- Wheat Improvement Training Course, Mexico, 2003, 6 months, 13 participants.
- Master Class in Soil-borne Pathogens of Cereals, Turkey, 2003, 2 weeks, 23 participants.
- Course "Improving Maize Productivity under Abiotic Stresses," India, 2004, 2 weeks, 50 participants.

Table 4 shows the number of trainees and the response rate by training event. The survey was distributed by the evaluators to a total of 128 trainees.[7] The overall response rate was 30%.

In addition to the 38 surveys from the targeted courses, we received 5 surveys from respondents who did not specify the course they took, which was possible if they used the option of responding anonymously via an internet version of the survey. We received 6 more surveys; 3 from trainees in the 2000 Bed Planting course, 2 from the Wheat Improvement 2000 course, and 1 from a 1996 Advanced Maize Improvement course. A survey was sent to a research leader who, when contacted for the research leaders survey, said that he was no longer a research leader but would be willing to complete a trainee survey for the course he attended. The other 5 were mistakenly distributed when we sent a draft version of the survey to CIMMYT staff for their review. Because the draft version was very similar to the final version, including many of the same questions with the same wording, we decided to include responses for the draft in the final data set. The 49 surveys received were completed by 47 trainees (2 trainees attended more than 1 course and answered separate questionnaires for each).

Table 4. Survey response rates by training event.

	Event					
	Maize Productivity 2004	Quality Protein Maize 2002	Soil-borne Pathogens 2003	Wheat Improvement 2002	Wheat Improvement 2003	Total
Surveys distributed	46	24	21	24	13	128
Surveys received	14	2	9	10	3	38
Response rate	30%	8%	43%	42%	23%	30%

[7] The original plan for distribution of surveys included participants from the courses "Advanced Wheat Improvement," 2001; "Advanced Wheat Improvement," 2002; and the Maize OPV Seed Production Workshop, 2002. But email addresses for participants were not available and attempts to reach them through CIMMYT contacts were not successful. These participants are not included in the calculation of the response rate.

Overall, trainees from at least 8 different courses are included in the sample (see Figure 5).

Research leaders survey. In fall 2004, research leaders from several nations were surveyed regarding their perceptions of the impact of CIMMYT training on their programs. Background information collected included the title of the respondent's position, the name of his resident organization, the crops he worked on, the number of people in his institution working on maize and/or wheat improvement, and the major sources of training and professional development for researchers in the institution. We also asked the respondents to report whether they had been trainees or trainers in CIMMYT training programs.

The survey then asked how many people in the respondent's organization had attended CIMMYT training and whether CIMMYT training for staff supervised by the respondent had had an impact on the organization. Respondents who said "no" or "don't know" did not answer the remaining questions. Other respondents were asked a series of questions about the nature of the impact at the individual and institutional level. (A copy of the questionnaire is provided in Appendix D. Research leaders in countries where Spanish is the official language received their questionnaires that language; all other questionnaires were in English.)

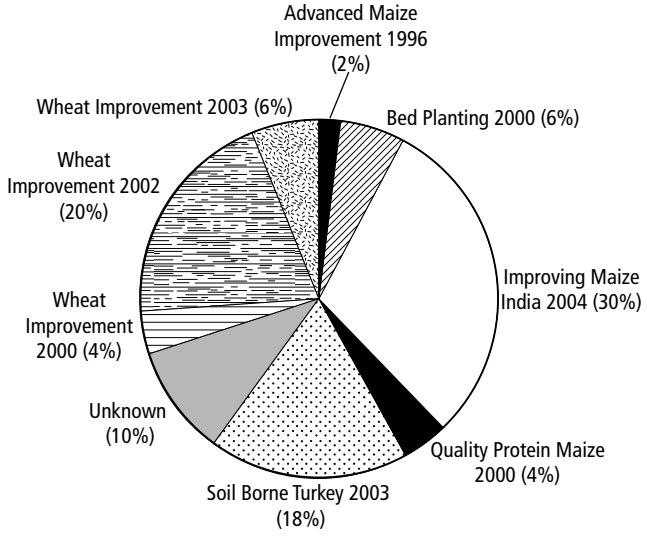


Figure 5. Courses represented in final sample for trainee survey.

The surveys were distributed to 47 research leaders in 24 countries. The leaders were identified in two ways. First, using lists of agricultural research organizations and networks available on the internet, we identified as many potential contacts as possible. Then, we circulated this list to CIMMYT headquarters and regional staff so that they could either confirm the appropriateness of the contacts we identified or provide alternative suggestions. The list of 47 research leaders includes only those who were confirmed or identified by CIMMYT staff. In addition, this list is limited to leaders for whom we had an email address or fax number, or the assistance of CIMMYT staff to deliver the survey. A sample compiled this way has the advantage of focusing on respondents most likely to be knowledgeable about the impact of CIMMYT training. However, a list of research leaders obtained from CIMMYT staff has a clear positive bias. To help counter the possibility of positive answers not based on actual observation, we asked respondents to provide specific examples of impacts they reported. In addition, research leaders receiving the survey were assured that their responses would be kept confidential, so that any negative comments would not affect their relationship with CIMMYT. However, our reliance on CIMMYT staff to distribute some surveys could have undermined the credibility of those assurances. Of the 47 research leaders on the list, 28 (60%) from 19 countries responded.

In the countries with more than one respondent, the institutions where the respondents worked were identified. When more than one respondent came from the same institution, the responses to questions about the impact of CIMMYT

training on the institution were aggregated across the multiple respondents so that each institution is represented in the database only once. For example, all four research leaders from Bangladesh work at the Bangladesh Agricultural Research Institute (BARI). The responses of each research leader about individual experiences are kept separate, but responses to questions about institutional impact are combined in a single answer for BARI. The two respondents from Ethiopia and the two from Kenya also came from the same national research institutions. The three respondents from Mexico and the three from China came from different institutions. Overall, the 28 individual respondents represented 23 agricultural research institutions.

3. The Views of CIMMYT Staff

The primary purpose of the interviews with CIMMYT staff was to understand their perceptions of the role of training in CIMMYT, the impact of that training, and the pathway through which impact was achieved. In addition, staff were asked if they had any recommendations for CIMMYT training. The results of the interviews are summarized below.

The role of training in CIMMYT

In interviews conducted in May 2004, CIMMYT staff described training as "one of the main pillars," "a key issue," "a core activity," and "the lifeblood" of the Center. They were not just referring to the role of training in the past. One scientist stated that training is "very, very crucial for our future impact." Another described training as "a key component for CIMMYT's long-term existence." The most common reasons given for the value of CIMMYT training were:

- An advantage in resources such as scientists, laboratories, and fields; developing country institutions do not have similar resources and so cannot compete when it comes to hands-on training.
- Its global and independent presence: CIMMYT is seen as "an honest broker" of knowledge.
- The use of hands-on work in the field and the laboratory. More than one scientist described the focus on hands-on, practical training as CIMMYT's "niche."
- The combination of headquarters and regional training courses: Many scientists spoke of the importance of the training programs in Mexico, citing the opportunities these courses provide to interact with a high number of scientists and with other visitors. At the same time, regional, specialized training offers more opportunity for trainees to participate in the training process.

Intended impact of CIMMYT training

The impact pathway from CIMMYT training to stronger research in developing country NARSs includes several steps. First, as described in the previous chapter, the training itself can take several forms, varying in length, topic, and location. Across these variations, however, there are core principles that define CIMMYT training. For example, as described above, one of the key principles of CIMMYT's training program is that hands-on work in the field and the laboratory is crucial to effective science. Another important element of CIMMYT's training program is that almost all CIMMYT scientists participate as trainers in one or more of the courses. The courses also often draw on scientists from other advanced research institutions and from developing nations. As a result, training participants have the experience of working and developing relationships with world-class scientists.

Impact on individual trainees

> *"Trained researchers have transferred what they have learned and observed in CIMMYT. Therefore, changes in their skills, morale and knowledge have given them a more positive attitude to their job as well as more self-esteem."*
> *— CIMMYT Scientist, May 2004*

The direct outcome of participation in CIMMYT training is the development of specific knowledge and skills by the individual trainees. The long courses focus on providing in-depth knowledge across several related topics, while the short courses focus on providing practical knowledge about specific topic. In addition to the knowledge and skills themselves, the training methods are

intended to develop the trainees' confidence in their knowledge and skills, their understanding of the importance of working hands-on in the field or in the laboratory in the research process, their ability to work in teams, and their awareness of the value of multidisciplinary research. Participating in CIMMYT training can also have effects that are not necessarily related to the scientific capacity of the trainee. For example, they may improve their English or Spanish language skills, which may in turn increase their access to scientific literature. CIMMYT training may be offered as a reward to a staff person or may lead to promotion or increased salary.

Impact on national agricultural research institutions

"There is definitely a demand for it [training]. The biggest thing for us is that it builds partnerships. It builds trust. Also, as former trainees move up in national programs and become policymakers, that helps us too. We may lose the scientist, but we gain a partner."— CIMMYT Scientist May 2004

From these individual outcomes, the next step in the impact pathway is the impact on the organizations that send the individuals. After gaining experience with large-scale breeding and improvement programs, trainees are expected to improve practices in the research organizations from which they come. Specific changes mentioned by CIMMYT scientists are the development of more systematic practices, the consideration of more relevant options in breeding decisions, improvements in research facilities, and, as one CIMMYT scientist said, "...better, faster, cheaper" research. CIMMYT trainees may also have opportunities to select germplasm or receive research tools during their training which can be used in their home research programs. When trainees take germplasm home or learn of germplasm which they later order, the training can play a significant role in increasing the diversity of germplasm being used in national research programs. Yet another organizational impact that CIMMYT hopes to have through its training program is increased local and national capacity for training, so that there is a multiplier effect of the individual training. Recently, CIMMYT has focused on developing stronger infrastructure for research and training through local teams and/or regional working groups or networks.

Beyond the individual and organizational impact, CIMMYT also seeks the development and enhancement of an international network of scientists connected to the Center. The training programs, especially the long training courses in Mexico, are seen as a way to develop a sense of connection to CIMMYT. As one scientist said, trainees become "part of the CIMMYT family." This enables trainees to look to CIMMYT scientists for ongoing support and future collaboration. In addition, CIMMYT training expands the network beyond the Center scientists and the trainees by bringing in senior researchers from outside CIMMYT to act as lecturers.

Impact on CIMMYT science

"The feedback from national programs is important because you find out how something doesn't work. For example, semidwarf wheat doesn't work in Kazakhstan. The Chinese don't want red grains, while in Kazakhstan, red grains are considered to be of higher quality than white. This kind of information helps explain why germplasm isn't adopted. " — CIMMYT Scientist May 2004

The above quote captures many of the ways that CIMMYT's professional development activities go beyond the impact on individual participants or their institutions and countries to have a reinforcing impact on CIMMYT's own research and development work. According to center staff, training develops a network of partners

in national programs who are familiar with the center's research and technologies, which benefits CIMMYT by furnishing:

- Credible information that leads to more efficient and effective research.
- Feedback used to adapt technologies to particular cultural and environmental contexts.
- Developing country research leaders receptive to CIMMYT's work and policies that support national-level research and development.

Barriers to achieving impact

CIMMYT scientists identified several barriers to achieving the desired effects of the center's training, including language, heterogeneity of trainee skills, and inadequate resources in home countries. Getting the right pool of trainees for a course can be problematic: participants may be selected by their home supervisors as a reward for good work, even though they may not be the people most likely to benefit from training. Some interviewees said that, even when the right person has been trained, the training loses its value when that person leaves the position for which they were trained. (Others, however, said that turnover is not bad if the trainee is promoted to a higher position, stays in food crops research, or moves to private sector research.) A barrier related to the environment in the national research organization is lack of support for new ideas by senior scientists or cultural constraints on introducing new ideas.

In addition to the barriers associated with the trainees and their institutions, CIMMYT-based constraints to providing the highest quality training were also mentioned. Interviewees reported that core funding for basic courses had shrunk and that project funding does not always include support for training. In a related concern, several interviewees referred to the lack of time allotted for training in their schedules, and the subsequent difficulty of balancing attention to their own research programs and developing training courses. Finally, it was suggested that CIMMYT was losing some of the good will developed through training activities, because of staff had not been able to maintain communication with past trainees.

Recommendations

The flip side of CIMMYT respondents' pride in the center's professional development activities and the value they attributed to them was resentment or disappointment over a recent lack of investment in training and the loss of institutional memory about training programs that had occurred. They had several recommendations for CIMMYT's training in the future.

Maintain or revitalize training. On the theme of maintaining or revitalizing training, several specific suggestions were made: (1) conduct a training needs assessment and then organize the training program around areas of greatest need; (2) centralize and organize training coordination; (3) maintain the long, Mexico-based courses because of their importance in building partnerships and showing the "seed-to-seed" cycle; (4) use headquarters training for topics that require specific laboratory equipment (e.g., molecular markers); (5) offer more short courses on specific topics (e.g., geographic information systems, agronomy, conservation agriculture, intellectual property rights, and others); and (6) increase the diversity of approaches to training (e.g., training courses with follow-up workshops and visiting networks, computerized preparation followed up with hands-on work in the laboratory or field).

The interviewees were aware that maintaining and improving training takes resources. Some recommended doing fundraising specifically for training, including selling places to private

sector participants. Aware of the lack of systematic information on CIMMYT trainees, some scientists recommended developing a management information system to track CIMMYT training and doing more follow-up and evaluation of training, and then using the resulting data to increase the visibility of CIMMYT training to donors.

Reduce the training burden on CIMMYT scientists. Recommendations for reducing the training burden on CIMMYT scientists included increasing partnerships with established centers of training, like universities, and national programs. One way to achieve that is by increasing support for national program staff to participate in masters and doctoral programs. A related recommendation was to support networks of trainees after their training so that their knowledge is disseminated.

For training provided by CIMMYT scientists, additional support could reduce the amount of time they spend preparing. Specific suggestions included developing a clearinghouse of training materials, the support of a training coordinator who is an educator, and information technology support for appropriate use of computer-based training and the development of training materials. While some scientists suggested using more educational technologies because they can save time, they also recognized the need to be strategic in the use of internet and other computer-based training, given that internet access is still limited for many CIMMYT partners.

Improve the process for selecting trainees. A variety of strategies were used and/or recommended to increase the likelihood that training participants are the ones CIMMYT wants to train. For example, some courses require prospective participants to complete a brief screening questionnaire; others negotiate behind the scenes with decision-makers in national programs to identify appropriate participants, before issuing an invitation to the program to nominate someone. CIMMYT staff in regional offices are very important in making sure that the people who come to Mexico for training are the right people.

Summary

The Center scientists and administrative staff interviewed expressed great pride in past accomplishments of CIMMYT training and great concern for its future. They identified specific kinds of impact on individuals, institutions, and their own research, while recognizing barriers to achieving this impact, including ensuring that training was targeted to the participants who would be able to use what they learned in their home research programs. Several recommendations were provided for strengthening training by using CIMMYT resources more efficiently and selecting trainees more strategically.

As an approach to understanding CIMMYT's training program from the view of those who implement and manage it, the key informant interviews were successful. The 25 people interviewed represented all the research areas and relevant administrative units. They included regional as well as headquarters staff. Despite these diverse perspectives, there was remarkable consistency in the interviewees' perceptions of CIMMYT training's strengths and weaknesses. The specificity of the responses as well as their consistency give confidence in the validity of the interview data. Because of this confidence, the authors of this study used the information obtained in the interviews to structure the questionnaires for the trainee and research leader surveys.

4. The Perspective of Trainees

To understand the utility and impact of CIMMYT training, trainees from selected courses were surveyed. As discussed in Section 2, the sample included trainees from various locations, who received training on different topics and in different years. This section describes the sample in more detail and presents respondents' perspectives on the effectiveness of the training and the niche of CIMMYT training among available options.

Description of the survey respondents

This section describes respondents' nationalities, crop specializations, occupations, workplaces, and supervisory responsibilities.

Nationality and region of respondents. Figure 6 shows the distribution of the trainees across the five areas of the world, using the classification system established by the World Bank. There were no respondents from Latin America and the Caribbean and only two respondents from sub-Saharan Africa.[8] Countries represented by the respondents are Turkey (10 respondents), India (6), Bangladesh (5), China (5), Iran (4), Kazakhstan (3), Nepal (2), Azerbaijan (1), Croatia (1), Georgia (1), Kyrgyzstan (1), Sudan (1), Thailand (1), Uganda (1), and Yugoslavia (1). Four respondents did not indicate their nationalities.

Crop specialization of respondents. Another characteristic relevant to interpreting the findings is whether the respondent works with maize or wheat. Figure 7 shows that a higher proportion of respondents worked with wheat (27 cases) than with maize (13 cases). The other seven trainees reported working with both crops.

Trainees also listed other crops they work on, including legumes (6), rice (3), sorghum (2), cotton (2), barley (2), coffee (1), sesame (1), and medicinal plants and vegetables (1).

Occupation. Most (23 or 49%) of the trainees who answered the survey were plant breeders (Table 5). Plant pathology was the second most-reported occupation with 11 responses (23% of the total). Agronomy received only four mentions (9%). Three people indicated that their jobs involved

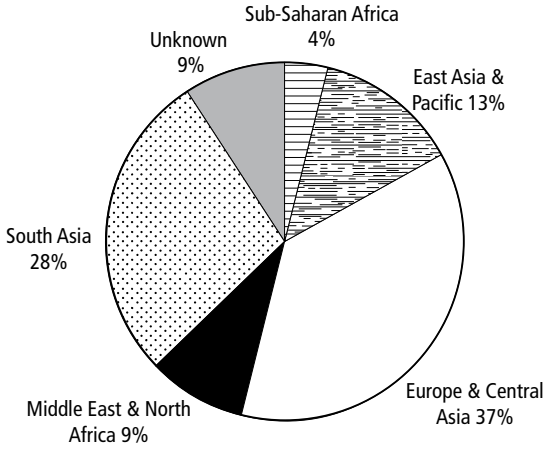


Figure 6. Regions represented by trainee respondents (total=47).

Table 5. Occupation of trainee respondents.

Type of work	Number of responses	Percent of total
Plant breeding	23	48.9%
Plant pathology	11	23.4
Agronomy	4	8.5
Other	3	6.4
Missing	6	12.8
Total	47	100.0

[8] The survey of research leaders, which is described in the next chapter, addresses this limitation to some extent. About 25% of the 27 research leaders who responded to the survey were from Latin America and another 25% were from Africa.

work other than the categories provided in the survey, including technology transfer, seed production, seed quality research, biochemical analysis, and biotechnology.

Among the 23 trainees who worked in plant breeding, an equal number worked with maize or wheat (10 for each). In contrast, almost all the plant pathologists specialized in wheat research (9 out of 11). Figure 8 shows the distribution among these two classifications.

Respondent workplace. Thirty-five of the respondents (75%) worked for a national research center (Table 6). Five of the others worked for a university or college. The remaining seven worked for non-governmental organizations, private institutions, non-research government agencies, or other kinds of institutions.

Respondents were also asked how much time they spent in various work environments: office, laboratory, experiment station, farmers' fields. Figure 9 shows that respondents were likely to spend at least a small proportion of their time in the office or farmers' fields. More than third (17 or 36%) of the respondents reported that they spent 50% or more of their time at the experiment station.

Supervisory responsibilities of respondents. Most respondents had little or no supervisory responsibilities. Twenty-one respondents (45%) reported that they supervised between one and five people (figure 10). Almost a third (14 or 30%) did

Table 6. Workplace of trainee respondents.

Workplace	Number of responses	Percent of total
National research center	35	74.5
University or college	5	10.6
Non-governmental organization	3	6.4
Private for-profit company	2	4.3
Non-research government agency	1	2.1
Other	1	2.1
Total	47	100.0

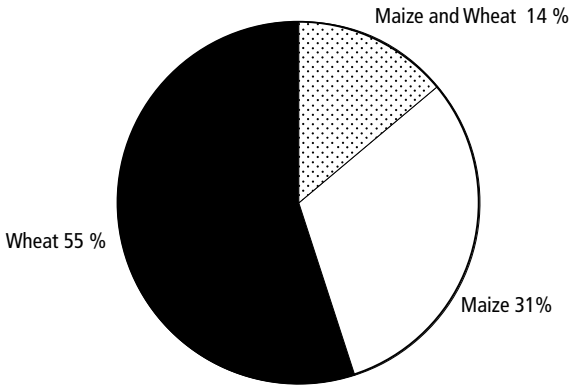


Figure 7. Specialization of trainee respondents: maize vs wheat (total = 47).

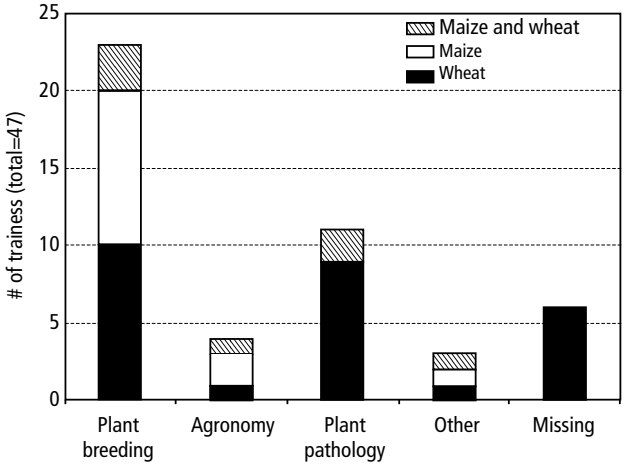


Figure 8. Distribution of trainee respondent occupations by crop specialization.

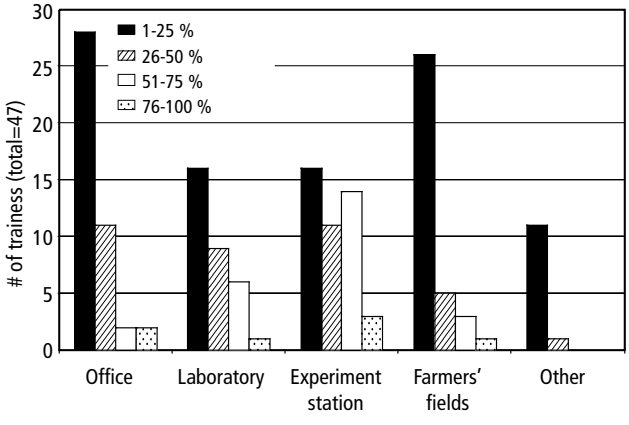


Figure 9. Proportion of time spent in different work environments.

not supervise any staff. Less than a quarter of the respondents supervised more than 5 people: 5 (11%) reported supervising from 6 to 10 people and 6 (13%) reported supervising more than 10 people.

The rest of this section summarizes the respondents' perceptions of the utility of the training and materials received, as well as the impacts on them and on their institutions.

Impact on the individual trainee

Survey questions addressed the skills trainees acquired, the overall relevance and use of the training, the use of materials they collected, personal development and communication with fellow trainees and instructors, and barriers to the use of the above. We received 49 completed surveys from 47 training event participants. Two respondents completed two surveys each for two different courses they attended. The sample size used to calculate percentages is thus 49.

Skills acquired during training. Respondents were asked to identify three skills learned in the training event. Not surprisingly, most skills related to plant breeding and selection. The other skills related to pathology, agronomy, project management, data analysis, and personal development. Examples of the comments provided for each of these categories of skills are provided in Table 7. (Throughout the report, the comments that are presented have been selected to provide the widest variety of examples of use or impact. In addition, comments are selected based on the clarity of their meaning and the detail of the description.)

Relevance and use of training. When asked about the relevance of the training course content to their work, 34 (69%) respondents answered that the training was "very relevant." An additional 9 (18%) reported that the training was "somewhat relevant." No one indicated that the training was not relevant.

As one would expect given the high ratings of relevance, almost all respondents (46 or 94%) reported having used "some" or "most" of what they learned in the first two months after training. Twenty-four (49%) said that they used "some" and 22 (45%) reported using "most" of what they learned. One trainee did not use any new knowledge or skills within the first two months after completing the course, and two trainees reported using the training only "a little." As shown in Figure 11, the number of trainees who used most of their learning increased

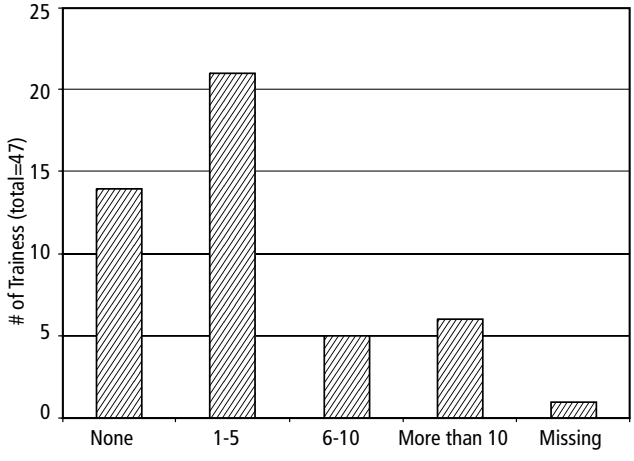


Figure 10. Number of people supervised by trainee respondents.

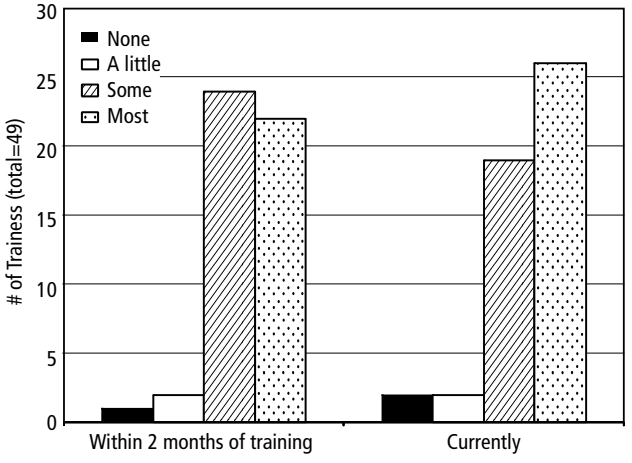


Figure 11. Extent to which training is used, immediately after training and currently.

when the period asked about was the present. Twenty-six respondents (53%) reported that they are currently using "most" of the training they received.

The respondents were asked to indicate whether or not they had used the training resources—manuals and printed materials, germplasm, and research tools other than germplasm—provided by CIMMYT. Figure 12 shows that everyone reported using the course manual and publications that were distributed during training. In response to the question about use of germplasm, eight (16%) said they had used germplasm collected during training; 25 (51%) reported that the question was

Table 7. Skills knowledge acquired, as reported by trainees.

Skill / knowledge	Sample comments
General selection and screening	• I have seen modern breeding and know how to work. • I appreciate the experience gained in CIMMYT, for it helped me a lot in implementation of my work relating to field control. • How to take correct observations. • Some screening methods. • Material selection. • How to evaluate new hybrids. • In systematization of my knowledge in breeding and to perform field experiments without assistance. • Before training, I did not know exactly about the effective procedure of maintaining maize germplasm and segregating population…We are practicing the procedures.
General pathology	• Pathology, evaluate diseases. • Wheat diseases diagnostics. • Isolation of plant pathogens. • Disease scoring. • The basics of diseases resistance. • Pathogen identification.
Specific breeding/pathology	• Conduction of simultaneous trials under stressed and non-stressed environments. I find this useful especially for drought tolerance screening. • Interactions between root rot pathogens and nematodes. • CIMMYT training had increased my self-confidence about root rot pathogens. • Identify rust disease. • Isolation, extraction and identification of soil borne fungi and plant parasitic nematodes. • I easily identified the plants suffering from either insect/disease (biotic stress) or drought, water-logging condition, high or low temperature, etc. (abiotic stresses).
Agronomy practices	• Zero-tillage. • Bed planting. • Yield components on machine harvesting. • Agronomy observation made in field relating to field control. • Planting systems. • Identify the proper time of irrigation for maximum yield. • Intercropping (maize with legumes). I have been working in maize from 1999. I am conducting low nitrogen trials from CIMMYT also. I made a very stupid job while conducting this trial in the summer of 2003. I planted the seeds in a field where legumes were grown earlier, as a result, the yield was higher than the normal trial (120:60:40 kg NPK/ha). After attending this training coarse, now I know very well how to deplete nitrogen level, conduct experiments and to identify the varieties. I have been worked as breeder and agronomist but I have been in CIMMYT for bed planting course. I carry out the bed planting trials and adapted this system in Southeast Asia of Anatolia. I also developed bed planter and bed former.
Planning and analysis	• Planning of crossing strategy (in national breeding program). • Problem identification and priority setting. • Alpha-lattice design for laying out experiments and analyzing data. The design is extremely useful especially in Hill areas where heterogeneity of experimental fields is an important consideration. • Proper management and efficient selection in international and national screening nurseries and yield trials. • Statistical and biometric skills (MSTATC).Use of randomization at the time of sowing. • Use of statistical analysis of data through MSTAT. Data analysis and interpretation of result of the experiments under abiotic stresses.

not applicable; and 15 (31%) answered that they did not use germplasm collected during training. (The two most likely reasons for a "not applicable" or "no" response are that the course did not focus on breeding and/or the trainee did not collect germplasm during the course.) In response to a separate question, 22 (45%) respondents reported having used other research materials. The questionnaire asked respondents to describe how they used the materials they collected or received. Their answers are presented below.

Use of course manual and other publications. All the respondents reported that they used the manuals and other printed materials received during the training program. A sample of the comments describing specific ways in which these materials were used follows:

- I used the reference material to learn about the methods and results of studies on plant resistance to plant parasitic nematodes.

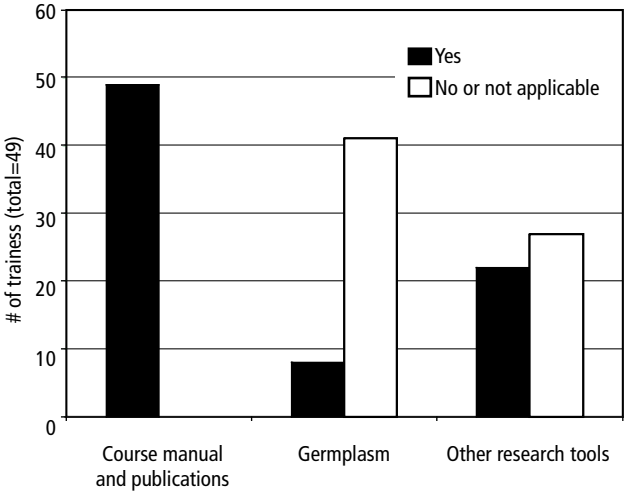


Figure 12. Use of materials received or collected during training. The figure combines the "no" and "not applicable" responses. Many of the respondents did not speak English as their first language and we were uncertain if everyone understood the distinction between the "no" and "not applicable" responses.

- During the training, we were provided some handouts, some books, some CDs, a training manual. All of these materials are very useful to me. Some of the papers are not in use, like QTL techniques to identify stress tolerant maize etc., in my poor country because of lack of physical facility. Others papers like methods of scoring leave curling, counting the number of branches of tassel to identify draught tolerant maize; methods of conducting low nitrogen trials, statistical procedures manual provided by J. Crossa and M. Bänziger are very useful for me. By using that manual, I became able to install the program, which was in a CD, proved by an agronomist working in CIMYYT Zimbabwe. Now I can easily randomize the treatments, prepare the seed nursery for different locations with different replications at a time, statistical analysis of the data (incomplete and complete block designs). I also became familiar with REML tools by using the manual and CD. Before going to this training, I used to analyze the data by using calculators, but after attending this training, I am using computer to analyze the data.
- I have received a CD, which contained report on maize and field notebooks. From the report I selected some maize germplasm and requested to the CIMMYT to send it to Bangladesh. Field notebook is helping to organize data books on different screening nursery and yield trials.

Use of germplasm. Some of the comments describing the use of germplasm are:

- I selected wheat from ME1 and ME5 and from country's nursery - I assessed them in my condition to enter it in my breeding cycle.
- These are resistant to stem rust, leaf rust and leaf blight and also having good agronomic characters: VK237/5/ATTILA/E/HUI/CARC//CHEN/CHTO/4/ATTILA; SUNCO/2*PASTOR; ALTAR84/AE.SQ//2*OPATA; VM272/5/ATTILA/3/HUI/CARAC//CHEN/CHTO/4/ATTILA.

- Germplasm were mainly resistance powder mildew and good quality materials. We use them to make cross with our materials. Now, we had got more 20 F2 populations.
- Spring durum and bread wheat yield trial; spring durum and bread wheat observation nurseries: I used CIMMYT germplasm for testing and selection in our conditions. Adaptation experiments are still continued.

Comments made by four people who did not collect germplasm are also relevant to the impact of CIMMYT training on the distribution of germplasm:

- I did not collect any germplasm. Actually the first reason is: the period or the training course was very short that we didn't get enough time to observe much germplasm in the field; secondly, it is little bit difficult to get maize seed sent from abroad by mail due to the import restriction of China.
- The germplasm I used isn't the one I collected by myself, but the one sent to me by Dr. He Zhonghu, there isn't name, only number, that's NO. 1, NO.2, and NO.4. I used these three germplasms as one parent to make cross combination for the scab resistance, now I have F1 seeds, I will have F2 seeds next year.
- I selected some parents in crossing blocks and also I did some crosses in CIMMYT but I did not collect them.
- Till time I don't received that germplasm. They included some high potential line and advance material in bread wheat and some of varieties that had been made with disease (yellow rust) for example, Seri82, and two set of advance and preliminary super wheat lines and advance materials.

These four comments suggest that even if germplasm was not collected during training, training programs can still increase awareness of CIMMYT as a resource for genetic material, which in turn increases the dissemination of the material internationally.

Use of other research tools. Hybridization kits, emasculation sets, spore collectors, identification materials, software CDs, books, and reference materials are the research tools that respondents identified. They described their use of the various research tools in these ways:

- Spores collector I use for artificial infection with *Fusarium* diseases (head blight).
- The software for alpha lattice design. Used for the current crop season and results are awaited.
- Microscope and other identification materials.
- I received an emasculation set. It was very useful for crossing. Also I received the number of books which were essential for my work. I think the books are sufficient for some next years.
- The research tools such as hybridization kits I used in the field for making crosses efficiently. I reviewed the CDs repeatedly containing class lectures of training instructors, different methods of inoculating plants and hybridization procedure to improve my theoretical and practical knowledge and skills in wheat breeding as well as in conservation tillage, grain quality, biotechnology, tissue culture, transgenic plants which are new areas of research incoming years. CDs containing different statistical program helped me a lot to design experiments and analyzing data more efficiently. These tools were also used to train my coworkers.

Personal development. CIMMYT training is designed to not only impart new skills and resources, but also to develop new ways of thinking about research. Two respondents made comments related to their development as researchers. One identified his new skill as the "discipline of working in the research institution." Another said, "I learned to use time and work with organizing efficiently."

In addition to the question about what skills they learned in the training, the survey asked about the extent to which the training motivated them to increase the amount of hands-on work they did and whether they had been promoted or had an increase in their salary because of CIMMYT training. Several CIMMYT scientists interviewed in preparation for this survey said they hoped trainees would leave training with a newfound appreciation for the importance of hands-on work in the field as part of the scientific process. When asked whether their training had affected their motivation to do hands-on work, 25 (51%) of the respondents indicated that CIMMYT training motivated them "a lot" to increase the amount of hands-on work that they did, and 14 (29%) reported that CIMMYT training gave them "some" motivation to increase the amount of hands-on work. Only two respondents (4%) reported no motivation at all, and another respondent (2%) stated that this question was not applicable.

Nine (18%) respondents said their salaries had increased since their training. Of these, four (8% of the total) said the increases were due at least in part to CIMMYT training. A similar pattern was found in responses to questions about being promoted since CIMMYT training. Nine (18%) respondents reported having been promoted, of whom two (4% of the total) said training had helped a lot and six (12%) reported that it had helped some.

Development of scientific networks. CIMMYT training has as one goal to foster increased interaction among scientists internationally and especially among scientists in developing nations. The survey asked CIMMYT trainees how much they interacted with each other and with CIMMYT scientists. In addition, several trainees gave comments about their increased communication and collaboration internationally.

As shown in Figure 13, most trainees who answered the question about how frequently they had communicated with former fellow trainees since the course said they had interacted at least once or twice a year. Twelve (24%) said they communicated less than once a year or not at all. There was no clear correspondence between frequency of interaction and year in which the course was offered. Of the eight who answered "less than once a year," two attended training in 2000, two in 2002, one in 2003, and two in 2004.

Most trainees also seemed to have had some communication with the training instructors. Thirty (61%) of the respondents reported that they had communicated with their instructors at least once or twice a year since the training course (Figure 14). In contrast to the frequency of interaction with fellow trainees, there seems to be a slight correlation between the year of the training course and the extent of interaction with instructors. Respondents from year 2000 courses were more likely to report frequent interaction with trainers. Four of the 18 respondents from the 2004 course said they had not communicated with instructors since the course. The course had been offered just a few months before the survey was conducted, however, so there is a limit to the amount of interaction they could have had.

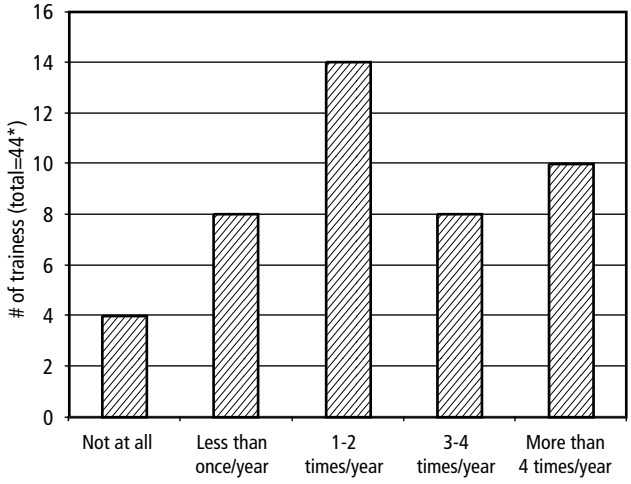


Figure 13. Frequency of interaction with fellow trainees after training. (Five respondents did not answer the question.)

The value of the interaction with fellow trainees and instructors was made clear in comments from 14 respondents about the development of collaborative relationships or new contacts in the scientific community. Examples of these comments include:

- I got a lot of friends from other countries and we always collaborate between us about scientific topics.
- I left behind my cultural differences. My best friend during training was person from country that my country was in war with few years ago.
- It affected [my] way of thinking in direction of international exchange of breeding materials.
- In my personal opinion, I consider this training course a valuable opportunity to pursue relevant professional technology and research skills. It was not only a training course to get knowledge on maize breeding on abiotic stresses from lectures and field trips, also it was an opportunity for all trainees to exchange our research experiences and skills. Furthermore, by communicating with each other after coming back to own countries, it is quite possible to establish an efficient network focusing on maize breeding on abiotic stresses in Asia.
- We learn progress up to date in the field, and got to know some international research fellows and scientists. All these are helpful for our research.
- This was the first time I have participated in an international scientific activity. Therefore this activity helped me to improve my English as well as experience on the subjects covered. In addition, I have gained self confidence to work with an international group of researchers.

Barriers to achieving impact from CIMMYT training. Through the background interviews with CIMMYT training staff and review of training documents, some potential barriers to the use of CIMMYT training were identified, including lack of access to farmers' fields, insufficient time or support from supervisors, and inadequate laboratory space or equipment. The survey asked respondents whether they faced these barriers. As Figure 15 shows, most of the respondents did not face these barriers in applying what they learned in training. The barriers most likely to be reported were inadequate equipment, insufficient laboratory space, and lack of access to farmers' fields. The respondents were most positive about the amount of time they had to apply what they learned and the support from their supervisors.

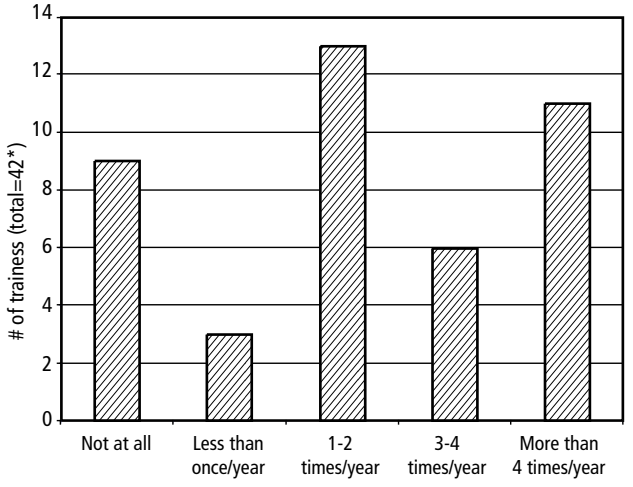


Figure 14. Frequency of interaction with instructors after training. (Seven respondents did not answer the question.)

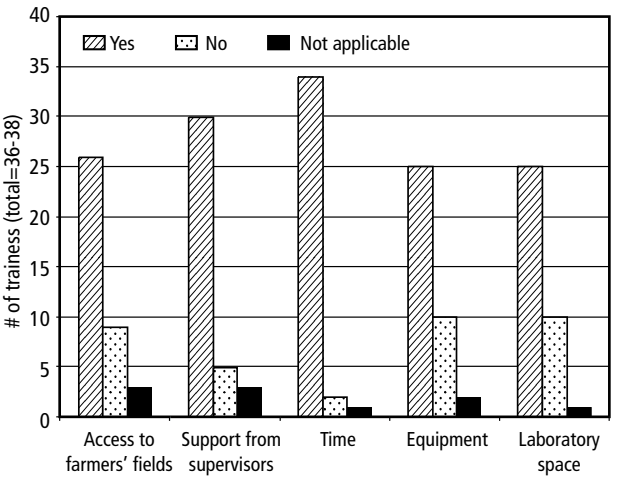


Figure 15. Factors that facilitate the use of training. (Total does not add up to 49 because of missing data.)

Impact on organizational or national research practices

The survey asked three questions about the impact of training at an organizational or national level:

1. Did CIMMYT training help your organization conduct research in new areas?
2. Did CIMMYT training help your organization improve agricultural practices locally or nationally?
3. Has CIMMYT training had an impact on any other aspects of your organization?

If the respondent answered "yes" to any of these questions, he was asked to describe the impact. Figure 16 summarizes the answers to the questions. For the first two questions, 30 (61%) respondents gave positive answers. The third question was more open-ended and most respondents skipped it. However, 13 (27%) of the respondents gave a positive answer to the question and provided comments. All comments related to the impact of CIMMYT training at the organizational or national level are discussed below.

The two questions about new research and new practices also asked for examples of the research or practices. Responses on those follow-ups were very similar. Selected comments are presented below in six categories: maize research, wheat research, biotechnology research, agronomy research, participatory research, and other research/practice areas. The number of comments in any category may reflect imbalances or omissions in the kinds of courses covered in the sample. For example, no courses in the sample focused solely on social science methods or biotechnology.

Comments related to impact on maize research.

- With the techniques learned in the training, we are transforming more normal inbred lines to QPM.
- I am working in the very remote area of western Nepal, situated in hilly area. The region is popularly known as dry land. After attending this training, I am very much interested to screen drought tolerant maize genotypes for the region. So I am proposing to conduct a field experiment on drought tolerant maize. We are also thinking to work on drought tolerant wheat. Because of poverty, farmers of this region generally do not apply chemical fertilizers, if some do, only nitrogenous fertilizer, i.e. urea. Almost, crops are grown by using farm yard manures only. So, my station is also interested to work in low nitrogen maize.
- We didn't do much job on maize drought/low-N tolerance breeding before. Nevertheless, we think it is necessary to operate such research program since these factors are main abiotic constraints in Yunnan province which affect the maize production significantly. Therefore, we have launched such research program since last year and what we learned in this training course will consequently benefit our program.
- To transform the normal lines to QPM with the molecular technique.
- Quality protein maize is very new in Bangladesh. My organization has collected some QPM inbreds from CIMMYT and developed a QPM hybrid variety, which has been released as BARI Hybrid Maize–5.
- Seed production is a very important work. Our organization is working on development of maize variety and production of seeds. Training has helped us to know about the right way of seed production.

Comments related to impact on wheat research.

- Before training there was no spring wheat research conducted in my country, but in this year we are growing spring wheats from CIMMYT and testing it in our trials, and if it gives good results we could spread some of it in production too.
- Giving awareness to the farmers about the soil borne diseases of wheat.

- Development of late heat tolerant wheat varieties: My organization is trying to develop late heat tolerant wheat varieties as our winter spell is very short and we belong to ME5 especially humid and warm environments.
- I am conducting the research work about evaluation of spring wheat for resistance and selection to diseases (rusts, leaf blights, common bunt) in the Southeast and North of Kazakhstan.

Comments related to impact on biotechnology research.

- In CIMMYT I collected some experiences and literature in biotechnology and now we are also improving DH and some of DNA techniques in my company too.
- Double haploid breeding: My organization is trying to do some research on producing double haploids with collaboration of Bangladesh Agricultural University.

Comments related to impact on agronomy research.

- My organization is trying to introduce bed planting, strip tillage and zero tillage along with bed planter, power tiller operated seeder (PTOS) at farmers' level, setting demonstrations in their fields. Now farmers are very much impressed on these demonstrations and some of them are using PTOS to decrease the turn-around time after harvest of *T. aman* rice. Some farmers are also using reaper and power thresher for harvesting of wheat which are manufactured locally.
- Recently we have developed bed planter (2-wheel driven), identified efficient varieties for bed planting situation, and we have demonstrated in farmers' fields with their participations.
- In Bangladesh, plant spacing was 25 x 75cm. Now we are using 20 x 75cm, according to CIMMYT training manual. As a result the total population has been increased and yield has also increased.
- Conservation tillage: research going on conservation tillage to introduce bed planting, strip tillage, zero tillage as well as bed planter, power tiller operated seeder (PTOS), etc., in farmers' field for better agronomic management and resource efficiency.
- After my training at CIMMYT HQ, we have initiated a new area of research on conservation agriculture both in research station and farmers' fields. Now, I try to introduce my knowledge for arsenic mitigation with new tillage techniques like bed planting.

Comments related to participatory research.

- Before our research mainly focused on the high-yield in the station field where the water supply was sufficient and other factors were appropriate for maize growth, rarely thought of the conditions of farmers' field. Now we have emphasized the farmers' direct benefit from field product by using some way similar to farmers participate approach. However, what we have done is just a beginning. We still need more time to improve agricultural practices.
- Participatory plant breeding (PPB): PPB is also going on as the farmers can take part selecting their own varieties according to their opinion.

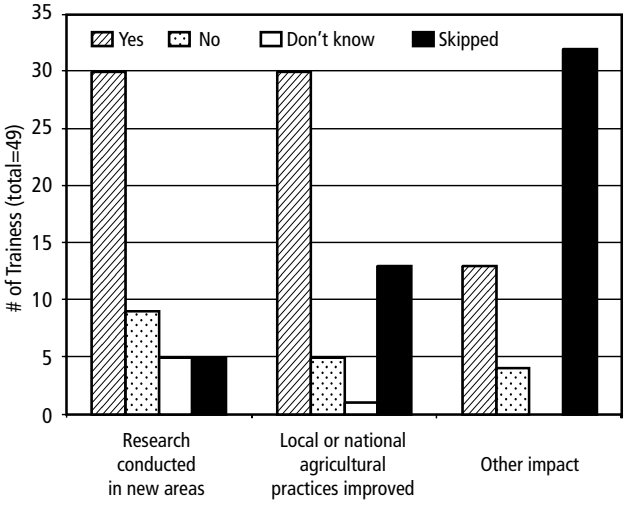


Figure 16. Impact of CIMMYT training on research and agricultural practices.

- Regarding participatory plant breeding (PPB), mother and baby trials were set up in farmers' field and the farmers' had a very good response to select varieties according to their opinion.

Comments related to other aspects of research.

- My organization improved agricultural practices locally using field control with the aim of issuing OECD certificates.
- Besides ASI and yield, we attached importance to other indices learned in training.
- The national disease resistance screening project coordinated by my organization started covering the screening of national germplasm against root rots in collaboration with another research institute.
- There is a lot of area located below new dams. In that area there are some civil projects to make canals and irrigation systems. The projects can increase irrigated area. Therefore are needed varieties adapted with high yield for that area.

CIMMYT niche in training available to NARSs

Three questions were asked to probe the extent to which CIMMYT training or something similar was available to the other people in the organizations that sent the trainees:

1. If CIMMYT did not exist, where would your organization go for similar kinds of training? Respondents were instructed to check as many of the following as applied: (a) Other international agricultural research center(s), (b) National university or research center(s), (c) Private company (or companies), (d) Nowhere: Similar kinds of training are not available elsewhere, and/or (d) Other. If respondents checked the last response, they were prompted to identify the specific places.
2. Have other staff in your organization attended a CIMMYT training program?[9]
3. Have you provided any training to your staff based on the training that you received at CIMMYT?

The survey asked trainees to identify other sources of training similar to that offered by CIMMYT. The respondents were offered five options and encouraged to mark all the choices they considered appropriate. As shown in the Figure 17, "other international agricultural research center(s)" was the most common response (23 or 49% of the 47 respondents). Thirteen respondents (28%) answered that similar kinds of training were not available elsewhere. This indicates the importance of the CGIAR centers in building capacity in general.

The next question focused more specifically on CIMMYT. Most (29 or 62%) of the 47 respondents knew of other staff in their organization who

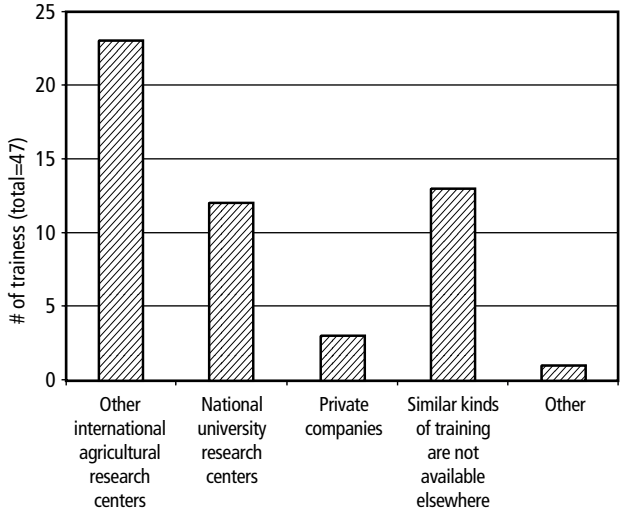


Figure 17. Alternative sources of training.

[9] A reviewer of a draft version of this report remarked that "staff" implies people below one in an organizational hierarchy and that "colleagues" might have been a better choice. This distinction was not noted by the CIMMYT staff who reviewed the draft survey. The issue is raised here so that the reader can consider whether the wording affected the responses obtained.

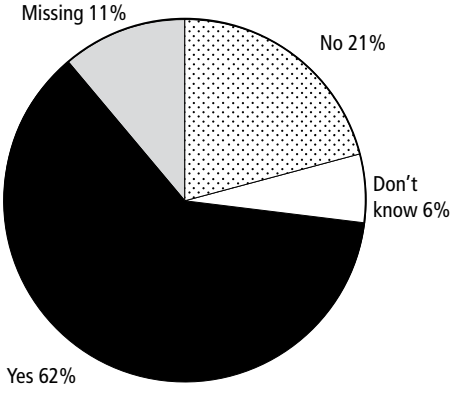
had attended CIMMYT training (Figure 18). Ten (21%) reported that they did not. The remaining respondents either stated that they did not know, or they did not answer the question. Of those who said that they knew of other staff, about half (16) stated that one to five of their colleagues had participated in CIMMYT training. The highest number of colleagues who had attended CIMMYT training was 15 and the average number reported was 4.5.

Figure 19 shows that little more than half of the respondents (25 or 53%) reported that they had provided training to colleagues based on the training they received from CIMMYT. Although the courses included in the sample for the survey did not have explicit "train the trainers" components, it is clear that course content was disseminated beyond individual course participants.

Summary and limitations

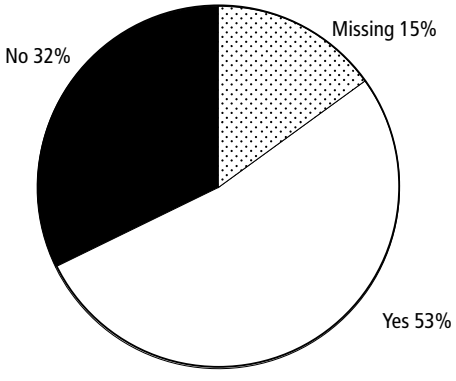
Overall, the respondents were very positive about the impact of the CIMMYT training. Several were able to give specific examples of the ways they had developed professionally and how research practices had changed in their organizations. Because of its summative focus on impact (instead of a formative focus on program development), the survey did not ask the respondents for recommendations for the future. Instead, concerns about CIMMYT training should be extrapolated from the answers above. For example, while the training was reported to be relevant and useful, 29% of the respondents reported that they had had less than one interaction with their training instructors after wards. Similarly, with over 25% of the respondents indicating that they did not have adequate laboratory space to apply what they learned, ways to address the resource constraints (or to adapt training to the constraints) may need to be developed. If the experiences of these respondents are representative, they give added weight to the suggestions made by CIMMYT scientists for addressing these and other issues. (See Section 3.)

Of course, the survey respondents represented only a small proportion of the number of participants in the targeted courses, and the targeted courses are only a small group of all the courses offered. Thus, the survey results appear to support the conclusion that CIMMYT training is achieving its goals, but do not answer the question of the extent to which these kinds of impacts and the gaps in impact are experienced across the large body of CIMMYT trainees.



Have others staff organization attended CIMMYT training?

Figure 18. Participation of trainees' colleagues in CIMMYT training (total = 47).



Have you provided training to your staff based on the training you received at CIMMYT?

Figure 19. Multiplier effect of CIMMYT training (total = 47).

5. The Perspective of Research Leaders

CIMMYT training is intended to affect not just individual trainees but also the agricultural research institutions and developing nations from which they come. To look at the effects of CIMMYT's training at these levels, research leaders around the globe were surveyed. This chapter describes the research leaders who responded to the survey and summarizes the findings.

Description of survey respondents and their institutions

Of the 47 research leaders whose contact information we had, 28 (60%) from 19 countries responded to the survey. As described in Section 2, the 28 respondents represent 23 agricultural research institutions. This section first describes the individual respondents by their nationality and experience with CIMMYT training. Then we describe the institutions they represent—the size of their staff working in maize and wheat, sources of training for the organization's staff, and the number of staff who have attended CIMMYT training.

Survey respondents. As shown in Figure 20, respondents from sub-Saharan Africa and Latin America make up a little over half the sample. (The relatively large proportions of respondents from sub-Saharan Africa and Latin American help to balance out the few or no respondents from those regions in the trainee survey.) The Middle East/North Africa region is the least well represented, with only one respondent. Table 8 lists the countries and number of respondents from each country. Most countries had only one respondent. Bangladesh, China, Ethiopia, Kenya, and Mexico had more than one respondent.

The survey asked respondents to indicate the major crops they work with. As shown in Figure 21, maize and wheat were the most common answers. Eight respondents indicated that they worked with both maize and wheat. The next most common crop specialization of the research leaders was sorghum. Seven respondents reported working with other crops and specifically mentioned barley, millet, oil crops, vegetable crops, tubers, and fruits, among others. In addition, one respondent stated that he now works primarily in administration.

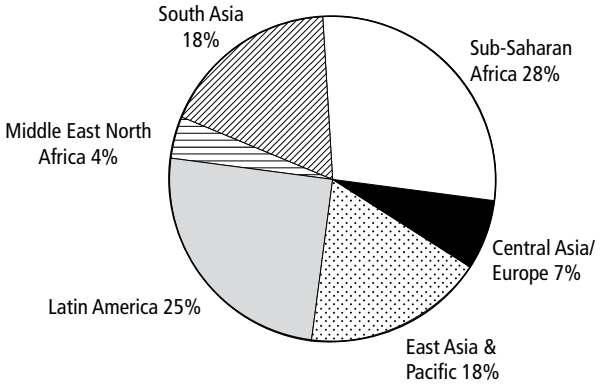


Figure 20. Regions represented by respondents (total = 28).

Table 8. Countries represented by respondents.

Region	Countries (# of respondents)
Sub-Saharan Africa (8 respondents)	Botswana (1) Ethiopia (2) Kenya (2) South Africa (1) Tanzania (1) Uganda (1)
Latin America (7 respondents)	Costa Rica (1) Guatemala (1) Honduras (1) Mexico (3) Panama (1)
South Asia (5 respondents)	Bangladesh (4) India (1)
East Asia/Pacific (5 respondents)	China (3) Myanmar (1) Vietnam (1)
Central Asia (2 respondents)	Kazakhstan (1) Kyrgyzstan (1)
Middle East/North Africa (1 respondent)	Iran (1)
Total	**19 countries and 28**

The survey targeted leaders in relevant research institutions in countries that have sent trainees to CIMMYT. As the following list of titles indicates, the survey respondents were at a senior level in their national agricultural research systems. As such, they would be expected to comment knowledgeably about the impact of CIMMYT training on their institution's research capacity. The names of the specific institutions are not provided because the respondents were assured that their responses would remain confidential.

Titles of survey respondents.[10]

- Director General
- Deputy Director General
- Chief Scientific Officer
- Research Director
- Director of Wheat Research
- Principal Investigator, Maize Program
- National Maize Research Project Coordinator
- Head of Crop Research & Development
- Manager, Crop Protection
- National Cereals Research Leader
- University Scientist
- Principal Cereal Breeder
- Agricultural University / Academy President
- Senior Agricultural Research Leader
- Head, Wheat Breeding
- Coordinator, Postgraduate Research, National Agricultural University

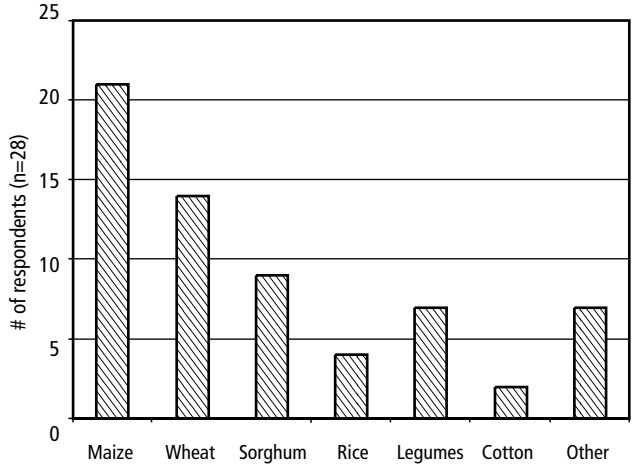


Figure 21. Crop specializations of research leaders. Respondents could check more than one crop; thus, the total across the crops adds up to more than 28.

Seventeen (61%) respondents had participated in CIMMYT training themselves, most in a formal course, and three as visiting scientists. These respondents had first-hand experience in a variety of courses, including:

- Maize Improvement and Advanced Maize Improvement. All respondents who reported attending the basic course also reported attended the advanced course.
- Wheat Improvement and Advanced Wheat Improvement. All respondents who reported attending the basic course also reported attended the advanced course.
- Applied Statistics.
- Quality Protein Maize.
- Sustainable Agricultural Systems.
- Genetic Disease Resistance.

The 17 respondents participated in a total of 29 CIMMYT professional development and training activities. Each respondent had visited CIMMYT-Mexico either for a course or as a visiting scientist. Other locations of training included Ethiopia, Honduras, Kenya, Panama, and Zimbabwe. Most of the CIMMYT training experienced by these respondents occurred in either the 1990s (10 or 34%) or 2000s (10 or 34%). The earliest training reported by one of the respondents was 1976. Five (17%) training or professional development activities occurred in the 1980s. The respondents did not provide information about the year of the other three training experiences. While more than half of the respondents had participated as a trainee or visiting scientist, only three (11%) reported that they had participated in CIMMYT training as instructors.

[10] Fewer than 28 titles are listed because some respondents had the same title.

National agricultural research organizations represented by survey respondents. Of the 23 institutions represented by the individual survey respondents, most (13 or 56%) had more than 15 staff working on maize or wheat improvement (Figure 22). Five (22%) had 6-15 employees involved in maize or wheat improvement. Five (22%) had 1-5 people working in maize or wheat.

With the large number of staff focusing on maize and wheat research, it is not surprising that CIMMYT is one of the major sources of training for the institutions represented in the survey sample (Figure23). Figure 23 identifies the sources of training reported by the research leaders. Twenty institutions (87%) said that CIMMYT was one of their major sources of training and professional development for staff. National agricultural universities or research centers were the next most commonly identified sources of training, with 17 (74%) of the institutional respondents mentioning them as a major source of training. According to the respondents, 10 of the institutions used other international agricultural research centers for training and 10 used other sources. The other sources mentioned were government agencies, advanced research institutions, and other universities in Africa, India, Europe, East Asia, and/or America.

As Figure 24 shows, more than 50% of the institutions had at least 10 staff who had attended a CIMMYT training event. One institution did not have any staff who had attended a CIMMYT training event. The representative from this institution responded "don't know" to the question about the impact of training on his institution. Especially since the sample for this survey consisted of people who had been identified by CIMMYT staff as knowledgeable research leaders in national agricultural research organizations, this result is important. The respondent wrote, "I know the importance of CIMMYT training programs but my institute has had no opportunity to participate in

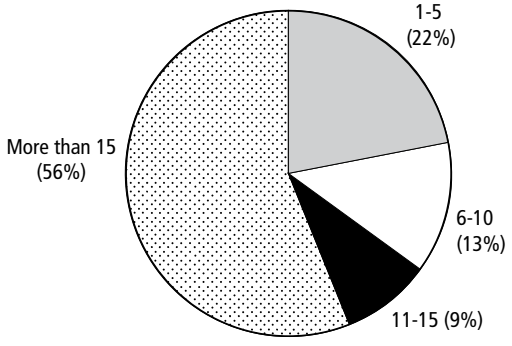


Figure 22. Size of maize/wheat research staff (total = 23 institutions).

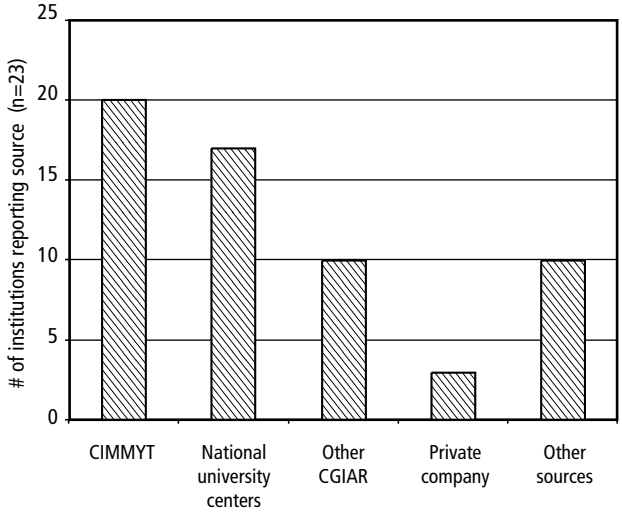


Figure 23. Major sources of training. (The total adds up to more than 23 because respondents could check more than one source of training or professional development for their institution.)

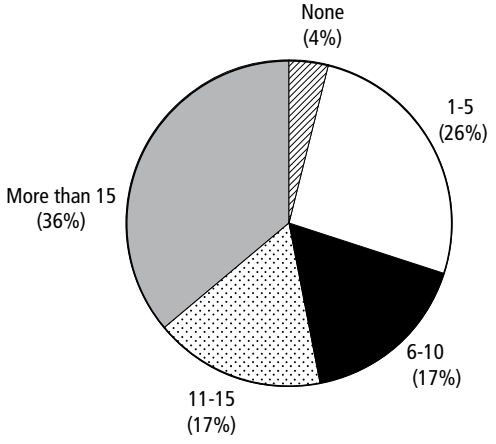


Figure 24. Number of staff who have attended CIMMYT training (total = 23 institutions).

any training programs." So, at least one relevant institution has not been exposed to and therefore has not had the chance to experience the impact of CIMMYT training.

Organizational and national impact

Research leaders from 22 institutions reported that CIMMYT training had an impact on their organization.[11] The data are organized into three sections. The first section presents the research leaders' opinions of the effects of CIMMYT training on individual staff members, including their personal development and their participation in scientific networks. The second section addresses the use of research materials obtained through the training program. The last section describes the impact on organizational or national research programs as reported by the research leaders.

Impact on individual trainees. The first set of questions about impact focused on changes in staff who had participated in CIMMYT training. As shown in Figure 25, the respondents were most likely to report an increase in the staff's interest in hands-on work. Since hands-on work is one of the values encouraged by CIMMYT's training programs, this is an important finding. The individual impact that was the next most commonly reported was increased communication with international scientists. Although reported less frequently than the other two outcomes, improved morale was also reported as evident in three out of every four institutions.

Some research leaders provided examples of the kinds of individual changes experienced by staff as a result of CIMMYT training. Improved skills in such areas as research planning and management, proposal and report writing, handling breeding material, and disseminating findings were mentioned. In addition, one respondent reported that he observed an improvement in the quality of basic research. Another respondent said, "They like thinking and become practical in the way CIMMYT scientists do." Finally, two respondents commented on the impact of their own participation in CIMMYT training on their research:

- In my opinion, my participation in CIMMYT training courses enabled the improvement (within time) of my understanding of the research approach. I have also been able to develop myself as a researcher due to the collaborative work with CIMMYT scientific staff placed in the Central American region. This is what I call 'day by day informal training'.
- The courses were very instrumental in equipping myself with the technical skills in the research work. I found them very useful and indeed changed my approach and attitude to maize

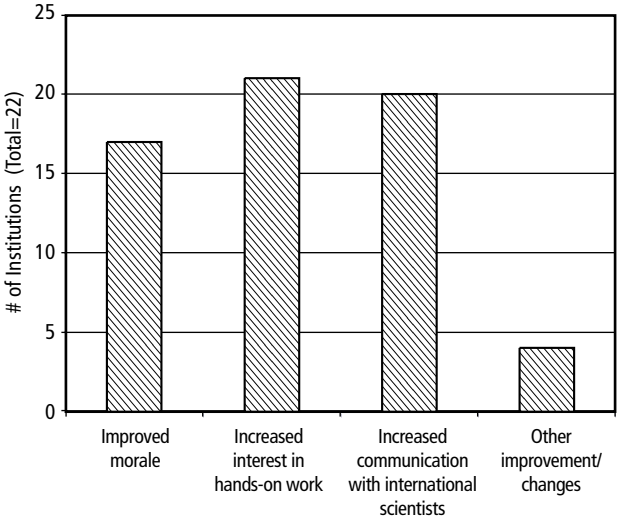


Figure 25. Impact on individual staff.

[11] The respondent who reported that nobody in his institution had attended CIMMYT training answered "Don't Know" to the question, "In your opinion has CIMMYT training had an impact on your organization? " That respondent skipped the rest of the questions and is not included in the data presented in this section.

research…They helped in the advancement of myself as a person and the maize research and development programme.

Respondents also commented about the role of CIMMYT training in developing scientific networks. They specifically mentioned that CIMMYT has helped scientists attend international conferences, connect with scientists in other international organizations (e.g., other international agricultural research centers), and take part in calls for papers. Other comments included:

- CIMMYT's training program promoted the understanding and enhanced the friendship among trainers and trainees from different countries.
- After having CIMMYT training, scientists feel free to communicate with the national and international scientist community. They have great impact on a hard-working mentality.
- This collaboration has also helped scientists in getting published new research papers based on collaborative research such as those related to multi-location nurseries. This has increased the confidence of the collaborating scientists.

Access to research materials and other resources. One of the ways that individual trainees affect the research agenda and capacity of their home institutions is through the materials they bring back from a training course. Research leaders were asked: What materials have the people in your organization brought back from CIMMYT training? They could check off the following responses: none, germplasm, computer software, course manual, publications other than the course manual, and/or other research tools. Those who checked off "other research tools" were asked to identify the tools. Germplasm and publications were the most common resources that trainees brought back to their institutions (Figure 26). Other research tools and resources mentioned were: (1) economic and socioeconomic methodologies; (2) harvesting bags; (3) moisture meters; (4) weighing scales; (5) lab inputs and crossing kits; (6) maize inoculation techniques; (7) results of molecular marker analysis; (8) vehicles; (9) computers; (10) global position system receivers; and (11) building stores and cold room. The research leaders were not prompted to provide comments about the tools, but some volunteered the following remarks about germplasm:

- CIMMYT provided so many germplasms that are very useful for breeders. Some used as parents, some used directly as varieties.
- Germplasm support for improvement programs of the University Center, as well as laboratory support in molecular markers and publications.
- 90% of the germplasm used is in commercially-released maize varieties from CIMMYT.
- CIMMYT is one of the most influential scientific-research partners in our wheat research programme. The germplasm we received from CIMMYT and introduced as new cultivars in different agro-ecological zones have had great and significant impacts on promoting wheat yield and increasing its production in the country. We owe part of our success in wheat self-sufficiency to CIMMYT and its wheat germplasm.

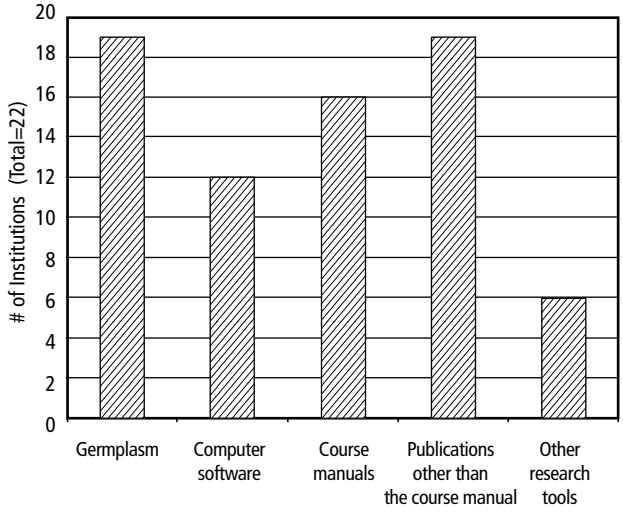


Figure 26. Resources brought back from training.

While these comments indicate the importance of CIMMYT training in the dissemination of germplasm, it is possible that respondents are not limiting themselves to germplasm obtained during training.

Impact on the institutions' research programs. Most research leaders responding to the survey also reported that CIMMYT training had affected their institutions' research programs (Figure 27), with positive answers for 19 (86%) of the institutions. Developing new areas of research and improving local or national agricultural practices were the effects most likely to be reported. A change in the way research was conducted was also reported for 18 (82%) of the institutions. The respondents were asked to give examples of the ways in which CIMMYT training had affected these aspects of their institutions' research programs. Some comments were very brief (such as "wheat breeding" or "quality protein maize"). Of those that provided more detail, some are included below. A full set of the comments is provided in Appendix C.

Comments about new ways of doing research.

- We have better information, human resources, germplasm access, and both more modern and efficient methodologies to perform our research work.
- Changes in the sow-experiment techniques, data gathering and data analysis.
- Some research activities are carried out as done at CIMMYT; e.g., laying out of experiments, data taking, inoculations, etc.
- CIMMYT has familiarized the maize researchers with latest developments and refined methodologies used in maize technology generation.
- Participatory research in the rice-wheat cropping system also got initiated by this interaction.
- A mother-baby trial methodology which enhances farmers participation in variety development.
- Better development of field practices (agronomists with better techniques to perform field experiments).
- Cooperation with CIMMYT certainly opened doors for collaboration on a wider scale within the region in terms of regional variety testing trials, setting up seed production schemes and supporting resource-poor farmers from a platform of collaborative networks with different stakeholders.

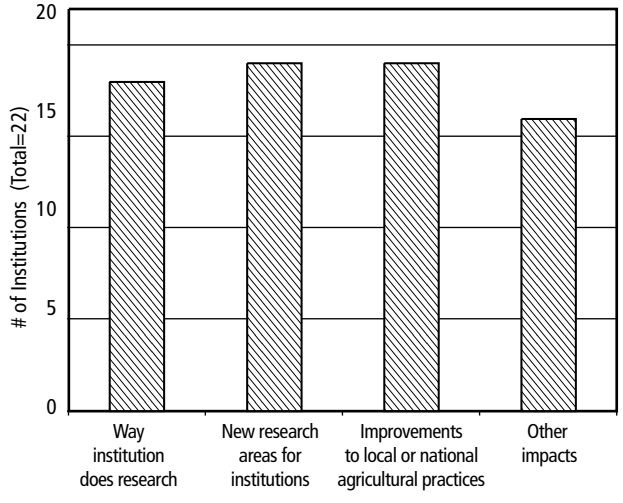


Figure 27. Changes in research programs resulting from staff participation in CIMMYT training.

Comments about new areas of research.

- CIMMYT training widened our research ideas. For example, some breeding techniques and methods, such as spring wheat, winter wheat, shuttle breeding, physiological approaches and selection of hybrid generations, etc., were used to increase yield potential and adaptability of cultivars, which have greatly improved our breeding efficiency. Four leading cultivars have been developed by me since 1990.
- The training courses organized by CIMMYT allow our staff to survey introduced germplasms to select donors and sources of valuable characteristics (traits) and for further involving in selection process to create new varieties.
- Able to maintain open pollinated varieties; improvement 9 maize inbred lines; releasing 5 hybrid varieties of maize; conduct effective wheat breeding program and releasing new wheat varieties.

- For wheat breeding program, breeders pay more attention to wheat quality, especially bread-baking quality, durable resistance to rust and powdery mildew, drought tolerance. For maize breeding program, breeders began to use marker assisted selection for QPM.
- Population improvement procedure and maintenance breeding procedure of composite varieties of maize were successfully implemented. Procedures of inbred line development, maintenance of inbreds and large-scale seed production of inbreds and hybrids were also successfully implemented.
- More emphasis is put on QPM variety development and providing improved varieties rather than hybrids to resource-poor producers for the sake of self-sufficiency in seed provision.

Comments about changes in local or national agricultural practices.

- New research trends in post-graduate study training programs have been implemented.
- Wheat bed planting system has been widely extended in Shandong Province of China.
- Better crop handling practices (sow, seed, post-harvest handling, seed production and preparation, among others).
- New and more environment-friendly technologies, increased efficiency in national problem-solving (drought, famine, disease tolerance, among others).
- Farmer-participatory variety selection was introduced to us by CIMMYT and it has become popular with government and aid institutions working with us to improve farmers' choice and quality of varieties in remote communities.
- The use of tied ridges; the use of cover crops such as mucuna; the use of improved varieties; the use of recommended type and rate of fertilizer.

Recommendations

Although respondents were not asked specifically for recommendations for CIMMYT's training program, several offered recommendations in response to an invitation to provide additional comments. Examples of the recommendations follow. A complete set of the recommendations can be found in Appendix C.

Increase regional training/use of regional experts.

- I do think that CIMMYT might consider, though, involving local expertise to a greater extent in their training programs. Country-specific or even region-specific knowledge could contribute to additional successful applications of technologies developed during combined or individual efforts.
- Perhaps our research professors be considered for upcoming training programs, and we allowed to use the different materials that CIMMYT publishes, as noted in your 10th question [about what materials trainees brought back from training].
- More required especially in the field of breeding for QPM and biotechnology. To reduce costs, those for QPM can be carried out in local countries.

Continue basic/Mexico-based training.

- Such trainings/visits must keep on going. A visit to an internationally-renowned center like CIMMYT some time is very helpful in motivating scientists to do innovative research in their own center.
- CIMMYT training is a very important and high-priority activity that has diminished sharply at all levels. It has special emphasis because it requires qualification for new researchers who are interested in adopting this approach. Also there is new technology that is not being utilized and, in several cases, not even agricultural research professionals have this knowledge available.
- In my opinion, CIMMYT should re-start and enhance wheat training program because it has a great impact on national wheat breeding and wheat production of the developing countries and we all knew CIMMYT's tremendous contribution on wheat improvement and wheat training program to world wheat breeding and wheat production.

- Since our people lack practical experience, we like to have field experiences in breeding, production technology by working together with CIMMYT scientists.
- Since collaboration with CIMMYT only one scientist of our Institute have been in 6 monthly training courses on wheat improvement in Mexico, CIMMYT. Would be desirable if the training of young specialists will be regularly, systematically.

Expand offerings.

- CIMMYT should organize courses for research managers (senior scientists, directors, etc) in addition to working scientists.
- In our view, it is necessary for CIMMYT to extend the works on corn. Corn is a main food crop in my country. For what: a) to increase the contacts of scientists; b) to conduct the training courses for young specialists; c) to send to our country the self-pollinated lines no hybrids.

General comments/recommendations.

- It is good to have a training backup that is consolidated in one strong body that has access to a wide range of expertise as well as facilities. CIMMYT also represents only two crops and therefore can focus all their efforts towards improvement of production and quality of genotypes. CIMMYT therefore plays an important support role, particularly for countries that do not have their own research and technology centers on commodities such as maize and wheat. For countries such as us who do have our own systems, CIMMYT is a strong partner and good supporter too, although in some sense there may arise areas of conflicting interests. Those are minor, however, and could be eliminated or scaled down through effective and positive communication and attitude. It has never been a real threat to us. CIMMYT's training is a well designed activity in which every theoretical lecture is accompanied by practical activities. Field visits during the training will give enough opportunity to select for taking home good performing materials under field conditions.
- I think CIMMYT has had great impact on NARS through its basic training courses. However, it is more appropriate to change the aims and scopes of training at CIMMYT to case studies as well as sabbatical studies for some countries.
- Newly-recruited wheat and maize scientists should have foundation training in different fields at CIMMYT. Senior scientists should visit CIMMYT as visiting scientists to cope-up with the new ideas and development in CIMMYT.

Summary and limitations

In general, a higher proportion of research leaders than trainees indicated knowledge of the impact of CIMMYT's training. While in some instances the research leaders may have been providing examples of the impact of CIMMYT research and collaborations—not just the impact of its training—most of the detailed comments support the research leaders' positive responses to questions about whether and how CIMMYT training has affected their organizations. As described in Section 2, the survey was distributed to respondents identified by CIMMYT scientists as the leaders in relevant organizations. Thus, the responses could be expected to be positive. As with the data from trainees, the information presented in this chapter is not necessarily representative of the experience of the leaders of maize and wheat research in all the countries in which CIMMYT would like its training to have an impact. In other words, while the survey of research leaders confirms that there has been some impact and identifies specific instances of impact, it does not allow any conclusion about the extent of impact.

6. Multiple Perspectives on the Impact of CIMMYT Training

Section 3 identified the intended effects of CIMMYT training. This section synthesizes the results of the trainee and research leader surveys in relation to those intended effects, discusses the limitations of the evidence provided by the surveys, and identifies issues related to the past and future impact of CIMMYT training.

Evidence of impact

The two surveys collected information from different perspectives. The trainee survey focused on the experience of the individual trainees. The research leader survey addressed the broader perspective of national agricultural research organizations that have sent staff to CIMMYT training programs. The results of the two surveys are consistent: each provides evidence that CIMMYT training has had the kind of impact that it is designed to have. Table 9 summarizes the findings of the two surveys in relation to the specific kinds of impact identified in Chapter 2.

Limitations of the evidence

While positive, the evidence has many limitations. First, the surveys are unable to provide information about the extent of impact. While we may say with confidence that CIMMYT training has made a difference from the perspective of most trainees and research leaders who responded to the survey, we do not know the extent to which the experiences they reported are shared by people who received the survey and did not answer; much less the many trainees and research leaders who were not included in the survey at all. As a result, if a different set of courses had been selected as the basis of the trainee sample, the trainee survey results might be different. Similarly, if we had been able to reach more research leaders, including those who were not accessible by email or fax, the research leader results might be different. However, the consistency of the responses across the trainees and research leaders, across regions, and between survey respondents and CIMMYT scientists indicate that the impacts reported here illustrate the kind of impact that CIMMYT training is having generally.

Another limitation of the study is that it does not consider the efficiency of CIMMYT training relative to other approaches to capacity-building. such as the visiting scientist model or the provision of support to national scientists pursuing advanced degrees. A related limitation is the lack of a comparison group. Without such a group, we do not know what would have happened in the absence of CIMMYT training. However, the interviews with the CIMMYT scientists indicate that, without training specifically from CIMMYT, there would have been less or slower dissemination of the materials CIMMYT has developed. In addition, the responses to survey questions about sources of training indicate that CIMMYT is a major source, although several of the research leaders said training could also be obtained from the national universities or research centers.

CIMMYT's investment in training

In recent years, CIMMYT has reduced the number of training staff and the amount of training offered in Mexico. According to a recent summary of the status of training in CIMMYT, funding sources for training are variable, with shrinking core funding and donors reluctant to support training as part of project funding. As shown in

the comments of research leaders, there is concern about these reductions. One aspect of this concern is the need for a balance between headquarters and regional training. The long, basic crop improvement courses in Mexico seem particularly embattled. Their location and length are seen as advantages or disadvantages, depending on the perspective. According to proponents, a Mexico location enables trainees to benefit from multidisciplinary training because of the greater access to scientists working in different research areas. In addition, trainees have the opportunity to see a big research facility and advanced equipment. Another advantage is that, by coming to CIMMYT's home office, trainees become part of the international "CIMMYT family." The length of the courses (6–9 months) is also important in developing a sense of connection to CIMMYT. One scientist said, "[The basic courses] are the backbone of our cooperation." Even more importantly, content drives the length of the courses: they need to follow the full crop cycle, from "seed-to-seed."

Table 9. Synthesis of survey results related to intended impact of CIMMYT training.

Type of impact	Trainee survey results (total = 49 surveys)	Research leader survey results (total = 22 institutions)
Individual		
Knowledge and skills	Respondents were asked to identify three skills that they had learned in the training event(s). Most skills related to plant breeding and selection. Others related to pathology, agronomy, project management, and data analysis.	Research leaders were not asked to assess the knowledge and skills of trainees. However, two research leaders commented positively on the impact of their own CIMMYT training experiences on their research skills.
Value of hands-on work	Twenty-five (51%) reported that CIMMYT training motivated them "a lot" to increase the amount of hands-on work that they do, and 14 (29%) indicated that CIMMYT training gave them "some" motivation to increase the amount of hands-on work.	Respondents in 21 (95%) of the institutions reported that trainees had increased interest in hands-on work. Respondents in 17 (77%) of the institutions represented in the sample reported that trainees' morale had increased.
Development of international networks	Thirty (61%) trainee respondents reported communicating with their instructors at least once/year. Several provided comments about the value of the relationships forged during the training. Thirty-two (65%) trainee respondents said they had interacted with their fellow trainees at least once a year.	Respondents in 20 (91%) of the reported that trainees had increased communication with international scientists. Several provided examples or supporting comments.
Research organization		
Receipt of research materials	All the trainees surveyed reported using the course manual and publications that were distributed during training. Eight (16%) trainees said they used germplasm collected during training. (Some courses did not offer the opportunity to collect germplasm.) Twenty-two (45%) respondents said they used other research materials, such as software, microscopes, and emasculation sets. Several respondents provided examples of use.	Respondents in 19 (86%) of the institutions reported that trainees received at least one kind of research resource during training. Specific examples of resources were given, including germplasm, weighing scales, and moisture meters.
New areas of research	Thirty (61%) trainee respondents reported that training led to the development of new research areas by their organizations. Examples included research on drought tolerant maize genotypes, spring wheat, double haploid breeding, and bed planting.	Respondents in 19 (86%) of the institutions reported that CIMMYT training had enabled the development of new areas of research. Specific examples included disease resistance, wheat quality, bed planting, and biotechnology.
New approaches to research/Use of knowledge and skills	Forty-six (94%) reported using the training within two months and 45 (92%) said they were using it currently.	Respondents in 18 (82%) of the institutions reported that CIMMYT training had changed the way the institution does research. Specific examples included increased scientific rigor and efficiency, and the use of participatory methods.
Changes in local or national agricultural training practices	Thirty (61%) of the trainee respondents reported that training led to changes in local and national agricultural practices. Examples included a change in plant spacing to increase yield and new screening for germplasm resistant to root rots.	Respondents in 19 (86%) of the institutions reported that CIMMYT training had enabled them to develop new areas of research. Specific examples included changes in use of bed planting system, sowing densities, and use of improved seed.

Those who argue for shorter courses and more courses in the regions point out that training in Mexico does not allow trainees to see the application of the knowledge in their own environment. The organizations that send the trainees also lose the trainee's time for half a year or more. With regard to the length of the courses, one scientist said, "There is value in seeing CIMMYT's big operation, but it isn't essential to be here for six months to get the idea of a large-scale program." As described in Section 3, several sources recommended increasing the number of short courses on specific topics, such as geographic information systems (GIS), statistics, agronomy, participatory research methods, conservation agriculture, socioeconomic analysis, intellectual property rights, writing funding proposals, and gender awareness. Balanced approaches that were suggested or are already in place include:

- Having basic training in Mexico with follow-up workshops and visiting networks.
- Improving the link between Mexico training and training offered by regional staff.
- Using either computer or print materials for trainees to get background and a theoretical foundation while still in their home countries, and then bringing trainees to Mexico for hands-on work in the laboratory or field.

Conclusion

All sources of evidence—interviews with CIMMYT scientists, previous surveys of CIMMYT trainees, testimonials in annual reports, internal reviews of the training program, and the current surveys of trainees and research leaders—indicate that training provided by CIMMYT achieves many of its goals. For the individual trainee, not only new knowledge and skills, but also new ways of thinking about research and new partnerships can be developed. The individual trainee often shares his or her knowledge with colleagues and brings new research materials and approaches to his or her institution. In time, these new materials and approaches can create changes in agricultural practices, such as enabling farmers to be more involved in the development of new varieties, increasing productivity in dry areas, or improving the quality of seed.

Training is not the only way to bring about such changes. There are other ways to increase knowledge and skills and to disseminate new materials and approaches. However, according to CIMMYT scientists and research leaders in developing nations, CIMMYT training has an advantage as an approach to changing research and farming practices. By integrating the teaching of new knowledge with hands-on practice and the dissemination of new materials, CIMMYT training has created collaborative relationships that facilitate its own work.

While the evidence described in this report illustrates the varied ways in which CIMMYT training achieves its goals, it does not support conclusions about the extent of the impact. Systematic evaluation of training courses and consistent tracking of training participants are needed before CIMMYT can go beyond establishing the *existence* of the impact from center training to discovering its *extent*.

Appendix A: Summary of Training Record Data, 1991-2001

This appendix presents the data given to the CGIAR Technical Advisory Committee (now the Science Council) for the system-wide study of training. Because of concerns with the quality of the record-keeping system, the accuracy of the data is uncertain. Nonetheless, it represents the best information available for those years. It is probably an undercount of training activities in the different categories.

Table A-1. Number of participants and training events, 1991-2001.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
Number of participants	197	147	187	166	189	219	256	349	492	1000	573	3775
Number of courses	9	8	10	9	12	14	15	20	26	40	22	185

Table A-2. Length of trainings, 1991-2001.

Length	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
< 10 days				1	2	1	3	7	8	18	13	53
10 - 30 days		2	3	1	1	5	3	5	8	11	5	44
> 30 days	9	6	7	7	9	8	9	8	10	11	4	88

Table A-3. Location of trainings, 1991-2001.

Location	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
Mexico	8	5	7	4	5	6	6	8	6	10	6	71
Argentina	1	1	1	1	1	1	1	1				8
Brazil					1	1	1	1	1	2		7
Ethiopia			1	1		1						3
Kenya		2	1	2	2	3	1	2	6	7	2	25
Thailand				1	2	1	1	1				6
Zimbabwe					1		1	2	8	2	1	15
Other						1	4	5	5	19	13	47

Table A-4. Program organizing trainings, 1991-2001.

Program	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
CIMMYT Maize Program	3	2	6	5	8	8	9	11	17	24	14	107
CIMMYT Wheat Program	5	6	4	4	4	5	5	4	4	10	2	53
CIMMYT Applied Bio Center	1					1	1	4	3	2	2	14
Collaborative Program									2	3	1	6
CIMMYT Natural Resources										1	1	2
CIMMYT Economics Program								1				1
Other											2	2

Table A-5. Thematic area of training, 1991-2001.

Thematic area	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
Wheat crop management	2	1	1	1	1	2	1	1		2		12
wheat improvement	1	2	1	1	1	1	2	1	2	6	2	20
Maize improvement	2	1	4	1	4	2	5	7	14	18	12	70
Cereal industrial quality	1	2	2	2	2	2	2	2	2	2		19
Maize crop management	1	1	2	3	4	5	3	3	4	3		29
Biotechnology	1					1	1	4	3	2	4	16
Experiment station mngt	1											1
Statistical methods		1		1		1	1			1	2	7
Social science								2	1	5		8
Natural resources mngt										1	2	3

Appendix B. Cost of Training

Strengthening NARS—Training	2001 (actual)	2002 (estimate)	2003 (plan)	2004 (plan)	2005 (plan)
Maize and wheat genetic resources: use for humanity	0.150	0.172	0.165	0.165	0.165
Improved maize for the world's poor	0.434	0.444	0.409	0.409	0.409
Improved wheat for the world's poor	0.143	0.117	0.085	0.085	0.085
Maize for sustainable production in stressed environments	0.038	0.048	0.033	0.033	0.033
Wheat for sustainable production in marginal environments	0.000	0.000	0.000	0.000	0.000
Wheat resistant to diseases and pests	0.000	0.000	0.000	0.000	0.000
Impacts of maize and wheat research	0.080	0.098	0.065	0.065	0.065
Building human capital	3.504	2.709	2.057	2.057	2.057
Conservation tillage and agricultural systems to mitigate poverty and climate change	0.037	0.057	0.070	0.070	0.070
Food and sustainable livelihoods for Sub-Saharan Africa	0.011	0.011	0.224	0.224	0.224
Maize for poverty alleviation and economic growth in Asia	0.152	0.140	0.105	0.105	0.105
Sustaining wheat production in South Asia, including rice-wheat systems	0.170	0.251	0.272	0.272	0.272
Food security for West Asia and North Africa	0.264	0.242	0.215	0.215	0.215
Agriculture to sustain livelihoods in Latin America and the Caribbean	0.358	0.268	0.238	0.238	0.238
Restoring food security and economic growth in Central Asia	0.067	0.133	0.069	0.069	0.069
New wheat science to meet global challenges	0.000	0.000	0.000	0.000	0.000
Apomixis: seed security for poor farmers	0.000	0.000	0.000	0.000	0.000
Biotechnology for food security	0.084	0.085	0.135	0.135	0.135
Biofortified grain for human health	0.021	0.021	0.007	0.007	0.007
Reducing grain losses after harvest	0.000	0.000	0.000	0.000	0.000
Technology assessment for poverty reduction and sustainable resource use	0.000	0.000	0.000	0.000	0.000
TOTAL Strengthening NARS—Training	5.513	4.796	4.149	4.149	4.149
TOTAL Strengthening NARS	10.233	9.194	7.897	7.897	7.897

Source: CIMMYT MTP 2003-2005, published August 2004. Table 4b: Allocation of project costs to CGIAR activities, 2003-2005 (in US$ million).

Appendix C. Comments by Research Leaders

This appendix provides the full set of verbatim comments that research leaders gave in response to open-ended questions in the survey.

The effects of CIMMYT training

On the way the organization does research.

- We have better information, human resources, germplasm access, and both more modern and efficient methodologies to perform our research work.
- Research approaches, increased efficiency, better quality.
- Better issue knowledge and problem-solving alternatives.
- Changes in the sow-experiment techniques, data gathering and data analysis.
- Better and more scientific rigorousness. Techniques to select and develop maize genotypes have improved.
- Some research activities are carried out as done at CIMMYT e.g. laying out of experiments, data taking, inoculations, etc.
- Increased activities in participatory research; intensity in applied and adaptive research has also increased; efficiency has increased for achieving national goal.
- CIMMYT has familiarized the maize researchers with latest developments and refined methodologies used in maize technology generation.
- More reliable researches at the organization.
- Participatory research in the rice-wheat cropping system also got initiated by this interaction.
- Support [of] farmers training and field days enables the institute to provide quality research work and extend its research area and involve more farmers.
- A mother-baby trial methodology which enhance farmers participation in variety development.
- Better development of field practices (agronomists with better techniques to perform field experiments).
- CIMMYT had an impact on helping to improve research activities of different disciplines of the organization.
- Establishment of infrastructure: Drought and low nitrogen tolerant germplasm screening sites; small irrigation facility.
- Cooperation with CIMMYT certainly opened doors for collaboration on a wider scale within the region in terms of regional variety testing trials, setting up seed production schemes and supporting resource-poor farmers from a platform of collaborative networks with different stakeholders.

On new areas of research.

- For wheat breeding program, the scale is getting bigger and put some materials both in dry land and irrigation land.
- CIMMYT training widened our research ideas. For example, some breeding techniques and methods, such as spring wheat ◊ winter wheat, shuttle breeding, physiological approaches and selection of hybrid generations, etc., were used to increase yield potential and adaptability of cultivars, which have greatly improved our breeding efficiency. Four leading cultivars have been developed by me since 1990.
- The training courses organized by CIMMYT allow our staff to survey introduced germplasms to select donors and sources of valuable characteristics (traits) and for further involving in selection process to create new varieties.
- Able to maintain open pollinated varieties; improvement 9 maize inbred lines; releasing 5 hybrid varieties of maize; conduct effective wheat breeding program and releasing new wheat varieties.

- Varietal development program is strengthened and as a result modern wheat varieties were released with proper production technologies that help the country in total wheat production and consumption.
- We change the priority in wheat breeding: resistant to diseases emerges as one of the key problems of breeding.
- Wild cross and shuttle breeding in wheat breeding.
- For wheat breeding program, breeders pay more attention to wheat quality, especially bread-baking quality, durable resistance to rust and powdery mildew, drought tolerance. For maize breeding program, breeders began to use marker assisted selection for QPM.
- Application of physiological approaches to wheat breeding; haploid breeding—wheat x maize technique; wheat cultivation— bed planting.
- Biotechnology area (not as the major responsible person, but as an active and strategic collaborator).
- The modern approaches to complex evaluation of selection material by detailed studying of seed technological properties; studying of new technologies of cereal crops treatment by bed planting in local conditions. This method promotes to decrease the seed sowing rate to 2-2.5 times, and reduce the consumption of irrigated water to 30-40%, and yield increasing & output of conditional seeds on growing in seed farms.
- In the tiny-cereal-crop improvement programs, as well as in maize. Their researchers are using knowledge acquired in CIMMYT.
- Insect rearing for maize streak virus research, research on QPM, development of nitrogen use efficient maize materials (use for low and high nitrogen screening sites).
- Example: participatory varietal selection, technology transfer and resource conservation.
- Population improvement procedure and maintenance breeding procedure of composite varieties of maize were successfully implemented. Procedures of inbred line development, maintenance of inbreds and large-scale seed production of inbreds and hybrids were also successfully implemented.
- More emphasis is put on QPM variety development and providing improved varieties rather than hybrids to resource-poor producers for the sake of self-sufficiency in seed provision.
- In the national scientific programs of our Center were introduced and now are investigated some problems of cultivation and seed growing, which were started with the help of CIMMYT, for example, furrow-irrigated bed planting systems.
- By staff of wheat breeding department who are trained by CIMMYT, a selection study of big numbers of wheat germplasm from CIMMYT has been conducted, and on the result of selection the new varieties were created, which are more adapted to local soil-climatic zones, particularly: a) Djamin - facultative wheat, which is released locally since 2005. The potential productivity in winter sowing is 9 t/h, in spring – 5 t/ha.; and b) Almira –winter wheat, it is now in State Variety Testing. The yield potential is 8.6 t/ha. Also big numbers of crossing by involving of germplasm received from CIMMYT as parental form were conducted by wheat breeding department's breeders. The corn breeders on the base of corn hybrids from CIMMYT began the work on creation of new self pollinated lines (parental forms) to get the high productive corn hybrids with 15-17 t/ha - seed yield, 85-90 t/ha –silos mass.
- In the farm fields in two regions by the scientists of our Center and help of CIMMYT, GTZ organized demonstrations of furrow-irrigated bed planting systems. International nurseries, tested in the plots of our Center enrich the genetic base of new developed breeding material.

On local or national agricultural practices.

- New research trends in post-graduate study training programs have been implemented.
- Wheat bed planting system has been widely extended in Shandong Province of China.

- Two leading cultivars, Jinan 17 and Jimai 19, which have high yield and good bread- or noodle-making quality and contain CIMMYT germplasm. Saric consanguinity has been extended more than 5.33 million ha in China and greatly promoted national wheat quality improvement.
- Better crop handling practices (sow, seed, post-harvest handling, seed production and preparation, among others).
- New and more environment-friendly technologies, increased efficiency in national problem-solving (drought, famine, disease tolerance, among others).
- Sowing densities, fertilization, new material use, soil management and others.
- An agricultural practice is to use improved seed. This is being promoted by the institution in field-work days, by product, via development projects.
- Due to CIMMYT- trained people, maize production technology has been improved resulting in getting higher yield.
- Total wheat production per unit area is increased nationally and as a result livelihood is changed.
- We have been employing different modern techniques of knowledge acquired from CIMMYT training for producing more seed yield to improve agricultural practices locally and nationally.
- Farmer-participatory variety selection was introduced to us by CIMMYT and it has become popular with government and aid institutions working with us to improve farmers' choice and quality of varieties in remote communities.
- Through introduction of improved crop management and cropping system practices.
- The use of tied ridges; the use of cover crops such as mucuna; the use of improved varieties; the use of recommended type and rate of fertilizer.
- By attending training courses of CIMMYT, national experts and researchers have transferred new technologies and knowledge to wheat producers through extension service.
- Crop improvement/mechanization/Country Almanac.

Recommendations for future CIMMYT training

Increase regional training/use of regional experts.

- I do think that CIMMYT might consider, though, involving local expertise to a greater extent in their training programs. Country-specific or even region-specific knowledge could contribute to additional successful applications of technologies developed during combined or individual efforts.
- Perhaps our research professors be considered for upcoming training programs, and we allowed to use the different materials that CIMMYT publishes, as noted in your 10th question [about what materials trainees brought back from training].
- More required especially in the field of breeding for QPM and biotechnology. To reduce on costs, those for QPM can be carried out in local countries.

Continue basic/Mexico-based training.

- Such trainings/visits must keep on going. A visit to an internationally renowned center like CIMMYT some time is very helpful in motivating scientists to do innovative research in their own center.
- CIMMYT training is a very important and high-priority activity that has diminished sharply at all levels. It has special emphasis because it requires qualification for new researchers who are interested in adopting this approach. Also there is new technology that is not being utilized and, in several cases, not even agricultural research professionals have this knowledge available.
- In my opinion, CIMMYT should re-start and enhance wheat training program because it has a great impact on national wheat breeding and wheat production of the developing countries and we all knew CIMMYT's tremendous contribution on wheat improvement and wheat training program to world wheat breeding and wheat production.
- Since our people lack practical experience, we like to have field experiences in breeding, production technology by working together with CIMMYT scientists.

- Since collaboration with CIMMYT only one scientist of our Institute have been in 6 monthly training courses on wheat improvement in Mexico, CIMMYT. Would be desirable if the training of young specialists will be regularly, systematically.

Expand offerings.

- CIMMYT should organize courses for research managers (Senior Scientists, Directors, etc.) in addition to working scientist.
- In our view, it is necessary for CIMMYT to extend the works on corn. Corn is a main food crop in my country. For what: a) to increase the contacts of scientists; b) to conduct the training courses for young specialists; c) to send to our country the self pollinated lines no hybrids.
- After reformation CIMMYT has to give attention not only to wheat and corn, also to other crops, which have the vital value in overcoming of poverty in our cattle-breeding republic, particularly, barley is one leading food crop.

General comments/recommendations.

- CIMMYT training activities must be continued to help the developing countries.
- It is good to have a training backup that is consolidated in one strong body that has access to a wide range of expertise as well as facilities. CIMMYT also represents only two crops and therefore can focus all their efforts towards improvement of production and quality of genotypes. CIMMYT therefore plays an important support role, particularly for countries that do not have their own research and technology centers on commodities such as maize and wheat. For countries such as us who do have our own systems, CIMMYT is a strong partner and good supporter too, although in some sense there may arise areas of conflicting interests. Those are minor, however, and could be eliminated or scaled down through effective and positive communication and attitude. It has never been a real threat to us. CIMMYT's training is a well designed activity in which every theoretical lecture is accompanied by practical activities. Field visits during the training will give enough opportunity to select for taking home good performing materials under field conditions.
- I think CIMMYT has had great impact on NARS through its basic training courses. However, it is more appropriate to change the aims and scopes of training at CIMMYT to case studies as well as sabbatical studies for some countries.
- I believe that training programs should continue as essential part of CIMMYT because they provide support to universities and national programs, either as scientific interchange or germplasm.
- Newly recruited wheat and maize scientists should have foundation training in different fields at CIMMYT. Senior scientists should visit CIMMYT as visiting scientists to cope-up with the new ideas and development in CIMMYT.
- It would be recommendable that our staffs have more frequent access to courses and internships (specific topics) to be developed in CIMMYT, in order to increase our training opportunities. Also, to have information about opportunities to perform post-graduate thesis in common interest topics between our technicians and CIMMYT scientists. For this latter subject, I offer myself (as a link) to establish a more formal relationship or an agreement about training matters between my institution and CIMMYT.
- Continue the training course without stop, and improve the way of training so as to meet the need of developing countries.
- CIMMYT's training activities should continue and strengthen.

Appendix D: Trainee Survey

CIMMYT Training Program Survey

This questionnaire asks your opinion about the CIMMYT training that you have attended. Your honest answers to the questions are needed so that CIMMYT can get an accurate picture of the strengths and weaknesses of the training program. Please complete the following questions and return the questionnaire within two weeks. Thank you very much for your time.

What CIMMYT courses have you participated in? *Please list both the name and the year of the course:*

_____

1. What type of work do you do?

- ☐ Plant breeding
- ☐ Agronomy
- ☐ Plant pathology
- ☐ Biotechnology
- ☐ Other (Please specify):_____

2. Where do you work?

- ☐ University or college
- ☐ National research center
- ☐ Government agency that does not do research
- ☐ Agricultural extension program
- ☐ Private company (for profit)
- ☐ Non-governmental organization (NGO - nonprofit)
- ☐ Other (Please specify)_____

3. How many people do you supervise?

- ☐ None
- ☐ 1-5
- ☐ 6-10
- ☐ More than 10

4. In your present work activities, what percentage of your time is spent in the following places? *(Please check one box for each place.)*

% time spent in:	1 - 25%	26 - 50%	51 - 75%	76 - 100%
Office				
Laboratory				
Experiment station				
Farmers' fields				
Other				

5. **What are the major crops that you work with?** *(Please check all the answers that are true for you.)*
   - ☐ Maize
   - ☐ Wheat
   - ☐ Sorghum
   - ☐ Rice
   - ☐ Legumes
   - ☐ Cotton
   - ☐ Not applicable: My work is not crop-specific.
   - ☐ Other (Please list):_____

6. **In the first two months after the training, how much of the training did you use?**
   - ☐ Most
   - ☐ Some
   - ☐ A little
   - ☐ None

7. **Today, in your current job, how much of your CIMMYT training do you use?**
   - ☐ Most
   - ☐ Some
   - ☐ A little
   - ☐ None

8. **Please list three behaviors or skills you have used most as a result of the training program.** *(Skip this question if you have not used any of the behaviors or skills taught in the training.)*
   1)
   2)
   3)

9. **Have you used the course manual or other printed materials that were distributed during the training?**
   - ☐ Yes
   - ☐ No
   - ☐ Not applicable: No printed materials were distributed during the training.

10. **Have you used the germplasm that you collected during the training?**
    - ☐ Yes
    - ☐ No *(Please skip to Question 12.)*
    - ☐ Not applicable: I did not collect any germplasm. *(Please skip to Question 12.)*

11. Please identify by name the germplasm that you collected and describe how you used it. If you used the germplasm in research, what were the research results? *(Feel free to the back of the page or attach extra pages if you need more room to write.)*

12. Have you used any tools (other than germplasm) that you received during the training?

☐ Yes

☐ No *(Please skip to Question 14.)*

☐ Not applicable: I did not collect any germplasm. *(Please skip to Question 14.)*

13. Please identify the research tools that you received and describe how you used them. Please describe the results of that use. *(Feel free to the back of the page or attach extra pages if you need more room to write.)*

14. How relevant was the content of the training to your work?

☐ Very relevant

☐ Somewhat relevant

☐ Not at all relevant

15. Has your salary increased since you participated in the CIMMYT training?

☐ Yes

☐ No *(Please skip to Question 17.)*

16. Did the CIMMYT training help you increase your salary?

☐ Yes, it helped a lot.

☐ Yes, it helped some.

☐ No, it was not a factor.

17. Have you been promoted to a more senior position since you participated in the CIMMYT training?

☐ Yes

☐ No *(Please skip to Question 19.)*

18. Did the CIMMYT training help you get promoted to a more senior position?

☐ Yes, it helped a lot.

☐ Yes, it helped some.

☐ No, it was not a factor.

19. How much (if at all) did the CIMMYT training motivate you to do more hands-on work in the field or laboratory?

☐ A lot

☐ Some

☐ Not at all

☐ Not applicable: I did a lot of hands-on work before the training.

☐ Other (Please explain): _____

20. Did the CIMMYT training help your organization conduct research in new areas?

☐ Yes
☐ No *(Please skip to Question 22.)*
☐ Don't know *(Please skip to Question 22.)*
☐ Not applicable: My organization does not conduct research. *(Please skip to Question 22.)*

21. Please describe your organization's new areas of research. *(Feel free to the back of the page or attach extra pages if you need more room to write.)*

22. Did the CIMMYT training help your organization improve agricultural practices locally or nationally?

☐ Yes
☐ No *(Please skip to Question 24.)*
☐ Don't know *(Please skip to Question 24.)*
☐ Not applicable *(Please explain, and then skip to Question 24):*

23. Please describe how your organization has improved agricultural practices locally or regionally. *(Feel free to the back of the page or attach extra pages if you need more room to write.)*

24. Do you have sufficient access to farmers' fields to apply what you learned in the CIMMYT training?

☐ Yes
☐ No
☐ Don't know
☐ Not applicable: My work does not require access to farmers' fields.

25. Do you have support from your supervisors to apply what you learned in the training?

☐ Yes
☐ No
☐ Don't know
☐ Not applicable (please explain): _____

26. Do you need more technical assistance to apply what you learned?

☐ Yes
☐ No
☐ Don't know
☐ Not applicable (please explain): _____

27. Do you have time to apply what you learned in the training?

☐ Yes
☐ No
☐ Don't know
☐ Not applicable (please explain): _____

28. Does your institution have the equipment you need to apply what you learned?

☐ Yes
☐ No
☐ Don't know
☐ Not applicable: No equipment is needed to apply what I learned.

29. Does your institution have enough laboratory space for you to apply what you learned?

☐ Yes
☐ No
☐ Don't know
☐ Not applicable: No laboratory space is needed to apply what I learned.

30. In your opinion, was this program a good investment for your organization?

☐ Yes
☐ No
☐ Don't know

31. Since the training program, how frequently have you communicated your fellow <u>trainees</u>?

☐ Not at all
☐ Less than once time per year
☐ 1-2 times/year
☐ 3-4 times/year
☐ More than 4 times/year

32. Since the training program, how frequently have you communicated any of the training <u>instructors</u>?

☐ Not at all
☐ Less than once time per year
☐ 1-2 times/year
☐ 3-4 times/year
☐ More than 4 times/year

33. If CIMMYT did not exist, where would your organization go for similar kinds of training? *(Please check all the answers that are true for your organization.)*

☐ Other international agricultural research center(s)
☐ National university or research center(s)
☐ Private company (or companies)
☐ Nowhere: Similar kinds of training are not available elsewhere.
☐ Other (please list):_____

34. Have you provided any training to your staff based on the training that you received at CIMMYT?

☐ No

☐ Yes

35. Have other staff in your organization have attended a CIMMYT training program?

☐ No

☐ Yes: **If yes, approximately how many other staff have attended a CIMMYT training program?**_____

_____

☐ Don't know

36. Please describe any other impact on <u>you personally</u> that has not been covered in this survey. *(Feel free to the back of the page or attach extra pages if you need more room to write.)*

37. Please describe any other impact on <u>your organization</u> that has not been covered in this survey. *(Feel free to the back of the page or attach extra pages if you need more room to write.)*

Thank you for your time and thoughtful reply!

Appendix E: Research Leader Survey

CIMMYT Training Program Survey

This questionnaire asks your opinion about the training conducted by the International Center for the Improvement of Maize and Wheat (CIMMYT). Your honest answers to the questions are needed so that CIMMYT can get an accurate picture of the impact of its training program. Please complete the following questions and return the questionnaire to Dr. Leslie Cooksy, CIMMYT consultant, within 10 days. She can be reached at ljcooksy@udel.edu or 1-302-831-4225 (fax) or 1-302-831-0765.
Thank you very much for your time.

1. **What is the name of the institution where you work?** _____
   _____
2. **What is the title of your position?** _____

3. **What are the major crops that you work with?** *(Please check all the answers that are true for you.)*
   - ☐ Maize
   - ☐ Wheat
   - ☐ Sorghum
   - ☐ Rice
   - ☐ Legumes
   - ☐ Cotton
   - ☐ Not applicable: My work is not crop-specific.
   - ☐ Other (Please list):_____ _____

4. **How many people in your institution are involved in activities related to the improvement of maize and/or wheat?**
   - ☐ None
   - ☐ 1-5
   - ☐ 6-10
   - ☐ 11-15
   - ☐ More than 15
   - ☐ Don't know

5. **What are the major sources of training and professional development for the staff in your organization?** *(Please check all the answers that are true for your organization.)*
   - ☐ National university or research center(s)
   - ☐ Private company (or companies)
   - ☐ CIMMYT
   - ☐ Other international agricultural research center(s)
   - ☐ Other (please describe): _____

6. Have you ever been a trainee in a CIMMYT training program?

☐ No

☐ Yes — *If yes, please provide the following information:*

Training name or topic (if more than one, please list all):

_____

Year of the training program: _____

Location of the training program: _____

7. Have you ever been an instructor in a CIMMYT training program?

☐ No

☐ Yes — *If yes, please provide the following information:*

Training name or topic (if more than one, please list all):

_____

Year of the training program: _____

Location of the training program: _____

8. Approximately how many people in your institution have attended a CIMMYT training program?

(If you have attended CIMMYT training, include yourself in the number.)

☐ None

☐ 1-5

☐ 6-10

☐ 11-15

☐ More than 15

☐ Don't know

9. In your opinion, has CIMMYT training had an impact on your organization?

☐ Yes

☐ No

☐ Don't know

If you answered No or Don't Know to Question 9, you do not have to answer any other questions. Please return the questionnaire as described in the letter. Thank you for your time.
If you answered Yes, please continue with the survey.

10. What materials have the people in your organization brought back from CIMMYT training? *(Please check all that apply.)*

☐ None

☐ Germplasm

☐ Computer software

☐ Other research tools (please describe):_____

☐ Course manual

☐ Publications other than the course manual

☐ Other (please describe):_____

11. Have you observed any changes in the way staff work after they have attended CIMMYT training?
***(Please** check all that apply.)*

☐ No, I have not observed any changes.
☐ Staff have improved morale after CIMMYT training.
☐ Staff have more interest in hands-on work in the field or laboratory after CIMMYT training.
☐ Staff have increased communication with international scientists after CIMMYT training.
☐ Other (please describe):_____

12. Has CIMMYT training affected the way your organization does research?

☐ No
☐ Don't know
☐ Not applicable: My organization does not conduct research.
☐ Yes – *Please describe the changes:*

13. Has CIMMYT training helped your organization conduct research in new areas?

☐ No
☐ Don't know
☐ Not applicable: My organization does not conduct research.
☐ Yes – *Please describe the new areas of research that were started because of CIMMYT training:*

14. Has CIMMYT training helped your organization improve agricultural practices locally or nationally?

☐ No
☐ Don't know
☐ Not applicable: My organization does not conduct research.
☐ Yes – *Please describe how CIMMYT training improved agricultural practices locally or nationally:*

15. Has CIMMYT had an impact on any other aspects of your organization?

☐ No
☐ Yes – *Please describe the other impacts:*

16. Do you have any other comments about CIMMYT's training activities?

Thank you for your time and thoughtful reply!