CIMMYT®

PEOPLE and PARTNERSHIPS:

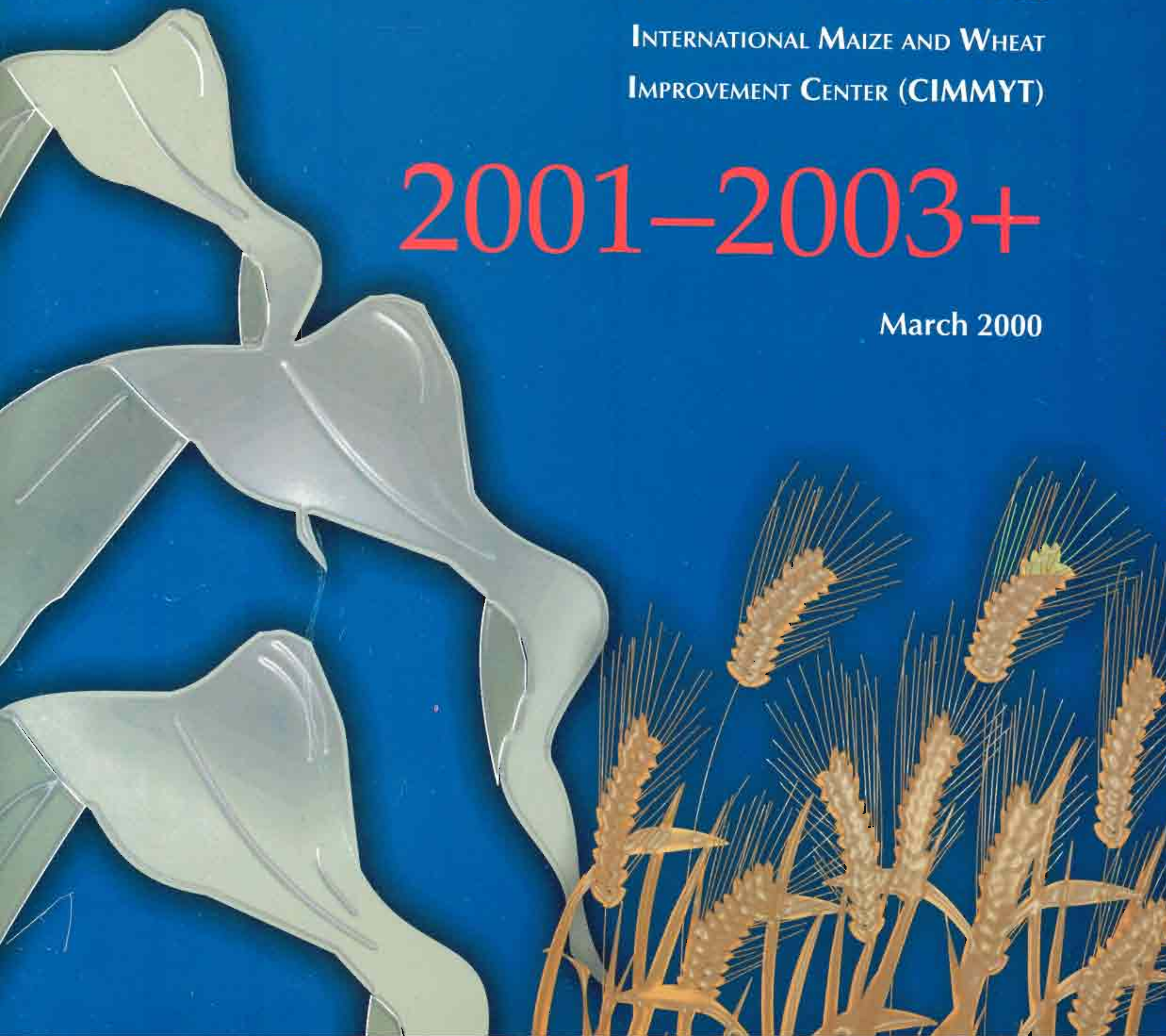
Medium-Term Plan

OF THE

INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER (CIMMYT)

2001–2003+

March 2000



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

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

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Contents

CIMMYT Research Plan and Budget, 2001-2003+

The research agenda set forth in this new *Medium-Term Plan* reflects CIMMYT's commitment to reaching the producers and environments where our products are most needed. The research agenda also reflects an inclusive approach that extends across disciplines and integrates contributions from many partners (farmers, advanced research institutes, non-governmental organizations, and others). Through new and more inclusive research arrangements, CIMMYT and its partners respond better and more rapidly to the needs of the world's poorest producers and consumers. Also, by exchanging information among a wider network of partners who share our goals, we improve the efficiency and targeting of our research.

As of this printing, we do not envision major alterations in the research agenda over the planning period; rather, the agenda will continue to evolve as better information becomes available for priority setting and as new collaborative research arrangements emerge. That said, it is important to emphasize that we and our partners are well aware that many new trends—affecting the socio-political, economic, and legal structures within which we conduct research—will alter the way that technology is developed for and delivered to farmers, and that these trends will inevitably transform our research agenda.

Our previous medium-term plans extensively reviewed the importance of research on maize and wheat for future food security, poverty alleviation, and resource conservation goals. Because this context for our research agenda is now well understood, it is not necessary to go into detail here. A few recent figures from the International Food Policy Research Institute (IFPRI)* suffice to emphasize why maize and wheat research will remain important for some time to come:

- Demand for wheat and maize will rise faster than demand for rice in developing countries to 2020. Demand for wheat will grow by 1.58% per year; demand for maize will grow by 2.35% per year.
- The world's farmers must produce 40% more grain by 2020 to meet demand for cereals, including wheat and maize. To reach this goal, farmers will need sound natural resource management practices.
- Even with projected production increases, by 2020 wheat will constitute more than 50% of the developing world's net cereal imports. Maize will constitute 33%.

CIMMYT's Contribution to Future Productivity Gains: Research Highlights and New Strategies, 1999

The following research highlights provide an idea of the avenues that CIMMYT is pursuing to attain the productivity gains so urgently needed by the poorest households in the next two decades.

* Pinstrup Anderson, P., R. Pandya-Lorch, and M.W. Rosegrant. 1999. *World Food Prospects: Critical Issues for the Early Twenty-first Century.* Washington, DC: International Food Policy Research Institute.

Research Agreement for the Development of Apomixis

In 1999, CIMMYT, France's Institut de Recherche pour le Développement, Pioneer Hi-Bred International, Inc., Limagrain, and Novartis Seeds AG reached a five-year research agreement for the development of apomictic plant varieties. The objective of the agreement is to understand the biology and genetics of apomixis for possible use in certain crop plants. For the seed producer partners in this collaboration, studying the basic biological processes responsible for apomixis might enable these companies to enhance their reliability as suppliers of quality seeds for farmers. For the public institutes, this collaboration will enhance fulfillment of their mission to provide the most productive crops possible to the world's poorest farmers.

Quality Protein Maize

In partnership with maize breeders worldwide, CIMMYT has developed high yielding maize varieties and hybrids whose grain possesses enhanced levels of two essential amino acids, effectively converting a staple of the poor into a cheap and accessible protein source. Superior hybrids and open-pollinated varieties of quality protein maize (QPM) have been evaluated in more than 30 nations. Results were remarkable, particularly in yield, where outstanding QPM hybrids often had an advantage of 1 t/ha or more over the best normal maize hybrids. This, together with QPM's promise for improving human nutrition, raised great interest in QPM in maize producing and consuming countries in 1999. Mexico, for example, released 16 new QPM varieties based on CIMMYT materials; China, El Salvador, and Guatemala each released 1 new QPM hybrid. Several developing nations launched QPM seed production and dissemination programs with help from CIMMYT. The Mexican Ministry of Agriculture's plan calls for more than two million hectares of QPM to be sown by 2002, which would make Mexico the world leader in QPM area.

Progress and Global Integration of Conservation Tillage Research

Conservation tillage is a focal point for integrating CIMMYT's wide-ranging research on biophysical processes, farmer experimentation, socioeconomics, modeling, and climate change. Rather than concentrating on research with narrow, site-specific applications, we are developing a research framework that will enable results to be more widely applicable, to contribute to the design of new methods for natural resources research, and to be relevant to issues of regional and global importance.

South Asia—The Rice-Wheat Consortium (RWC) for the Indo-Gangetic Plains has been instrumental in developing tillage technologies that are applicable throughout South Asia. Now about 20,000 ha are under zero tillage in the Indo-Gangetic Plains, about half in India and half in Pakistan. About 70% of the wheat planted in Bangladesh is sown with minimum tillage practices that allow earlier sowing and raise the productivity of the cropping system. Partly because of these impacts, the RWC was cited in the CGIAR review of ecoregional programs as one of the System's two most successful ecoregional efforts. (CIMMYT is the convening Center for this ecoregional initiative.) The Asian

Pacific Association of Agricultural Research Institutes (APAARI) has chosen the RWC as their best example of a successful partnership, to be presented as such to the Global Forum on Agricultural Research (GFAR) session at the CGIAR Mid-Term meeting in 2000.

Bolivia—In the Bolivian highlands, where smallholders face serious water constraints, including drought in recent years, wheat research focuses on water conservation and water use efficiency, primarily through retaining crop residues. Two methods of residue retention are being examined. The first is to apply straw to the surface of the field after seeding, a low-input but high-labor solution. The second is a small, no-till, animal-drawn seed drill, which has been designed by a local research project. Demonstration plots with the residue retention technology provoked considerable interest among farmers: in the 1998/99 season, an average yield increase of 60% across sites was associated with residue retention.

Future activities—Future conservation tillage research will include greater activity on climate change issues, especially the contribution of conservation tillage to increasing soil carbon levels and thereby carbon sequestration, potentially a huge impact. CIMMYT and France's Center for International Cooperation in Agricultural Research for Development (CIRAD) are developing a new Global Program under GFAR on Direct Sowing, Mulch-based Systems, and Conservation Tillage. In Mexico, the second phase of a conservation tillage project in features a wider array of partnerships, has become more national in scope, and benefits from closer links with the global network of CIRAD.

Stress Tolerant Maize for Africa

More milestones have been reached in CIMMYT's broad effort to stabilize and increase maize production sustainably in African environments affected by abiotic and biotic stresses. All of this research, which depends on the efforts of many partners worldwide, gives special emphasis to technologies that reduce losses in subsistence farming systems, where poverty is widespread.

Maize systems to withstand drought and infertile soils—Two large, multiple-partner projects** have set off a major methodological transformation in maize research in the region: breeders now subject experimental maize to controlled drought and low nitrogen stress for selection. Regional networks and stress screening sites have been established. Formerly isolated researchers are exchanging stress tolerant germplasm and information. As a result, in southern Africa researchers have identified experimental varieties that yield 50% more under drought and low nitrogen conditions than leading cultivars. This has attracted the attention of breeders, agronomists, extensionists, non-governmental organizations (NGOs), and farmers, and the varieties are being tested widely on-farm. Outstanding selections from this work will be offered to farmers through private seed markets, NGOs, and community-based seed production schemes. These breeding efforts are complemented by research

** Partners include the International Institute of Tropical Agriculture (IITA); the West and Central Africa Collaborative Maize Network (WECAMAN) operating under the sub-regional organization, CORAF; the East and Central Africa Maize and Wheat Network (ECAMAW) of the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA); and the National Agricultural Research Programs of the Southern Africa Development Community (SADC).

on interactions between stress tolerant germplasm, management practices (e.g., interactions between cultivars and soil fertility/moisture management practices), and farmers' preferences.

Insect-resistant maize for African farming systems—CIMMYT initiated a major new partnership with the Kenya Agricultural Research Institute (KARI) in 1999 to develop and disseminate insect-resistant maize to resource-poor farmers. Several discussions have helped define the project, in which researchers will combine conventional host-plant resistance factors with novel resistance via biotechnology. The project will also analyze the social and economic impacts of the proposed maize varieties and provide KARI staff opportunities for training and experience in the development, evaluation, and dissemination of biotechnology-derived, insect-resistant germplasm. A major stakeholders' meeting early in 2000 will present the proposed project for discussion and feedback from a wide audience of stakeholders.

Control of Striga *in African farming systems*—The parasitic weed *Striga* reduces maize yields across large areas of sub-Saharan Africa, but research has yielded few control strategies suitable for farmers with little cash, labor, or access to inputs. By 1999, CIMMYT, KARI, the International Institute of Tropical Agriculture (IITA), University of Sheffield (UK), and Weizmann Institute of Science (Israel) could announce good progress towards three control strategies. The first strategy consists of coating seed of herbicide-resistant maize with a very small amount of herbicide (a near-term control strategy that is effective, economic, and can be used until the other two strategies become available). A package of appropriate germplasm, agronomic recommendations, and deployment strategies based on this technology will soon be available. Second, researchers have screened wild relatives of maize (teosinte and *Tripsacum*) for *Striga* resistance as a preliminary step toward developing populations that breeders can use as a source of favorable alleles. Third, by crossing normal maize with special genetic stocks containing transposons, researchers have identified alleles for *Striga* resistance. Further research will investigate the potential value of resistant alleles, at the phenotypic and molecular levels, and introduce the most promising ones into adapted maize germplasm for release. Even more important, the mutant alleles will make it possible to characterize the molecular basis of the signals involved in the interactions between maize and *Striga*, information needed to develop long-term, sustainable control strategies.

Impact of Wheat and Maize Research

In 1999, two studies confirmed the continuing utility of CIMMYT-related wheat and maize for farmers and for plant breeding research. CIMMYT's contribution to world wheat production is enormous. Spring bread wheat, the predominant wheat grown in the developing world, is sown on 68 million hectares of land in countries as geographically diverse as Ethiopia, China, and Brazil. In 1997, between 80% and 90% of the spring bread wheat area in the developing world outside China was planted to cultivars with CIMMYT breeding materials in their pedigrees. China planted approximately one-third of its spring bread wheat area to CIMMYT-related germplasm. Results for spring durum wheats are also impressive. In West Asia/North Africa (WANA), where 80% of the developing world's spring durum wheat is grown, more than half of the area is sown to CIMMYT durum crosses. In Latin America, more than 90% of the area sown to spring durum is planted with CIMMYT crosses.

The maize impact study focused on Latin America, where 75% of the commercially produced maize seed (and a similar proportion of area planted to improved materials) contains CIMMYT germplasm. One implication of this finding is that public maize breeding programs are performing a useful function and that the products generated obviously have value, because they are used so extensively by the private sector. Studies to be released in 2000 will provide overviews of maize research impacts in Africa and Asia. A global summary study will be released as well.

Wheat in Central Asia and the Caucasus

CIMMYT has made a long-term commitment to revitalizing wheat research in this region, where the agricultural sector is still adjusting to challenging economic circumstances. Wheat production expanded in the region over the past four to six years, but in many instances the beleaguered research system has found it difficult to supply farmers with suitable varieties (for example, in some areas wheat is susceptible to yellow rust). To provide varieties that will perform better, considerable attention is being given to strengthening and building regional networks for germplasm and information exchange, improving the efficiency of breeding programs where necessary, and providing training (especially in pathology) to researchers. The development of sustainable agricultural practices is an additional priority. Assessments of agricultural policy and genetic resource issues are also underway.

In situ Conservation and Management of Genetic Resources

By 1999, a project linking CIMMYT, Mexico's Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP), and smallholders in Oaxaca, Mexico, had made considerable progress in assessing whether farmers' welfare could be increased through participatory maize breeding while maintaining or enhancing genetic diversity. The lessons learned from this research will have important implications for future research on genetic resources and crop improvement.

In phase one of the project, maize landraces from the region were collected and characterized; eight landraces were improved with the help of farmers; and a baseline survey of socioeconomic conditions, varietal diversity, and farm household management of diversity was conducted. In phase two, the economic costs and benefits of three types of farmer participation in crop improvement are compared, using a research treatment that gives farmers access to improved landraces, a wider array of non-improved landraces representing the morphological diversity present in the region, and training in seed selection and management. This project approaches the question of gene flows and farmer management at the individual household level. Future research will build on this work to examine the community-level social systems that mediate farmers' access to genetic resources. These systems are significant, for they may ultimately determine whether entire indigenous crop populations are maintained or disappear.

Cutting-Edge GIS Tools for Non-GIS Specialists

Many national research programs in developing countries could benefit from spatially referenced data on climate, soils, infrastructure, crop distribution, and the natural resource base, in part to ascertain the extent to which their site-specific research may have relevance to larger areas. Now, new GIS tools make it increasingly easy for researchers to do just that. The Country Almanacs (updated and expanded in 1999) contain spatially referenced base data, along with the most commonly requested maps, plus search and viewing tools, on a single CD. They have emerged as a stand-alone GIS tool that is widely demanded and used by national research programs and private sector partners. The Africa Maize Research Atlas, also available on CD in 1999, is a compendium of digital data on climate, soils, elevation, land use, population, and maize-related information for sub-Saharan Africa. The Atlas allows researchers without prior experience in the use of GIS to characterize regions of interest, assess climate risks to agriculture, target promising germplasm and agronomic practices (even predicting potential impacts), and perform other useful analyses.

Financial Highlights

For CIMMYT to maintain the flexibility and innovation needed to achieve its humanitarian research objectives, a stable and sufficient funding base is essential. Over the 2001-2003 planning period, we are implementing several strategies to compensate for recent fluctuations in funding levels, protect our research agenda from the impact of unexpected reductions in funding, and develop a more stable and extensive funding base.

Operating Budget

In 1999, CIMMYT's budget was higher than originally estimated (US$ 36.1 million, compared to the original March 1999 projection of US$ 34.4 million). This difference was caused primarily by a change in our accounting procedure for booking targeted contributions. Beginning in 1999, we fully account for all expenditures and/or commitments within the current calendar year.

Although 1999 ended without any deficit in operating funds, our financial reserve was seriously affected when the European Commission (EC) defaulted on its total core payments to the CGIAR in 1999. As a result, CIMMYT charged US$ 1.45 million against its financial reserve (working capital). Thus the major impact of the EC default was to deplete our financial reserves rather than to curtail research activities. At the end of 1999, an additional US$ 0.84 million were written off, including exchange rate losses on 1997 and 1998 EC contributions, as well as contributions from Pakistan and Thailand.

Sources of Additional Funding in 1999

Targeted funds accounted for most additional resources in 1999, particularly funding for core special projects. The increase in targeted contributions reflects several circumstances. First, CIMMYT has made a concerted effort to develop highly focused, strategic partnerships directed at specific major challenges for maize and wheat research. Second, throughout the non-profit research sector there is growing impetus and scope to support research with non-traditional sources of income. Collaborative alliances with non-traditional supporters are enabling us to sustain our research agenda and channel additional funding to partners in national agricultural research systems.

Revised Budget Estimate for 2000

Our budget estimate for 2000 is more conservative than projected in March 1999 (approximately 1.5% less), owing to the volatility of traditional funding sources and increasing competition for resources, both from inside and outside the CGIAR System. The same factors that affected revenues in 1999 may also be present in 2000, particularly if contributions are unduly delayed and/or exchange rates fluctuate significantly. More specifically, CIMMYT and some other CGIAR Centers will not receive core unrestricted support from Germany in 2000, and the Center will also be affected by changing conditions for financial support from the EC.

Projected Trends over the 2001-2003 Planning Period

Based on current trends, it is clear that targeted funding will constitute a growing share of research resources. We anticipate that approximately 42% of the Center's funding will be unrestricted, and 58% will be restricted in one form or another. To command greater flexibility in responding to new challenges and opportunities, and to avoid some of the limitations of restricted funding, we have adopted a resource mobilization strategy focusing on non-traditional sources of income and research support. We have also made considerable efficiency gains in the use of resources through periodic reviews of our activities with a view to identifying cost-saving initiatives.

During the 2001-2003 planning period, we foresee an increase of about 2% per year, in real terms, in the Center's budget. This modest increase will permit moderate growth in key areas and some scope to respond to unexpected needs. In our budget projections we will maintain a conservative approach to exchange rates, which has proven most prudent in recent years. Approximately half of CIMMYT's expenditures are in Mexican pesos, and the peso continues to perform strongly against the US dollar (the peso appreciated by 5% over 1999). In Mexico an inflation rate of 10% (CPI) is forecast for 2000, a rate that the government projects to reduce by 3-4% by 2003.

Total expenses for salaries and allowances are targeted to remain below 60% of the operating budget, as recommended by our Board of Trustees in 1994. Other operating costs are projected to remain constant, in line with long-term trends.

In implementing externally funded research projects, consultancies, and technology transfer efforts, the Center provides a range of high-quality support services. Our current overhead rate, authorized by the Board of Trustees, is a minimum of 20%. More recent audited figures, including full project costing (see our *Audited Financial Statement*, 1998), indicate that overhead as currently defined (indirect/direct costs) is actually 30.7%. Full cost recovery on projects is a critical component of our financial structure, helping to ensure the delivery of high quality research products. We have improved the rate of overhead recovery in recently implemented funding arrangements, although on average, when less recent funding arrangements are taken into account, overhead recovery remains below 20%.

Center Staffing

Internationally recruited research staff will increase very slightly in 2000, based on a redefinition of CIMMYT's research objectives. We will continue with succession planning, which was initiated in 1999, by replacing some senior positions with Associate Scientist and Postdoctoral positions. The number of adjunct staff (researchers working at CIMMYT on fixed-term projects or by agreement with another institution) has increased markedly as partner agencies have funded individuals with specific types of expertise that complement resident staff expertise. Finally, we plan to recruit a new staff member to develop resource mobilization strategies targeting non-traditional sources of income. We have also redefined the responsibilities of our technical writing staff to include support for fund raising and plan to add resources to this important function.

As previously anticipated, the number of nationally recruited staff declined very slightly over 1999 and is projected to remain steady during the planning period.

Financial Indicators and Capital Investments

Owing to the EC default and other write-offs, mentioned earlier, by the end of 1999 our Financial Statements showed a balance in Center reserves equivalent to 51 days of working capital. This figure is well below the level of 80-90 days recommended by the Board of Trustees. In 2000-2001, the Center will replenish its reserve through renewed EC funding and contributions from reduced capital expenditures. Our objective is to reach the recommended reserve level by the end of the planning period. This strategy is absolutely crucial to guard ourselves fully against future financial vulnerability.

The use of capital leasing was successfully implemented in 1999 as a strategy to free up capital. Capital leasing was applied to computer equipment in 1999 and is being evaluated as a means of acquiring other major capital items, such as vehicles, so that we may retain maximum flexibility in deploying capital funds.

Our most pressing capital investment need is to find a new research site to replace Poza Rica Research Station, an important breeding site for lowland tropical maize that was destroyed by floods in October 1999. Research conducted at Poza Rica helped CIMMYT to meet the needs of resource-poor farmers cultivating 55 million hectares of maize in Africa, Asia, and Latin America (about 70% of the maize area in developing countries, excluding Argentina, China, and South Africa). A new station represents an initial investment of approximately US$ 700,000. We plan to subsidize this crucial research facility with special financial resources. Special assistance has already been received from the CGIAR Finance Committee (US$ 250,000) and Australia (A$ 50,000).

Table 1. CIMMYT research agenda requirements, by output,[1/] 2001 (expenditure in US$ millions)

Center projects	Germplasm improvement	Germplasm collection	Sustainable production	Policy	Enhancing NARSs	Project totals
001. Conservation and management of genetic resources	0.527	1.342		0.264	0.264	2.397
002. Developing core germplasm and integrating interdisciplinary approaches for maize improvement	1.172	0.384	0.149		0.426	2.131
003. Developing core germplasm and integrating interdisciplinary approaches for wheat improvement	1.409	0.426	0.786		0.655	3.277
004. Increasing maize productivity and sustainability in stressed environments: abiotic and biotic stress	0.555	0.123	0.370		0.185	1.233
005. Increasing wheat productivity and sustainability in stressed environments: abiotic stress	0.387	0.129	1.550		0.517	2.583
006. Increasing wheat productivity and sustainability in stressed environments: biotic stress	1.404	0.401			0.201	2.006
007. Gauging the productivity, equity, and environmental impact of modern maize and wheat production systems				0.450	0.265	0.715
008. Building partnerships through human resource development					4.163	4.163
009. Improving food security in sub-Saharan Africa	1.851	0.329	1.234	0.247	0.452	4.113
010. Meeting the accelerating demand for maize development, production, and delivery in South and Southeast Asia and in China	0.901	0.180	0.180	0.180	0.360	1.802
011. Sustainable wheat production systems in the Indo-Gangetic Plains	0.318	0.079	0.636	0.079	0.477	1.589
012. Increasing cereal food production in West Asia and North Africa	0.680	0.163	0.122	0.068	0.326	1.360
013. Enhancing Latin American maize and wheat production systems	1.340	0.254	1.159	0.181	0.688	3.622
014. Increasing cereal food production in Central Asia and the Caucasus	0.071	0.047	0.118	0.024	0.212	0.472
015. Raising the yield potential of wheat	0.375	0.021			0.021	0.417
016. Apomixis: equity in access to hybrid vigor for resource-poor farmers	0.366	0.022	0.043			0.431
017. Using genetic engineering for the improvement of maize and wheat in developing countries	0.623		0.249	0.125	0.249	1.245
018. Improving human nutrition by enhancing bio-available protein and micronutrient concentration in maize, wheat, and triticale	0.312				0.078	0.390
019. Genetic approaches to reducing post-harvest losses	0.150		0.120		0.030	0.299
020. Priority setting and technology forecasting for increased research efficiency	0.181		0.073	0.125	0.052	0.430
021. Learning to more effectively confront problems of resource degradation in maize and wheat systems	0.073		0.292	0.073	0.049	0.487
Output totals	**12.695**	**3.901**	**7.081**	**1.816**	**9.670**	35.162

[1/] Please refer to Table 2 for the crosswalk between CGIAR Activities and the new CGIAR Outputs.

Table 2. CIMMYT research agenda: allocation of resources, 1999-2003 (expenditure in US$ millions)

Output	Allocation of resources by outputs, logical framework format				
	1999 (actual)	2000 (estimated)	2001 (proposed)	2002 (planned)	2003 (planned)
Germplasm improvement *(Activity: Germplasm enhancement & breeding, plus networks, as appropriate)*	13.0	12.4	12.7	12.9	13.2
Germplasm collection *(Activity: Saving biodiversity, plus networks, as appropriate)*	4.0	3.8	3.9	4.0	4.1
Sustainable production *(Activity: Production systems development and management, protecting the environment, and networks, as appropriate)*	7.3	6.9	7.1	7.2	7.4
Policy *(Activity: Improving policies, plus networks, as appropriate)*	1.9	1.8	1.8	1.9	1.9
Enhancing NARSs *(Activity: Strengthening NARSs — the three sub-activities, plus networks, as appropriate)*	9.9	9.5	9.7	9.9	10.1
Total	**36.1**	**34.5**	**35.2**	**35.9**	**36.6**

Activity	Allocation of resources by CGIAR Activity				
	1999 (actual)	2000 (estimated)	2001 (proposed)	2002 (planned)	2003 (planned)
Increasing productivity, of which:	13.1	12.5	12.8	13.0	13.3
Germplasm enhancement and breeding	10.5	10.1	10.3	10.5	10.7
Production systems development and management	2.6	2.5	2.5	2.6	2.6
Protecting the environment	7.0	6.7	6.8	6.9	7.1
Saving biodiversity	4.9	4.7	4.8	4.9	5.0
Improving policies	1.4	1.3	1.4	1.4	1.4
Strengthening NARSs, of which:	9.7	9.3	9.4	9.6	9.8
Training and professional development	5.2	5.0	5.1	5.2	5.3
Documentation, publications, information dissemination	1.4	1.3	1.3	1.4	1.4
Organization and management counselling	1.7	1.6	1.6	1.6	1.7
Networks	1.5	1.4	1.4	1.4	1.5
Total	**36.1**	**34.5**	**35.2**	**35.9**	**36.6**

Table 3. CIMMYT research agenda project and output cost summary, 1999-2003 (in US$ millions)

Summary by project	1999 (actual)	2000 (estimated)	2001 (proposed)	2002 (planned)	2003 (planned)
001. Conservation and management of genetic resources	2.5	2.3	2.4	2.4	2.5
002. Developing core germplasm and integrating interdisciplinary approaches for maize improvement	2.2	2.1	2.1	2.2	2.2
003. Developing core germplasm and integrating interdisciplinary approaches for wheat improvement	3.4	3.2	3.3	3.3	3.4
004. Increasing maize productivity and sustainability in stressed environments: abiotic and biotic stress	1.3	1.2	1.2	1.3	1.3
005. Increasing wheat productivity and sustainability in stressed environments: abiotic stress	2.7	2.5	2.6	2.6	2.7
006. Increasing wheat productivity and sustainability in stressed environments: biotic stress	2.1	2.0	2.0	2.0	2.1
007. Gauging the productivity, equity, and environmental impact of modern maize and wheat production systems	0.7	0.7	0.7	0.7	0.7
008. Building partnerships through human resource development	4.3	4.1	4.2	4.2	4.3
009. Improving food security in sub-Saharan Africa	4.2	4.0	4.1	4.2	4.3
010. Meeting the accelerating demand for maize development, production, and delivery in South and Southeast Asia and in China	1.9	1.8	1.8	1.8	1.9
011. Sustainable wheat production systems in the Indo-Gangetic Plains	1.6	1.6	1.6	1.6	1.7
012. Increasing cereal food production in West Asia and North Africa	1.4	1.3	1.4	1.4	1.4
013. Enhancing Latin American maize and wheat production systems	3.7	3.6	3.6	3.7	3.8
014. Increasing cereal food production in Central Asia and the Caucasus	0.5	0.5	0.5	0.5	0.5
015. Raising the yield potential of wheat	0.4	0.4	0.4	0.4	0.4
016. Apomixis: equity in access to hybrid vigor for resource-poor farmers	0.4	0.4	0.4	0.4	0.4
017. Using genetic engineering for the improvement of maize and wheat in developing countries	1.3	1.2	1.2	1.3	1.3
018. Improving human nutrition by enhancing bio-available protein and micronutrient concentration in maize, wheat and triticale	0.4	0.4	0.4	0.4	0.4
019. Genetic approaches to reducing post-harvest losses	0.3	0.3	0.3	0.3	0.3
020. Priority setting and technology forecasting for increased research efficiency	0.4	0.4	0.4	0.4	0.4
021. Learning to more effectively confront problems of resource degradation in maize and wheat systems	0.5	0.5	0.5	0.5	0.5
Total	36.1	34.5	35.2	35.9	36.6

Summary by output	1999 (actual)	2000 (estimated)	2001 (proposed)	2002 (planned)	2003 (planned)
Germplasm improvement	13.0	12.4	12.7	12.9	13.2
Germplasm collection	4.0	3.8	3.9	4.0	4.1
Sustainable production	7.3	6.9	7.1	7.2	7.4
Policy	1.9	1.8	1.8	1.9	1.9
Enhancing NARSs	9.9	9.5	9.7	9.9	10.1
Total	36.1	34.5	35.2	35.9	36.6

Table 4. CIMMYT allocation of project costs to CGIAR Activities, 1998-2002 (in US$ millions)

Project	Activity	1999 (actual)	2000 (estimated)	2001 (planned)	2002 (planned)	2003 (planned)
001. Conservation and management of genetic resources	Enhancement and breeding (Maize)	0.27	0.26	0.27	0.27	0.28
	Enhancement and breeding (Wheat)	0.27	0.26	0.27	0.27	0.28
	Saving biodiversity	1.37	1.31	1.33	1.36	1.39
	Improving policies	0.27	0.26	0.27	0.27	0.28
	Strengthening NARSs—Training	0.11	0.11	0.11	0.11	0.11
	Strengthening NARSs—Information	0.16	0.16	0.16	0.16	0.16
		2.46	**2.35**	**2.40**	**2.44**	**2.49**
002. Developing core germplasm and integrating interdisciplinary approaches for maize improvement	Enhancement and breeding (Maize)	0.88	0.84	0.86	0.87	0.89
	Production systems (Maize)	0.11	0.10	0.11	0.11	0.11
	Protecting the environment	0.20	0.19	0.19	0.20	0.20
	Saving biodiversity	0.40	0.38	0.39	0.40	0.41
	Strengthening NARSs—Training	0.40	0.38	0.39	0.40	0.41
	Strengthening NARSs—Information	0.20	0.19	0.19	0.20	0.20
		2.19	**2.09**	**2.13**	**2.17**	**2.22**
003. Developing core germplasm and integrating interdisciplinary approaches for wheat improvement	Enhancement and breeding (Wheat)	1.51	1.44	1.47	1.50	1.53
	Production systems (Wheat)	0.06	0.05	0.05	0.05	0.06
	Protecting the environment	0.71	0.68	0.69	0.71	0.72
	Saving biodiversity	0.66	0.63	0.64	0.66	0.67
	Strengthening NARSs—Training	0.14	0.14	0.14	0.14	0.14
	Strengthening NARSs—Networks	0.29	0.27	0.28	0.28	0.29
		3.37	**3.21**	**3.28**	**3.34**	**3.41**
004. Increasing maize productivity and sustainability in stressed environments: abiotic and biotic stress	Enhancement and breeding (Maize)	0.37	0.36	0.36	0.37	0.38
	Production systems (Maize)	0.07	0.07	0.07	0.07	0.07
	Protecting the environment	0.47	0.45	0.46	0.47	0.48
	Saving biodiversity	0.18	0.17	0.17	0.18	0.18
	Strengthening NARSs—Training	0.03	0.03	0.03	0.03	0.03
	Strengthening NARSs—Information	0.07	0.07	0.07	0.07	0.07
	Strengthening NARSs—Org & Mgt	0.03	0.03	0.03	0.03	0.03
	Strengthening NARSs—Networks	0.03	0.03	0.03	0.03	0.03
		1.27	**1.21**	**1.23**	**1.26**	**1.28**
005. Increasing wheat productivity and sustainability in stressed environments: abiotic stress	Enhancement and breeding (Wheat)	0.57	0.54	0.55	0.57	0.58
	Production systems (Wheat)	0.10	0.09	0.10	0.10	0.10
	Protecting the environment	1.32	1.26	1.28	1.31	1.33
	Saving biodiversity	0.35	0.34	0.34	0.35	0.36
	Strengthening NARSs—Information	0.10	0.10	0.10	0.10	0.11
	Strengthening NARSs—Org & Mgt	0.10	0.10	0.10	0.10	0.11
	Strengthening NARSs—Networks	0.10	0.10	0.10	0.10	0.11
		2.65	**2.53**	**2.58**	**2.63**	**2.69**
006. Increasing wheat productivity and sustainability in stressed environments: biotic stress	Enhancement and breeding (Wheat)	0.38	0.36	0.37	0.37	0.38
	Production systems (Wheat)	0.19	0.18	0.18	0.19	0.19
	Protecting the environment	0.89	0.85	0.87	0.89	0.90
	Saving biodiversity	0.41	0.39	0.40	0.41	0.42
	Strengthening NARSs—Information	0.09	0.09	0.09	0.09	0.10
	Strengthening NARSs—Org & Mgt	0.09	0.09	0.09	0.09	0.10
		2.06	**1.97**	**2.01**	**2.05**	**2.09**
007. Gauging the productivity, equity, and environmental impact of modern maize and wheat production systems	Improving policies	0.44	0.42	0.43	0.44	0.45
	Strengthening NARSs—Training	0.07	0.06	0.06	0.06	0.07
	Strengthening NARSs—Information	0.07	0.06	0.06	0.06	0.07
	Strengthening NARSs—Org & Mgt	0.07	0.06	0.06	0.06	0.07
	Strengthening NARSs—Networks	0.10	0.09	0.09	0.10	0.10
		0.73	**0.70**	**0.72**	**0.73**	**0.74**
008. Building partnerships through human resource development	Strengthening NARSs—Training	3.39	3.24	3.30	3.37	3.44
	Strengthening NARSs—Information	0.13	0.13	0.13	0.13	0.13
	Strengthening NARSs—Org & Mgt	0.62	0.60	0.61	0.62	0.63
	Strengthening NARSs—Networks	0.12	0.12	0.12	0.12	0.13
		4.28	**4.08**	**4.16**	**4.25**	**4.33**

Table 4. Cont'd.

Project	Activity	1999 (actual)	2000 (estimated)	2001 (planned)	2002 (planned)	2003 (planned)
009. Improving food security in sub-Saharan Africa	Enhancement and breeding (Maize)	1.90	1.82	1.85	1.89	1.93
	Production systems (Maize)	0.61	0.59	0.60	0.61	0.62
	Protecting the environment	0.71	0.68	0.69	0.71	0.72
	Saving biodiversity	0.36	0.35	0.35	0.36	0.37
	Improving policies	0.11	0.11	0.11	0.11	0.11
	Strengthening NARSs—Training	0.01	0.01	0.01	0.01	0.01
	Strengthening NARSs— Information	0.01	0.01	0.01	0.01	0.01
	Strengthening NARSs—Org & Mgt	0.15	0.15	0.15	0.15	0.15
	Strengthening NARSs—Networks	0.35	0.33	0.34	0.35	0.35
		4.22	**4.03**	**4.11**	**4.20**	**4.28**
010. Meeting accelerating demand for maize development, production, anddelivery inSouth and Southeast Asia and in China	Enhancement and breeding (Maize)	0.49	0.47	0.48	0.49	0.50
	Production systems (Maize)	0.22	0.21	0.21	0.22	0.22
	Protecting the environment	0.34	0.32	0.33	0.33	0.34
	Saving biodiversity	0.16	0.16	0.16	0.16	0.17
	Improving policies	0.18	0.17	0.17	0.18	0.18
	Strengthening NARSs—Training	0.15	0.14	0.14	0.15	0.15
	Strengthening NARSs—Information	0.05	0.05	0.05	0.05	0.05
	Strengthening NARSs—Org & Mgt	0.10	0.09	0.09	0.10	0.10
	Strengthening NARSs--Networks	0.16	0.16	0.16	0.16	0.17
		1.85	**1.77**	**1.80**	**1.84**	**1.88**
011. Sustainable wheat production systems in the Indo-Gangetic plains	Enhancement and breeding (Wheat)	0.25	0.24	0.24	0.24	0.25
	Production systems (Wheat)	0.39	0.38	0.38	0.39	0.40
	Protecting the environment	0.56	0.53	0.55	0.56	0.57
	Saving biodiversity	0.09	0.09	0.09	0.09	0.09
	Improving policies	0.09	0.09	0.09	0.09	0.09
	Strengthening NARSs—Training	0.15	0.15	0.15	0.15	0.16
	Strengthening NARSs—Information	0.09	0.09	0.09	0.09	0.09
		1.63	**1.56**	**1.59**	**1.62**	**1.65**
012. Increasing cereal food production in West Asia and North Africa	Enhancement and breeding (Wheat)	0.56	0.54	0.55	0.56	0.57
	Protecting the environment	0.26	0.25	0.25	0.26	0.26
	Saving biodiversity	0.18	0.17	0.17	0.18	0.18
	Strengthening NARSs—Training	0.23	0.22	0.22	0.23	0.23
	Strengthening NARSs—Information	0.03	0.03	0.03	0.03	0.03
	Strengthening NARSs—Org & Mgt	0.06	0.06	0.06	0.06	0.06
	Strengthening NARSs—Networks	0.07	0.07	0.07	0.07	0.07
		1.40	**1.33**	**1.36**	**1.39**	**1.41**
013. Enhancing Latin American maize and wheat production systems	Enhancement and breeding (Maize)	1.01	0.97	0.99	1.01	1.03
	Enhancement and breeding (Wheat)	0.25	0.24	0.25	0.25	0.26
	Production systems (Maize)	0.41	0.39	0.40	0.40	0.41
	Production systems (Wheat)	0.10	0.10	0.10	0.10	0.10
	Protecting the environment	0.60	0.57	0.58	0.59	0.60
	Saving biodiversity	0.32	0.31	0.31	0.32	0.33
	Improving policies	0.09	0.08	0.09	0.09	0.09
	Strengthening NARSs—Training	0.31	0.30	0.31	0.31	0.32
	Strengthening NARSs—Information	0.18	0.17	0.17	0.18	0.18
	Strengthening NARSs—Org & Mgt	0.24	0.23	0.23	0.24	0.24
	Strengthening NARSs—Networks	0.20	0.19	0.20	0.20	0.20
		3.72	**3.55**	**3.62**	**3.69**	**3.77**
014. Increasing cereal food production in Central Asia and the Caucasus	Enhancement and breeding (Wheat)	0.20	0.19	0.19	0.19	0.20
	Production systems (Wheat)	0.03	0.03	0.03	0.03	0.03
	Saving biodiversity	0.07	0.07	0.07	0.07	0.07
	Improving policies	0.05	0.05	0.05	0.05	0.05
	Strengthening NARSs—Training	0.07	0.07	0.07	0.07	0.07
	Strengthening NARSs—Information	0.01	0.01	0.01	0.01	0.01
	Strengthening NARSs—Org & Mgt	0.02	0.02	0.02	0.02	0.02
	Strengthening NARSs—Networks	0.02	0.02	0.02	0.02	0.02
		0.49	**0.46**	**0.47**	**0.48**	**0.49**
015. Raising the yield potential of wheat	Enhancement and breeding (Wheat)	0.38	0.37	0.37	0.38	0.39
	Strengthening NARSs—Information	0.02	0.02	0.02	0.02	0.02
	Strengthening NARSs—Org & Mgt	0.02	0.02	0.02	0.02	0.02
		0.43	**0.41**	**0.42**	**0.43**	**0.43**

Table 4. Cont'd.

Project	Activity	1999 (actual)	2000 (estimated)	2001 (planned)	2002 (planned)	2003 (planned)
016. Apomixis: Equity in access to hybrid vigor for resource-poor farmers	Enhancement and breeding (Maize)	0.16	0.16	0.16	0.16	0.17
	Enhancement and breeding (Wheat)	0.16	0.16	0.16	0.16	0.17
	Production systems (Maize)	0.03	0.03	0.03	0.03	0.03
	Production systems (Wheat)	0.03	0.03	0.03	0.03	0.03
	Saving biodiversity	0.06	0.06	0.06	0.06	0.06
		0.44	**0.42**	**0.43**	**0.44**	**0.45**
017. Using genetic engineering for the improvement of maize and wheat in developing countries	Enhancement and breeding (Maize)	0.29	0.28	0.29	0.29	0.30
	Enhancement and breeding (Wheat)	0.15	0.14	0.14	0.14	0.15
	Protecting the environment	0.53	0.50	0.51	0.53	0.54
	Saving biodiversity	0.21	0.20	0.21	0.21	0.21
	Strengthening NARSs—Training	0.06	0.05	0.05	0.05	0.06
	Strengthening NARSs—Information	0.04	0.04	0.04	0.04	0.04
		1.28	**1.22**	**1.24**	**1.27**	**1.29**
018. Improving human nutrition by enhancing bioavailable protein and micronutrient concentrations in maize, wheat, and triticale	Enhancement and breeding (Maize)	0.16	0.15	0.15	0.16	0.16
	Enhancement and breeding (Wheat)	0.08	0.07	0.07	0.07	0.08
	Production systems (Maize)	0.06	0.05	0.06	0.06	0.06
	Production systems (Wheat)	0.03	0.03	0.03	0.03	0.03
	Strengthening NARSs—Training	0.03	0.02	0.02	0.03	0.03
	Strengthening NARSs—Information	0.03	0.03	0.03	0.03	0.03
	Strengthening NARSs—Org & Mgt	0.03	0.02	0.02	0.03	0.03
		0.40	**0.38**	**0.39**	**0.40**	**0.41**
019. Genetic approaches to reducing post-harvest losses	Enhancement and breeding (Maize)	0.06	0.05	0.05	0.05	0.06
	Enhancement and breeding (Wheat)	0.06	0.05	0.05	0.05	0.06
	Production systems (Maize)	0.01	0.01	0.01	0.01	0.01
	Production systems (Wheat)	0.01	0.01	0.01	0.01	0.01
	Protecting the environment	0.16	0.15	0.15	0.16	0.16
	Strengthening NARSs—Information	0.02	0.02	0.02	0.02	0.02
		0.31	**0.29**	**0.30**	**0.30**	**0.31**
020. Priority setting and technology forecasting for increased research efficiency	Enhancement and breeding (Crops)	0.11	0.10	0.10	0.10	0.11
	Production systems (Crops)	0.08	0.07	0.08	0.08	0.08
	Protecting the environment	0.08	0.07	0.08	0.08	0.08
	Improving policies	0.13	0.12	0.12	0.13	0.13
	Strengthening NARSs—Org & Mgt	0.05	0.05	0.05	0.05	0.05
		0.44	**0.42**	**0.43**	**0.44**	**0.45**
021. Learning to more effectively confront problems of resources degradation in maize and wheat systems	Production systems (Maize)	0.03	0.03	0.03	0.03	0.03
	Production systems (Wheat)	0.03	0.03	0.03	0.03	0.03
	Protecting the environment	0.17	0.16	0.16	0.16	0.17
	Saving biodiversity	0.09	0.08	0.09	0.09	0.09
	Improving policies	0.03	0.03	0.03	0.03	0.03
	Strengthening NARSs—Training	0.05	0.05	0.05	0.05	0.05
	Strengthening NARSs—Information	0.06	0.05	0.05	0.05	0.06
	Strengthening NARSs—Org & Mgt	0.05	0.05	0.05	0.05	0.05
		0.50	**0.48**	**0.49**	**0.50**	**0.51**

		1999 (actual)	2000 (estimated)	2001 (proposed)	2002 (planned)	2003 (planned)
Summary by undertaking:	Increasing productivity	13.1	12.5	12.8	13.0	13.3
	Protecting the environment	7.0	6.7	6.8	6.9	7.1
	Saving biodiversity	4.9	4.7	4.8	4.9	5.0
	Improving policies	1.4	1.3	1.4	1.4	1.4
	Strengthening NARSs	9.7	9.3	9.4	9.6	9.8
	Total:	**36.1**	**34.5**	**35.2**	**35.9**	**36.6**
Summary by output:	Germplasm improvement	10.5	12.4	12.7	12.9	13.2
	Germplasm collection	4.9	3.8	3.9	4.0	4.1
	Sustainable production	7.3	6.9	7.1	7.2	7.4
	Policy	1.4	1.8	1.8	1.9	1.9
	Enhancing NARSs	9.9	9.5	9.7	9.9	10.1
	Total:	**34.0**	**34.5**	**35.2**	**35.9**	**36.6**

To include above for 1999 and 2000:

Rice/Wheat Interactions	Latin America Ecoregion
Mountain Agriculture	Other

Table 5. CIMMYT research agenda, 1999-2003: investments by sector, commodity, and region (in US$ millions)

Production sector and commodity	1999 (actual)	2000 (estimated)	2001 (proposed)	2002 (planned)	2003 (planned)
Germplasm improvement 1/					
Crops	10.5	10.1	10.3	10.5	10.7
Barley					
Maize	5.3	5.1	5.2	5.3	5.4
Wheat	5.2	5.0	5.1	5.2	5.3
Livestock					
Trees					
Fish					
Total	10.5	10.1	10.3	10.5	10.7
Sustainable production 1/					
Crops	11.0	10.5	10.7	11.0	11.2
Barley					
Maize	8.3	7.9	8.1	8.2	8.4
Wheat	2.8	2.6	2.7	2.7	2.8
Livestock					
Trees					
Fish					
Total	11.0	10.5	10.7	11.0	11.2
Total research agenda 2/					
Crops	36.1	34.5	35.2	35.9	36.6
Barley					
Maize	16.8	16.1	16.4	16.7	17.0
Wheat	19.3	18.4	18.8	19.2	19.5
Livestock					
Trees					
Fish					
Total	36.1	34.5	35.2	35.9	36.6

Region	1999 (actual)	2000 (estimated)	2001 (proposed)	2002 (planned)	2003 (planned)
Sub-Saharan Africa	13.0	12.4	12.7	12.9	13.2
Asia	10.8	10.3	10.6	10.8	11.0
Latin America and the Caribbean	8.7	8.3	8.4	8.6	8.8
West Asia and North Africa	3.6	3.4	3.5	3.6	3.7
Total	36.1	34.5	35.2	35.9	36.6

1/ Includes overheads, and must add up to the sum of the individual sectors/commodities from the project portfolio.
2/ Equals sum of sectors/commmodities in "Increasing Productivity," scaled up to total investments for the research agenda.

Table 6. CIMMYT research agenda, 1999-2003: expenditure by functional category, and capital investments (in US$ millions)

Object of expenditure	1999 (actual)	2000 (estimated)	2001 (proposed)	1/ 2002 (planned)	1/ 2003 (planned)
Personnel	18.9	18.3	18.7	18.6	19.0
Supplies and services	14.1	13.7	14.0	14.3	14.6
Operational travel	1.8	1.7	1.8	1.8	1.8
Depreciation	1.4	0.7	0.7	1.2	1.2
Total	**36.1**	**34.5**	**35.2**	**35.9**	**36.6**

Capital investments	1999 (actual)	2000 (estimated)	2001 (proposed)	2002 (planned)	2003 (planned)
Physical facilities					
Research	0.2	0.1	0.1	0.1	0.1
Training					
Administration					
Housing					
Auxiliary units					
Sub-total	**0.2**	**0.1**	**0.1**	**0.1**	**0.1**
Infrastructure and leasehold					
Furnishing and equipment					
Farming	0.1	0.1	0.1	0.1	0.3
Laboratory and scientific	0.2	0.1	0.1	0.2	0.2
Office	0.1			0.1	0.1
Housing					
Auxiliary units	0.0				
Computers	0.4	0.3	0.3	0.4	0.4
Vehicles	0.6	0.2	0.2	0.3	0.3
Aircraft					
Sub-total	**1.3**	**0.7**	**0.7**	**1.1**	**1.3**

Capital fund cash reconciliation	1999 (actual)	2000 (estimated)	2001 (proposed)	2002 (planned)	2003 (planned)
Balance, January 1	-0.2	-0.2	0.0	0.1	0.2
Plus: annual depreciation charge	1.4	0.7	0.7	1.2	1.2
Plus / minus: disposal gains/(losses)	0.0	0.0	0.0	0.0	0.0
Plus / minus: other	0.6	0.1	0.1	0.0	0.1
Minus: asset acquisition costs	-1.9	-0.7	-0.7	-1.1	-1.3
Equals: Balance, December 31	**-0.2**	**0.0**	**0.1**	**0.2**	**0.3**

1/ This column is not required for the Financing Plan Submission (September).
Improved policy analyses and techniques for policy formulation and public management are accessible to NARSs.

Table 7. CIMMYT research agenda financing summary, 1999-2000 (in US$ millions)

Member	1999 /1		2000 /2	
	($ actual)	(nat. currency)	($ esti-mated)	(nat. currency)
Unrestricted contributions				
Australia	0.57	0.90	0.56	0.88
Austria	0.15		0.15	
Belgium	0.12	4.87	0.12	4.87
Brazil	0.08		0.04	
Canada	0.70	1.04	0.71	1.04
China	0.12		0.12	0.12
Denmark	0.66	4.60	0.61	4.60
EC		0.04		
Germany	0.38	0.70		
India	0.11		0.11	
Japan	2.64	270.00	2.47	270.00
Korea	0.05		0.05	
Mexico	0.02		0.04	
Norway	0.20	1.60	0.20	1.6
Pakistan				
Peru	0.03		0.03	
Philippines	0.03		0.03	
Portugal	0.25		0.10	
Spain	0.02		0.02	
Sweden	0.36	3.00	0.23	2.00
Switzerland	0.20	0.30	0.21	0.35
Thailand	0.02		0.06	
USA	4.33		4.33	
World Bank	3.44		3.50	
New donors			0.1	
Subtotal	**14.47**		**13.82**	

1/ This column to be completed only in the Research Agenda submission (March).
2/ This column to be completed in both the Agenda and Financing Plan submissions.
3/ This column to be completed only in the Financing Plan submission (September).

	1999		2000	
	($ actual)	(nat. currency)	($ esti-mated)	(nat. currency)
Targeted contributions				
ADB	0.41		0.53	
Argentina (INTA)	0.06			
Australia				
ACIAR	0.27		0.29	
AusAID	0.22		0.17	
CRC	0.23		0.21	
GRDC	0.40		0.53	
Univ. S. Queensland			0.05	
Austria			0.01	
Bangladesh	0.15		0.17	
Belgium	0.35		0.35	
Bolivia	0.31		0.18	
Protrigo	0.16		0.04	
Brazil			0.04	
Canada				
CIDA	0.74		0.77	
Agriculture and Agri-Food Canada	0.02		0.03	
IDRC	0.09		0.09	
CGIAR Centers				
CIAT	0.01		0.01	
ICRAF	0.03			
IFPRI	0.07		0.04	
ILRI			0.09	
IPGRI	0.03		0.05	
CGIAR Finance Committee	0.47		0.57	
China			0.16	
Colombia	0.18		0.16	
Colciencias	0.02			
Denmark (Danida)	0.00		0.05	
EC	1.61		1.96	
Ecuador (PROMSA)			0.02	
Foundations				
Carter Center			0.25	
Eiselen Foundation			0.11	
Ford Foundation	0.09		0.06	
Fundación Guanajuato	0.04		0.02	
Fundación Sonora	0.12			
Hilton Foundation	0.06		0.06	
Nippon Foundation	0.28		0.27	
Novartis Foundation	1.11		1.37	
Rockefeller Foundation	0.73		0.84	
Sasakawa Global 2000	0.03			
France	0.94		1.07	
IRD			0.04	
Germany	0.85		0.63	
IAEG	0.03		0.03	
IDB	0.78		0.52	
IFAD	0.70		0.56	
Iran	0.20		0.12	
Japan	0.05		0.07	
IARC	0.00			
JIRCAS	0.10		0.03	
Kenya			0.02	
Korea	0.07		0.07	
Mexico	0.43		0.55	
Netherlands	0.60		0.30	
Norway (NORAD)	0.00			
OPEC	0.03		0.04	
Other	0.06			
Peru	0.03		0.05	
Portugal			0.14	

Table 7. Cont'd.

	1999		2000	
	($ actual)	(nat. currency)	($ estimated)	(nat. currency)
Targeted contributions				
Private sector				
Agrovegetal	0.10		0.10	
Bimbo	0.04		0.04	
IFDC	0.08		0.09	
Monsanto	0.15		0.11	
Pioneer	0.03			
Private Sector Consortium	0.49		0.54	
Private Sector Southern Cone			0.06	
Rhone Poulenc			0.10	
Republic of South Africa	0.11		0.10	
ARC	0.01		0.07	
Spain	0.08		0.08	
Sweden (Sida)	0.26		0.14	
Switzerland (SDC)	1.87		1.56	
UK				
DFID	1.17		1.25	
John Innes Centre	0.02			
UNDP				
Regional Bureau for Africa	0.81		0.56	
SEED	0.06		0.15	
Universities				
Cornell University	0.09		0.03	
Oregon State University	0.06			
Stanford University	0.03		0.07	
Uruguay (INIA)	0.10		0.15	
USA				
USAID	0.18		0.39	
USDA	0.25		0.26	
World Bank	0.18		0.17	
Subtotal	19.37		19.77	
Total contributions	33.84		33.58	

Total agenda financing	1999 ($ actual)	2000 ($ estimated)
Member contributions	33.84	33.58
+ Center income	0.73	0.85
= Total financing	34.57	34.43

1/ This column to be completed only in the Research Agenda submission (March).

2/ This column to be completed in both the Agenda and Financing Plan submissions.

3/ This column to be completed only in the Financing Plan submission (September).

Table 8a. CIMMYT allocation of 1999 member financing to projects by undertaking (in US$ millions)

Project	Member	Total	Undertaking: Increasing productivity: Breeding	Increasing productivity: Systems	Protecting environment	Saving biodiversity	Improving policies	Strengthening NARSs: Training	Strengthening NARSs: Other
001. Conservation and management of genetic resources	**March 1999 submission**	**2.340**	**0.54**			**1.30**	**0.27**	**0.10**	**0.13**
	Denmark	0.040	0.01			0.02	0.00	0.00	0.00
	Japan	0.060	0.03			0.02	0.01	0.00	0.00
	Unrestricted + center income	2.361	0.50			1.33	0.26	0.11	0.16
	Total project cost	**2.461**	**0.54**	**0.0**	**0.0**	**1.37**	**0.27**	**0.11**	**0.16**
002. Developing core germplasm and integrating interdisciplinary approaches for maize improvement	**March 1999 submission**	**2.080**	**0.65**	**0.21**	**0.23**	**0.41**		**0.40**	**0.20**
	Colombia	0.027	0.01						0.02
	EC	0.134	0.04	0.00	0.03	0.03		0.01	0.02
	France	0.049	0.01	0.01	0.00	0.01		0.01	0.01
	Germany	0.080	0.03	0.01	0.04	0.00		0.00	0.01
	Hilton Foundation	0.098	0.03	0.00	0.01	0.02		0.02	0.02
	IDB	0.090	0.04	0.00	0.00	0.01		0.04	0.01
	IFAD	0.080	0.01	0.00	0.00	0.00		0.06	0.01
	Korea	0.009	0.01						
	Mexico	0.036	0.03					0.01	
	Nippon Foundation	0.125	0.03	0.01	0.03	0.01		0.03	0.01
	Sweden	0.066	0.07						
	Switzerland	0.098	0.02	0.00	0.00	0.01		0.06	0.01
	Novartis Foundation	0.151	0.08	0.01	0.01	0.03		0.01	0.02
	United Kingdom	0.168	0.10	0.02	0.03			0.02	
	USA	0.168	0.07	0.01	0.01			0.09	
	Unrestricted + center income	0.810	0.29	0.05	0.06	0.28		0.05	0.08
	Total project cost	**2.189**	**0.88**	**0.11**	**0.20**	**0.40**	**0.0**	**0.40**	**0.20**
003. Developing core germplasm and integrating interdisciplinary approaches for wheat improvement	**March 1999 submission**	**3.200**	**1.44**	**0.05**	**0.68**	**0.63**		**0.14**	**0.27**
	Australia	0.244	0.08	0.00	0.04	0.04		0.01	0.08
	EC	0.455	0.20	0.01	0.10	0.09		0.02	0.04
	Germany	0.089	0.04		0.02	0.02		0.00	0.01
	IDB	0.357	0.16	0.01	0.07	0.07		0.02	0.03
	Iran	0.152	0.07	0.00	0.03	0.03		0.01	0.01
	Mexico	0.069	0.04		0.01	0.01		0.00	0.00
	Netherlands	0.211	0.11		0.04	0.04		0.01	0.02
	USA	0.056	0.03		0.02	0.01		0.00	0.00
	Unrestricted + center income	1.732	0.79	0.04	0.38	0.35		0.08	0.10
	Total project cost	**3.365**	**1.50**	**0.05**	**0.71**	**0.66**	**0.00**	**0.14**	**0.29**
004. Increasing maize productivity and sustainability in stressed environments: abiotic and biotic stress	**March 1999 submission**	**1.200**	**0.34**	**0.09**	**0.44**	**0.14**		**0.06**	**0.10**
	Colombia	0.036	0.01	0.00	0.01	0.01		0.00	0.01
	France	0.072	0.03	0.04	0.00	0.01		0.00	0.01
	Germany	0.045	0.02	0.00	0.01	0.01		0.00	0.00
	Hilton Foundation	0.089	0.03	0.00	0.02	0.02		0.01	0.02
	IDB	0.169	0.08	0.01	0.02	0.03		0.00	0.03
	IFAD	0.098	0.02	0.00	0.00	0.03		0.00	0.04
	Korea	0.018	0.01	0.00	0.00	0.00		0.00	0.01
	Others	0.071	0.04	0.00	0.01	0.00		0.00	0.02
	Sweden	0.054	0.02	0.00	0.01	0.01		0.00	0.02
	Switzerland	0.088	0.01		0.05	0.02			
	UNDP	0.101	0.04	0.01	0.02	0.03			
	United Kingdom	0.086	0.02	0.01	0.03	0.02		0.02	
	USA	0.027	0.02	0.00	0.00	0.01		0.00	
	Unrestricted + center income	0.312	0.02	0.01	0.29				
	Total project cost	**1.266**	**0.37**	**0.07**	**0.47**	**0.18**	**0.00**	**0.03**	**0.15**
005. Increasing wheat productivity and sustainability in stressed environments: abiotic stress	**March 1999 submission**	**2.520**	**0.55**	**0.09**	**1.25**	**0.33**		**0.15**	**0.15**
	Australia	0.180	0.04	0.01	0.09	0.02		0.01	0.01
	Canada	0.312	0.07	0.01	0.16	0.04		0.02	0.02
	EC	1.120	0.25	0.06	0.54	0.14		0.06	0.06
	Iran	0.152	0.03	0.01	0.08	0.02		0.01	0.01
	Others	0.092	0.03	0.00	0.04	0.01			
	Spain	0.071	0.01	0.00	0.04	0.01		0.00	0.00
	Unrestricted + center income	0.725	0.14	0.03	0.37	0.10		0.04	0.04
	Total project cost	**2.652**	**0.57**	**0.10**	**1.32**	**0.36**	**0.00**	**0.15**	**0.15**
006. Increasing wheat productivity and sustainability in stressed environments: biotic stress	**March 1999 submission**	**1.960**	**0.36**	**0.18**	**0.85**	**0.39**			**0.18**
	Australia	0.089	0.02	0.01	0.04	0.02			
	EC	0.535	0.09	0.05	0.24	0.10			0.05
	Mexico	0.036	0.01	0.00	0.02	0.01			
	Netherlands	0.294	0.04	0.03	0.13	0.06			0.03
	Others	0.071	0.01	0.00	0.03	0.01			0.01
	Switzerland	0.320	0.08	0.03	0.10	0.06			0.03
	Unrestricted + center income	0.714	0.13	0.07	0.33	0.14			0.06
	Total project cost	**2.059**	**0.38**	**0.19**	**0.89**	**0.41**	**0.00**	**0.00**	**0.18**

Table 8a. Cont'd.

Project	Member	Total	Undertaking: Increasing productivity – Breeding	Increasing productivity – Systems	Protecting environment	Saving biodiversity	Improving policies	Strengthening NARSs – Training	Strengthening NARSs – Other
007. Gauging the productivity, equity, and environmental impact of modern maize and wheat production systems	**March 1999 submission**	**0.700**					**0.42**	**0.06**	**0.22**
	EC	0.169					0.10	0.01	0.05
	France	0.049					0.02	0.02	0.01
	Germany	0.045					0.03	0.00	0.01
	IDRC	0.027					0.02	0.00	0.01
	Netherlands	0.178					0.11	0.02	0.05
	Rockefeller Foundation	0.087					0.06	0.01	0.02
	Switzerland	0.125					0.08	0.01	0.04
	Unrestricted + center income	0.054					0.03	0.02	
	Total project cost	**0.734**	**0.00**	**0.00**	**0.00**	**0.00**	**0.44**	**0.10**	**0.19**
008. Building partnerships through human resource development	**March 1999 submission**	**4.070**						**3.17**	**0.90**
	ADB	0.534						0.38	0.15
	EC	0.353						0.27	0.09
	IFAD	0.362						0.28	0.08
	Norway	0.036						0.04	
	Unrestricted + center income	2.990						2.55	0.44
	Total project cost	**4.275**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.52**	**0.76**
009. Improving food security in sub-Saharan Africa	**March 1999 submission**	**3.980**	**1.76**	**0.53**	**0.72**	**0.35**	**0.16**	**0.04**	**0.45**
	Canada	0.229	0.10	0.03	0.05	0.02	0.01	0.00	0.02
	EC	0.428	0.20	0.03	0.07	0.05	0.04	0.00	0.04
	Germany	0.089	0.03	0.02	0.02	0.01	0.00	0.00	0.01
	IFAD	0.045	0.02	0.01	0.01	0.00	0.00	0.00	0.00
	OPEC	0.048		0.04	0.01				
	Rockefeller Foundation	0.159	0.02	0.09	0.03	0.01	0.00	0.00	0.01
	South Africa	0.045		0.01		0.01	0.02		0.01
	Sweden	0.096	0.03	0.04	0.02	0.01	0.00	0.00	0.01
	Switzerland	0.328	0.05	0.02	0.06	0.06			0.14
	Novartis Foundation	0.315	0.21	0.02		0.05		0.02	0.03
	UNDP Africa	0.410	0.36	0.02					0.03
	United Kingdom	0.464	0.20	0.06	0.12	0.04	0.01		0.05
	Unrestricted + center income	1.569	0.69	0.23	0.34	0.09	0.04	0.00	0.18
	Total project cost	**4.224**	**1.90**	**0.61**	**0.71**	**0.35**	**0.12**	**0.02**	**0.51**
010. Meeting the accelerating demand for maize development, production, and delivery in South and Southeast Asia and in China	**March 1999 submission**	**1.760**	**0.45**	**0.21**	**0.30**	**0.15**	**0.19**	**0.32**	**0.15**
	ADB	0.089	0.03	0.02	0.02	0.01		0.02	0.01
	Germany	0.089	0.03	0.01	0.02	0.01	0.01	0.02	0.01
	IDB	0.328	0.10	0.03	0.06	0.03	0.03	0.05	0.03
	Others	0.045	0.02		0.01	0.00	0.00	0.01	0.00
	Switzerland	0.282	0.08	0.04	0.06	0.02	0.02	0.05	0.02
	Novartis Foundation	0.299	0.06	0.03	0.04	0.03	0.05	0.06	0.03
	Unrestricted + center income	0.719	0.18	0.09	0.13	0.06	0.07	0.13	0.05
	Total project cost	**1.851**	**0.49**	**0.22**	**0.33**	**0.16**	**0.19**	**0.32**	**0.15**
011. Sustainable wheat production systems in the Indo-Gangetic Plains	**March 1999 submission**	**1.550**	**0.30**	**0.50**	**0.37**	**0.08**	**0.08**	**0.10**	**0.11**
	Australia	0.089	0.02	0.03	0.02	0.01	0.01	0.01	0.00
	Canada	0.145	0.02	0.03	0.04	0.01	0.01	0.02	0.02
	France	0.066	0.01	0.02	0.03	0.00	0.00	0.00	0.00
	Iran	0.152	0.03	0.05	0.04	0.01	0.01	0.01	0.01
	Italy	0.035	0.01	0.01	0.01	0.00	0.00	0.00	0.00
	Netherlands	0.455	0.11	0.15	0.12	0.02	0.02	0.02	0.03
	USA	0.065	0.01	0.01	0.04	0.00	0.00	0.00	0.01
	Unrestricted + center income	0.624	0.05	0.09	0.27	0.05	0.05	0.08	0.03
	Total project cost	**1.631**	**0.25**	**0.39**	**0.56**	**0.09**	**0.09**	**0.14**	**0.11**
012. Increasing cereal food production in West Asia and North Africa	**March 1999 submission**	**1.330**	**0.51**		**0.25**	**0.17**		**0.23**	**0.17**
	Australia	0.048	0.03		0.01	0.00		0.02	0.00
	Bangladesh	0.089	0.03		0.02	0.01		0.01	0.02
	Others	0.080	0.01		0.02	0.01		0.03	0.01
	World Bank	0.128	0.05		0.02	0.02		0.02	0.01
	United Kingdom	0.071	0.03		0.01	0.01		0.01	0.01
	USA	0.079	0.03		0.01	0.01		0.02	0.01
	Unrestricted + center income	0.901	0.38		0.18	0.12		0.12	0.10
	Total project cost	**1.396**	**0.56**	**0.00**	**0.26**	**0.18**	**0.00**	**0.23**	**0.16**
013. Enhancing Latin American maize and wheat production systems	**March 1999 submission**	**3.540**	**0.94**	**0.42**	**1.13**	**0.27**	**0.18**	**0.23**	**0.39**
	Colombia	0.048	0.02	0.01	0.01	0.00	0.00	0.00	0.00
	EC	0.428	0.11	0.01	0.15	0.03	0.04	0.03	0.06
	Germany	0.089	0.02	0.01	0.03	0.01	0.01	0.01	0.01
	Hilton Foundation	0.022	0.01				0.01	0.01	0.01
	IDB	0.482	0.13	0.06	0.14	0.03	0.02	0.04	0.06
	IDRC	0.045	0.01	0.01	0.02	0.00	0.00	0.01	0.01
	IFAD	0.027	0.01	0.00	0.01	0.00	0.00	0.00	0.00

Table 8a. Cont'd.

Project	Member	Total	Undertaking: Increasing productivity — Breeding	Systems	Protecting environment	Saving biodiversity	Improving policies	Strengthening NARSs — Training	Other
013. Cont'd.	Mexico	0.052	0.03	0.01	0.01			0.00	
	Others	0.071	0.01	0.01	0.02		0.01	0.00	0.01
	Switzerland	0.725	0.30	0.05	0.20	0.05	0.02	0.04	0.08
	United Kingdom	0.071	0.02	0.01	0.02	0.01	0.00	0.01	
	Uruguay	0.110	0.06	0.04				0.01	
	Unrestricted + center income	1.550	0.53	0.31		0.19		0.26	0.27
	Total project cost	**3.720**	**1.26**	**0.51**	**0.61**	**0.32**	**0.11**	**0.41**	**0.50**
014. Increasing cereal food production in Central Asia and the Caucasus	**March 1999 submission**	**0.460**	**0.21**	**0.00**	**0.10**	**0.09**		**0.06**	
	World Bank	0.326	0.15	0.04		0.05	0.05	0.04	
	CG Finance Committee	0.114	0.05			0.02		0.04	
	Unrestricted + center income	0.045	0.01					0.04	
	Total project cost	**0.485**	**0.20**	**0.04**	0.00	0.07	0.05	**0.12**	**0.00**
015. Raising the yield potential of wheat	**March 1999 submission**	**0.410**	**0.36**						**0.06**
	Australia	0.031	0.03						0.00
	Iran	0.152	0.14						0.01
	Unrestricted + center income	0.245	0.21						0.03
	Total project cost	**0.428**	**0.38**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**
016. Apomixis: equity in access to hybrid vigor for resource-poor farmers	**March 1999 submission**	**0.420**	**0.20**	**0.09**	**0.06**	**0.03**	**0.06**		
	France	0.231	0.17	0.01		0.06			
	Mexico	0.010	0.01	0.00		0.00			
	Private Sector Consortium	0.182	0.13	0.05					
	Unrestricted + center income	0.020	0.02						
	Total project cost	**0.443**	**0.33**	**0.06**	**0.00**	**0.06**	**0.00**	**0.00**	**0.00**
017. Using genetic engineering for the improvement of maize and wheat in developing countries	**March 1999 submission**	**1.220**	**0.50**	**0.15**	**0.33**	**0.14**	**0.04**	**0.00**	**0.06**
	Novartis Foundation	0.558	0.18		0.28	0.10			
	France	0.190	0.06		0.02	0.01			0.10
	Unrestricted + center income	0.530	0.20		0.23	0.10			
	Total project cost	**1.278**	**0.44**	**0.00**	**0.53**	**0.21**	**0.00**	**0.00**	**0.10**
018. Improving human nutrition by enhancing bio-available protein and micronutrient concentration in maize, wheat, and triticale	**March 1999 submission**	**0.380**	**0.30**					**0.08**	
	Nippon Foundation	0.309	0.20	0.05				0.06	
	United Kingdom	0.019	0.01	0.01				0.00	
	Unrestricted + center income	0.073	0.03	0.03				0.02	
	Total project cost	**0.401**	**0.24**	**0.08**	**0.00**	**0.00**	**0.00**	**0.08**	**0.00**
019. Genetic approaches to reducing post-harvest losses	**March 1999 submission**	**0.290**	**0.12**		**0.15**				**0.02**
	Rockefeller Foundation	0.227	0.08	0.02	0.11				0.01
	United Kingdom	0.054	0.02		0.03				0.00
	Unrestricted + center income	0.027	0.01		0.01				0.00
	Total project cost	**0.308**	**0.11**	**0.02**	**0.16**	**0.00**	**0.00**	**0.00**	**0.02**
020. Priority setting and technology forecasting for increased research efficiency	**March 1999 submission**	**0.420**	**0.18**		**0.08**		**0.12**		**0.05**
	EC	0.114	0.03	0.02	0.02		0.03		0.01
	France	0.097	0.02	0.03	0.02		0.02		0.01
	IDB	0.042	0.01		0.01		0.01		0.01
	IDRC	0.050	0.01	0.01			0.02		0.01
	Netherlands	0.094	0.04	0.01	0.02		0.02		0.01
	Unrestricted + center income	0.044	0.01	0.01	0.01		0.01		0.00
	Total project cost	**0.441**	**0.11**	**0.08**	**0.07**	**0.00**	**0.13**	**0.00**	**0.05**
021. Learning to more effectively confront problems of resource degradation in maize and wheat systems	**March 1999 submission**	**0.480**		**0.08**	**0.15**	**0.08**	**0.04**	**0.03**	**0.08**
	Australia	0.014		0.01	0.00		0.00	0.00	0.00
	Colombia	0.040			0.02	0.01	0.00	0.00	0.01
	EC	0.293		0.05	0.10	0.05	0.03	0.02	0.04
	France	0.108		0.01	0.03	0.02	0.01	0.02	0.02
	United Kingdom	0.027			0.01	0.00			0.01
	USA	0.009		0.00	0.00	0.00	0.00	0.00	0.00
	Unrestricted + center income	0.009		0.00	0.00	0.00	0.00	0.00	0.00
		0.500	**0.00**	**0.08**	**0.17**	**0.09**	**0.04**	**0.04**	**0.09**

Center totals	Total	Undertaking: Increasing productivity — Breeding	Systems	Protecting environment	Saving biodiversity	Improving policies	Strengthening NARSs — Training	Other
Total targeted funding	**19.37**	5.79	1.78	2.94	4.42	1.14	2.61	2.02
Total unrestricted funding	**14.47**	4.64	0.70	3.86	0.39	0.15	2.52	2.37
Total center income	**0.73**	0.10	0.10	0.20	0.10	0.11	0.09	0.10
Total allocations	**34.57**	**10.53**	**2.58**	**6.99**	**4.91**	**1.40**	**5.22**	**4.49**

Table 8b. CIMMYT allocation of 2000 member financing to projects by undertaking (in US$ millions)

Project	Member	Total	Undertaking: Increasing productivity – Breeding	Increasing productivity – Systems	Protecting environment	Saving biodiversity	Improving policies	Strengthening NARSs – Training	Strengthening NARSs – Other
001. Conservation and management of genetic resources	**March 1999 submission**	**2.34**	**0.54**			**1.30**	**0.27**	**0.10**	**0.13**
	Denmark	0.04	0.01		0.0	0.0	0.0	0.0	0.0
	Japan	0.06	0.03		0.0	0.0	0.0	0.0	0.0
	Unrestricted + center income	2.25	0.48		0.0	1.3	0.2	0.1	0.2
2.350	**Total project cost**	**2.35**	**0.52**	**0.00**	**0.0**	**1.31**	**0.26**	**0.11**	**0.15**
002. Developing core germplasm and integrating interdisciplinary approaches for maize improvement	**March 1999 submission**	**2.08**	**0.65**	**0.21**	**0.23**	**0.41**		**0.40**	**0.20**
	Colombia	0.03	0.01	0.00	0.00	0.00		0.00	0.02
	EC	0.13	0.04	0.00	0.03	0.03		0.01	0.02
	France	0.05	0.01	0.01	0.00	0.01		0.01	0.01
	Germany	0.08	0.03	0.01	0.03	0.00		0.00	0.00
	Hilton Foundation	0.09	0.03	0.00	0.01	0.02		0.02	0.02
	IDB	0.09	0.04	0.00	0.00	0.00		0.04	0.01
	IFAD	0.08	0.01	0.00	0.00	0.00		0.06	0.01
	Korea	0.01	0.01	0.00	0.00	0.00		0.00	0.00
	Mexico	0.03	0.03	0.00	0.00	0.00		0.01	0.00
	Nippon Foundation	0.12	0.03	0.01	0.03	0.01		0.03	0.01
	Sweden	0.06	0.06	0.00	0.00	0.00		0.00	0.00
	Switzerland	0.09	0.02	0.00	0.00	0.01		0.06	0.01
	Novartis Foundation	0.14	0.08	0.00	0.00	0.03		0.01	0.02
	United Kingdom	0.16	0.10	0.02	0.03	0.00		0.02	0.00
	USA	0.16	0.06	0.00	0.00	0.00		0.09	0.00
	Unrestricted + center income	0.77	0.28	0.04	0.05	0.27		0.05	0.08
2.090	**Total project cost**	**2.09**	**0.84**	**0.10**	**0.19**	**0.38**	**0.00**	**0.38**	**0.19**
003. Developing core germplasm and integrating interdisciplinary approaches for wheat improvement	**March 1999 submission**	**3.20**	**1.44**	**0.05**	**0.68**	**0.63**		**0.14**	**0.27**
	Australia	0.23	0.08	0.00	0.04	0.03		0.01	0.07
	EC	0.43	0.19	0.01	0.10	0.09		0.02	0.04
	Germany	0.08	0.04	0.00	0.02	0.02		0.00	0.01
	IDB	0.34	0.15	0.00	0.07	0.07		0.01	0.03
	Iran	0.15	0.06	0.00	0.03	0.03		0.01	0.01
	Mexico	0.07	0.04	0.00	0.01	0.01		0.00	0.00
	Netherlands	0.20	0.11	0.00	0.04	0.03		0.01	0.01
	USA	0.05	0.02	0.00	0.02	0.01		0.00	0.00
	Unrestricted + center income	1.65	0.75	0.03	0.36	0.33		0.08	0.10
3.213	**Total project cost**	**3.21**	**1.44**	**0.05**	**0.68**	**0.63**	**0.00**	**0.14**	**0.28**
004. Increasing maize productivity and sustainability in stressed environments: abiotic and biotic stress	**March 1999 submission**	**1.20**	**0.34**	**0.09**	**0.44**	**0.14**		**0.06**	**0.10**
	Colombia	0.03	0.01	0.00	0.01	0.00		0.00	0.00
	France	0.07	0.02	0.03	0.00	0.00		0.00	0.00
	Germany	0.04	0.02	0.00	0.01	0.01		0.00	0.00
	Hilton Foundation	0.08	0.03	0.00	0.02	0.01		0.00	0.01
	IDB	0.16	0.08	0.01	0.02	0.03		0.00	0.03
	IFAD	0.09	0.02	0.00	0.00	0.03		0.00	0.04
	Korea	0.02	0.01	0.00	0.00	0.00		0.00	0.01
	Others	0.07	0.04	0.00	0.01	0.00		0.00	0.02
	Sweden	0.05	0.02	0.00	0.01	0.01		0.00	0.02
	Switzerland	0.08	0.01	0.00	0.05	0.02		0.00	0.00
	UNDP	0.10	0.04	0.01	0.02	0.03		0.00	0.00
	United Kingdom	0.08	0.02	0.01	0.03	0.01		0.02	0.00
	USA	0.03	0.02	0.00	0.00	0.01		0.00	0.00
	Unrestricted + center income	0.30	0.02	0.01	0.28	0.00		0.00	0.00
1.209	**Total project cost**	**1.21**	**0.36**	**0.07**	**0.45**	**0.17**	**0.00**	**0.06**	**0.10**
005. Increasing wheat productivity and sustainability in stressed environments: abiotic stress	**March 1999 submission**	**2.52**	**0.55**	**0.09**	**1.25**	**0.33**		**0.15**	**0.15**
	Australia	0.17	0.03	0.01	0.09	0.02		0.01	0.01
	Canada	0.30	0.06	0.01	0.15	0.04		0.02	0.02
	EC	1.07	0.24	0.06	0.52	0.14		0.06	0.06
	Iran	0.15	0.03	0.01	0.07	0.02		0.01	0.01
	Others	0.09	0.03	0.00	0.04	0.01		0.00	0.00
	Spain	0.07	0.01	0.00	0.04	0.01		0.00	0.00
	Unrestricted + center income	0.69	0.14	0.03	0.35	0.10		0.04	0.04
2.536	**Total project cost**	**2.53**	**0.55**	**0.10**	**1.26**	**0.34**	**0.00**	**0.14**	**0.14**
006. Increasing wheat productivity and sustainability in stressed environments: biotic stress	**March 1999 submission**	**1.96**	**0.36**	**0.18**	**0.85**	**0.39**			**0.18**
	Australia	0.08	0.02	0.01	0.04	0.02			0.00
	EC	0.51	0.09	0.05	0.23	0.10			0.05
	Mexico	0.03	0.01	0.00	0.02	0.01			0.00
	Netherlands	0.28	0.04	0.03	0.13	0.06			0.03
	Others	0.07	0.01	0.00	0.03	0.01			0.01
	Switzerland	0.31	0.08	0.03	0.10	0.06			0.03
	Unrestricted + center income	0.68	0.12	0.06	0.31	0.13			0.05
1.967	**Total project cost**	**1.97**	**0.36**	**0.18**	**0.85**	**0.39**	**0.00**	**0.00**	**0.17**

Table 8b. Cont'd.

Project	Member	Total	Undertaking: Increasing productivity: Breeding	Increasing productivity: Systems	Protecting environment	Saving biodiversity	Improving policies	Strengthening NARSs: Training	Strengthening NARSs: Other
007. Gauging the productivity, equity, and environmental impact of modern maize and wheat production systems	**March 1999 submission**	**0.70**					**0.42**	**0.06**	**0.22**
	EC	0.16					0.10	0.01	0.05
	France	0.05					0.02	0.02	0.01
	Germany	0.04					0.03	0.00	0.01
	IDRC	0.03					0.02	0.00	0.01
	Netherlands	0.17					0.11	0.02	0.05
	Rockefeller Foundation	0.08					0.06	0.01	0.02
	Switzerland	0.12					0.07	0.01	0.03
	Unrestricted + center income	0.05					0.03	0.02	0.00
0.702	**Total project cost**	**0.70**	**0.00**	**0.00**	**0.00**	**0.00**	**0.42**	0.10	0.18
008. Building partnerships through human resource development	**March 1999 submission**	**4.07**						**3.17**	**0.90**
	ADB	0.51						0.37	0.14
	EC	0.34						0.25	0.08
	IFAD	0.35						0.27	0.08
	Norway	0.03						0.03	0.00
	Unrestricted + center income	2.85						2.43	0.42
4.081	**Total project cost**	**4.08**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**3.36**	**0.72**
009. Improving food security in sub-Saharan Africa	**March 1999 submission**	**3.98**	**1.76**	**0.53**	**0.72**	**0.35**	**0.16**	**0.04**	**0.45**
	Canada	0.22	0.10	0.03	0.04	0.02	0.01	0.00	0.02
	EC	0.41	0.19	0.03	0.07	0.05	0.04	0.00	0.03
	Germany	0.08	0.03	0.02	0.02	0.01	0.00	0.00	0.01
	IFAD	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00
	OPEC	0.05	0.00	0.04	0.01	0.00	0.00	0.00	0.00
	Rockefeller Foundation	0.15	0.01	0.09	0.03	0.01	0.00	0.00	0.00
	South Africa	0.04	0.00	0.01	0.00	0.01	0.02	0.00	0.01
	Sweden	0.09	0.02	0.04	0.01	0.01	0.00	0.00	0.01
	Switzerland	0.31	0.05	0.02	0.06	0.06	0.00	0.00	0.13
	Novartis Foundation	0.30	0.20	0.02	0.00	0.05	0.00	0.01	0.02
	UNDP Africa	0.39	0.35	0.02	0.00	0.00	0.00	0.00	0.03
	United Kingdom	0.44	0.19	0.06	0.11	0.03	0.01	0.00	0.05
	Unrestricted + center income	1.50	0.66	0.22	0.32	0.09	0.04	0.00	0.17
4.034	**Total project cost**	**4.03**	**1.82**	**0.58**	**0.68**	**0.33**	**0.12**	**0.02**	**0.49**
010. Meeting the accelerating demand for maize development, production, and delivery in South and Southeast Asia and in China	**March 1999 submission**	**1.76**	**0.45**	**0.21**	**0.30**	**0.15**	**0.19**	**0.32**	**0.15**
	ADB	0.08	0.02	0.02	0.02	0.01	0.00	0.01	0.01
	Germany	0.08	0.02	0.01	0.02	0.01	0.01	0.01	0.01
	IDB	0.31	0.10	0.03	0.05	0.03	0.03	0.05	0.03
	Others	0.04	0.02	0.00	0.01	0.00	0.00	0.01	0.00
	Switzerland	0.27	0.08	0.04	0.05	0.02	0.02	0.04	0.02
	Novartis Foundation	0.29	0.06	0.03	0.04	0.03	0.05	0.05	0.03
	Unrestricted + center income	0.69	0.17	0.08	0.13	0.06	0.07	0.12	0.05
1.767	**Total project cost**	**1.77**	**0.47**	**0.21**	**0.31**	**0.16**	**0.18**	**0.31**	**0.14**
011. Sustainable wheat production systems in the Indo-Gangetic Plains	**March 1999 submission**	**1.55**	**0.30**	**0.50**	**0.37**	**0.08**	**0.08**	**0.10**	**0.11**
	Australia	0.08	0.02	0.03	0.02	0.01	0.01	0.01	0.00
	Canada	0.14	0.02	0.03	0.04	0.00	0.00	0.02	0.02
	France	0.06	0.01	0.02	0.02	0.00	0.00	0.00	0.00
	Iran	0.15	0.03	0.05	0.03	0.01	0.01	0.01	0.01
	Italy	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00
	Netherlands	0.43	0.10	0.14	0.11	0.02	0.02	0.02	0.03
	USA	0.06	0.01	0.01	0.04	0.00	0.00	0.00	0.01
	Unrestricted + center income	0.60	0.05	0.09	0.26	0.05	0.05	0.08	0.03
1.556	**Total project cost**	**1.56**	**0.24**	**0.37**	**0.53**	**0.09**	**0.09**	**0.13**	**0.11**
012. Increasing cereal food production in West Asia and North Africa	**March 1999 submission**	**1.33**	**0.51**		**0.25**	**0.17**		**0.23**	**0.17**
	Australia	0.05	0.02		0.01	0.00		0.01	0.00
	Bangladesh	0.08	0.03		0.02	0.01		0.01	0.02
	Others	0.08	0.01		0.02	0.01		0.03	0.01
	World Bank	0.12	0.05		0.02	0.02		0.02	0.01
	United Kingdom	0.07	0.03		0.01	0.01		0.01	0.01
	USA	0.08	0.03		0.01	0.01		0.02	0.01
	Unrestricted + center income	0.86	0.37		0.17	0.12		0.11	0.10
1.332	**Total project cost**	**1.33**	**0.53**	**0.00**	**0.25**	**0.18**	**0.00**	**0.22**	**0.15**
013. Enhancing Latin American maize and wheat production systems	**March 1999 submission**	**3.54**	**0.94**	**0.42**	**1.13**	**0.27**	**0.18**	**0.23**	**0.39**
	Colombia	0.05	0.02	0.01	0.01	0.00	0.00	0.00	0.00
	EC	0.41	0.11	0.01	0.14	0.03	0.04	0.02	0.06
	Germany	0.08	0.02	0.01	0.03	0.01	0.01	0.01	0.01
	Hilton Foundation	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	IDB	0.46	0.13	0.06	0.13	0.03	0.02	0.04	0.05
	IDRC	0.04	0.01	0.00	0.01	0.00	0.00	0.00	0.01
	IFAD	0.03	0.01	0.00	0.01	0.00	0.00	0.00	0.00

Table 8b Cont'd

Project	Project	Total	Undertaking: Increasing productivity: Breeding	Increasing productivity: Systems	Protecting environment	Saving biodiversity	Improving policies	Strengthening NARSs: Training	Strengthening NARSs: Other
013. Cont'd.	Mexico	0.05	0.03	0.00	0.01	0.00	0.00	0.00	0.00
	Others	0.07	0.01	0.01	0.02	0.00	0.01	0.00	0.01
	Switzerland	0.69	0.29	0.05	0.19	0.05	0.01	0.04	0.07
	United Kingdom	0.07	0.02	0.01	0.02	0.01	0.00	0.01	0.00
	Uruguay	0.11	0.06	0.04	0.00	0.00	0.00	0.01	0.00
	Unrestricted + center income	1.48	0.51	0.29	0.00	0.18	0.00	0.24	0.26
3.551	**Total project cost**	**3.55**	**1.20**	**0.48**	**0.58**	**0.31**	**0.10**	**0.39**	**0.48**
014. Increasing cereal food production in Central Asia and the Caucasus	**March 1999 submission**	**0.46**	**0.21**	**0.00**	**0.10**	**0.09**		**0.06**	
	World Bank	0.31	0.14	0.04		0.05	0.05	0.04	
	Others	0.11	0.05	0.00		0.02	0.00	0.04	
	Unrestricted + center income	0.04	0.01	0.00		0.00	0.00	0.03	
0.463	**Total project cost**	**0.46**	**0.19**	**0.04**	**0.00**	**0.07**	**0.05**	**0.12**	**0.00**
015. Raising the yield potential of wheat	**March 1999 submission**	**0.41**	**0.36**					**0.06**	
	Australia	0.03	0.03		0.00	0.00	0.00	0.00	0.00
	Iran	0.15	0.14		0.00	0.00	0.00	0.00	0.01
	Unrestricted + center income	0.23	0.20		0.00	0.00	0.00	0.00	0.03
0.409	**Total project cost**	**0.41**	**0.37**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.04**
016. Apomixis: equity in access to hybrid vigor for resource-poor farmers	**March 1999 submission**	**0.42**	**0.20**	**0.09**	**0.06**	**0.03**	**0.06**		
	France	0.22	0.16	0.00		0.05			
	Mexico	0.01	0.01	0.00		0.00			
	Private Sector Consortium	0.17	0.13	0.05		0.00			
	Unrestricted + center income	0.02	0.02	0.00		0.00			
0.423	**Total project cost**	**0.42**	**0.32**	**0.05**	**0.00**	**0.05**	**0.00**	**0.00**	**0.00**
017. Using genetic engineering for the improvement of maize and wheat in developing countries	**March 1999 submission**	**1.22**	**0.50**	**0.15**	**0.33**	**0.14**	**0.04**	**0.00**	**0.06**
	Novartis Foundation	0.53	0.17		0.27	0.10			0.00
	France	0.18	0.06		0.02	0.01			0.10
	Unrestricted + center income	0.51	0.19		0.22	0.10			0.00
1.220	**Total project cost**	**1.22**	**0.42**	**0.00**	**0.50**	**0.20**	**0.00**	**0.00**	**0.10**
018. Improving human nutrition by enhancing bio-available protein and micronutrient concentration in maize, wheat, and triticale	**March 1999 submission**	**0.38**	**0.30**					**0.08**	
	Nippon Foundation	0.29	0.19	0.04				0.06	
	United Kingdom	0.02	0.01	0.01				0.00	
	Unrestricted + center income	0.07	0.03	0.02				0.02	
0.382	**Total project cost**	**0.38**	**0.23**	**0.08**	**0.00**	**0.00**	**0.00**	**0.08**	**0.00**
019. Genetic approaches to reducing post-harvest losses	**March 1999 submission**	**0.29**	**0.12**		**0.15**				**0.02**
	Rockefeller Foundation	0.22	0.07	0.02	0.11				0.01
	United Kingdom	0.05	0.02	0.00	0.03				0.00
	Unrestricted + center income	0.03	0.01	0.00	0.01				0.00
0.294	**Total project cost**	**0.29**	**0.10**	**0.02**	**0.15**	**0.00**	**0.00**	**0.00**	**0.02**
020. Priority setting and technology forecasting for increased research efficiency	**March 1999 submission**	**0.42**	**0.18**		**0.08**		**0.12**		**0.05**
	EC	0.11	0.03	0.02	0.02		0.03		0.01
	France	0.09	0.02	0.03	0.01		0.02		0.01
	IDB	0.04	0.01	0.00	0.01		0.01		0.01
	IDRC	0.05	0.01	0.01	0.00		0.02		0.01
	Netherlands	0.09	0.03	0.01	0.01		0.02		0.01
	Unrestricted + center income	0.04	0.00	0.01	0.01		0.01		0.00
0.420	**Total project cost**	**0.42**	**0.11**	**0.08**	**0.06**	**0.00**	**0.12**	**0.00**	**0.05**
021. Learning to more effectively confront problems of resource degradation in maize and wheat systems	**March 1999 submission**	**0.48**		**0.08**	**0.15**	**0.08**	**0.04**	**0.03**	**0.08**
	Australia	0.01		0.01	0.00	0.00	0.00	0.00	0.00
	Colombia	0.04		0.00	0.01	0.01	0.00	0.00	0.01
	EC	0.28		0.05	0.09	0.05	0.03	0.02	0.04
	France	0.10		0.01	0.03	0.01	0.01	0.02	0.02
	United Kingdom	0.03		0.00	0.01	0.00	0.00	0.00	0.01
	USA	0.01		0.00	0.00	0.00	0.00	0.00	0.00
	Unrestricted + center income	0.01		0.00	0.00	0.00	0.00	0.00	0.00
0.477	**Total project cost**	**0.48**	**0.00**	**0.07**	**0.16**	**0.09**	**0.04**	**0.04**	**0.08**

Center totals	Total	Undertaking: Increasing productivity: Breeding	Increasing productivity: Systems	Protecting environment	Saving biodiversity	Improving policies	Strengthening NARSs: Training	Strengthening NARSs: Other
Total targeted funding	19.77	6.77	1.76	4.23	2.06	0.74	1.86	2.41
Total unrestricted funding	13.82	3.13	0.65	2.35	2.53	0.55	3.04	1.56
Total center income	0.85	0.14	0.05	0.09	0.10	1.10	0.07	0.30
Total allocations	**34.43**	**10.04**	**2.46**	**6.67**	**4.69**	**1.38**	**4.97**	**4.28**

Table 9. CIMMYT research agenda, staff composition, 1999-2003

	1999 (actual) Hired by:		2000 (estimated) Hired by:		2001 (proposed) Hired by:		2002 (planned) Hired by:		2003 (planned) Hired by:	
	Center	Other	Center	Other	Center	Other	Center	Other	Center	Other
Internationally recruited staff (IRS)										
Research and research support, of which:	90	16	92	20	90	15	90	15	90	15
Post-doctoral Fellows	12	3	16	3	13	2	13	2	13	2
Associate Professionals	6	4	6	9	6	7	6	7	6	7
Training / communications, of which:	5	0	6	0	6	0	6	0	6	0
Post-doctoral Fellows										
Associate Professionals										
Research management, of which:	7	1	8	0	7	0	7	0	7	0
Post-doctoral Fellows										
Associate Professionals										
Total	**102**	**17**	**106**	**20**	**103**	**15**	**103**	**15**	**103**	**15**
Support Staff										
Outreach national staff	106		106		106		106		106	
Mexico national staff	640		640		640		640		640	
Total	**746**		**746**		**746**		**746**		**746**	
Grand total	**848**	**17**	**852**	**20**	**849**	**15**	**849**	**15**	**849**	**15**

Table 10. CIMMYT cash requirement, revenue flow, and currency shares, 1999-2001 (in US$ thousands)

	Monthly cash uses and sources											
1999 1/	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Cash requirement	2.893	2.610	2.267	2.757	2.433	2.786	1.808	2.588	2.125	2.560	2.720	2.610
Member and center income	4.180	0.395	2.474	1.741	2.229	1.696	2.919	1.844	3.831	0.914	3.772	4.632
Net monthly position	**1.287**	**-2.215**	**0.207**	**-1.016**	**-0.204**	**-1.090**	**1.111**	**-0.744**	**1.706**	**-1.646**	**1.052**	**2.022**
Accumulated position	**1.287**	**-0.928**	**-0.721**	**-1.737**	**-1.941**	**-3.031**	**-1.920**	**-2.664**	**-0.958**	**-2.604**	**-1.552**	**0.470**
2000 2/	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Cash requirement	2.510	2.310	2.120	2.150	2.250	2.400	2.850	2.650	2.500	2.550	2.650	2.700
Member and center income	4.740	2.580	2.000	1.520	2.690	2.230	2.910	1.800	3.470	2.740	3.720	3.500
Net monthly position	**2.230**	**0.270**	**-0.120**	**-0.630**	**0.440**	**-0.170**	**0.060**	**-0.850**	**0.970**	**0.190**	**1.070**	**0.800**
Accumulated position	**2.230**	**2.500**	**2.380**	**1.750**	**2.190**	**2.020**	**2.080**	**1.230**	**2.200**	**2.390**	**3.460**	**4.260**
2001 3/	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Cash requirement	2.980	2.510	2.360	2.650	2.430	2.780	1.810	2.590	2.130	2.570	2.730	2.650
Member and center income	4.350	0.890	2.150	1.680	2.450	1.980	2.850	1.950	3.530	1.120	3.850	4.500
Net monthly position	**1.370**	**-1.620**	**-0.210**	**-0.970**	**0.020**	**-0.800**	**1.040**	**-0.640**	**1.400**	**-1.450**	**1.120**	**1.850**
Accumulated position	**1.370**	**-0.250**	**-0.460**	**-1.430**	**-1.410**	**-2.210**	**-1.170**	**-1.810**	**-0.410**	**-1.860**	**-0.740**	**1.110**

	Currency structure of expenditures								
	1999 1/ (actual)			**2000 2/ (estimated)**			**2001 3/ (planned)**		
Currency	Amount	$ value	% share	Amount	$ value	% share	Amount	$ value	% share
US Dollar	16.5	16.50	48%	16.5	16.55	48%	17.2	17.23	
Currency A	170.1	17.87	52%	179.2	17.92	52%	197.3	17.93	
Others 4/									
Total		34.37			34.47			35.16	

1/ This part to be completed only in the Research Agenda submission (March).
2/ This part to be completed in both the Agenda & Financing Plan submissions.
3/ This part to be completed only in the Financing Plan submission (September).
4/ All other currencies the sum of which accounts for less than 5% of total expenditure.

Table 11. CIMMYT statement of financial position, 1999-2003 (in US$ thousands)

Assets	1999 (actual)	2000 (estimated)	2001 (proposed)	2002 (planned)	2003 (planned)
Current assets					
Cash and cash equivalents	8,017	7,222	6,321	5,788	6,193
Accounts receivable					
Donors	4,989	3,399	3,427	2,949	2,858
Employees	335	321	300	220	204
Other	986	1,056	1,400	1,221	1,130
Inventories	185	150	210	190	205
Total current assets	**14,512**	**12,148**	**11,658**	**10,368**	**10,590**
Fixed assets					
Property, plant, and equipment	33,277	34,100	34,923	35,746	36,569
Less: accumulated depreciation	-18,807	-19,364	-19,921	-20,478	-21,035
Total fixed assets - net	**14,470**	**14,736**	**15,002**	**15,268**	**15,534**
Total assets	**28,982**	**26,884**	**26,660**	**25,636**	**26,124**
Liabilities and net assets					
Current liabilities					
Bank indebtedness					
Accounts payable					
Donors	6,278	4,327	3,395	2,978	2,595
Employees	263	197	74	90	90
Others	628	410	500	420	480
In-trust accounts	11	118	125	130	130
Accruals and provisions	2,409	1,782	1,658	1,220	1,880
Total current liabilities	**9,589**	**6,834**	**5,752**	**4,838**	**5,175**
Long-term liabilities	448	310	300		
Total liabilities	**10,037**	**7,144**	**6,052**	**4,838**	**5,175**
Net assets					
Capital invested in fixed assets					
Center owned	14,116	14,176	14,236	14,296	14,356
In custody					
Capital fund	-154	-44	64	194	285
Operating fund	4,983	5,608	6,308	6,308	6,308
Other funds					
Total net assets	**18,945**	**19,740**	**20,608**	**20,798**	**20,949**
Total liabilities and net assets	**28,982**	**26,884**	**26,660**	**25,636**	**26,124**

Project 1 (G1): Conservation and management of genetic resources

Overall goal	Indicators	Assumptions and risks
Productivity of resources in maize and wheat production is increased, and the sustainable management of natural resources is improved. This goal reflects CIMMYT's commitment to the Global Plan of Action for Plant Genetic Resources for Food and Agriculture as a means of implementing the Convention on Biological Diversity.	• Global food security is increased. • Environmental well-being is improved.	• In studies of the impact of germplasm improvement research, improved food security and environmental well-being can be attributed to the use of genetic resources.

Intermediate goal	Indicators	Assumptions and risks
Agrobiodiversity in sustainable farming systems is enhanced through research involving the collection, conservation, evaluation, and equitable sharing of maize, wheat, and triticale genetic resources, appropriate related species, and related information.	• Continued conservation and *ex situ* management of maize, wheat, and related genetic resources. • Increased evaluation and utilization of maize, wheat, and related genetic resources by researchers and farmers. • Increased information for researchers, farmers, and policy makers on social, economic, and policy issues in maize and wheat genetic resource management and conservation, *ex situ* and *in situ*.	• Resources are available to conserve genetic resources and conduct associated activities. • Policy environment is conducive to international exchange and dissemination of genetic resources, information, and collaborative research.

Purpose	Indicators	Assumptions and risks
CIMMYT researchers and partners worldwide obtain, maintain, and share germplasm, information, and other products needed to develop superior, genetically diverse seed for farmers' maize and wheat production systems.	• Reduced genetic vulnerability in farmers' fields, leading to improved production and food security.	• International exchange of germplasm and information continues.

Outputs	Indicators	Assumptions and risks
1. Better conservation of genetic resources *ex situ* and *in situ*. 2. Improved characterization and evaluation of germplasm. 3. Improved methods for conservation, evaluation, and economic assessment of genetic resources. 4. Novel germplasm with new genes/ desirable traits for future breeding efforts is developed through novel conventional and molecular technologies. 5. Improved and more widely available information (genetic, agronomic, economic) on genetic resources. 6. Information for policy related to genetic resources and genetic diversity. 7. Training in the safe, sustainable care of genetic resource collections (i.e., in conservation); in resource evaluation and utilization; and in issues related to *in situ* conservation, the economics of genetic resources, and policies that influence genetic resource conservation and utilization. 8. Better understanding of genetic diversity and genetic resource flows in farmers' fields and at the community level, as well as a better understanding of the implications for *in situ* conservation strategies.	1. The safe, sustainable care of genetic resource collections. 2. Measurably enhanced characterization and evaluation of genetic diversity. 3. Availability of improved methods for conservation, evaluation, and economic assessment of genetic resources. 4. Measurable increase in genetic diversity available to breeding programs. 5. Better information related to genetic resources available to researchers and genebank managers. 6. Better information related to genetic resource policy available to policy makers. 7. More trained researchers who can contribute to the goals listed previously. 8. Better documentation of genetic resource management and flows *in situ*, at the household and community levels. 9. Viable seed from regeneration is available for distribution.	• See above.

Activities	Milestones 2001-2003	Assumptions and risks
1. Landraces and wild relatives are collected and maintained; improved lines and populations are preserved (contributes to output 1).	• Maize genetic resource holdings will exceed 20,000 accessions with introductions from Latin American Maize Regeneration Project (LAMP); most of these will be bar coded. • By early 2001, we will have verified that no more wheat accessions originated in areas affected by Karnal bunt. • The identity of cultivars in the overall wheat collection will be verified, and gaps in the collection identified (on-going activity).	
2. Characterization of genetic resources (contributes to outputs 2-5).	• Collections of accessions characterized through the development of trait descriptors, including passport data and DNA fingerprinting as it becomes available. • The main techniques that CIMMYT will use to fingerprint maize lines and populations will be identified through a pilot study. • Large-scale fingerprinting of maize lines, populations, and races completed; data compiled in database and analyzed. • As needed, part of the core subset accessions will be characterized for seed chemical content for prebreeding. • Part of the core subset collections of maize will be evaluated for heterotic patterns for prebreeding. • Multi-ovary trait further characterized to 1) determine consistency of gene expression between F_3 families and F_2 plants; 2) increase the understanding of trait inheritance based on F_3 results; and 3) attempt to dissect the multi-ovary trait through molecular markers using bulk-segregant analysis.	
3. Evaluation strategies and statistical methods are developed (contributes to outputs 1-5).	• Material selected from screening 10,000 wheat landraces from Iran, Turkey, and Oaxaca as being of value will be further evaluated and characterized for yield components and physiological and agronomic traits. • About 500 synthetics derived from emmer wheat will be evaluated for resistance/tolerance to Russian wheat aphid, leaf and yellow rust, and septoria leaf blotch in 2000. • Selections from the 5,000 accessions of *Triticum* spp. evaluated for resistance to yellow rust, tan spot, and fusarium head blight will be crossed with improved wheats and distributed to cooperators. • In addition to the LAMP core subsets, some 1,500 maize accessions are designated and published as a race-oriented breeding core from the evaluation trials.	
4. Prebreeding techniques—conventional as well as cytogenetic and molecular—are developed to enable researchers to incorporate diversity into new germplasm (contributes to output 4).	• Techniques are developed/refined and put into use. • Heterotic maize germplasm pools developed and used.	

Activities	Milestones 2001-2003	Assumptions and risks
5. Information related to genetic resources used to enhance the conservation and utilization of genetic diversity (contributes to outputs 1 and 3-8).	• MZBANK will include passport and characterization data on new introductions and will have information on race-oriented breeding core subsets of the maize collection. • All information entered on wheat genetic resources (including data on the origin, pedigrees, and characteristics of CIMMYT genebank accessions), integrated into the International Wheat Information System (IWIS), and made available to partners without charge via CD-ROM. • Improved methodology for interaction between breeders and farmers, including the access to and use of farmers' extensive knowledge of crops and crop varieties, breeding criteria, and consumption and production constraints. • Development of methods for assessing the economic value of accessions in the wheat collection, the economic impact of different types of genetic resources and their diversity on productivity and yield stability at aggregate and household levels, and the economic and genetic impact of on-farm improvement of landraces in rural communities. • Development of methods to assess the feasibility of *in situ* conservation strategies and the implications of policy alternatives for farmers' behavior.	

Duration: 2001–2003+
Collaborators: Other CGIAR centers, NARSs, NGOs, and ARIs.
Costs: US$ 2.397M
System linkages: Germplasm improvement (22%)
Germplasm collection (56%)
Policy (11%)
Enhancing NARSs (11%)

Project 2 (G2): Developing core germplasm and integrating interdisciplinary approaches for maize improvement

Overall goal	Indicators	Assumptions and risks
Productivity of maize and its nutritive value increased in the developing world, and sustainability of maize-based farming systems enhanced.	Surveys of impact indicate 5% maize yield increase and improved nutrition for poor farmers in developing countries.	• Governments in Latin America and Africa will enhance policy in support of agriculture. • Maize imports will be reduced.
Intermediate goal	**Indicators**	**Assumptions and risks**
New high yielding, input efficient, stress tolerant maize germplasm and innovative technologies will be developed and partially adopted.	• Progress reports indicating efficiency of maize breeding methods. • Adoption of new hybrids and varieties measured by CIMMYT Economics Program impact studies. • Policy makers in national programs endorse CIMMYT Maize Program activities. • Use of CIMMYT germplasm in the seed industry and NARSs documented.	• Comprehensive national agricultural research policies in agreement with the national development plans in developing countries. • Credit and agricultural inputs available at the national level.
Purpose	**Indicators**	**Assumptions and risks**
A network of maize scientists in the developing world provides high yielding, input efficient, stress tolerant germplasm and information for increasing maize productivity and sustainability.	• National research capacities enhanced. • Eighty percent of maize breeders in NARSs and the seed industry use CIMMYT inbred lines resistant to biotic and abiotic stresses. • The use of CIMMYT germplasm in improved varieties reaches 70% in developing countries.	• Private seed industry disseminates germplasm containing CIMMYT material. • National programs receive more support from public and private sectors.
Outputs	**Indicators**	**Assumptions and risks**
1. High yielding, input efficient, stress tolerant, lodging resistant, stable, high nutritional value, and environmentally compatible cultivars for maize-based systems in developing countries. 2. Stable germplasm with broad adaptation, superior performance, and stress tolerance, which will enhance CIMMYT's capacity for the global exchange of germplasm and the creation of novel genotypes. 3. A forum for efficient exchange of germplasm, experiences, and information among global maize scientists. 4. Through NARSs and CIMMYT's regional programs, more efficient transfer of CIMMYT's research outputs to benefit resource-poor farmers. 5. Information on population and line performance in a wide array of environments and on efficient means to build broadly adapted germplasm using molecular and conventional approaches. 6. Information on relationships among important maize germplasm groups from NARSs, ARIs, and CIMMYT, resulting in more efficient development of superior cultivars and use of improved international maize germplasm. 7. Maize germplasm from NARSs and CIMMYT classified with respect to heterotic patterns.	1. By 2002, the CIMMYT Maize Program in collaboration with NARSs will have developed and identified, via international testing, new hybrids and synthetics with 20% higher yield than the current best seed industry checks. 2. By 2002, the CIMMYT Maize Program will have developed inbred progenitors, hybrids, and synthetic varieties with excellent yield stability and resistance to biotic and abiotic stresses. NARSs, in collaboration with CIMMYT, will have released hybrids and synthetics with broad adaptation and nutritive value added, and with 10% more yield than the best seed industry checks. 3. Improved exchange of germplasm and information. 4. More rapid transfer of research outputs to farmers. 5. Performance information available, as well as information on relative advantages of conventional and nonconventional breeding approaches. 6. More information available on relationships among important maize germplasm groups. 7. By 2002, CIMMYT-Mexico will have completed the study of testers and heterotic groups and will have distributed results to partners in the public and private sectors to improve the efficacy of breeding methods.	• CIMMYT Maize Program budget is sustained. • The number of CIMMYT maize scientists is sustained. • Collaboration with the private sector is enhanced. • National programs receive priority and relationships with CIMMYT are strengthened.

Activities	Milestones 2001-2003	Assumptions and risks
1. Formation, evaluation, and selection of early and late maturity inbred lines with white and yellow endosperm adapted to tropical, subtropical, mid-altitude, and highland environments (contributes to outputs 1, 2).	• A total of 150 broadly adapted, stable inbred lines with good general combining ability; general resistance to major foliar diseases, ear rots, insect pests, and abiotic stresses; added nutritive value; and characterized for heterotic response, will be released for use by partners.	• Resource levels (staff and budgets) remain stable.
2. Early, advanced, and elite generation nurseries to include 9,000, 900, and 200 trials, respectively (contributes to outputs 1-5).	• Nurseries formed and distributed.	
3. Evaluation of early and advanced generation testcrosses (contributes to outputs 3, 6).	• Data available.	
4. Simultaneous evaluation under specific abiotic stresses (drought, low N, high density) and biotic stresses (foliar diseases, ear rots, and insects) (contributes to outputs 1, 2, 5).	• Data available.	
5. Formation, evaluation, and selection of synthetics with the following characteristics: early maturity, late maturity, disease resistance, tolerance to drought and low N, and mid-altitude and highland adaptation (contributes to outputs 1, 2).	• Some 80 new open-pollinated varieties (OPVs) and synthetics, both normal and quality protein maize (QPM), will be developed and tested through international trials.	
6. Formation and evaluation of advanced single crosses and testcrosses for subtropical, mid-altitude, and highland regions; formation and evaluation of hybrids resistant to biotic and abiotic stresses (contributes to outputs 1, 2).	• About 150 (normal and QPM) new, high yield potential, stable hybrids will be developed and tested through international trials.	
7. By 2001, QPM hybrids released in India, Vietnam, Venezuela, Nicaragua and Honduras; hybrids and OPVs released in eastern and southern Africa, Asia, and Latin America (contributes to outputs 1, 2, 4).	• Approximately 40 inbred lines and 25 OPVs and hybrids (normal and QPM) will be released by national programs and seed produced by national and private seed companies. • All products in this period will be characterized for abiotic and biotic stress tolerance. • In collaboration with G4, R2, R5, and F4, we will release normal and QPM hybrids, synthetics, and lines resistant to stresses.	• Effective seed industry in place. • Extension service active in developing countries.
8. Two white and two yellow heterotic maize populations with tolerance to acidic, aluminum toxic soils and adaptation to the lowland tropics will be developed (contributes to outputs 1, 2).	• In close collaboration with G4, 10 source OPVs with specific stress tolerance and excellent performance will be identified through testing in Mexico and elsewhere.	
9. Select 440 testcrosses among inbred lines and 2 testers under low N for 10% superior lines for hybrid formation and pedigree projects (contributes to outputs 1, 2).	• In close collaboration with G4, 20 inbred lines with good general combining ability, specific abiotic and biotic stress tolerance, and excellent performance potential in unstressed environments will be identified.	
10. Selection and evaluation of QPM lines conducted in subtropical, tropical, and highland germplasm with the assistance of molecular markers (contributes to outputs 1, 2, 5).	• Molecular marker-assisted breeding will be routine for at least two traits.	

Activities	Milestones 2001-2003	Assumptions and risks
11. Both QPM and normal maize evaluated for industrial quality (tortillas) in Mexico, Central America, and Venezuela (contributes to outputs 1, 2).	• Gender-sensitive breeding traits associated with quality of food products (color, flour recovery rate, cooking time, texture) will assume greater importance in breeding.	
12. Extensive study in heterotic patterns initiated in tropical, subtropical, and highland subprograms (contributes to outputs 1, 2, 7).	• Major heterotic patterns in tropical and subtropical maize identified, used by several NARSs, and published widely.	
13. During 2001 three types of training will be conducted in Mexico: 1) maize breeding training course in Spanish and English; 2) advanced training course for leaders of NARSs; and 3) Visiting Scientist travel to subprograms in Mexico and national programs in Africa, Latin America, and Asia (contributes to outputs 3, 4).	• About 80 national researchers will be trained in applied maize breeding.	

Duration: 2001-2003
Collaborators: Other CGIAR centers, NARSs, and ARIs.
Costs: US$ 2.131M
System linkages: Germplasm improvement (55%)
Germplasm collection (18%)
Sustainable production (7%)
Enhancing NARSs (20%)

Project 3 (G3): Developing core germplasm and integrating interdisciplinary approaches for wheat improvement

Overall goal	Indicators	Assumptions and risks
To increase food production and enhance food security in the irrigated and high rainfall environments of the developing world while protecting the environment and preserving the biodiversity of wheat, triticale, and barley.	• Increased wheat, triticale, and barley production in the irrigated and high rainfall regions of the developing world. • Increased adoption of resource-conserving technologies by farmers. • More diversity in the wheat, triticale, and barley varieties sown in farmers' fields.	• Governments in developing countries will continue with policies that support agricultural development.

Intermediate goals	Indicators	Assumptions and risks
1. Improved food production through the introduction of higher yielding, disease resistant wheat, triticale, and barley varieties in irrigated and high rainfall environments of the developing world. 2. Enhanced food security as a result of greater yield stability in farmers' fields. 3. Improved crop management strategies to ensure that farmers take full advantage of the improved characteristics of modern varieties.	• Higher wheat, triticale, and barley yields. • Adoption by farmers of higher yielding wheat, triticale, and barley varieties with improved disease and pest resistance. • Adoption by farmers of improved crop management practices that go with improved varieties. • Greater genetic diversity of sown varieties, which as a result are less vulnerable to diseases, pests, and environmental variability.	• NARSs will use CIMMYT germplasm to develop and release adapted varieties to farmers. • Risk that NARSs have reduced resources for improvement work.

Purpose	Indicators	Assumptions and risks
To produce high yielding, disease resistant wheat, triticale, and barley lines that NARSs can use to develop and release varieties adapted to local conditions, and to generate sustainable crop management practices that allow varieties to reach their full yield potential.	• Superior, disease resistant wheat, triticale, and barley germplasm with broader genetic diversity is developed and distributed to NARSs. • Improved, sustainable crop management strategies developed and transferred to NARSs.	• NARSs will continue to evaluate and release germplasm adapted to local conditions.

Outputs	Indicators	Assumptions and risks
1. High yielding, disease resistant germplasm combining stability, input efficiency, and input responsiveness for irrigated and high rainfall conditions. 2. Improved levels of durable resistance to diseases (the three rusts, Karnal bunt, tan spot, septoria tritici, helminthosporium leaf blight, barley yellow dwarf, and fusarium head blight, among others). 3. Wheat, triticale, and barley germplasm with improved industrial and nutritional quality. 4. Genotypes better adapted to current and future management situations, that perform better under reduced tillage, residue retention, and other relevant cultural practices. 5. New genetic sources of selected traits available from the germplasm bank. 6. New stocks in 42- or 28-chromosome backgrounds, including new translocations from alien species and wheat relatives, provided to NARS breeders. 7. Improved integrated nutrient management systems that increase nutrient use efficiency and minimize adverse environmental effects.	1. Improved germplasm of relevant adaptation disseminated to cooperators in irrigated and high rainfall environments. 2. Improved resistant germplasm disseminated to cooperators. 3. Germplasm with improved quality disseminated to cooperators. 4. Improved germplasm that performs well under different cultural practices disseminated to cooperators. 5. Genetic stocks available. 6. Development of 42-chromosome wheats containing "small" alien segments carrying traits relevant for irrigated and high rainfall wheat production. 7. Management systems under development.	• CIMMYT resources for the development of wheat, triticale, and barley germplasm are maintained. • Germplasm exchange remains free, open.

Activities	Milestones 2001-2003	Assumptions and risks
1. Empirical breeding combined with trait-oriented analytical and molecular approaches to develop parental stocks for irrigated and high rainfall production conditions (contributes to outputs 1, 3).	• Every year, transfer to NARSs in target environments 500 lines with improved yield potential and resistance to the most important biotic stresses. • Identification of exotic genetic stocks, including related genera, wheat wild relatives, landraces, and unadapted cultivars, for incorporation into germplasm adapted to irrigated and high rainfall wheat production. • Fifty lines/year derived from crosses involving diverse genetic stocks.	• See above.
2. Pre-breeding to produce new genetic stocks in 42- or 28- chromosome backgrounds (contributes to outputs 5, 6).	• Ten lines derived from new genetic stocks each year.	
3. Quality requirements for NARS partners researched and documented (contributes to output 3).	• Quality requirements will be precisely targeted by mega-environment by 2003.	
4. More efficient quality procedures developed to facilitate the development of better quality and more specific germplasm (contributes to output 3).	• Development of new quality procedures by 2002.	
5. Transfer of newly identified sources of adaptation, yield traits, and disease resistance using new sources of diversity such as synthetic wheats (contributes to outputs 2, 4, 6).	• Distribution of 100 lines with new sources of resistance by 2003.	
6. Germplasm distributed through the International Nursery System to NARSs in target environments for testing and collection of performance data (contributes to outputs 1, 2, 3, 4, 6).	• Distribution of nine international nurseries every year.	
7. Conduct strategic crop management research to identify management solutions to factors limiting production and productivity in irrigated and high rainfall environments (contributes to outputs 4, 7).	• Dissemination of promising crop management strategies to NARSs within the next five years.	

Duration: 2001-2003+
Collaborators: 100 NARSs in 30 countries, 5 ARIs, and two CGIAR centers.
Costs: US$ 3.277 M
System linkages: Germplasm improvement (43%)
Germplasm collection (13%)
Sustainable production (24%)
Enhancing NARSs (20%)

Project 4 (G4): Increasing the productivity and sustainability of maize in the presence of stress

Overall goal	Indicators	Assumptions and risks
Contribute to food security, natural resource conservation, and poverty reduction by increasing the productivity, stability, and sustainability of maize in the presence of abiotic and biotic stresses.	• Greater and more sustainable food security and economic stability of maize-based farming communities across countries and regions of the developing world.	• Socioeconomic, climatic, and edaphic factors dictate that the majority of maize in the developing world continues to be produced in the presence of abiotic and biotic stress factors.

Intermediate goal	Indicators	Assumptions and risks
Stabilize and increase maize production in a sustainable manner in tropical and subtropical environments that are affected by abiotic and biotic stresses, with special emphasis on research targeted at resource-poor farming systems.	• Increased and more stable aggregate maize production in regions characterized by large variability in pests, weather, and other production factors. • Higher and more stable family incomes in unfavorable environments, benefiting the poorest, especially women and children. • Reduction in the unfavorable environmental impacts of maize farming systems in stress environments. • Enhanced biodiversity through the deployment of diverse genetic resources, reduced use of pesticides, and reduced expansion of maize farming systems into valuable ecologies. • Trained researchers familiar with research options for stress environments, to accelerate the development of sustainable maize farming systems for a wider range of environments. • Larger impacts of maize-related research, particularly in stress environments.	• Genetic variability and agronomic options exist, and information can be developed and compiled, to increase maize productivity and sustainability in the presence of abiotic and biotic stresses, especially in view of the specific socioeconomic circumstances and preferences of resource-poor farmers.

Purpose	Indicators	Assumptions and risks
Achieve increased, more stable, and sustainable maize production in the presence of abiotic and biotic stresses.	• Adoption of improved and sustainable maize production systems by resource-poor farmers in unfavorable environments. • More appropriate use of genetic and natural resources in stress environments.	• See above.

Outputs	Indicators	Assumptions and risks
1. Characterization of the relative importance of biotic and abiotic stress factors in maize growing environments, and of farmers' preferences in stress environments. 2. Conventional and molecular breeding methodologies for identifying germplasm with resistance/tolerance to major biotic and abiotic stresses. 3. Germplasm that tolerates/resists stresses such as acidic and phosphorus-deficient soils, drought, low nitrogen, insects, and diseases. 4. Agronomic interventions and decision support systems for stress environments (in conjunction with projects R1, R2, R4, R5). 5. Information on germplasm resources, breeding methodologies, and crop management options for stress environments, and information on their potential impact.	1. Quantitative estimates available of the importance of various abiotic and biotic stresses for maize production, food security, economic stability, and the status of natural resources, resulting in improved priority setting by research managers and maize researchers. 2. Accelerated development of maize germplasm that is more appropriate for stress environments and that meets the specific needs of resource-poor farmers. 3. Maize germplasm sources available that carry tolerance/resistance to the most relevant biotic and abiotic stresses and that are adapted to the major agroecologies. 4. Environment-specific agronomic interventions and decision support systems that are attractive to resource-poor farmers in unfavorable environments and that manage natural resources sustainably. 5. NARS scientists and policy makers are aware of and use maize germplasm and research methods to increase, stabilize, and sustain maize production in unfavorable environments.	• Continued development and availability of GIS databases and related information. • Genetic variability in maize germplasm; access to that variability. • New scientific options are and continue to become available; access to those options. • Interest by NARS partners in achieving increased, more stable, and sustainable maize production. • Constant-to-increased commitment by donors to contribute to greater and more sustainable food security and economic stability of maize-based farming communities in

Outputs	Indicators	Assumptions and risks
6. Capacities to work with national researchers to access germplasm and apply technologies that increase maize productivity and sustainability in stress environments (in conjunction with projects G8, R1, R2, R4, R5, F3).	6. Maize researchers are trained in technologies that increase maize productivity and sustainability in stressed environments, and facilities for developing stress tolerant maize germplasm are available to NARS breeders in different agroecological zones.	countries and regions across the developing world.

Activities	Milestones 2001-2003	Assumptions and risks
1. Compile and make available geo-referenced data on environment, population, and maize production in the tropics and subtropics to increase research effectiveness and the sustainable use of genetic and natural resources, particularly in stress environments (contributes to output 1).	• Revised definition of maize mega-environments at the global level. • Africa Maize Research Atlas (data on climate, soil, elevation, land use, population, nutrition, and maize production compiled at the continental level) made available in a user-friendly manner to researchers. • Country Almanacs developed for 10 countries in sub-Saharan Africa. • Similarities of maize growing environments in sub-Saharan Africa and Latin America established for more effective use of Latin American maize genetic resources in Africa. • Through collaboration with other institutions, better access to improved geo-referenced soils and maize distribution information.	• Further development of GIS databases by other public institutions. • Continued access to GIS databases developed by public institutions. • Collaboration and continued funding of partner institutions. • Increased funding.
2. Compile information on the importance and distribution of major insect pests and diseases of tropical maize and their interactions with the environment and management factors (contributes to output 1).	• Standard maize nurseries for identifying the presence and variability of pathogens and insects developed and distributed to collaborators, who return geo-referenced site data. • Hot spots for disease and insect stress identified; similarity maps for those sites developed. • Survey completed of major insect pests of maize, based on published reports and information from local experts. • Survey completed on pathogen diversity of the corn stunt complex, *Cercospora zea-maydis*, *Exserohilum turcicum*, *Puccinia sorghi*, maize streak virus, downy mildews. • Improved quantification of losses from stem borer damage in selected ecologies.	• Collaboration and continued funding of partner institutions. • Continued-to-increased funding.
3. Enhance knowledge of the physiology and genetics of mechanisms that confer tolerance/resistance to major biotic and abiotic stresses in maize (contributes to outputs 2 and 5).	• Relationship between promising physiological mechanisms and tolerance/resistance to abiotic and biotic stress factors established. • Relationship established among mechanisms that confer tolerance to several abiotic stress factors for more effective selection of maize germplasm adapted to complex stress environments (focus on flowering process; root development; leaf senescence/stay-green). • Inheritance studies completed in relevant germplasm for mechanisms that confer tolerance/resistance to drought, low soil N, acid soil/low pH, suboptimal temperatures, *E. turcicum*, *C. zea-maydis*, *P. sorghi*, downy mildews, corn stunt complex, *Rhizoctonia solani*, and *Physopella zeae*. • Quantitative trait loci (QTLs) identified in relevant germplasm for mechanisms that confer tolerance/resistance to drought, low soil N, low soil pH/Al toxicity, low soil P, suboptimal temperatures, *Busseola fusca*, *Chilo partellus*, *E. turcicum*, *C. zea-maydis*, maize streak virus, downy mildews, *Fusarium moniliforme*.	• Collaboration and continued funding of partner institutions. • Continued-to-increased level of funding. • Other public and private institutions progress on technologies that identify and isolate genes, and are willing to share that knowledge and to give access to technologies.

Activities	Milestones 2001-2003	Assumptions and risks
	• QTLs identified that are related to drought tolerance and are stable across maize materials. • Significant progress towards identifying and isolating genes and physiological pathways of traits associated with drought tolerance; options for following a candidate gene approach and for functional genomics explored for one additional stress tolerance/resistance mechanism. • Twenty publications in referred journals. • Fifty contributions to scientific conferences.	
4. Develop improved and more efficient selection methodologies for identifying maize with resistance and tolerance to major stresses, which is acceptable to resource-poor farmers (contributes to outputs 2 and 3).	• Cost-effectiveness of marker-assisted selection (MAS) compared to conventional selection for stress tolerance/resistance mechanisms where QTLs have been identified, and cost-effective strategies implemented in breeding programs of G2. • Application of MAS strategies to improve resistance/tolerance of selected germplasm to drought, downy mildews, maize streak virus, *B. fusca, C. partellus,* and *F. moniliforme.* • Routine identification of genotypes presenting high and moderated resistance to maize streak virus using molecular markers. • Develop and disseminate user-friendly statistical design and data analysis and management techniques that improve efficiency of maize breeding programs by 30%. • Selection for leaf toughness implemented in selected breeding programs of G2, enabling selection for multiple borer resistance where insect rearing is not possible. • Cost-effective methods developed for testing cultivars at the release stage in a manner that better considers stress environments and preferences of resource-poor farmers.	• Collaboration and continued funding of partner institutions. • Continued-to-increased funding.
5. Develop sources that provide highest levels of resistance and tolerance to various stresses on a broad genetic background; focus on priority stresses in different environments (eastern Africa; southern Africa; South American lowlands; Mesoamerican lowlands; Asian lowlands; highlands; and subtropics) (contributes to output 3).	• Thirty synthetics or open-pollinated varieties and 250 inbred lines recommended to national research programs because of relevant/superior tolerance/resistance in adapted genetic background. • Mapped genetic sources with highest stress tolerance/resistance available for drought, low soil N, low soil pH/Al toxicity, low soil P, *Spodoptera frugiperda, Diatraea* sp., *B. fusca, C. partellus, E. turcicum, C. zea-maydis* maize streak virus, downy mildews, *F. moniliforme.*	• Collaboration and continued funding of partner institutions. • Continued-to-increased funding.
6. Develop environment-specific agronomic interventions and decision support systems that are attractive to resource-poor farmers in unfavorable environments and that manage available natural resources in a sustainable manner (in collaboration with R1, R2, R4, and R5) (contributes to output 4).	• See descriptions of R1, R2, R4, and R5 in this publication.	• Most environment-specific agronomic interventions and decision support systems are developed as part of regional projects. • Collaboration and continued funding of partner institutions. • Continued-to-increased funding.

Activities	Milestones 2001-2003	Assumptions and risks
7. Analyze interactions between cultivars, management practices, and farmers' preferences under the influence of unfavorable environments (in collaboration with R1, R2, R4, and R5) (contributes to output 5).	• Cultivar x management practices evaluated under farmers' conditions, obtaining farmers' evaluation as well as assessment of socioeconomic and institutional constraints of improved and sustainable maize production systems, with priority given to: acid soil tolerant germplasm and related agronomic practices, Latin America; drought and low nitrogen tolerant germplasm and related resource management techniques, eastern and southern Africa; stem borer resistant germplasm and pest management strategies, Mexico and eastern Africa; *Striga* tolerant germplasm and related management practices, eastern Africa (see R1). • Global scientific workshop on approaches that achieve increased, more stable, and sustainable maize production in the presence of abiotic and biotic stresses.	• Collaboration and continued funding of partner institutions. • Increased funding.
8. Provide partners with easily accessible information on stress-tolerant maize germplasm and molecular information (in collaboration with G2) (contributes to output 5).	• Regional and global trials and networks used for systematically and collaboratively evaluating elite maize germplasm for the most important stresses for that ecology, and for establishing and using molecular information. • Annual publication on stress tolerance/resistance of globally and regionally available elite maize germplasm from CIMMYT, if possible as well from NARSs.	• Collaboration and continued funding of partner institutions. • Continued-to-increased funding.
9. Develop training material/technical reports on selection methodologies and agronomic interventions that increase maize productivity and sustainability in stressed environments (contributes to output 5).	• Training material/technical reports developed that document: 1) proven breeding techniques for selecting maize tolerant to drought, low N, and low soil pH/Al toxicity; 2) insect resistance breeding and the use of leaf toughness as a surrogate for artificial infestations; 3) inoculation techniques for important maize diseases; 4) use of improved statistical design and analysis techniques for trials executed under the complex and difficult conditions of stress environments; and 5) options for farmer participatory variety selection in stress environments. • *Revised field guide on tropical maize diseases.* • Training material/technical reports on agronomic interventions that increase maize productivity and sustainability in stressed environments (from R1, R2, R4, R5).	• Collaboration and continued funding of partner institutions. • Continued-to-increased funding.
10. Train maize scientists in technologies that increase maize productivity and sustainability in stress environments (in collaboration with G8) (contributes to output 6).	• Two hundred and fifty national scientists trained in the use of GIS data, resulting in more appropriate planning and execution of agricultural research projects and in increased collaboration across country boundaries. • One hundred and fifty NARS scientists trained through short courses, workshops, or visiting scientist fellowships in 1) developing and identifying stress tolerant maize cultivars suited to resource-poor farmers' conditions and preferences; and 2) developing agronomic interventions suited to stress environments and resource-poor farmers' socioeconomic conditions (in collaboration with R1, R2, R4, and R5). • Fifteen PhD/MSc students produce theses on subjects related to increasing maize productivity and sustainability in stress environments.	• Increased funding.

Activities	Milestones 2001-2003	Assumptions and risks
11. Develop facilities that NARS breeders in different agroecological zones can use to develop stress tolerant maize germplasm (in collaboration with R1, R2, R4, and R5) (contributes to output 6).	• Regionally accessible sites established for: 1) MAS in Kenya, Zimbabwe, and selected Asian countries; 2) drought, low N, and low pH screening in Africa, Asia, Latin America; 3) screening for Striga in Africa (see R1); 4) screening for stem borers in Africa, Asia, Latin America. • National research programs supported in use of artificial inoculation or infestation techniques for screening regionally relevant germplasm.	• Increased funding.

Duration: 2001–2003+

Collaborators: National agricultural research systems of Africa, Latin America, and Asia; Universidad Nacional de Saõ Paulo, Brasil; University of Ottawa, Canada; Universidad Nacional de Colombia, Colombia; University of Hannover, Germany; European research team involved in INCO-DC project; John Innes Center, England; Natural Resources Institute, England; Punjab Agricultural University, India; Colegio de Posgraduados, Mexico; UNAM, Mexico; University of the Philippines, Philippines; Swiss Institute of Technology, Zurich, Switzerland; Université de Neuchatel, Switzerland; Cornell University, USA; Iowa State University, USA; University of Minnesota, USA; Mississippi State University/USDA, USA; Ohio State University, USA; Texas A&M University, USA; Texas Tech University, USA; other CGIAR centers, including CIAT, ICIPE, ICRAF, ICRISAT, IITA, ILRI, and IRRI; private seed companies; and non-governmental institutions.

Costs: US$ 1.233M

System linkages: Germplasm improvement (45%)
Germplasm collection (10%)
Sustainable production (30%)
Enhancing NARSs (15%)

Project 5 (G5): Increasing wheat productivity and sustainability in stressed environments: Abiotic stress

Overall goal	Indicators	Assumptions and risks
Generate benefits for resource-poor farmers in marginal areas subject to abiotic stress by improving wheat yield, stability, profitability, and sustainability.	• Rural livelihoods in marginal environments improved.	• Wheat genetic resources for marginal environments are available.

Intermediate goal	Indicators	Assumptions and risks
Develop and disseminate superior wheat and triticale germplasm, in conjunction with crop management technologies, appropriate for abiotic stress environments of developing countries.	• Adoption of improved wheat and triticale germplasm in developing country areas subject to abiotic stress. • Adoption of improved crop management technologies.	• Resources continue to be available for the development of improved germplasm.

Purpose	Indicators	Assumptions and risks
CIMMYT and NARS partners collaborate to obtain, maintain, and share germplasm and information needed to develop and disseminate superior wheat and triticale germplasm suitable for abiotic stress environments.	• Improved wheat and triticale germplasm available for researchers and farmers in developing countries.	• See all assumptions/risks above.

Outputs	Indicators	Assumptions and risks
1. New sources of drought adaptive traits identified and incorporated into currently adapted germplasm. 2. Germplasm that performs better under different management technologies, such as reduced tillage, and suitable residue retention. 3. New sources of adaptation for heat and cold tolerance identified, incorporated into adapted germplasm, and disseminated to NARS collaborators. 4. Environments suffering nutrient stress mapped and technologies to reduce nutrient constraints made available. 5. New genetic sources of tolerance to nutrient stress identified and incorporated into germplasm. 6. New, more efficient methodologies for selecting wheat and triticale cultivars under abiotic stress conditions. 7. Improved crop management technologies—including reduced tillage systems and implements, residue management, and nutrient management—developed for rainfed wheat and triticale cropping systems. 8. A crop information system that provides decision support for improving characterization of wheat germplasm with respect to abiotic stresses and increases the efficiency of experimental trials.	1. Better drought tolerant, input responsive varieties available to farmers growing wheat and triticale in variable, risky rainfall environments. 2. Wheat and triticale varieties suitable for reduced tillage and other management strategies available to farmers in variable, risky rainfall environments. 3. Germplasm with heat and cold tolerance characterized and made available for farmers in areas suffering heat and cold extremes. 4. Geographical information on nutrient stress available for technology development/ dissemination. 5. Germplasm with adaptation to nutrient stress made available to NARSs. 6. Adoption of more efficient selection methodologies by CIMMYT and NARS breeding programs. 7. Information available on residue management, and adoption of reduced tillage by smallholder farmers. 8. Adoption of crop information system that increases research efficiency in developing wheat and triticale cultivars for abiotic stress environments.	• Genetic resources and screening methodologies available; active collaboration with research partners; germplasm exchange unrestricted. • Data available for mapping. • Adoption encouraged by availability of locally available, inexpensive implements; no competing uses of crop residues; and other important conditions for success (e.g., policies, credits). • Suitable data and resources available to develop information system.

Activities	Milestones 2001-2003	Assumptions and risks
1. Develop new parental materials using genetic diversity from a range of sources containing relevant traits for grain yield, abiotic stress tolerance, and end-use quality (contributes to output 1).	• By 2001, 30-150 drought-tolerant sources identified.	
2. Incorporate drought adaptive traits using trait-oriented analytical and molecular approaches together with empirical breeding methods (contributes to output 1).	• By 2001, adoption of improved screening methodologies by CIMMYT and national breeding programs.	
3. Distribute germplasm through the International Nursery System; incorporate information about performance in targeted environments into a crop information system (contributes to output 1, 8).	• Provision of improved, drought tolerant germplasm to NARSs.	
4. Identify, evaluate, and incorporate parental materials tolerant of heat and cold (contributes to output 3).	• Identification of 100-200 heat- and cold-tolerant sources.	
5. Crop improvement using empirical, analytical, and molecular approaches and shuttle breeding, genotype x management interactions, and multilocation testing (contributes to output 3).	• Adapted germplasm with heat and cold tolerance available.	
6. Disseminate heat-and cold-tolerant germplasm and related information (contributes to output 3).	• Increased understanding of environments with heat and cold stress.	
7. Characterize potential progenitors and develop new parental materials adapted to nutrient stresses, including N, P, Zn, B, Mn, Cu stresses (contributes to output 5).	• Genetic sources of tolerance to nutrient stresses available.	
8. Crop improvement using empirical, analytical, and molecular approaches to develop tolerant germplasm and appropriate management practices (contributes to output 5).	• Nutrient status of collaborating research sites determined.	
9. Develop specialized International Nursery to facilitate the exchange of germplasm between CIMMYT and NARSs (contributes to output 5).	• Nursery established.	• Support from collaborating institutions available.
10. Identify potential stress adaptive traits, evaluate field screening methodologies, and determine genetic basis of these traits (contributes to output 6).	• By 2001, identification and confirmation of relevant stress adaptive traits.	
11. Develop molecular, physiological, and conventional selection tools (contributes to output 6).	• By 2003, adoption of more efficient selection methodologies by CIMMYT and national breeding programs.	

Activities	Milestones 2001-2003	Assumptions and risks
12. Develop and adapt improved crop management strategies, including reduced tillage, residue management, machinery, rotations, nutrient management, and bed systems (contributes to output 7).	• Zero-till animal traction seeder developed in Bolivia. • Other prototype implements developed.	• Support from collaborating institutions available.
13. Disseminate crop management strategies to NARSs, NGOs, and farmers (contributes to output 7).	• Information on appropriate strategies available. • Reduced tillage systems adopted by smallholder farmers.	• Limitations to dissemination not present (e.g., inadequate extension infrastructure, inappropriate policies).
14. Advise CIMMYT and NARS breeding programs on appropriate management practices for germplasm screening (contributes to output 7).	• Germplasm screened at CIMMYT under different management strategies.	
15. Study the biological basis of genotype x abiotic stress interactions, and improve the characterization of germplasm, production environments, and selection environments for abiotic stresses (contributes to output 8).	• Improved characterization of wheat germplasm and greater research trial efficiency.	
16. Develop a crop information system as a decision support system (contributes to output 8).	• Better utilization of data and information by breeding programs in research on abiotic stresses.	• Resources available for system development.

Duration: 2001-2003
Collaborators: Other CGIAR centers, NARSs, and ARIs.
Costs: US$ 2.583M
System linkages: Germplasm improvement (15%)
Germplasm collection (5%)
Sustainable production (60%)
Enhancing NARSs (20%)

Project 6 (G6): Increasing wheat productivity and sustainability in stressed environments: Biotic stress

Overall goal	Indicators	Assumptions and risks
Wheat, triticale, and barley productivity is increased, yield stability is enhanced, and the impact of agriculture on the environment is reduced.	• Results of CIMMYT impact studies.	

Intermediate goal	Indicators	Assumptions and risks
The stability of wheat, triticale, and barley production is increased through the strategic deployment of more genetically diverse germplasm with durable disease and pest resistance, and the dissemination of relevant epidemiological information.	• Better understanding of global epidemiology and improved knowledge of the disease resistance present in wheat, triticale, and barley cultivars on the part of CIMMYT researchers and NARS partners. • Identification of diverse sources of resistance to wheat, triticale, and barley diseases and pests. • Wheat, triticale, and barley germplasm with more durable disease resistance distributed to NARSs. • Application of chemical pesticides reduced due to the use of disease resistant cultivars. • Development of molecular markers and marker-assisted selection (MAS) strategies for use in disease resistance breeding.	• Patents on molecular markers and techniques may prevent their unrestricted use.

Purpose	Indicators	Assumptions and risks
Genetic vulnerability in farmers' fields is reduced and yield stability is increased as NARSs release improved disease resistant varieties and are better able to manage the diseases and pests that attack wheat, triticale, and barley.	• High yielding, disease resistant wheat, triticale, and barley varieties developed and released by NARSs from CIMMYT's improved, disease resistant germplasm. • Improved pathogen surveillance at the global and regional levels. • Global and regional networking and strengthening of NARSs' capability to conduct their own disease surveys and forecast important changes in pest populations.	• Limited research capacity of certain NARSs in the areas of disease and pest etiology and epidemiology.

Outputs	Indicators	Assumptions and risks
1. Wheat, triticale, and barley cultivars with broader based genetic resistance to emerging and mutating pathogens that could cause extensive crop losses. 2. Strategies for the effective control of diseases and pests in current and changing production systems. 3. Information on occurrences at the global and regional levels of diseases, pests, and new virulences, as well as of their relevance to cultivars sown in farmers' fields. 4. More efficient field and lab diagnostic techniques and better characterization of pathogens and pests. 5. Marker-assisted selection strategies effective for incorporating various resistance genes.	1. Availability of germplasm with better genetic resistance. 2. Disease and pest control strategies under development 3. Information on disease and pest distribution and pathogen variation made available to CIMMYT researchers, NARS partners, and other collaborators. 4. Availability of PCRs, QTLs, and other markers for multigenic resistance traits. 5. Application of molecular markers increases efficiency of selection for resistance to biotic stresses.	• Limited capacity of NARSs to use efficient resistance screening techniques and apply biotechnological tools.

Activities	Milestones 2001-2003	Assumptions and risks
1. Advanced wheat, triticale, and barley lines plus materials from the Wide Crosses Unit and the CIMMYT genebank rigorously screened for resistance to various diseases and pests at hot spots in Mexico and around the world (contributes to outputs 1-3).	• Each year, new sources of resistance identified and distributed.	• Germplasm exchange remains free and open.

Activities	Milestones 2001-2003	Assumptions and risks
2. Continuous determination of the distribution and importance of targeted diseases and pests, and of the crop losses they cause (contributes to outputs 1-3).	• Data on crop losses caused by targeted diseases and pests available annually for making strategic crop protection and breeding decisions.	
3. Strengthening NARSs' capability to conduct their own disease surveys and forecast changes in pest populations that could affect the stability of crop production (contributes to outputs 1-4).	• Strategies for the effective control of newly emerging diseases and pests will be assessed and made available to NARSs by 2003.	
4. Tagging of genes conferring resistance to biotic stresses to develop diagnostic markers (contributes to outputs 4, 5).	• First MAS strategies in place by 2001.	
5. Mapping genes that confer resistance to leaf rust, yellow rust, fusarium head blight, and Karnal bunt, among other diseases (contributes to outputs 4, 5).	• Each year, information on the number, location, and effect of genes conferring resistance to leaf rust, yellow rust, fusarium head blight, and Karnal bunt will be made available.	
6. Pathogen surveillance through sampling, diagnostic surveys, disease monitoring, and virulence analyses at the global and regional levels (contributes to outputs 1-4).	• Data available.	• Support (financial, human resources) and skills available.

Duration: 2001–2003+
Collaborators: Other CGIAR centers, NARSs, NGOs, and ARIs.
Costs: US$ 2.006M
System linkages: Germplasm improvement (70%)
Germplasm collection (20%)
Enhancing NARSs (10%)

Project 7 (G7): Gauging the productivity, equity, and environmental impact of modern maize and wheat systems

Overall goal	Indicators	Assumptions and risks
Enhance the rate of adoption of agricultural technology and its implications for improving research resource allocation.	• Improved adoption of agricultural technology in developing countries. • Improved methods for research resource allocation.	• Developing countries remain committed to improving agricultural technology and thereby improving the welfare of the poor.

Intermediate goal	Indicators	Assumptions and risks
Improve our understanding of the adoption of agricultural technology and the implications for improving research resource allocation by studying the processes by which improved germplasm and management practices are diffused in developing countries.	• Information documenting impacts of research and factors affecting technology adoption. • Information to guide strategies for deploying new technology. • Information for more efficient research resource allocation. • Methods for conducting impact and resource allocation studies.	• Sharing of data and information is unimpeded. • Private seed companies may not be willing to divulge their use of CIMMYT germplasm.

Purpose	Indicators	Assumptions and risks
Evaluate the impact of research by CIMMYT and its partners to improve the general understanding of factors affecting technology adoption, improve research resource allocation, and improve the deployment of new technology.	• See above.	

Outputs	Indicators	Assumptions and risks
1. Updated and expanded knowledge about the development and diffusion of improved maize and wheat germplasm in developing countries. 2. Updated and expanded knowledge about the development and diffusion of crop and resource management practices in developing countries. 3. Improved understanding of the role of institutions and policies in facilitating the spread of Green Revolution technology. 4. Improved understanding of factors affecting the adoption of new technology in maize- and wheat-based cropping systems. 5. Research priority setting information/ model. 6. Impact studies of CIMMYT's maize and wheat germplasm.	1. Information on the productivity, equity, and environmental impact of maize and wheat germplasm in developing countries. 2. Information on the productivity, equity, and environmental impact of crop and resource management practices in developing countries. 3. Improved understanding of the technological, political, and economic processes behind the Green Revolution in wheat. 4. Case studies to document the adoption of agricultural technology and explore specific issues related to the adoption process. 5. Information for the priority setting component of project F6 (specifically, for incorporating information on technology spillovers into the design of national and international agricultural research programs in Latin America). 6. Greater use of impact information in public awareness and resource mobilization.	• Same as above.

Activities	Milestones 2001-2003	Assumptions and risks
1. Conduct regional studies of the impact of CIMMYT maize germplasm (Latin America, Africa, Asia) (contributes to outputs 1 and 4-6).	• Report published, 2000; information disseminated as needed in nontechnical publications, media, funding documents.	• Same as above.
2. Conduct global study of the impact of CIMMYT maize germplasm (contributes to outputs 1 and 4-6).	• Report published, 2000; information disseminated as needed in nontechnical publications, media, funding documents.	• Same as above.
3. Conduct global study of the impact of CIMMYT wheat germplasm (contributes to outputs 1 and 4-6).	• Report published, 2000; information disseminated as needed in nontechnical publications, media, funding documents.	• Same as above.

Activities	Milestones 2001-2003	Assumptions and risks
4. Conduct studies of the impact of genetic resource use on wheat productivity in China and Australia (contributes to outputs 1 and 4-6).	• Reports published, 2000; information disseminated as needed in nontechnical publications, media, funding documents.	• Same as above.
5. Identify, characterize, and evaluate crop and resource management technologies generated at the national and regional levels, including processes used to generate and promote technologies (contributes to outputs 2 and 4-6).	• Literature review on soil fertility research in Nepal. • Literature review on farmers' liming practices in Zimbabwe. • Literature review on zero tillage experience, 2000. • Monitoring study of farmers' management of nitrogenous fertilizer in Zimbabwe.	
6. Conduct case studies of the adoption and impacts of crop and resource management technologies at the national and regional levels (contributes to outputs 2 and 4-6).	• Baseline survey conducted in Nepal to assess farmers' current varietal preferences and crop management practices. • Surveys conducted in Mexico and Central America to determine factors affecting farmers' adoption of conservation tillage practices. • Key informants interviewed in South America to determine factors affecting farmers' adoption and diffusion of zero tillage practices.	
7. Compare "more successful" and "less successful" experiences in developing and adopting crop and resource management technologies with respect to technology, physical environment, and political and economic variables; use this information to identify the key policy variables that affect the impact of crop and resource management technologies (contributes to outputs 2 and 4-6).	• Based on literature reviews and case studies listed above, we will have determined which factors distinguish "more successful" and "less successful" technologies in Central America. • Procedures developed for targeting specific crop and resource management technologies to particular sets of circumstances in Central America. • Participatory, community-based methods developed for promoting successful adoption of crop and resource management technologies in Central America. • Based on experience with zero tillage technologies, policy recommendations developed for improving research and extension systems.	• It is possible to develop participatory, community-based methods. • Pilot studies may reveal that communities are unwilling to participate/ collaborate.
8. Through networks and workshops, disseminate results of activities under output 2 (contributes to outputs 2 and 4-6).	• Manage SoilFertNet in southern Africa. • Train national research staff in participatory, community-based methods for promoting sustainable adoption of crop and resource management technologies in Central America. • Conduct workshops to educate policy makers in Central America about participatory, community-based methods for promoting successful adoption of crop and resource management technologies.	
9. Through literature reviews and case studies, document key policy variables concerning investment in research, technology development, and infrastructure in selected "Green Revolution" sites (contributes to outputs 3-6).	• Case studies completed for India and other locations (elsewhere in South Asia; Mexico; West Asia).	
10. Contrast "more successful" with "less successful" sites with respect to political and economic variables as well as physical environment and technology (contributes to outputs 4-6).	• Detailed policy and research agenda developed for Green Revolution areas in 21st century.	

Activities	Milestones 2001-2003	Assumptions and risks
11. Identify institutional issues influencing research cooperation in Latin America, in particular the evolution of formal and informal research networks (contributes to outputs 4-6).	• Database of institutional variables created, 2000. • Database with composition of crossing blocks created, 2000. • Changes in patterns of collaboration in plant breeding research identified, 2000. • Germplasm flows for wheat and maize in Latin America, and the impact of these flows, documented. • Flows of crop management technologies identified, 2000. • Organization of research systems in several Latin American countries analyzed and documented in case studies, 2000.	
12. Estimate research production functions to help identify economies of scale and scope in research; identify the potential for increasing the efficiency of national research programs in Latin America through increased collaboration and reallocation of resources (contributes to outputs 4-6).	• Research cost functions estimated, 2000. • Study published on the potential for increasing the efficiency of research systems in the region by exploiting spillovers and economies of scale and scope, 2001.	
13. Formulate policy recommendations for increasing the efficiency of national research programs in Latin America (contributes to outputs 4-6).	• Policy recommendations formulated and written up, 2001. • Workshop held to disseminate results of activities and policy recommendations developed under output 4.	
14. Case studies of the adoption of improved germplasm and crop and resource management technologies in Africa, Asia, and Latin America (contributes to outputs 5, 6).	• Approximately 15 collaborative adoption studies with national research programs.	
15. Case studies of the impact of varietal adoption and participatory plant breeding on the *in situ* conservation of genetic resources (contributes to outputs 5, 6).	• Case studies, working papers, journal articles, and (perhaps) proceedings produced.	
16. Study of the relationships between maize technology adoption and poverty in southern Mexico (component of an IAEG study) (contributes to outputs 5, 6).	• Case studies, working papers, journal articles, and (perhaps) proceedings produced.	
17. Case studies of the role of the seed industry in affecting the diffusion of improved germplasm (contributes to outputs 5, 6).	• Case studies, working papers, journal articles, and (perhaps) proceedings produced.	

Duration: 2001-2003+
Collaborators: 100+ NARSs, CGIAR Impact Assessment and Evaluation Group (IAEG).
Costs: US$ 0.715M
System linkages: Policy (63%)
Enhancing NARSs (37%)

Project 8 (G8): Building partnerships through human resource development

Overall goal	Indicators	Assumptions and risks
Develop an effective corps of scientists in the public research sector of developing countries to address emerging challenges to the productivity, profitability, and sustainability of maize and wheat.	• Greater development, dissemination, and adoption of technologies that improve the productivity, profitability, and sustainability of maize and wheat in developing countries.	• The kinds of training offered by CIMMYT continue to be valued and supported. • National agricultural research programs will not be further weakened by reduced budgets, high staff turnover, an inability to bridge the knowledge and information gap between developing and industrialized country research organizations, and the funding challenges that weaken support from international public research institutes. • National research systems are not prevented from functioning by civil disorder.

Intermediate goal	Indicators	Assumptions and risks
Enhance the capacity of scientists in NARSs to improve their use of research resources through human resource development and research partnerships.	• Higher quality, more relevant maize and wheat research in NARSs. • Technology is more rapidly available to farmers. • Researchers in NARSs can increasingly address locally important constraints and increasingly contribute to strategically important research at the regional and global levels. • Stronger strategic research partnerships established as a result of links between alumni of CIMMYT training efforts and CIMMYT. • As a result of CIMMYT training initiatives, there is increased international awareness of, and support for, research by CIMMYT and its partners.	• Continued availability of in-service training and strong, sustainable human resource development programs in NARSs.

Purpose	Indicators	Assumptions and risks
Empower researchers in NARSs to conduct research more efficiently, share expertise with others, and improve collaboration across disciplines and institutions.	• See above.	• See above.

Outputs	Indicators	Assumptions and risks
1. Specialized group training on advanced research tools and methods in research related to maize and wheat (including crop improvement, agronomy, economics, natural resource management, and biotechnology). 2. On-the-job training in areas of mutual interest and high priority for national research programs and CIMMYT. 3. NARSs are supported in efforts to develop local training capacity and conduct regional training initiatives. 4. Greater communication among researchers supported through international fora, such as conferences and workshops.	1. Improved capacity in NARSs to conduct more innovative and strategic research as needed. 2. Sharing of research skills between national researchers and CIMMYT staff; achievement of mutually important research objectives; improved collaboration between national research programs and CIMMYT. 3. Improved capacity for local and regional training by NARSs. 4. Improved communication and collaboration among researchers from many different organizations, including national programs, advanced research institutes, international centers, and NGOs (plus dissemination of research results through proceedings, Internet, and other media).	• The kinds of training offered by CIMMYT continue to be valued and supported, and suitable candidates are identified for training. • Support exists for regional and local training.

Activities	Milestones 2001-2003	Assumptions and risks
1. Offer courses in strategic research areas at CIMMYT headquarters (contributes to output 1).	• Approximately 80 researchers attend 5-7 courses in strategic research areas at CIMMYT headquarters each year.	• The kinds of training offered by CIMMYT continue to be valued and supported, and suitable candidates are identified for training.
2. Offer courses relevant to needs of particular countries or regions (contributes to output 1).	• Approximately 8-12 courses are held in individual countries or sponsored by CIMMYT regional programs each year. • Successful completion of phase 1 of the Asian Maize Biotechnology Network (AMBIONET), a major new research and training initiative.	• The kinds of training offered by CIMMYT continue to be valued and supported, and suitable candidates are identified for training.
3. Curriculum is reviewed and new courses and training materials are developed as needed (contributes to outputs 1 and 3).	• New headquarters-based group training on sustainable systems offered to senior researchers from national agricultural research programs. • Training materials (based on case studies) developed for sustainable systems training. • New course on advanced wheat improvement research. • New course on seed production. • Identification of NARS/international center courses to which CIMMYT could contribute through distance learning technology.	• Resources are available to develop new courses of immediate value to national research programs.
4. Host visiting scientists to work on research of mutual interest (contributes to output 2).	• Each year, CIMMYT hosts 100-200 visiting researchers.	• Suitable candidates are identified for visiting scientist fellowships and support is available.
5. Supervise and/or support research towards MSc or PhD (contributes to output 2).	• Approximately 18 theses are produced each year.	• Suitable candidates are identified and support is available.
6. Offer postdoctoral fellowships in major research efforts at CIMMYT (contributes to output 2).	• CIMMYT has from 10-15 postdoctoral fellows at any given time.	• Suitable candidates are identified and support is available.
7. Support the availability of crop management research training at the local level in Africa, Latin America, and Asia (contributes to output 3).	• Courses on-going.	• Funding available for regional and local training; effective partnerships with national programs or other organizations result in high-quality local training.
8. Offer international conferences and workshops (contributes to output 4).	• Approximately 10 international conferences and workshops are organized and hosted each year.	
9. Human resource development opportunities at CIMMYT announced to national program researchers and other potentially interested persons worldwide (contributes to outputs 1-4).	• Course announcements sent each year. • Conference and workshop announcements sent as needed. • New brochure and poster published and distributed.	
10. Maintain database of CIMMYT training alumni (contributes to outputs 1-4).	• Database made available for consultation by headquarters and outreach staff. • Data available for analysis of impact of CIMMYT's human resource development efforts.	

Duration: 2001–2003+
Collaborators: Other CGIAR centers, every national research program conducting research related to maize or wheat; NGOs; ARIs.
Costs: US$ 4.163M
System linkages: Enhancing NARSs (100%)

Project 9 (R1): Improving food security in sub-Saharan Africa

Overall goal	**Indicators**	**Assumptions and risks**
Enhance food supplies and food security in sub-Saharan Africa through the development and deployment of maize and wheat germplasm with resistance to pests and diseases and tolerance to environmental stresses.	• Greater and more sustainable food security and economic stability of maize and wheat-based farming communities across countries and regions of sub-Saharan Africa.	• Food security and increased food supplies are a priority for governments of countries in sub-Saharan Africa.
Intermediate goal	**Indicators**	**Assumptions and risks**
Enhance the development and deployment of efficient, productive, and sustainable maize and wheat technologies and systems.	• Increased development and dissemination of improved maize and wheat varieties. • Increased use of better crop production systems, especially for soil fertility maintenance and pest management, that conserve natural resources and increase productivity. • Increased understanding of the economics and impacts of improved maize and wheat farming systems in sub-Saharan Africa. • Trained researchers from NARSs who contribute to the development of sustainable maize and wheat farming systems.	• Genetic resources, and management options exist, and information can be developed and disseminated, to promote sustainable maize and wheat farming systems.
Purpose	**Indicators**	**Assumptions and risks**
CIMMYT and NARS partners in sub-Saharan Africa collaborate to develop improved maize and wheat germplasm, technologies, and systems for resource-poor farmers.	• Adoption of improved and sustainable maize and wheat cropping systems by resource-poor farmers in sub-Saharan Africa.	• See above.
Outputs	**Indicators**	**Assumptions and risks**
1. Twenty high yielding maize cultivars with resistance to biotic stresses (maize streak virus, gray leaf spot) and tolerance to abiotic stresses (drought and low N). 2. Maize germplasm development and evaluation program implemented in eastern and southern Africa. 3. More than 100 on-farm testing sites developed in collaboration with public extension agencies, NGOs, and universities to screen maize germplasm for drought and low N tolerance. 4. Maize seed provided to NGOs for production and distribution in Mozambique, Angola, Zimbabwe Ethiopia, and Malawi. 5. New wheat cultivars (2 durum, 10 bread wheat) with waterlogging adaptation developed for Ethiopia and with rust resistance for eastern Africa. 6. Soil fertility technologies identified and disseminated to 5,000 farm advisers and 40,000 farmers. 7. Policy guidelines and economic information developed on soil fertility issues. 8. Improved farming systems developed: 5 alternate crop management options, and N management strategies for maize and legumes in Malawi and Zimbabwe.	1. NARS releases of CIMMYT-derived germplasm. 2. Maize germplasm evaluation sites established across eastern and southern Africa for a range of traits. 3. On-farm testing sites established. 4. NGOs deploy improved maize seed in Mozambique, Angola, Zimbabwe, Ethiopia, and Malawi. 5. Wheat cultivars released in Ethiopia and eastern Africa. 6. Smallholder farmers adopt "best bet" technologies for improving soil fertility. 7. Information on the costs and benefits of external inputs such as seed, fertilizer, and lines available to NARS researchers. 8. Farming systems that provide at least 20% marginal rate of return above current practice adopted in Malawi and Zimbabwe. 9. Farmers use *Striga* management strategies in western Kenya. 10. Maize and wheat researchers trained in eastern and southern Africa. 11. Information on improved maize and wheat production technologies available. 12. Policy briefs and recommendations available.	• NARSs continue to invest in maize and wheat plant breeding programs.

Outputs	Indicators	Assumptions and risks
9. Five thousand farmers in western Kenya participating in *Striga* management demonstrations. 10. Trained maize and wheat researchers. 11. Impact studies showing benefits of improved maize and wheat production technologies for resource-poor farmers. 12. Policy briefs and recommendations that encourage improved maize and wheat production systems.		

Activities	Milestones 2001-2003	Assumptions and risks
1. Development of maize germplasm adapted to biotic and abiotic stresses in sub-Saharan Africa, including: 1) characterization of the region for maize stresses, using GIS, models, and crop distribution data; 2) development and evaluation of maize germplasm for resistance to *Striga* and stem borers, and tolerance to drought and low N; 3) establishment of collaborative maize breeding programs with NARSs through exchange of germplasm in regional trials, and exchange of technical information; 4) development of maize germplasm adapted to highlands; 5) development of methodology for control of *Striga* using herbicide as a seed treatment; and 6) standardization of contracts and material transfer agreements for germplasm and intellectual property issues (contributes to outputs 1-4).	• By 2003, 20 maize cultivars yielding at least 10% more than the best local checks will be released. • By 2001, acid soil test sites established in southern Africa.	
2. Deployment of maize germplasm adapted to sub-Saharan Africa, including: 1) on-farm evaluation of new maize hybrids and open-pollinated varieties (OPVs); 2) establishment, with NARSs, of seed production activities; 3) seed delivery and seed testing procedures; 4) promotion of farmer participatory methods for the improvement and deployment of maize; and 5) economic analysis of on-farm experiments (contributes to outputs 3, 4).	• By 2001, 100 on-farm test sites established for drought and low N. • Maize seed available to NGOs in Angola, Ethiopia, Malawi, Mozambique and Zimbabwe.	
3. Development and deployment of wheat germplasm adapted to sub-Saharan Africa, including: 1) shuttle breeding program between Ethiopia and CIMMYT-Mexico for durum wheat; 2) regional collaboration through the exchange of wheat germplasm and information; and 3) on-farm demonstrations of new wheat varieties utilizing farmer participatory approaches (contributes to output 5).	• By 2003, two durum wheat cultivars will be released for waterlogged conditions in Ethiopia with a yield advantage of 15%. • By 2003, two to five bread wheat cultivars will be released.	

Activities	Milestones 2001-2003	Assumptions and risks
4. Promotion of sustainable maize- and wheat-based systems in sub-Saharan Africa, involving: 1) investigating long-term trends in productivity and sustainability of cropping systems; 2) studying the dynamics of nutrients in smallholder fields, measuring organic efficiency of N inputs, and determine "best bet" soil fertility improvement technologies; 3) identifying and evaluating soil moisture conservation technologies and integrating appropriate methods with soil fertility management practices; 4) evaluating organic practices for the control of *Striga*; 5) evaluating herbicide seed treatments for *Striga* control, developing strategies to manage the development of herbicide resistance, and evaluating integrated approaches to *Striga* control; 6) developing NARSs' capacity to undertake economic evaluation, priority setting, and policy research for "best bet" management technologies; and 7) synthesizing information on "best bet" technologies and preparing management brochures, research reports, and a newsletter (contributes to outputs 6-8).	• By 2001, at least 25 soil fertility technologies for smallholder farmers will have been identified. • By 2001, at least 12 "best bet" soil fertility technologies will have been promoted with 5,000 farm advisors and 40,000 farmers. • By 2003, at least five crop management options for maize providing 20% gains in returns will be adopted. • By 2002, policy guidelines will be available for soil fertility issues including seed, fertilizer, and lime.	
5. Enhancing human resources and partnerships by: 1) identifying training opportunities for graduate students; 2) establishing links with other training institutions in the region; 3) developing training materials; 4) developing and presenting short courses for NARS scientists; 5) organizing and conducting regional maize and wheat conferences; and 6) facilitating networks on crop systems research and development (contributes to outputs 9, 10).	• By 2003, at least 5,000 farmers in western Kenya will participate in cropping systems trials to reduce the impact of *Striga*. • Courses and other training opportunities will be identified and implemented.	
6. Impact assessment and socioeconomic analysis, including 1) studies to describe, characterize, and document maize and wheat production systems; 2) studies to assess economic profitability of improved germplasm and new natural resource and crop management technologies; and 3) interactions among NARS socioeconomists through regional networking and training (contributes to outputs 11, 12).	• By 2003, publications on the impact of sustainable maize and wheat production technologies will be available.	

Duration: 2001-2003
Collaborators: Other CGIAR centers, NARSs, and ARIs.
Costs: US$ 4.113M
System linkages: Germplasm improvement (45%)
Germplasm collection (8%)
Sustainable production (30%)
Policy (6%)
Enhancing NARSs (11%)

Project 10 (R2): Meeting the accelerating demand for maize development, production, and delivery in South and Southeast Asia and in China

Overall goal	Indicators	Assumptions and risks
Enhanced productivity, profitability, and sustainability of maize-based systems in South and Southeast Asia and China through better availability and dissemination of improved open-pollinated varieties (OPVs) and hybrids of varying maturity, which maintain yield stability through improved tolerance to stresses.	• Increased maize area. • Improved maize production at national level and per unit area of land. • Greater area planted to improved maize, particularly hybrids. • Increased shift to use of single-cross hybrids in some countries.	• Adequate funding and sound government policies in favor of maize/ agricultural research and private sector initiatives.

Intermediate goal	Indicators	Assumptions and risks
Availability and adoption of high yielding, improved maize with adequate levels of tolerance/resistance to key stresses prevalent in the region.	• Increased use of cost-effective, efficient breeding methods and strategies. • Increased focus on hybrid development and stress tolerant germplasm. • Greater adoption of improved germplasm, particularly hybrids. • Support to CIMMYT germplasm distribution policy as evident from increased requests of CIMMYT international/regional maize trials. • Increased use of CIMMYT germplasm by national agricultural research systems (NARSs) and private sector. • Better understanding of constraints and processes affecting delivery of germplasm products to farmers.	• Adequate investment in research, efficient varietal testing and release policies, and balanced policies towards seed industry.

Purpose	Indicators	Assumptions and risks
Enhance cooperation among maize researchers in the region to develop germplasm products that will meet need(s) of various production environments to attain increased maize productivity, sustainability, and food security for the Asian region.	• Increased maize research collaboration, including greater participation of public and private sector research in regional networks. • CIMMYT-developed OPVs, inbreds, and inbred-based maize germplasm are increasingly used (directly and indirectly) by the public and private sectors. • Greater interest in strengthening maize research teams through in-country training. • Greater interest in securing and using germplasm from CIMMYT, particularly germplasm possessing downy mildew and other stress resistance traits. • More diverse germplasm available at farmers' level to reduce genetic vulnerability to biotic stresses. • Greater understanding of factors affecting the sustainability of maize-based systems in Nepal.	• Continuous seed industry growth and NARS ability to obtain support for some activities requiring active collaboration.

Outputs	Indicators	Assumptions and risks
1. Availability of hybrid-oriented germplasm combining tolerance/ resistance to major biotic and abiotic stresses prevalent in different maize production environments, including: 1) sources of downy mildew resistance in different seed colors and maturity groups; 2) normal and quality protein maize (QPM) inbred-based maize germplasm and strengthened inbred line development efforts through supply of early generation bulks; 3) inbreds with specific strengths as donors for resistance and for development of specific stress tolerant hybrid combinations; 4) superior	1. New and better synthetics and hybrids available with enhanced yield performance comparable to or better than commercial hybrids and other local checks (identified via global maize testing system). New releases of 30-40 tropical maize inbreds for strengthening hybrid development efforts in different maturity groups. Reliable sources of donor stocks for transferring stress resistance to other potentially useful germplasm. Stress-tolerant inbreds available. Sufficient maize inbred testers in different maturity groups and colors to strengthen breeding efforts in population improvement and to develop specific hybrid combinations. Improved sources of germplasm with improved tolerance/ resistance to several biotic and abiotic stresses.	• Sustained level of budget and staffing resources. • Collaboration with NARSs and private sector maintained or further enhanced. • Availability of good testing sites in NARSs. • Enough trained and skilled maize researchers. • Methods can be developed and adapted for use in a range of national program settings.

Outputs	Indicators	Assumptions and risks
normal and QPM hybrid combinations in different maturity groups, seed color, to fit into various maize based cropping systems; 5) better grouping of inbreds and source populations for combining ability and heterotic patterns; and 6) inbreds with tolerance or resistance to drought, downy mildew, and viruses developed through the use of molecular tools. 2. Superior general and special trait OPVs and synthetics. 3. More trained researchers in breeding, hybrid development, and biotechnology. 4. New and better tester lines in different maturity groups and seed color to aid hybrid development in NARSs. 5. Efficient and cost-effective methodologies and strategies in population and hybrid research activities. 6. Increased seed production activities by the private and public sectors, NGOs, and farmer groups; more researchers trained in seed production. 7. Better characterization of production environments and maize-based systems. 8. Better awareness of preference factors for consumption, utilization, and marketing of maize grain. 9. Greater availability of sustainability-enhancing practices for maize-based farming in Nepal.	2. Improved sources of germplasm with improved tolerance/resistance to several biotic and abiotic stresses. 3. More rapid development of improved maize germplasm for Asia. 4. Stronger hybrid development capacity in national research programs. 5. Greater availability of improved maize and source germplasm. 6. Greater availability of improved seed for farmers. 7. Improved information for researchers. 8. Improved information for researchers. 9. Sustainability-enhancing practices for maize in Nepal.	• Interest and funding available to support seed production, especially for a wider range of farmers. • Availability of skilled researchers and support for interdisciplinary collaboration.

Activities	Milestones 2001-2003	Assumptions and risks
1. Improvement of source populations for hybrid-oriented traits and stresses, particularly downy mildew (contributes to outputs 1, 5).	• Two additional cycles of selection completed in four early and four late maize populations. • Expectations for further improvement of 2.5% per cycle in yield and reduced percentage of downy mildew affected plants. • Improved inbreeding tolerance for better extraction of inbred lines. • Increased use of germplasm by several countries.	• No budgetary constraints. • Cropping cycles favorable for progeny regeneration and evaluation.
2. Formation and evaluation of synthetics and OPV products (contributes to outputs 2, 5).	• Eight to ninety synthetics formed and tested. Seed increase of six to eight superior ones for further testing in NARSs.	• Normal cropping season for growth, and no serious climatic hazards.
3. Inbred line development and evaluation (contributes to outputs 1, 4).	• Fifty to sixty inbred lines identified for release having good combining ability and hybrid performance.	
4. General and special trait pedigree populations as sources for extracting lines (contributes to outputs 1, 4, 5).	• Announcement of 80-100 S3 bulks for accelerating inbred line development efforts.	
5. Screening germplasm to abiotic (drought, low N) and biotic stresses (downy mildew, BLSB, stalk rots, leaf blights) (contributes to output 1).	• Six to ten superior inbreds identified for each stress.	• Good environment for evaluation of stress(es) under natural and/or artificial conditions.
6. Hybrid formation and evaluation (contributes to output 1).	• Identification of 12-15 superior early and late maturity hybrids for further extensive testing and release in different countries.	• Good retrieval of data from well-conducted experiments.

Activities	Milestones 2001-2003	Assumptions and risks
7. Research on maize inbred testers (contributes to outputs 1, 4).	• Identification of at least four early yellow and four late yellow inbred testers for accelerating hybrid development efforts.	• Good field experimentation and retrieval of data.
8. Strengthening regional testing of hybrids, lines, and OPVs (contributes to outputs 1, 2).	• Evaluation of 100 early and 100 late yellow pretested promising hybrids; 150 early and late yellow lines in each category; and about 100 early and late synthetics.	• Enough seed quantities for testing each trial at 25-30 locations.
9. Strengthening of QPM development and dissemination efforts (contributes to output 1).	• A few QPM hybrids released in at least three to four countries in the region.	• Need support in QPM germplasm and in collaborative efforts.
10. Supporting activities of existing regional networks (TAMNET) (contributes to output 3).	• Early and late hybrid trials constituted and tested across the region. Ten to twelve superior ones identified for further testing and release in some countries.	• Adequate seed quantities, testing sites, and cooperation of NARSs and private sector.
11. Collaborative activities with headquarters and outreach programs (contributes to outputs 1, 2).	• Identification of new sources of lines, hybrids, and OPVs.	• Availability of land and timely arrival of seed.
12. Evaluation of RILs and transfer of stresses using marker-assisted selection techniques (contributes to output 1).	• Identification of three to four lines tolerant to each stress (drought, downy mildew, and viruses).	• Functioning of biotech laboratories and availability of chemicals and appropriate germplasm.
13. Strengthening human resources in hybrid maize technology (contributes to outputs 3, 6).	• Courses given to 150-200 participants.	• In-country interest and availability of resource persons.
14. GIS tools for characterizing production environments and maize-based cropping systems in Nepal (contributes to output 7).	• A few researchers trained in GIS and production maps constructed for several mid-hill districts in Nepal.	• Availability of information and suitability of researchers for training.
15. Socioeconomic surveys to determine factors affecting preference and consumption patterns in Nepal (contributes to output 8).	• Rapid rural assessments conducted for most of the mid-hill districts.	• Accessibility of areas and surveyors' knowledge of the local language(s).
16. Nutrient management in mid-hills of Nepal (contributes to output 9).	• Determining severity of nutrient limitations for future research and formulating appropriate recommendations.	• Good and relevant testing sites for making general recommendations.
17. Optimizing productivity of maize-wheat system (contributes to output 9).	• Identification of suitable varieties, planting dates, fertilizer application for overall productivity of the system.	• Relevant sites for conduct of experiments.
18. Optimizing maize-based intercropping systems with millets and legumes (contributes to output 9).	• Suitable varieties for maize, millets, and legumes identified along with planting time and method of seeding.	• Relevant sites for conduct of experiments.
19. Seed production training courses in different countries (contributes to outputs 3, 6).	• Seed production and field trial training for 200-250 participants in six to seven countries.	• Funding availability and interest of national programs.
20. Enhancing participatory, community-based seed production practices (contributes to outputs 1, 2, 9).	• Experience gained and relevance of success determined for four to five countries.	

Duration: 2001-2003
Collaborators: CIMMYT staff (HQ and outreach), NARSs, local seed companies, multinationals, NGO groups, progressive farmer groups.
Costs: US$ 1.802M
System linkages: Germplasm improvement (50%)
Germplasm collection (10%)
Sustainable production (10%)
Policy (10%)
Enhancing NARSs (20%)

Project 11 (R3): Sustainable wheat production systems in the Indo-Gangetic Plains

Overall goal	Indicators	Assumptions and risks
Contribute to the alleviation of poverty and increased sustainability of agriculture in South Asia through the development and deployment of more efficient, productive, and sustainable technologies for the wheat production systems in this densely populated, impoverished region.	• Availability of more productive, profitable, and sustainable technologies.	• Conducive policy environment for the diffusion and adoption of more efficient, productive, and sustainable technologies.

Intermediate goal	Indicators	Assumptions and risks
Reverse downward productivity trends and, at the same time, achieve the yield increases necessary to meet growing food demand in the four distinct wheat production environments in the region, through technologies that include a combination of efficiency-enhancing crop management practices and well-adapted varieties.	• Productivity trends become stable or improve. • Increased adoption of efficiency-enhancing crop management practices and well-adapted varieties.	• Unrestricted exchange of germplasm and crop management technologies. • NARSs have sufficient research and extension capacity to develop and extend new technologies. • Availability of suitable local machinery. • Robust methods, models, and techniques for assessing long-term productivity trends.

Purpose	Indicators	Assumptions and risks
Overcome declining productivity in wheat-based systems and help South Asia meet increasing food demand, especially for the 500 million poor people living in the region.	• Availability of more productive, profitable, and sustainable technologies.	• See above.

Outputs	Indicators	Assumptions and risks
1. Characterization of the agroecology of wheat systems in South Asia. 2. Identification of improved wheat varieties suited to the eastern Subcontinent. 3. Epidemiological, crop surveillance, and crop loss assessment studies for the helminthosporium leaf blight (HLB) complex and for the rust diseases of wheat. 4. Reduced and zero tillage systems for timely planting, improved crop stands, and increased water and nutrient efficiency in irrigated rice-wheat systems. 5. Bed planting systems to increase the efficiency and productivity of irrigated wheat systems in South Asia. 6. Assessment of productivity trends in the rice-wheat systems of the Indo-Gangetic Plains. 7. Improved social science input to the Rice-Wheat Consortium. 8. Expanded scientific knowledge base of partner researchers in the region and a greater capacity for working in site-specific, multidisciplinary teams. 9. Closer links with farmers and greater farmer participation in technology generation.	1. More effective use of geographic information systems (GIS) and crop modeling techniques in the region, leading to improved targeting of promising technologies, both agronomic and germplasm-based, and improved priority setting and impact assessment. 2. Wheat productivity and farmer/consumer incomes will increase with greater availability of well-adapted cultivars for rice-wheat cropping systems. 3. Agronomic factors reducing disease losses will be identified, and germplasm with improved resistance will be available, leading to higher on-farm yields. 4. Greater adoption of reduced tillage practices, with accompanying benefits for system sustainability, profitability, productivity, and natural resource use. 5. Greater adoption of bed planting systems, with accompanying benefits for system sustainability, profitability, productivity, and natural resource use. 6. Methods, models, and techniques for assessing long-term productivity trends and socioeconomic implications; sustainability indicators for explaining declining productivity; methods for conducting long-term soil and root health studies. 7. Greater capacity of national program researchers to identify and address farm-level and policy constraints to sustained or improved productivity growth in the region. 8. Better trained and increasingly multidisciplinary research teams conducting research on sustainable systems in the region. 9. Greater integration of farmers' needs and knowledge in technology development.	• See above.

Activities	Milestones 2001-2003	Assumptions and risks
1. With readily available data, produce a preliminary characterization of the four environments using GIS; produce a second iteration as new data are collected (contributes to output 1).	• Preliminary maps and report describing the four major production regions.	• Data are available and shared by the NARSs. The quality and scale of the data are good.
2. Develop more detailed databases that include cropping systems, biotic constraints, and socioeconomic data; develop site-level characterization and databases (contributes to output 1).	• More complete databases for characterizing the region and selected research sites. • Revised and more detailed report characterizing the region and sites, including specific coverage of climatic, edaphic, and biotic constraints; cropping systems; and socioeconomic data. • Site similarity analyses for key research or production areas in South Asia and other regions.	• Cooperation of NARS scientists in compiling and sharing these data.
3. Use GIS and crop models to characterize the yield potential and yield gaps in the region; disease prevalence; potential for reduced tillage and bed planting systems; and long-term productivity trends (contributes to all project outputs).	• Maps and other GIS/modeling products.	• Appropriate data and tools are available, including models and GIS capability at the NARS level.
4. Develop methods for conducting rapid surveys using GPS and visual assessment at the scales of coverage ranging from the regional to the district level (contributes to all project outputs).	• Methods for conducting and analyzing rapid surveys using GPS units.	• Cooperation of NARSs.
5. Develop and implement a strategy for increasing use of GIS and crop models in the region (contributes to all project outputs; link with G8).	• Increased use of GIS and crop modeling in the region.	• Availability of equipment and trained scientists in the NARSs.
6. Fully implement a germplasm and information exchange network based on a common nursery (Eastern Gangetic Plains Screening Nursery) (contributes to output 2).	• Increased germplasm and information exchange. • Farmer testing and adoption of new germplasm.	• Unrestricted sharing of germplasm in the region.
7. Use additional sources of resistance to HLB and leaf rust derived from synthetic and other wild relatives of wheat (contributes to outputs 2, 3).	• Resistant germplasm available.	• Unrestricted sharing of germplasm in the region. • Suitable disease resistance available.
8. Develop and identify varieties that perform well under surface seeding and zero-till establishment techniques (contributes to output 4).	• Germplasm available.	• Suitable methods and equipment available for testing germplasm under these systems.
9. Study breeding methodologies identified in the targeted areas (contributes to output 2).	• Appropriate methodologies adopted by network members.	• Cooperation of NARSs.
10. Identify molecular markers associated with late-heat tolerance and HLB resistance (contributes to outputs 2, 3; link with G6).	• Germplasm that tolerates late heat stress and resists HLB.	• Markers are available.
11. Exchange information regarding the association of morpho-physiological traits with grain yield under late-heat stress (contributes to output 2; done in collaboration with G5).	• Preliminary physiological studies on late heat stress available as selection aid.	

Activities	Milestones 2001-2003	Assumptions and risks
12. Identify pathogen populations associated with HLB. Identify the primary source of inoculum causing HLB in the rice-wheat system, as well as the effect of alternate hosts, crop residue (especially under reduced tillage systems), or soil in the survival of *Helminthosporium* pathogens. Identify pathogen aggressiveness and virulence (contributes to output 3).	• Epidemiology of HLB complex better understood at regional level.	• NARS cooperation and availability of scientists.
13. Study the effect of soil fertility and heat stress on HLB severity. Assess yield losses from HLB in farmers' fields and evaluate the effect of rotation or other crop management practices on reducing losses. Test promising genotypes for leaf blight resistance under different tillage and crop management practices (contributes to outputs 3, 5, 7).	• Agronomic factors reducing losses identified. • Set of agronomic practices to reduce yield losses from HLB identified.	• NARS cooperation and availability of scientists to identify effects.
14. Evaluate new sources of genetic resistance and advanced germplasm for resistance to the HLB complex. Test parental lines for disease resistance and heat tolerance from targeted crosses. Use screening methods to identify germplasm with slow disease progress. Conduct a regional trial at selected key sites to monitor host-pathogen interactions. Characterize the level and type of HLB resistance in germplasm. Conduct correlation studies using material selected in Poza Rica, Mexico, with national program collaboration (contributes to outputs 2, 3).	• Germplasm with improved HLB resistance; attainable yield significantly increased.	
15. Conduct quantitative HLB and rust disease surveys using GIS/GPS and other criteria for better characterization of wheat cropping systems and crop losses (contributes to outputs 1, 3).	• Better characterization of HLB and rust prevalence in wheat systems.	
16. Collect and evaluate rust samples at the regional level. Identify pathogen aggressiveness and virulence. Identify changes in virulence through trap nurseries sown at selected key sites to monitor host-pathogen interactions at the regional level. Test parental lines to be used as new sources of resistance in targeted crosses. Use screening methods to identify germplasm with slow disease progress and durable rust resistance (contributes to outputs 2, 3).	• Germplasm developed through faster deployment of durable resistance to emerging rust races; reduced yield losses.	
17. Strengthen national capacity to monitor rust virulence and characterize rust races. Foster national capacity for race typing by training visiting scientists in the region and in CIMMYT-Mexico. Increase links between regional programs and centers of excellence on rust genetics (contributes to outputs 2, 3; links with G6, G3, G8).	• Germplasm developed through faster deployment of durable resistance to emerging rust races; reduced yield losses. • Assessment of training needs for rust monitoring in Pakistan and evaluation of natural yellow rust epidemic development in North West Frontier Province.	

Activities	Milestones 2001-2003	Assumptions and risks
18. Increase the flow of information on rust movement in the region and from neighboring countries (contributes to output 3).	• System in place for predicting changes in rust virulence.	
19. Obtain appropriate sets of differentials for leaf and yellow rusts from CIMMYT-Mexico (contributes to output 3).	• Sets of differentials available.	
20. Evaluate wheat genotypes developed by national programs in areas where new yellow rust virulence has already developed (contributes to output 3).	• Genotypes evaluated.	
21. Develop/refine recommendations on fertilizer, water, weed control, variety, disease management and other biotic controls needed for the various reduced tillage options (contributes to output 4; links with G3, G5).	• A set of recommendations on reduced tillage options for rice-wheat farmers. • Expansion of village-level, farmer participatory research to support development of technologies and recommendations.	• Cooperation of NARS scientists.
22. Collect research station and on-farm data to assess the economics and sustainability of reduced tillage practices (contributes to outputs 4, 7). Monitor the changes in soil and biotic factors in farmers' fields where the new tillage options are being adopted.	• Data collected and analyzed; results published.	• Ability to set up monitoring fields in key locations.
23. Conduct medium-term experiments to evaluate the effects of reduced tillage systems on soil and biotic factors over time. Use of dry-seeded rice establishment in these systems will be encouraged, where appropriate (contributes to outputs 4, 6).	• Data collected and analyzed; results published.	• Cooperation of NARSs.
24. Quantify short- and long-term benefits of bed planting systems (contributes to output 5, G3).	• Quantify water and nutrient use efficiency, reduced lodging, improved weed control, and yield potential expression. • Economic analyses comparing bed and conventional planting systems.	• Ability to set up monitoring fields in key locations.
25. Initiate planned, proactive methods of introducing appropriate machine prototypes to rice-wheat farming communities. Develop communications material on tillage and bed planting practices for farmers, administrators, and others (contributes to outputs 4, 5).	• Improve, develop, and disseminate videos in several languages on the Chinese hand tractor/ accessories, surface seeding, zero-tillage, and bed planting. • Farmers adopt the new tillage options.	• Cooperation of NARS scientists and extension agents.
26. Encourage local manufacture of improved prototype accessories for rice-wheat crop operations (e.g., seeding, reaping), and promote local development of appropriate bed planting equipment. Introduce prototype equipment from outside the region (contributes to outputs 4, 5).	• Identification of prototype equipment that could be manufactured locally; identification of local manufacturers. • Suitable equipment available for testing in farmers' fields.	• Local manufacturers can be encouraged to participate. • Import of equipment from overseas allowed. • Funds available for purchase.
27. Collect data from tillage experiments to verify models that provide a better understanding of the longer-term implications of reduced tillage. Collect data to verify predictive models for performance of bed-planted wheat (contributes to outputs 1 and 4-6).	• Suitable predictive models developed.	• A suitable model is available.

Activities	Milestones 2001-2003	Assumptions and risks
28. Through GIS and crop modeling, determine areas suitable for bed planting and for tillage practices (contributes to outputs 4, 5; links with F7).	• Map showing areas suitable for bed planting, reduced tillage options.	• Suitable models and data available. • GIS facilities available.
29. Scientist travel, within the region and to CIMMYT-Mexico, to improve awareness of other work on tillage and bed planting and to participate in collaborative exchange of ideas (contributes to outputs 4, 5; links to G8).	• A network of scientists motivated to conduct good research on tillage and bed planting practices in rice-wheat systems.	• Clearance of suitable scientists and approval for travel.
30. Quantify and interpret trends in rice-wheat system productivity as a basis for developing strategies to reverse negative productivity trends, by: 1) analyzing data from long-term rice-wheat experiments and agronomic monitoring projects; 2) developing district-level GIS maps of soil survey and agronomic monitoring data to be used for extrapolation of results; 3) assessing the role of nutrient mining (macro- and micronutrient deficiencies), degradation of soil physical properties, organic matter declines, and root and soil health in negative productivity trends; 4) collecting soil and climate data from experiments for modeling; 5) developing techniques for sampling the soil biological and root health properties in long-term experiments; and 6) conducting experiments on soil solarization to quantify the role of soilborne pathogens in yield declines (output 6).	• At a site-level meeting with national collaborators, plan future directions, discuss suitable methodologies, and assess local needs. • Published methodologies, models, and techniques for trend and socioeconomic analysis of long-term experiments and agronomic monitoring data. • Published report on the extent of productivity declines in the region, factors involved in these declines, and suggestions on how they can be reversed. • District-level map showing agronomic monitoring data in relation to soil survey data. • Use of an available model to explain trends in the experiments. • A set of sustainability indicators to help explain productivity declines. • A methodology for conducting soil and root health studies in long-term trials.	• Availability of funds and suitable social scientists to do this work.
31. Country-level policy studies; farm-level constraints studies (output 7; links with G7, G8, F6, F7).	• A network of social scientists organized for addressing constraints to enhancing productivity in rice-wheat systems. • Policy and macro-level constraints to enhancing and sustaining productivity growth in rice-wheat systems identified, 2000. • Farm-level constraints to technology adoption identified through multidisciplinary research in farmers' fields, 2000. • Technology and policy instruments for enhancing/sustaining rice-wheat productivity growth identified.	

Duration: 2001–2003+

Collaborators: Other CGIAR centers (3); NARSs (4) and universities (2) in the region; NGOs (1); ARIs (9); local equipment manufacturers.

Costs: US$ 1.589M

System linkages: Germplasm improvement (20%)
Germplasm collection (5%)
Sustainable production (40%)
Policy (5%)
Enhancing NARSs (30%)

Project 12 (R4): Increasing cereal food production in West Asia and North Africa (WANA)

Overall goal	Indicators	Assumptions and risks
Greater food and feed self-sufficiency and poverty alleviation in West Asia and North Africa through increased productivity and stability of wheat production systems, which will reduce pressure to cultivate marginal lands, thus protecting the environment.	• Domestic production starts to rise in WANA. • Contribution to poverty alleviation through increases in farm income brought about by higher on-farm productivity.	• Population growth will be brought under control.

Intermediate goal	Indicators	Assumptions and risks
Cereal productivity in WANA increased through the development and dissemination of improved bread wheat and durum wheat germplasm and the implementation of sustainable cropping systems.	• Modern varieties sown in regions of Turkey, Iran, and Morocco where large areas are still under unimproved cultivars. • Sustainable cropping systems begin to replace fallow/cereal systems that favor soil erosion and declining soil fertility.	• Government policies that support dissemination of improved agricultural technologies.

Purpose	Indicators	Assumptions and risks
Farmers and consumers in WANA benefit from increased crop productivity, as a result of bread and durum wheats with higher yield potential, greater stability, improved disease resistance, improved tolerance to abiotic stresses, and better end-use quality.	• Increased productivity, fewer disease epidemics, and use of wheats with improved grain quality in farmers' fields.	• Commitment of NARSs and support from local institutions.

Outputs	Indicators	Assumptions and risks
1. Winter and facultative bread and durum wheats with enhanced yield potential, yield stability, disease resistance, abiotic stress tolerance, and better end-use quality. 2. Spring bread and durum wheats with higher yield potential, resistance to biotic and abiotic stresses, and better grain quality developed for dryland conditions. 3. New breeding methodologies for stress environments developed and disseminated. 4. Better classification of WANA into mega-environments to allow identification of locations most suitable for selecting for specific traits and for shuttle breeding. 5. Integrate the use of physiological traits and molecular markers in conventional breeding. 6. Use synthetic wheats and other biotechnological products for widening genetic diversity. 7. Resistance to root rot disease and nematodes incorporated into elite wheat germplasm. 8. NARS research capabilities enhanced. 9. Improved information on consumption and production characteristics of priority to farm households.	1. Improved winter and facultative wheats available for cooperators; wheats of desirable quality available to local processing industry/households. 2. Improved spring wheats available to cooperators; wheats of desirable quality available to local processing industry/households. 3. New breeding methodologies developed and disseminated. 4. Classification of environments within WANA improved. 5. Application of marker-assisted selection (MAS) in breeding bread and durum wheats. 6. Greater genetic diversity available to breeders. 7. Spring and winter wheat varieties in WANA are more tolerant to root rot disease and nematodes; reduced losses from root rot disease and nematodes in farmers' fields. 8. Post-course employment assignment in NARSs for trainees. 9. Greater and faster acceptance of new varieties by farmers.	• See above.

Activities	Milestones 2001-2003	Assumptions and risks
1. Selection and promotion of facultative and winter wheat germplasm with tolerance to abiotic (heat, cold, drought, zinc) and biotic (yellow rust, bunts, and smuts) stresses and improved quality traits for WANA (contributes to output 1).	• Five winter and facultative bread and durum wheat cultivars with high yield potential, disease resistance, and acceptable quality identified for promotion by 2002.	• CIMMYT continues to maintain resources for activities in WANA.
2. Classify winter wheat growing environments (contributes to outputs 1, 3).	• Nurseries prepared for all major mega-environments by 2002.	
3. Use of molecular markers for improving nematode resistance in bread wheat, and for quality and drought tolerance in durum (contributes to outputs 3, 5).	• New designs and techniques used by the CIMMYT/ICARDA bread wheat and durum breeding programs, as well as by three regional NARSs, by 2003.	
4. Identify physiological traits and molecular markers for resistance to abiotic and biotic stresses and improved grain quality (contributes to outputs 3, 5).	• By 2003 four specific populations mapped for the three main environments; identification of physiological selection criteria and of QTLs for improving quality traits.	
5. Evaluation of synthetic wheats from CIMMYT's Wide Crosses Unit and development of doubled haploid populations (contributes to output 6).	• By 2003, 20 synthetic wheats evaluated and 200 doubled haploid populations developed.	
6. Breeding for biotic and abiotic stress resistance, as well as for improved grain quality for specific end-products (contributes to outputs 1, 2).	• Every year, development of 150 durum wheat and 150 bread wheat genotypes resistant to biotic and abiotic stresses, plus 70 and 50, respectively, with improved grain quality. • Every year, 8 spring bread wheat and 10 durum wheat nurseries distributed to 20-25 NARSs.	
7. Human resource capacity of regional NARSs developed through research collaboration and training in sustainable crop management practices (contributes to output 8).	• Ten NARS scientists trained over a period of five years.	
8. Elite and advanced wheats evaluated for root rot and nematode disease (contributes to output 7).	• Reaction of elite and advanced wheat lines to root rot and nematodes documented by 2003. • Five hundred advanced and elite winter wheat lines evaluated for root rot reaction every year.	
9. Investigation of factors influencing farmer varietal choice and implications for income equity, genetic resource conservation, and future breeding and research priorities.	• Implementation of farm-level surveys to collect primary data for economic analysis of household decision making behavior. • Understanding the specific requirements for wheat and wheat products and the ability of existing varieties (traditional and improved) to satisfy household requirements. • Identification of obstacles for adoption of improved varieties and analysis of implications for crop breeding research in regions of widespread landrace cultivation.	

Note: CIMMYT efforts on wheat improvement in WANA focus on breeding but do not include research on agronomy.

Duration: 2001–2003+
Collaborators: Other CGIAR centers, NARSs, NGOs, and ARIs.
Costs: US$ 1.360M
System linkages: Germplasm improvement (59%)
Germplasm collection (12%)
Sustainable production (9%)
Policy (5%)
Enhancing NARSs (24%)

Project 13 (R5): Enhancing maize and wheat production systems in Latin America and the Caribbean

Overall goal	Indicators	Assumptions and risks
Enable smallholders in Latin America's subsistence maize, wheat, and barley cropping systems to make the transition to an agriculture that generates surplus (food, income) without harming natural resources.	• Increased adoption of agricultural technologies that increase productivity and profitability while ameliorating problems with the natural resource base.	• The strength of research and extension organizations in the region is not further eroded by loss of trained staff, by unreliable funding, or other factors. • Exchange of germplasm, other technology, and information is not restricted by intellectual property legislation. • Political will exists to support regional research, extension, and/or policy initiatives.

Intermediate goal	Indicators	Assumptions and risks
Through the development, validation, promotion, and adoption of sustainable technologies, increase the sustainability, productivity, and profitability of the most important maize, wheat, and barley cropping systems for smallholders in Latin America and the Caribbean.	• See above.	• See above.

Purpose	Indicators	Assumptions and risks
Build on CIMMYT's extensive experience with regional research networks to develop, validate, and promote the adoption of sustainable, productive, and profitable maize, wheat, and barley technologies for smallholders in Latin America and the Caribbean.	• See above.	• See above.

Outputs	Indicators	Assumptions and risks
1. Production systems are characterized, major problems diagnosed, and priorities established for research. 2. Technological components for those production systems are generated and made available to partners in the region. 3. Adoption and impact of past and current R5 activities assessed. 4. Effective, efficient partnerships forged with national research systems, NGOs, the private sector, and other organizations in the region. 5. Regional partners, including national research systems, are strengthened through consulting, training, and other means. 6. With partners in the region, sustainable networking and funding strategies are developed, implemented, and managed to achieve the goals of R5.	1. Improved characterization of maize, wheat, and barley production systems (e.g., economic and social importance of system; status of natural resources; factors affecting system productivity and sustainability; factors affecting technology adoption, system competitiveness) leads to the development of workplans to address prioritized constraints. 2. Appropriate technologies (e.g., germplasm, crop management and resource conservation practices, integrated pest management strategies) for high priority regions/problems are developed; they are disseminated through a greater effort in extension and information dissemination—promotion, publications, bulletins, seminars, workshops, and other media. 3. The adoption and impact of technologies developed for increased, more stable, more profitable, and more sustainable crop production are documented; researchers and policy makers have better knowledge of factors that influence adoption and impact of such technologies. 4. More effective partnerships formed to achieve R5 objectives.	• Mechanisms for sharing data and information can be established and accessed. • Genuine commitment by organizations in the region to devise more effective means of working together.

Outputs	Indicators	Assumptions and risks
	5. Stronger research and extension capacity among regional partners achieved through traditional means, such as training and consulting, and enhanced by CIMMYT serving as an honest broker on issues related to intellectual property legislation, biotechnology, biosafety, transgenic cultivars. 6. Stable and more long-term regional research arrangements improve the likelihood of achieving the overall goal of R5.	

Activities	Milestones 2001-2003	Assumptions and risks
1. Through links with CIMMYT's Natural Resources Group and partners in the region (e.g., Zonas Competitivas), develop a better understanding of regional cropping systems and their productivity/ sustainability challenges (contributes to output 1).	• Diagnostic studies; GIS-based characterization; *ex ante* economic analyses; information on competitiveness of maize, wheat, and barley cropping.	
2. Germplasm development, testing, and promotion (contributes to output 2; links to other global and regional CIMMYT projects).	• Germplasm developed, validated, and promoted.	• Regional mechanisms for germplasm exchange and technology extension function well.
3. Improved seed production (e.g., through new links with private companies) (contributes to output 2).	• Wider availability and adoption of improved germplasm.	• Private companies have an interest in producing seed of germplasm appropriate for farmers who are not yet commercial producers.
4. Strategic agronomic research (contributes to output 2; links to other global and regional CIMMYT projects).	• Appropriate technologies available for testing.	• Regional/local mechanisms exist for testing and extending complex technology.
5. Development of component technologies (contributes to output 2).	• Suitable germplasm and agronomic practices available for evaluation and testing.	
6. Monitor and analyze long-term consequences of proposed technologies (contributes to output 2; links to F7).	• Information on long-term consequences available.	• Methods for monitoring and analyzing long-term consequences of technologies can be developed.
7. Generate and evaluate strategies for integrated pest management (contributes to output 2).	• Tested strategies available.	• Regional/local mechanisms exist for testing and extending complex technology.
8. Conduct adaptive on-farm research on technologies (contributes to output 2).	• On-farm research (conducted mostly by partner organizations) to further refine technologies developed under R5.	• Local capacity to conduct on-farm research.
9. Conduct studies of the adoption and impact of technologies developed through R5 (contributes to output 3; links with G7).	• Better knowledge—through publications, workshops, other means of sharing information—of factors affecting adoption (e.g., extension, seed production, credit, community action) available to improve the adoption and impact of productivity-enhancing, resource-conserving technologies. • Better policies facilitate extension and adoption of technologies. • By 2005, five publications on impact assessment and factors affecting adoption (focus on germplasm and management technologies). • Five policy studies conducted. • Three policy recommendations developed.	• Information can be obtained from private seed companies on their use of CIMMYT germplasm.

Activities	Milestones 2001-2003	Assumptions and risks
10. Establish effective, efficient partnerships (contributes to output 4).	• By 2002, two regional networks promote germplasm developed through R5. • Relations established with one to three NGOs to transfer technologies developed through R5. • Agreements with private companies for seed production. • Additional projects underway with advanced research institutes, farmer groups, and other CGIAR centers to achieve goals of R5.	• Funding, staffing, and legal framework enables networks to be established. • Possible to identify topics of mutual interest for collaboration with advanced research institutes, NGOs, farmer groups.
11. Local, in-country, and regional training (contributes to output 5; links with G8).	• Twenty participants each year in short courses.	• Suitable candidates available for training.
12. In-service training (contributes to output 5; links with G8).	• Fifteen participants each year in specialized in-service training courses.	• Suitable candidates available for training.
13. Academic training in universities (contributes to output 5; links with G8).	• Two researchers receive graduate training.	• Suitable candidates available for training.
14. Development of special research skills (contributes to output 5; links with G8).	• Ten field days/workshops on special topics.	
15. Project development, management, and funding (contributes to output 6).	• Stable and more long-term research arrangements.	• Governments recognize that it is in their long-term interest to devise more sustainable research arrangements for the region.

Duration: 2001–2003+
Collaborators: Other CGIAR centers, NARSs, NGOs, and ARIs.
Costs: US$ 3.622M
System linkages: Germplasm improvement (37%)
Germplasm collection (7%)
Sustainable production (32%)
Policy (5%)
Enhancing NARSs (19%)

Project 14 (R6): Increasing cereal food production in Central Asia and the Caucasus (CAC)

Overall goal	Indicators	Assumptions and risks
Poverty will be alleviated, food security enhanced, and the ecology of the region protected through increased wheat production as a result of using higher yielding wheats in conjunction with sustainable crop management practices and renovating the research infrastructure.	• An invigorated agricultural sector will produce more food and generate more income for resource-poor farmers and consumers, thereby acting as an engine of growth for the economies of CAC.	• Countries of CAC provide policy support for their agricultural sectors.

Intermediate goal	Indicators	Assumptions and risks
Wheat production in the region will increase through the development of higher yielding, disease and pest resistant varieties, and sustainable cropping systems.	• The average wheat yield per hectare in CAC will increase as a result of improved varieties and more appropriate cropping systems.	• NARSs of CAC have appropriate germplasm and related management technologies.

Purpose	Indicators	Assumptions and risks
The national wheat breeding and dissemination activities in CAC countries will be strengthened to enable NARSs to deliver new, more appropriate varieties and cropping practices to farmers.	• NARSs benefit from improved wheat germplasm and better coordinated regional testing activities. • Farmers benefit from new varieties that have improved resistance to diseases and pests.	• NARSs have the capacity to deliver improved germplasm and cropping practices to farmers.

Outputs	Indicators	Assumptions and risks
1. Superior winter and facultative wheat germplasm for CAC. 2. Superior high-latitude spring wheat germplasm targeted to northern Kazakhstan. 3. Modern, sustainable cropping practices for high latitude spring wheat and irrigated facultative/winter wheat. 4. Regional wheat improvement and genetic resources network established. 5. Strengthened NARS wheat breeding/ research capacity. 6. Economic analyses of wheat production in CAC.	1. New wheat cultivars with resistance to pests and diseases tested in farmers' fields; enhanced quality and diversity of wheat germplasm adapted to CAC; segregating populations for selecting lines adapted to rainfed and irrigated conditions. 2. New high-latitude cultivars adapted to northern Kazakhstan. 3. Cropping practices available. 4. Exchange of information among NGOs, CIMMYT, and ARIs on regional ecology, disease spectrum, and soil and plant performance. 5. An active, targeted training program operating in CAC. 6. Economic analyses available.	• Exchange of germplasm at the regional level continues. • NARSs have sufficient staff resources.

Activities	Milestones by 2002	Assumptions and risks
1. Identification and promotion of winter wheat germplasm suitable for the region, its formal testing, and promotion among farmers (contributes to output 1).	• At least 30 lines identified to be included in advanced testing by regional NARSs. • At least 15 lines included in official varietal testing in at least five countries and promoted with farmers through on-farm trials and demonstration plots.	• See above.
2. Characterization and classification of breeding environments in winter wheat and spring wheat regions (contributes to outputs 1, 2).	• Three documents describing environment and important constraints. • Winter and spring wheat breeding programs in Mexico and Turkey re-oriented based on identified constraints.	
3. Breeding suitable spring wheat germplasm and establishment of shuttle breeding program (contributes to output 2).	• Preselected segregating populations regularly sent to the region for testing under local conditions. • Shuttle breeding program established. • Best germplasm identified in region will be yield tested.	

Activities	Milestones by 2002	Assumptions and risks
4. Identification and promotion of new technologies through on-farm trials and demonstrations (contributes to outputs 1-3).	• Experiments to identify suitable technologies for promotion. • Wide-scale on-farm trials and demonstrations to promote new technologies. • Training courses on how to promote new technologies.	
5. Improved wheat breeding capacity and renovation of machinery and equipment (contributes to outputs 4, 5).	• Review of wheat breeding and development of a plan for its improvement in two countries. • Support in providing machinery, equipment, and infrastructure in two countries. • Introduction of new breeding approaches in five countries.	
6. Analyses of prospects and policies for wheat production in the region (contributes to output 6).	• Analyses of current production practices and future prospects in five countries. • Analysis of wheat production and demand, trade possibilities, and relevant policies at a regional level in CAC.	

Duration: 2001–2003+
Collaborators: Other CGIAR centers, NARSs, NGOs, and ARIs.
Costs: US$ 0.472M
System linkages: Germplasm improvement (15%)
Germplasm collection (10%)
Sustainable production (25%)
Policy (5%)
Enhancing NARSs (45%)

Project 15 (F1): Raising the yield potential of wheat

Overall goal	Indicators	Assumptions and risks
Global food security is improved thanks to increased wheat production through the use of higher yielding wheats, offsetting the need to bring new land under production, thus protecting natural ecosystems.	• Greater production of wheat grain from the same amount of cultivated land contributes to meeting growing food demand in the developing world.	• Population growth predictions and food demand projections are correct.

Intermediate goal	Indicators	Assumptions and risks
Wheat yield potential is raised over current thresholds through conventional breeding assisted by new physiology-based technologies and molecular markers.	• Greater understanding of the physiological and genetic mechanisms that determine yield in wheat. • The use of physiological selection criteria and marker-assisted selection (MAS) as tools for improving yield potential becomes more common in conventional breeding programs at CIMMYT and elsewhere.	• Molecular markers can be found for traits of interest. • Conventional breeding is not already optimal in efficiency.

Purpose	Indicators	Assumptions and risks
NARS scientists and other researchers have access to improved wheat germplasm with higher yield potential and better yield stability, as well as to more efficient methods for selecting and developing higher yielding plants.	• Farmers realize higher, more stable wheat yields through the adoption of higher yielding, more input efficient cultivars developed and released by NARSs from CIMMYT germplasm with improved yield potential.	• Public sector continues to exist.

Outputs	Indicators	Assumptions and risks
1. Technologies to facilitate breeding, such as physiological selection criteria and molecular markers, identified and developed. 2. Identification of yield-enhancing traits and genes from a broad genetic resource base. 3. Inbred lines with good male traits developed and improved for use in wheat hybrid production. 4. Higher yielding wheats that do not lodge under the weight of their large, grain-laden spikes. 5. Improved understanding of how major genes (*Vrn* and *Ppd*) interact with the environment to modify wheat phasic development.	1. These technologies are applied in wheat breeding programs worldwide at different stages of breeding. 2. Information available. 3. Improved cross pollination between female and male lines in hybrid seed production. 4. Improved understanding of the traits that contribute to lodging resistance. 5. Data on *Vrn* and *Ppd* interaction with environment available.	• NARSs will continue to have unrestricted access to germplasm and information.

Activities	Milestones 2001-2003	Assumptions and risks
1. Evaluate genetic gains associated with using physiological selection criteria such as stomatal aperture-related traits (SATs) (contributes to outputs 1, 2).	• Clarification of conditions permitting most efficient and reliable quantification of SATs within a large germplasm improvement program, by 2003.	
2. Determine the association of physiological traits such as SATs with yield in a set of historic lines with different yield potential (contributes to outputs 1, 2).	• Physiological understanding of the link between SATs and yield in CIMMYT material by 2005.	

Activities	Milestones 2001-2003	Assumptions and risks
3. Assess the potential of genetic sources of variation in physiological traits (e.g., dark green leaves, high biomass production, large spikes) that could become additional selection criteria useful in breeding for increased yield potential (contributes to outputs 1, 2).	• Traits such as leaf chlorophyll content during grainfilling, grainfilling rate, and spike size quantified on a small set of lines by 2003.	
4. Cross CIMMYT lines with other materials known to have good male traits to develop inbred lines for use in hybrid combinations (contributes to output 3).	• Lines found to be good general combiners converted to male lines with good anther extrusion and pollen production by 2002.	• Risk that male inbred lines developed by CIMMYT breeders will not produce the highest yielding hybrids.
5. Identify anatomical and biochemical traits associated with lodging resistance (contributes to output 4).	• Lodging resistance traits identified and used in selection indices by 2002.	
6. Global yield trials through CIMMYT's International Nurseries network (contributes to output 5).	• Determination of the adaptive role of the *Vrn* and *Ppd* genes across diverse wheat-growing mega-environments of the developing world by 2002.	

Duration: 2001–2003+
Collaborators: Other CGIAR centers, NARSs, NGOs, and ARIs.
Costs: US$ 0.417M
System linkages: Germplasm improvement (90%)
Germplasm collection (5%)
Enhancing NARSs (5%)

Project 16 (F2): Apomixis: Equity in access to hybrid vigor for resource-poor farmers

Overall goal	Indicators	Assumptions and risks
The development and adoption of apomictic maize that will enable resource-poor farmers to retain superior seed for sowing from one production cycle to the next, leading to reduced genetic vulnerability in farmers' fields, improved production, and greater food security.	• Reduced genetic vulnerability in farmers' fields, leading to improved production and food security. • Farmers retain superior seed from apomictic varieties.	• Policies, regulations, and/or consumer/farmer acceptance do not impede research or prevent farm-level adoption of apomictic maize. • Apomictic varieties can be developed, manipulated, and deployed successfully

Intermediate goal	Indicators	Assumptions and risks
Successful introduction and use of apomixis in a crop background, based on a clear understanding of the regulation of apomixis in wild apomicts.	• Better information on the biology of apomixis in wild apomicts compared to maize-*Tripsacum* hybrid derivatives. • Increased knowledge of factors regulating the expression of apomixis in wild apomicts and maize-*Tripsacum* hybrids. • Improved understanding of the potential for farm-level adoption and impact of apomictic maize, obtained through *ex ante* impact assessment.	• Resources and technology allow a sufficient understanding of the regulation of apomixis in wild apomicts. • Apomixis can be successfully introduced into a crop species.

Purpose	Indicators	Assumptions and risks
We will enable poor farmers to recycle seed without losing part of the beneficial traits embodied in their varieties by identifying the components of apomixis and their genetic regulation, identifying other constraints to the expression of apomixis in grain crops, and introgressing apomixis into maize.	• Same as for overall goal, above.	• See above.

Outputs	Indicators	Assumptions and risks
1. Apomictic maize. 2. Improved knowledge of the genetic control of apomixis in wild species. 3. Improved knowledge of the factors affecting apomixis expression in grain crops. 4. Identification and isolation of major genes involved in apomixis expression. 5. Improved understanding of the potential benefits and constraints related to the adoption of apomictic maize.	1. Apomictic germplasm is made available to CIMMYT breeders. 2. Information on genetic control of apomixis in wild species. 3. Information on apomixis expression in grain crops. 4. Genes are made available for expression studies through genetic engineering and reverse genetics. 5. *Ex ante* study of impact of apomictic maize conducted.	• Outcomes also depend on results of a risk assessment study examining the mechanisms conditioning geneflow between apomictic plants/species and other plants/species. • Resources and technology are available and adequate.

Activities	Milestones 2001-2003	Assumptions and risks
1. Intergeneric hybrids (contributes to all objectives).	• Production of apomictic maize-*Tripsacum* additional lines. • Molecular markers to identify *Tripsacum* chromosomes.	• See above.
2. Diplospory (contributes to all objectives).	• Progress in achieving objective.	• See above.
3. Gene-tagging (contributes to all objectives).	• Tagging and isolation of genetic components of sexual and apomictic plant reproduction.	• See above.
4. Kernel development (contributes to all objectives).	• Components of endosperm regulation in *Tripsacum*. • Components of endosperm regulation in maize.	• See above.

Duration: 2001-2003.
Collaborators: CIMMYT, Institut de Recherche pour le Développement (IRD), 3 private companies.
Costs: US$ 0.431M
System linkages: Germplasm improvement (85%)
Germplasm collection (5%)
Sustainable production (10%)

Project 17 (F3): Using genetic engineering to improve maize and wheat for developing countries

Overall goal	Indicators	Assumptions and risks
Sustainability of maize and wheat production systems is increased and the pesticide load in fragile ecosystems is reduced.	• Crop cultivars with genetic resistance to pests and pathogens produce higher and more stable yields without chemical applications for disease and pest control.	• The current debate over genetically modified products will lead to policies that will allow their use in conjunction with appropriate biosafety measures.

Intermediate goal	Indicators	Assumptions and risks
Maize and wheat productivity in developing countries is increased through the development and deployment of genetically engineered cultivars with improved pest and pathogen resistance following biosafety measures/regulations to ensure environmental safety.	• More efficient and quicker development of pest and disease resistant maize and wheat using genetic engineering as an aid to conventional breeding. • Evaluation of transgenic maize and wheat under field conditions applying biosafety measures. • Development of appropriate strategies for the deployment of transgenic maize and wheat in small farmers' fields.	• The current trend in some countries towards banning genetically modified products will not thwart the rational application of genetic engineering to plant breeding. • Appropriate regulatory frameworks for biotechnology products in targeted countries are established and implemented. • Appropriate licenses for release of third-party intellectual property can be negotiated.

Purpose	Indicators	Assumptions and risks
NARSs obtain transgenic maize and wheat germplasm with improved pest and disease resistance, as well as training in using biosafety measures when testing transgenics.	• A regulatory framework developed for deploying transgenic maize and wheat. • NARSs develop and apply appropriate biosafety measures/regulations for importing and testing transgenic materials in greenhouse and field trials. • Farmers benefit as a result of more efficient and faster introduction of beneficial traits into maize and wheat germplasm.	• See above

Outputs	Indicators	Assumptions and risks
1. Maize and wheat germplasm with enhanced resistance to major insect pests and pathogens for distribution to NARS breeders. 2. Efficient, effective transformation methods for maize and wheat. 3. Gene constructs, including stress resistance genes and high activity promoters. 4. Molecular breeding strategies for transferring transgenes to maize and wheat germplasm. 5. NARS researchers trained in the application of appropriate biosafety measures/regulations when testing transgenic materials in greenhouse and field trials. 6. Management strategies for the deployment of transgenics to optimize the effectiveness and durability of genetically engineered pest and pathogen resistance. 7. Information on the benefits of transgenics disseminated among potential users.	1. Reduction in yield losses caused by pests and pathogens in farmers' fields; reduced pesticide load in maize and wheat production systems; and more durable resistance to pests and pathogens through the combined application of conventional host plant resistance breeding and genetic engineering. 2. Methods available. 3. Constructs available. 4. Strategies under development. 5. Researchers trained in biosafety. 6. Management strategies under development. 7. Information on benefits available.	• The current trend in some countries towards banning genetically modified products will not thwart the rational application of genetic engineering to plant breeding. • Appropriate regulatory frameworks for biotechnology products in targeted countries are established and implemented. • Appropriate licenses for release of third-party intellectual property can be negotiated.

Activities	Milestones 2001-2003	Assumptions and risks
1. Develop genetically engineered maize and wheat adapted to tropical and subtropical environments, with enhanced resistance to pests and pathogens (contributes to outputs 1-3).	• Tropical maize containing genes conferring resistance to targeted insect pests by 2003. • Transgenic wheat containing fungal pathogen resistance genes developed by 2003. • Field trials of transgenic germplasm conducted in Mexico and other developing countries starting in 2001.	
2. Increase the efficiency and effectiveness of transformation systems for maize and wheat (contributes to outputs 2, 3).	• More efficient and effective maize and wheat transformation systems in place by 2002 through the enhancement or development of transformation processes.	
3. Identify and acquire genes, promoters, and enhancing sequences that confer resistance to major pests and pathogens (contributes to outputs 1, 3).	• Acquisition of genes and/or transgenic germplasm that allows their incorporation into transgenic maize and wheats.	
4. Develop and apply genetic engineering without the use of herbicide or antibiotic selectable markers (contributes to outputs 3, 6).	• By 2002 insect resistant tropical maize developed, containing only the gene of interest (i.e., no genes for resistance to herbicides or antibiotics). • By 2002 wheat resistant to fungal pathogens developed, containing only the gene of interest (i.e., no genes for resistance to herbicides or antibiotics).	
5. Develop strategies for the deployment of transgenic maize and wheat in small-scale farming systems (contributes to outputs 4-6).	• Determine the environmental soundness of insect resistant maize and the measures to be taken in order not to compromise the environment by 2005. • Transgenics distributed to NARSs for incorporation into breeding programs by 2005.	
6. Train NARS scientists in the development and deployment of transgenics (contributes to outputs 1, 5).	• NARS scientists trained in the development and deployment of transgenic plants each year.	
7. Transfer to NARSs accurate information on the advantages and potential risks of transgenics (contributes to output 7).	• Understanding of the benefits of transgenics and therefore potential acceptance of them by NARSs and farmers by 2005.	

Duration: 2001-2003+
Collaborators: Other CGIAR centers, NARSs, NGOs, ARIs (e.g., CRC for Molecular Plant Breeding-Australia), and the private sector.
Costs: US$ 1.245M
System linkages: Germplasm improvement (50%)
Sustainable production (20%)
Policy (10%)
Enhancing NARSs (20%)

Project 18 (F4): Improving human nutrition by enhancing bioavailable protein and micronutrient concentrations in maize, wheat, and triticale

Overall goal	Indicators	Assumptions and risks
The effects of poverty are alleviated by helping to reduce nutrition-related work performance deficiencies, disease, and deaths among the most vulnerable groups in the developing world.	• Improved nutrition of poor women and children, especially those whose diet is based primarily on cereals. • Reduced morbidity rates and increased growth rates among recently weaned children in areas where cereal-based diets predominate.	• Nutritional status of the poor in developing countries may be improved with cereal-based diets.

Intermediate goal	Indicators	Assumptions and risks
The nutritional quality of maize, wheat, and triticale grain is enhanced, making a balanced diet in the absence of animal protein more attainable.	• Development and improvement of maize germplasm sources with high protein content. • Enhanced levels of micronutrients in maize, wheat, and triticale genotypes. • Increased information for breeders on the existing genetic diversity for micronutrient concentration.	• Enhanced levels of micronutrients in maize, wheat, and triticale may be developed.

Purpose	Indicators	Assumptions and risks
NARSs will have access to protein- and micronutrient enhanced maize, wheat, and triticale germplasm from which to develop cultivars with high protein content and high concentrations of iron, zinc, and vitamin A.	• Resource-poor farmers have access to nutrient-enriched cereal cultivars. • Maize with improved protein quality (QPM) significantly improves the nutritional quality of the diets of people who depend on maize for sustenance.	• NARSs and others are able to disseminate nutrient-enriched cereal cultivars.

Outputs	Indicators	Assumptions and risks
1. Maize germplasm sources and inbred lines with higher levels of lysine and tryptophan (QPM maize). 2. Maize, wheat, and triticale germplasm with higher concentrations or improved availability of micronutrients that could be used as parents in breeding programs. 3. More efficient screening methods for selecting for micronutrient-enriched maize, wheat, and triticale grain. 4. Determination of the genetic relationship between nutrient concentration and agronomic performance. 5. Determination of factors affecting the adoption by resource-poor farmers of nutrient-enriched cereal cultivars and identification of key constraints. (Depends on funding availability.) 6. Relationship of micronutrient concentrations with baking and other quality traits of wheat documented.	1. Superior QPM hybrids and varieties identified and distributed to participating NARSs and NGOs. 2. Germplasm for use as parent material available. 3. Efficient transfer of improved-quality traits to elite germplasm via conventional breeding and/or molecular markers. 4. Improved information on genetic relationship between nutrient concentration and agronomic performance. 5. Factors affecting adoption better documented and understood. 6. Better information on nutrient concentrations and quality traits available.	• Improved quality trait germplasm available.

Activities	Milestones 2001-2003	Assumptions and risks
1. Identification of superior and stable QPM donor germplasm with good combining ability for quality, yield, and other traits, and introduction of QPM traits into elite normal endosperm lines and narrow-based synthetic varieties (contributes to output 1).	• Ten inbred lines with at least double the levels of lysine and tryptophan than normal endosperm maize identified by 2003.	

Activities	Milestones 2001-2003	Assumptions and risks
2. Examine genotypic variation and genotype x environment interactions for grain Fe and Zn concentrations in improved maize and wheat germplasm by 2001 (contributes to outputs 1, 2).	• Among current improved maize, wheat, and triticale germplasm, identification of germplasm with increased grain concentrations or improved bioavailability of Fe and Zn by 2001.	
3. Evaluate the genetic diversity for micronutrient concentration of Fe and Zn in landraces and wild relatives of maize, wheat, and triticale (contributes to output 3).	• Identification by 2003 of key landraces and wild relatives of maize, wheat, and triticale as sources of high Fe and Zn concentration or bioavailability.	
4. Evaluate the inheritance of increased grain Fe and Zn concentration in maize and wheat (contributes to output 3).	• Information developed by 2003 to assist breeders in incorporating increased Fe and Zn concentrations from source germplasm into adapted germplasm.	
5. Identify molecular markers associated with high concentrations of Fe and Zn in wheat and triticale, and with the opaque 2 gene in maize (contributes to outputs 1-3; depends on funding).		
6. Economic studies on adoption (contributes to output 4; depends on funding).		

Duration: 2001–2003+
Collaborators: Other CGIAR centers, NARSs, NGOs, and ARIs.
Costs: US$ 0.390M
System linkages: Germplasm improvement (80%)
Enhancing NARS (20%)

Project 19 (F5): Genetic approaches to reducing post-harvest losses

Overall goal	Indicators	Assumptions and risks
Generate benefits for subsistence farmers by developing maize and wheat germplasm resistant to storage pests and diseases.	• Grain losses reduced; grain quality improved (surveys indicate post-harvest losses of 20% in maize and 10% in wheat, and grain quality is compromised with insect debris and production of mycotoxin during storage).	• Food security depends on constant supply of quality cereals. • Grain storage systems will continue to be inadequate for resource-poor farmers.

Intermediate goals	Indicators	Assumptions and risks
Quantify the losses associated with post-harvest pests in developing countries, and develop new maize and wheat populations and lines with elevated levels of resistance to storage pests and diseases.	• Models developed and published from which good estimates of post-harvest losses can be derived by NARSs. • Maize and wheat varieties with improved grain quality. • Breeding methods that accelerate the development of resistant germplasm. • Policy makers in national programs endorse the adoption of improved storage methods for resource-poor farmers. • Extend the use of CIMMYT germplasm in the seed industry and NARSs.	• Models for predicting losses can extend to other pest species and maize growing ecologies. • Resource-poor farmers will store improved varieties with good levels of resistance to post-harvest pests. • NARSs will promote germplasm with such traits. • Grain will be acceptable for food preparation.

Purpose	Indicators	Assumptions and risks
To develop source germplasm from which the biochemical and genetic basis for resistance mechanisms can be defined and then exploited within the context of traditional and marker-assisted breeding programs.	• Resistant sources are twice as resistant as elite CIMMYT germplasm. • Biochemical resistance mechanisms extend across a wide range of accessions, varieties, and lines. • Resistance can be transferred in a cost-effective and timely manner (based on economic analysis).	• Resistance is available in CIMMYT's germplasm collections. • CIMMYT has access to ARI labs for conducting biochemical analysis. • Molecular tools are sufficiently advanced for monitoring quantitative grain quality traits.

Outputs	Indicators	Assumptions and risks
1. Maize lines resistant to *Prostephanus truncatus* and *Sitophilus zeamais* with high nutritional value and processing qualities for tropical ecologies. 2. Stress tolerant, high yielding germplasm with improved resistance to storage pests. 3. Technical report on breeding methodologies for developing maize varieties with improved resistance to post-harvest pests and diseases. 4. On-farm testing and training of farmers and NGOs to improve dissemination of resistant germplasm. 5. Insure that quality protein maize (QPM) is moderately resistant to post-harvest pests using rapid screening technologies.	1. By 2002, the CIMMYT Maize Program in collaboration with NARSs will have developed and identified (via international testing) new lines and synthetics that are twice as resistant to post-harvest pests than local germplasm. 2. By 2004, the CIMMYT Maize Program will have developed inbreds and synthetics with improved drought tolerance and resistance to post-harvest pests for mid-altitude and lowland tropical ecologies through marker-assisted selection (MAS). 3. CIMMYT publications on the topic of post-harvest resistance research available by 2002. 4. By 2002, CIMMYT has strong linkages with NGOs to deliver improved post-harvest technology to resource poor farmers. 5. Farmers adopt QPM for both nutritional quality and storage attributes.	• CIMMYT Maize Program budget is sustained. • Collaboration with ARIs is enhanced. • National programs receive priority and relationships with CIMMYT are strengthened. • CIMMYT will have access to post-harvest technologies from ARIs and the private sector for testing.

Activities	Milestones 2001-2003	Assumptions and risks
1. Form source populations for resistance to the major storage pests of maize.	• All CIMMYT lines will be characterized for resistance to ear rots and two storage pests (*S. zeamais* and *P. truncatus*).	
2. Elucidate resistance mechanism through biochemical characterization of resistant sources.	• Lines with twice the level of resistance to *S. zeamais* and *P. truncatus* will be released by 2002.	

Activities	Milestones 2001-2003	Assumptions and risks
3. Characterize the processing qualities of resistant maize germplasm in collaboration with ARIs.	• Biochemical mechanism for resistance to storage pests of maize will be elucidated and results published in refereed journals by 2002.	
4. Define the economic importance of post-harvest pests using GIS and on-farm surveys over a broad range of ecologies and storage practices.	• Report on the post-harvest losses in Mexico will be presented in 2001 and published in 2002.	
5. Evaluate the performance of new resistant lines/varieties under specific stresses (drought, low N, high density, and stem borers).	• By 2002, lines and synthetics are released with both good yield stability and storage potential.	
6. Test the interaction between alternate control tactics and kernel resistance, including biological controls, "soft-technologies" such as diatomaceous earth, storage structures, and drying technologies.	• The best storage package is identified based on ecology and cultural practices for storage.	
7. Test the potential gene products (proteins) that could be used in transformation of maize and wheat kernels for improved storage capabilities.	• Screening results using artificial diets and protein toxins published by 2002.	

Duration: 2001–2003
Collaborators: Other CGIAR centers (IITA), NARSs, and ARIs (University of Ottawa; Agriculture and Agri-Food Canada).
Costs: US$ 0.299M
System linkages: Germplasm improvement (50%)
Sustainable production (40%)
Enhancing NARSs (10%)

Project 20 (F6): Priority setting and technology forecasting for research efficiency

Overall goal	Indicators	Assumptions and risks
Increase research efficiency and impact of NARSs and CIMMYT by improving research priority setting and resource allocation.	• Improved research priority setting and resource allocation resulting from better information.	• NARSs and CIMMYT have the capacity to use information related to research priority setting and resource allocation.

Intermediate goal	Indicators	Assumptions and risks
The priority-setting capacity of CIMMYT and NARSs is strengthened by: improved technology forecasting for a range of environments; projection of the likely impacts of emerging technologies; and understanding of factors that determine the efficiency of research and extension institutions.	• Sources of productivity in research institutions identified. • Economic and social issues surrounding new research procedures involving biotechnology identified. • Policy options for productivity enhancement, environmental protection, and food security for maize and Asian upland farming systems identified.	• National policies and resources allow analysis of research priority setting and resource allocation decisions.

Purpose	Indicators	Assumptions and risks
Generate greater impact and returns to research by NARSs and CIMMYT through improved information and mechanisms for resource allocation.	• Better identification of productivity, economic, and social issues and policy options leading to increased efficiency of research resource allocation.	• See above.

Outputs	Indicators	Assumptions and risks
1 Organization of NARSs, their interaction with CIMMYT, germplasm flows, and research spillovers documented for nine countries. 2. Report on productivity of public sector plant breeding institutions in nine countries. 3. Report on the potential effect of apomixis: 1) on the economics of seed production; 2) in farmers' fields; 3) on seed products; and 4) on research. 4. Report on the economics of marker-assisted selection (MAS) versus conventional plant breeding. 5. Report on the benefits and costs of investment in *Bt* maize research. 6. Improved knowledge of Asian upland maize farming systems with emphasis on constraints to future productivity. 7. Identification of key policy options for the sustainable intensification of maize in the uplands.	1. Improved information to increase the flow of improved germplasm among participating countries. 2. By 2003, better information available on the plant breeding programs in nine countries. 3. By 2002, better information to develop a deployment strategy for apomictic maize. 4. By 2002, a set of guidelines for integrating MAS into plant breeding programs in cost-effective way. 5. By 2002, guidelines for research decision makers on integrating *Bt* resistance into maize germplasm. 6. By 2003, provide country-specific research and development plans for upland maize. 7. By 2003, establish a network of researchers and stakeholders interested in maize systems in the Asian uplands.	• Information on germplasm flows is not increasingly limited by intellectual property restrictions. • Sufficient information on seed flows and management at the farm level to understand potential effects of apomictic maize in farmers' fields.

Activities	Milestones 2001-2003	Assumptions and risks
1. Identify stakeholders engaged in technology generation and transfer in the nine participating countries (contributes to outputs 1, 2).	• Stakeholders identified (2001-2002).	
2. Collect information on factors governing national and international innovation systems and, more specifically, detailed information on the most important maize and wheat research institutions (contributes to outputs 1, 2).	• Reports for each of the collaborating countries on the organization of its national research system and interactions with CIMMYT (2003).	

Activities	Milestones 2001-2003	Assumptions and risks
3. Analyze the framework and stakeholders for national and international innovation systems and identify constraints and problems in the implementation of maize and wheat research (contributes to outputs 1, 2).	• By 2003, provide information to CIMMYT and NARS policy makers to improve the design of research policies.	
4. Analyze germplasm flows into and out of the participating countries (contributes to output 3).	• Report on maize and wheat germplasm flows for all collaborating countries (2003).	
5. Evaluate the potential impact of apomixis on the cost of maize seed production, and generate a deployment strategy for apomictic maize (contributes to output 4).	• Report on potential effect of apomixis on maize seed production costs (2003).	
6. Evaluate costs of achieving plant breeding goals through conventional breeding methods compared to MAS; develop guidelines for CIMMYT and others on integrating MAS into breeding programs (contributes to output 5).	• Report on the economics of MAS versus conventional plant breeding (2003).	
7. Evaluate costs and benefits of *Bt* maize for breeding programs and farmers in developing countries (contributes to output 6).	• By 2003, release report on the expected returns to investment in *Bt* maize research.	
8. Identify: 1) constraints to sustainable maize productivity in Asian uplands; 2) key policy issues affecting upland maize; and 3) maize research and development options (contributes to output 7).	• By 2003, have an improved understanding of Asian upland maize farming systems and the key policy issues. • By 2003, evaluate country-specific maize research and development options.	

Duration: 2001-2003
Collaborators: Other CGIAR Centers, NARSs, and ARIs.
Costs: US$ 0.430M
System linkages: Germplasm improvement (42%)
Sustainable production (17%)
Policy (29%)
Enhancing NARSs (12%)

Project 21 (F7): Learning to more effectively confront problems of resource degradation in maize and wheat systems

Overall goal	Indicators	Assumptions and risks
Foster the development of more productive and sustainable maize and wheat systems in priority areas, thereby helping to improve food security, nutritional status, and incomes.	• Increased adoption of sustainable agricultural practices in farmers' fields. • Increased awareness of the food-based system of food production for more complete human nutrition.	• Sustainable systems can be developed that are attractive to farm families given their livelihood strategies.

Intermediate goals	Indicators	Assumptions and risks
Develop an integrative, systems-oriented framework in which researchers can use the new methods developed through this project to rapidly define threats to maize and wheat system sustainability and move promptly to find and assess suitable solutions.	• Better methods are available for research on sustainable agricultural systems. • Researchers, farmers, and extension staff employ a systems perspective in developing and diffusing solutions to problems affecting the sustainability of maize and wheat systems. • Diagnostics can be developed or adopted to rapidly define any sustainability threats.	• A systems approach is important in fostering the development of more productive and sustainable agroecosystems.

Purpose	Indicators	Assumptions and risks
Build on the considerable knowledge base within CIMMYT to develop more effective methods for natural resources management research that can be used both within and outside of CIMMYT.	• Better methods and tools for research on sustainable agricultural systems are developed by: synthesizing and analyzing research results from a range of settings; conducting additional research to fill gaps in knowledge of sustainability problems; and using/developing new applications of information technology and statistical methods to solve sustainability problems. • Multidisciplinary research teams increasingly use these methods and tools to diagnose and solve problems affecting the sustainability of maize and wheat systems.	• Research teams are willing to use a systems approach and to experiment with/ learn about new methods. • Financial and human resources can be found for synthesis of past research on sustainable systems.

Outputs	Indicators	Assumptions and risks
1. Synthesis of lessons learned by CIMMYT scientists in generating more productive and sustainable maize and wheat system technologies (e.g., synthesize experience on: the performance of specific technologies, such as tillage practices and water and nutrient management practices, under defined conditions; farmer participatory research; and statistical tools). 2. Develop improved methods for research on sustainable systems. 3. Strengthen the capacity to use a systems perspective within CIMMYT and with our research partners.	1. Improved understanding of how to manage natural resources management research. Improved understanding of the consequences of resource degradation, and the effects of technical change on resource quality and system productivity, at different levels of system hierarchy. 2. Robust, effective framework for natural resources management research, acceptable to a wide range of stakeholders and partners, and featuring improved research methods. 3. Better collaboration among scientists from several disciplines and among research partners. More rapid development and dissemination of productivity-enhancing, resource-conserving practices for maize and wheat systems. Training materials and other publications distill and document research results and improved methods.	• Stable staffing and resources, within CIMMYT and across partner organizations, enable work to continue.

Activities	Milestones 2001-2003	Assumptions and risks
1. Synthesize earlier research by region (contributes to outputs 1, 2).	• Documents synthesizing research results, lessons learned, potential methodological implications for research on sustainable systems.	• Research time and resources available for retrospective studies; retrospective studies can be done without taking away from current research.
2. Develop formal databases to conserve and facilitate access to research results (contributes to outputs 1, 2).	• Sustainable Farming Systems Database (SFSD) available to researchers.	• Data ownership issues can be handled.

Activities	Milestones 2001-2003	Assumptions and risks
3. Literature reviews of state of the art on selected themes (contributes to outputs 1, 2).	• Literature reviews published.	• Research time and resources available.
4. Spatial characterization at the district level, target areas (contributes to outputs 2, 3).	• Country Almanacs developed and distributed (almanacs provide non-users of GIS with spatially referenced datasets, with querying and viewing tools). • Spatial Characterization Tool available to conduct site similarity analyses. • Criteria developed for using interpolation techniques to create surfaces, for defined conditions.	• Data available, data ownership issues can be handled.
5. Modeling and assessment of long-term consequences (e.g., of experiments on soil fertility, tillage, and other themes related to sustainable agriculture) (contributes to outputs 2, 3).	• Revised crop growth and phenology routines of CERES (Maize and Wheat). • APSIM assessed for accuracy in Makaholi and Bulawayo regions of Zimbabwe and Chitedze in Malawi. • Two bed planting experiments focusing on collecting data to develop a simulation model for water movement. • DSSAT model modified to incorporate routines for zero tillage and nitrogen cycling. • Data reporting, standards, and minimum data sets established for long-term experiments on different research themes. • Data from long-term trials on soil fertility and tillage—the latter recently initiated—assembled in a format that researchers can use, share (e.g., SFSD model-ready output). • Various datasets from long-term trials in Africa and South Asia available.	• Model capacity matches important field research questions. • Collaborators have access to hardware and software suitable for model application.
6. Scaling up and extrapolation of natural resource management technologies (contributes to outputs 2, 3).	• Data (collected with national researchers) available for GIS characterization and modeling applications (e.g., experiments to allow modeling of processes, such as soil organic matter, nitrogen efficiency, and water use). • Development of techniques for interpolating data within GIS. • Models linked with GIS and targeting of technologies. Spatial representation of likely biophysical performance of a defined technology (e.g., conservation tillage technology in Jalisco, Mexico). • Soil fertility management technologies tested widely with farmers and synthesis of results/ adoption available. • Application of APSIM to assess benefits of soil fertility management technologies across sites (see above). • Non-GIS approaches to scaling up explored and developed.	

Activities	Milestones 2001-2003	Assumptions and risks
7. Farmer participatory research (contributes to outputs 2, 3).	• Modeling linked with farmer participatory research in Zimbabwe through work with farmers to guide phrasing of questions posed to simulation models; farmers also assess model outputs. • Monitoring farmers' fields to anticipate and measure changes over time in system productivity and resource quality (e.g., soil chemistry, physics, microbiology) as a result of technical change. • Experiments in methods for farmer experimentation (in Nepal, India, Bangladesh, Mexico, Zimbabwe) documented and assessed. • Model approaches developed for collaboration between CIMMYT, national program partners, and farmers. • Continued progress of national researchers in farm monitoring, data collection, and statistical analysis.	
8. Soil fertility studies (contributes to outputs 2, 3).	• Data collected for modeling soil organic matter (see above). • Effects of technologies on soil fertility documented (see above). • Soil fertility assessment manual developed. • Tools for Soil Fertility Network, including methods manual, datasets, literature on soil tests kits.	
9. Facilitate use of the research synthesis, methods, and tools described above (contributes to outputs 2, 3).	• Documentation (e.g., training manuals, other print/electronic publications) and dissemination (e.g., databases, GIS tools) of research results/ methods. • Case studies in management of research on sustainable systems (Soil Fertility Network, Africa; Rice-Wheat Consortium, South Asia). • GxExMxP research paradigm (i.e., germplasm x environment x management x people) promoted within CIMMYT and with research partners. • Formal training courses developed, including Sustainable Systems Training. • A systems perspective is incorporated into new research projects by CIMMYT and partners.	

Duration: 2001–2003+
Collaborators: Other CGIAR centers, approximately eight NARSs, six NGOs, and seven ARIs.
Costs: US$ 0.487M
System linkages: Germplasm improvement (15%)
Sustainable production (60%)
Policy (15%)
Enhancing NARSs (10%)

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