innovations

Consultative Group on International Agricultural Research

Annual Report 2004

CGIAR

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Consultative Group on International Agricultural Research

innovations in agricultural research

the cgiar at a glance

The Consultative Group on International Agricultural Research (CGIAR) is a strategic alliance of countries, international and regional organizations, and private foundations supporting 15 international agricultural research Centers that work with national agricultural research systems and civil society organizations including the private sector. The Alliance mobilizes agricultural science to reduce poverty, foster human well-being, promote agricultural growth and protect the environment. The CGIAR generates global public goods that are available to all. In 2004, CGIAR Members contributed US$437 million — the single largest investment in generating public goods for the benefit of poor agricultural communities worldwide.

The CGIAR has five areas of focus:

- **Sustainable production** of crops, livestock, fisheries, forests and natural resources;
- **Enhancing national agricultural research systems** through joint research, policy support, training and knowledge-sharing;
- **Germplasm improvement** for priority crops, livestock, trees and fish;
- **Germplasm collection, characterization and conservation**, as the genetic resources that the CGIAR holds in public trust, and makes available to all, include some of the world's largest genebanks; and
- **Policy research** on matters that have a major impact on agriculture, food, health, the spread of new technologies, and the management and conservation of natural resources.

The CGIAR mobilizes agricultural science to reduce poverty, foster human well-being, promote agricultural growth and protect the environment

CGIAR 2004 Annual Report

innovations in agricultural research

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Ian Johnson has been Chairman of the Consultative Group on International Agricultural Research since 2000.

Message from the Chairman and Director: Nurturing Science… Nurturing People

The scope and power of science are exciting and sometimes frightening. The Consultative Group on International Agricultural Research (CGIAR) is concerned with the nurturing aspect of science: its capacity to enrich and improve the human condition. Our founders were convinced that the results of scientific breakthroughs, transferred across borders and adapted to local agro-ecological conditions in developing countries, could generate a shift from handouts to hope. We were reminded of their confidence in the nurturing power of science at the 2004 Annual General Meeting in Mexico, because that is where international agricultural research began some 6 decades ago with the launch of a joint venture that mobilized international and national scientific resources to meet local needs.

The global impact of international agricultural research and innovation has validated our founders' vision. Productivity increases fueled by science-based technologies and enabling policies have helped to increase incomes and fight the deadly combination of poverty and hunger. Science has provided, as well, the means for prudently managing natural resources. The significance of such science-based breakthroughs is widely acknowledged. The CGIAR System received the King Baudouin International Development Prize, and many other international and national awards have been bestowed on the Centers and individual scientists. The quest for breakthroughs continues, as research reports from the Centers confirm (see pages 19-34).

The quest must not cease, because new challenges abound in an ever-changing world. Science itself constantly changes. Developments in biological science have created new opportunities as well as new concerns. We are more sensitive to the ecological imprint of agriculture than ever before. The agricultural research community has broadened. Scientists in national agricultural research systems (NARS), civil society and the private sector are all involved. The scope of agriculture in developing countries has changed, including an increasing focus on high-value crops, underutilized crops and new products. And the speed of change continues to accelerate.

More will change in the future. We need to look ahead, therefore, at least to the middle of this century, because research is a long-term enterprise. The world's population, which was 3.6 billion in 1971, the founding year of the CGIAR, has grown to the current 6 billion and is expected to exceed 9 billion by 2050. The world of 2050 will be more densely populated

CGIAR Director Francisco Reifschneider (*center*) with Wu Li (*left*) and Zhu Zhiwei of the China National Rice Research Institute in Hangzhou.

Our founders shared the conviction that the results of scientific breakthroughs, transferred across borders and adapted to local agro-ecological conditions in developing countries, could generate a shift from handouts to hope

and heavily urbanized, with current trends leading to over 65 percent of the population living in urban areas. Global gross domestic product could rise from today's US$35 trillion to $135 trillion, with potential benefits to countries both rich and poor, if specific interventions are undertaken.

The demand for food could double, and demand will diversify as incomes rise and consumers spend more on better, high-value foods. The need to produce more and better food will intensify pressure on natural resources. Breakthroughs will have to create technologies for increased productivity while at the same time addressing climate change and such natural resource issues as biodiversity loss, soil degradation and water scarcity. And these technologies must be socially acceptable. Africa will require special efforts. In addition, how agriculture affects human health, nutrition and landscape management will become much more important in the years ahead.

Some important issues of today and tomorrow such as ensuring fair access to fair markets, correcting inequitable patterns of production and consumption, meeting infrastructure needs, and improving governance lie outside the direct competence of the CGIAR. There is much, however, that directly concerns us. How should we respond? The long-term nature of research requires us to have a clear set of priorities that enable us to define our goals and decide how best to meet them. The Science Council's priority-setting exercise will advise us on that need. The priorities for the next decade or so are expected to be adopted in 2005 but will evolve further in the future.

The key products of the CGIAR are knowledge, technology, policy advice, and services related to global public goods such as the genebanks. We must equip ourselves to deliver them effectively, espousing new and creative mechanisms, reoriented institutions, and vibrant partnerships to the extent that these are necessary to enhance the impact of agricultural research. The competitive system within the Challenge Programs is one such mechanism. The Scientific and Know-how Exchange Program between Centers and the private sector is another. We must explore other mechanisms for strengthening collaboration between NARS and the CGIAR Centers, as well as between farmers and researchers. Equally important is the need to have strong NARS in countries of the South and North alike.

The skills required to meet the needs of today and tomorrow are not available within one institution or alliance. Partnerships will therefore be critically important to achieving real breakthroughs. Partnerships must be genuine and have a clear purpose if they are to work. Token partnerships are worse than no partnerships at all. Effective partnerships require mutual respect, mutual commitment, mutual understanding and mutual goals. Internal as well as external partnerships are necessary.

Breakthroughs will have to create technologies for increased productivity while at the same time addressing climate change and such natural resource issues as biodiversity loss, soil degradation and water scarcity

The continuum between global public goods and private rights requires us to think more creatively and equitably about intellectual property issues, so that the strengths of all those involved from a smallholder subsistence farmer to the largest corporation may be combined to assist countries in their development efforts.

The tasks ahead are formidable and require institutions that are constantly recreating themselves to address the required changes and challenges. We feel we are ahead of the game. We have met the objectives of the initial phase of the CGIAR reform program launched in 2001. Decision-making is more nimble. Transparency, accountability, efficiency and impact are enhanced. To sharpen our emphasis on science, we created a more focused Science Council.

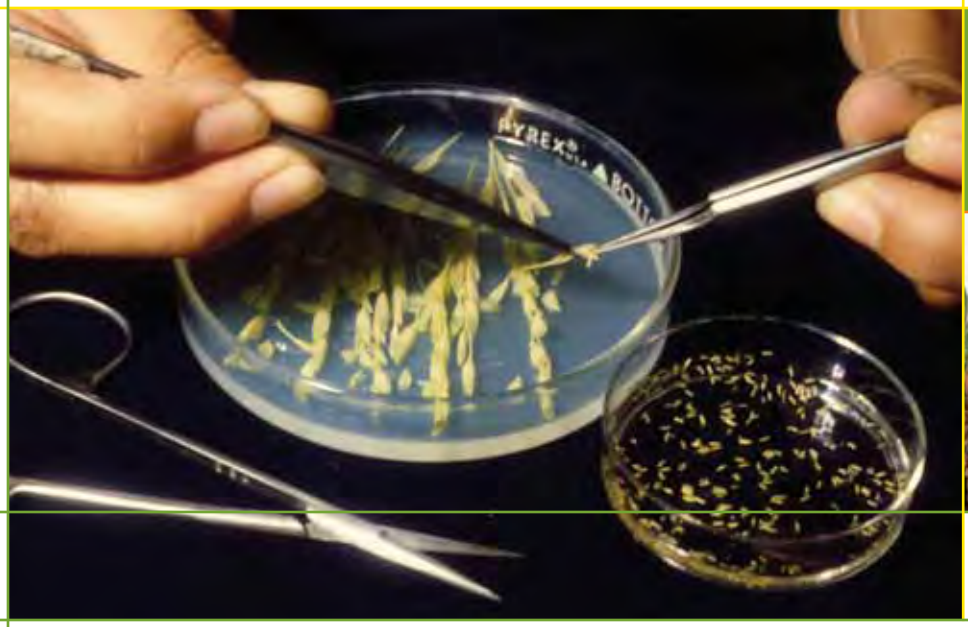
In the interests of consistency and efficiency, we adopted the first CGIAR Charter at the 2004 Annual General Meeting.

We are moving forward steadily in the next wave of reform with several initiatives. These include the development of our Performance Measurement System whose main objective is to promote high Center performance and accountability in achieving goals. We are addressing the necessary changes to enhance the alignment of Center programs and structure, beginning in sub-Saharan Africa. CGIAR Members have responded positively and generously to these changes. In 2004, Member contributions exceeded the $400 million mark for the first time.

The pieces are locking into place. The way in which the CGIAR functions is undergoing transformation. Science continues to be nurtured. Center scientists are the pivot of the work done by the CGIAR System. Their innovations offer hope to the weakest and most vulnerable in society.

Ian Johnson
CGIAR Chairman

Francisco J.B. Reifschneider
CGIAR Director



Science Council: A Productive and Challenging First Year

The Science Council of the Consultative Group on International Agricultural Research (CGIAR) began operations in January 2004. During the first year of its existence, the Council developed and pursued a strategy to help promote a more cohesive and sharply focused, high-quality research program by the 15 Future Harvest Centers of the CGIAR. The aim is to have the greatest possible impact on the alleviation of poverty and hunger and the sustainable management of natural resources. This strategy consists of seven key elements:

1. Developing a cohesive research program based on a small number of key CGIAR System priorities;
2. Developing and implementing new and improved monitoring and evaluation processes for CGIAR-supported research;
3. Strengthening medium-term plans (MTPs) and the related logical frameworks for Centers, Challenge Programs and inter-Center programs in the context of the new System priorities;
4. Combining the MTPs with annual reporting of accomplishments for better planning and performance appraisal;
5. Contributing to the regional alignment of CGIAR research;
6. Estimating the impact of CGIAR-supported research; and
7. Helping to mobilize research outside the CGIAR to fight poverty and the unsustainable management of natural resources.

The CGIAR is actively aligning its System priorities to refine a research portfolio designed to help achieve the Millennium Development Goals. On the basis of earlier work by the interim Science Council and knowledge gathered from participatory approaches, the Science Council developed a proposed research program for the CGIAR that consists of 20 **research priorities** organized within five key areas. The key criteria used to identify the priorities are the expected impact on poverty, food security, nutrition and natural-resource management; the international public goods nature of the research; and the CGIAR's comparative advantage in undertaking the research, given alternative sources of supply.

The Science Council has developed new **medium-term plan guidelines** in collaboration with the CGIAR Secretariat. These guidelines stress the importance of realistic and measurable goals and objectives along with clearly identified milestones, timelines and proposed activities. The intent of the Science Council is to pay greater attention to MTPs. The Science Council will attempt to be as constructive and helpful as possible in evaluating MTPs for the purpose of informing all stakeholders of the CGIAR and for further strengthening the research by the Future Harvest Centers.

New medium-term plan guidelines stress the importance of realistic and measurable goals and objectives along with clearly identified milestones, timelines and proposed activities

The aim is to have the greatest possible impact on the alleviation of poverty and hunger and the sustainable management of natural resources

In 2004, the Science Council was heavily involved in CGIAR efforts to improve **performance appraisal**, with particular reference to five performance-measurement elements: output, outcome, impact, quality of research staff, and quality and relevance of programs. The output and outcome indicators will be based on MTPs and System priorities.

While the Science Council is not leading CGIAR efforts to improve **programmatic alignment** at the regional level, it has contributed to the programmatic alignment for sub-Saharan Africa undertaken by CGIAR-appointed task forces.

The Science Council's Standing Panel on **Impact Assessment** continues to enhance work in that regard. A CGIAR impact website at http://impact.cgiar.org is now fully functional. Work continues on case studies on the impact of CGIAR research on natural resource management, and a number of other impact-assessment studies, including an assessment of training evaluation and impact.

Through its Standing Panel on **Mobilizing Science,** the Science Council has completed a survey of CGIAR Centers' ongoing scientific collaboration. The data are currently being analyzed. The panel has also taken the lead in developing the first of a series of biannual publications on Science for Agricultural Development. This Council-led publication will be launched at the 2005 Annual General Meeting in Morocco.

Through its Standing Panel on **Priorities and Strategies**, the Science Council undertook a number of studies to support its work on priorities and strategies during 2004, including a study on biosafety, a study on animal and fish genetic resources, an analysis of poverty mapping, and preliminary work on food safety and ethics. Analyses are also underway on the relationship between international public goods and intellectual property rights.

Through its Standing Panel on **Monitoring and Evaluation** (SPME), the Science Council undertook external reviews of two Centers as well as a CGIAR Systemwide program, and it initiated the planning for external reviews of three additional Centers to be completed in 2006. In addition, Science Council members and staff allocated a significant amount of time to a thorough assessment of the MTPs submitted by Centers and Challenge Programs. This work was led by the SPME.

The new Science Council had a productive and challenging year in 2004. In addition to completing a number of unfinished activities taken over from the interim Science Council, the Science Council initiated several new activities. The resulting time pressure on Council members and staff was significant, but I believe the results are fully commensurate with the efforts made. I look forward to another year of constructive work by the Science Council for the benefit of the CGIAR, the people we serve and the environment.

Per Pinstrup-Andersen, Chair, CGIAR Science Council

Center directors and Board chairs met in Aleppo, Syria, to shape programmatic and organizational alignments within the CGIAR.

Board Chairs and Center Directors: Collaborating for Scientific and Technological Breakthroughs

As we celebrate here some achievements in 2004 of the combined efforts of the Future Harvest Centers of the Consultative Group on International Agricultural Research (CGIAR), we also report on how the Committee of Board Chairs (CBC) and the Center Directors Committee (CDC) are reforming the way that Centers collaborate for greater scientific and technological impact.

Last year saw significant progress in highlighting to high-level policymakers and international initiatives, such as the Copenhagen Consensus and the Group of Eight (G8) Action Plan, how investing in research on water, food and the environment is key to improving the livelihoods of millions of rural poor. The G8 Action Plan called for increased efforts in Africa and increased funding for the CGIAR Challenge Program on Water and Food, the Forum for Agricultural Research in Africa, and the New Partnership for Africa's Development.

Noting the increasing need for partnerships and inter-Center collaboration to achieve the complex CGIAR mission, the CBC and CDC embarked on a program to facilitate close, effective cooperation. In May, the two Committees met in Syria to deepen their engagement with the major programmatic and global organizational alignments of the CGIAR, which had been set in motion through the work of the CGIAR Sub-Saharan Africa task forces.

In July, a follow-up retreat in Ethiopia, brought together CDC members, representatives of the CBC and senior Center staff.

Before the retreat, the group met with key African research leaders as part of a larger consultative process guiding the formulation of a vision and research agenda for sub-Saharan Africa and ensuring that the CGIAR Centers are effective partners. The retreat report, *Towards a Framework for Collective Action*, was widely circulated and discussed at the Centers, and at the Executive Council meeting in September. At the Committee meetings in Mexico, which preceded the 2004 Annual General Meeting in October, the recommendations of the retreat led the Committees to agree unanimously to form an Alliance of the Future Harvest Centers of the CGIAR and embark immediately on African reforms. The Alliance will primarily

- develop and sustain outstanding collective partnerships with external partners,
- enhance the effectiveness and efficiency of inter-Center collaboration and collective action, and
- position the Centers to manage organizational change.

To ensure that the Centers can adequately discharge their responsibility to conserve the germplasm collections held in trust for the public good under the new International Treaty on Plant Genetic Resources for

Food and Agriculture, the Centers are working together to upgrade their genebanks. Coordinated by the System-wide Genetic Resources Program, a US$13.6 million upgrade commenced in 2003 and neared completion at the end of 2004.

The Treaty came into force in June 2004 and established a new framework for the use and exchange of genetic resources — a framework of great importance to the Centers holding plant genetic materials. The CGIAR, together with the Food and Agriculture Organization of the United Nations, has launched a complementary initiative: the Global Crop Diversity Trust is an endowment being raised so that the interest on it can support in perpetuity the preservation of agricultural biodiversity. We are delighted to announce that the Trust came into being as an independent international organization on 20 October after 12 countries signed the agreement establishing it. By the end of 2004, it had raised more than $50 million.

In 2004, a review of CGIAR Centers' activities to rebuild agriculture in countries affected by conflict, natural disaster or economic transition found that our efforts had benefited over 50 countries. Too often, aid agencies rely on massive seed shipments from abroad, often of unsuitable varieties. Our scientists recommend that the focus shift toward strengthening local seed systems instead. Most rural livelihoods ultimately depend on access to the right crops to grow. Here, national genebanks provide the foundation. Since 1999, nine Centers have combined to help their national partners create a Plant Genetic Resources Network for the newly independent transitional states of Central Asia and the Caucasus. The Network's achievements by 2004 included the establishment of (and training of scientists for) nine plant genetic resource units, the collection of over 2,400 new cereal and legume accessions, and the renovation and activation of a genebank in Uzbekistan. In addition, storage facilities were undergoing renovation in Azerbaijan, Georgia, Kyrgyzstan and Tajikistan. These achievements were in addition to research on crop improvement, crop diversification and water management.

At the end of March 2004, the International Service for National Agricultural Research ceased to be an independent Center. On April 1, its program began operations at the International Livestock Research Institute, Addis Ababa campus, as a research and outreach division of the International Food Policy Research Institute. The CBC and CDC were briefed on this during their meetings the following month.

As part of their oversight functions, the Committees and the CGIAR Secretariat commissioned an external review of the Gender and Diversity Program, which was completed in 2004. During the May meetings, based on the positive results of the external review, the Committees approved the key recommendation to extend the program for another 4 years.

In 2005, we will build on the programmatic and organizational progress made in 2004. Successful collective action depends on ensuring and acknowledging the importance of involving all components of the CGIAR from the outset. The guiding principle for our work together must be: "Our allegiance is first and foremost to the poor."

A. Uzo Mokwunye, CBC Chair 2004
Kanayo F. Nwanze, CDC Chair 2004

the science we support

Decades of research had failed to isolate the the cause of pigeonpea sterility mosaic disease, and P. Lava Kumar (shown with his parents) knew the odds were stacked against him.

No-till is one of many innovations researched and, where appropriate, promoted in South Asia by R.K. Malik (left) and the Rice-Wheat Consortium for the Indo-Gangetic Plains.

Brian Perry's career in veterinary science has enlarged like a tree, seasonally adding growth rings while maintaining its original shape.

2004 CGIAR Science Awards for Excellence: Realizing Human Potential

Measles took the life of P. Lava Kumar's little sister and gave the world a virologist. "In one case in a million, the virus enters the nervous system," recalled the former undergraduate in chemistry and biology. "My sister was that one. When she died at the age of 17, I decided to work in virology."

A dozen years later, Dr. Kumar's contribution to the control of a stubborn crop virus won him the 2004 Promising Young Scientist Award from the Consultative Group on International Agricultural Research (CGIAR). Like the winners of the Outstanding Scientist Award, the King Baudouin Award and other CGIAR Science Awards (reported on page 12), Dr. Kumar exemplifies the human potential from which scientific excellence springs.

One in a Million

Having earned an MS degree in virology near his home in Andhra Pradesh, Lava Kumar planned a doctoral thesis on bluetongue, a viral infection of sheep and cattle. His professor urged him to apply instead for an opening at the International Crops Research Institute for the Semi-Arid Tropics. With British government support, he would study sterility mosaic disease, which depresses pigeonpea yields across the Indian subcontinent, costing poor farmers more than US$300 million annually. Decades of research had failed to isolate the pathogen that causes the disease, and the young researcher knew the odds were stacked against him.

"But we were sure of making progress on disease variability thanks to DNA markers developed in Scotland for the mite that transmits the virus," he explained. "This guaranteed my PhD. Simultaneously, we worked on isolating the pathogen. We were fortunate to make progress in both areas."

The breakthrough identification of the pigeonpea sterility mosaic virus occurred at the turn of the millennium. Dr. Kumar is now helping to develop resistant pigeonpea varieties, one of which has been released in southern Karnataka.

"We're still in the early days of understanding the virus," Dr. Kumar said. "The job now is to characterize its different strains and develop pigeonpea breeding stock with broad-based resistance. This can then be bred into varieties popular in the various disease hotspots."

Rooted in Science

The career of Brian Perry, the winner of the 2004 Outstanding Scientist Award, has enlarged like a tree, seasonally adding growth rings while maintaining its original shape.

"I've been lucky enough to avoid high-level administration," said Dr. Perry, who was born into farming in Norfolk, England. He has specialized in tropical veterinary medicine for more than 3 decades, since 1987 at what is now the International Livestock Research Institute (ILRI) in Kenya, integrating epidemiology and economics to inform policy on animal health. "I never left science behind. I'm involved in policy issues today, but science remains the basis of my involvement."

Dr. Perry described his work on the dynamics of tick-borne diseases as an early climax of his career. "In many settings you can use a combination of animals' natural resistance and periodic re-infections to achieve population immunity," he explained. "Define where such endemic stability exists and where it doesn't, and learn how to promote it. You may still need to control ticks, but you do so strategically, promoting endemic stability."

Dr. Perry's approach to animal-health constraints on trade is similarly strategic. "We try to promote the capacity of developing countries to meet sanitary requirements, to engage in trade in a way that is recognized as safe by developed markets keen to keep diseases out," he said. "At the same time, we must quantify the risks involved and ask if the rules are fair. Derived animal products are usually much safer than live animals. So what are the real risks of importing them?"

The newest growth ring of Dr. Perry's career is identifying three key livestock-mediated pathways out of poverty. This framework now underpins ILRI's research strategy and has influenced the Food and Agriculture Organization of the United Nations and World Bank strategies. Dr. Perry enumerated the pathways: "First, ensure animals' survival and so maintain the fundamental livestock assets of the poor. Second, make intensification with improved breeds, feed and drugs sustainable. And, finally, promote fair access to markets for safe products."

South Asian Champion

R.K. Malik was an early champion of no-till agriculture, an innovative method that protects the environment, saves farmers money and boosts their wheat yields. An agronomist at Haryana Agricultural University in India, Dr. Malik credits no-till with changing his whole approach to research.

No-till is one of many innovations researched and, where appropriate, promoted in South Asia by the Rice-Wheat Consortium for the Indo-Gangetic Plains, the recipient of the 2004 King Baudouin Award. Convened by the International Maize and Wheat Improvement Center (CIMMYT by its Spanish acronym), the Consortium links the national agricultural research systems of Bangladesh, India, Nepal and Pakistan with each other and with an array of research institutions, donors, NGOs, corporations and farmers groups.

Dr. Malik first saw no-till in 1995 at CIMMYT's headquarters near Mexico City, where he sought management solutions to an urgent weed problem. Herbicide-resistant littleseed canary grass (*Phalaris minor*) had emerged in the wheat fields of his native Haryana in 1993 and become a serious problem the following year.

The winners of the Outstanding Scientist, Promising Young Scientist and King Baudouin Awards exemplify the human potential from which scientific excellence springs

"No-till allowed farmers who grew rice and wheat in rotation to advance the planting of wheat by 15 days and so reduce the emergence of *Phalaris*," he explained. "And we hoped that input savings from no-till would allow farmers to buy the expensive new *Phalaris* herbicide once it became available."

Haryana resolved its *Phalaris* crisis, but the benefits of no-till — in particular its fuel, water and labor savings — have propelled expansion of the method to a 10th of the rice-wheat lands of the Indo-Gangetic Plains: 1.3 million hectares and counting. This despite a near consensus that farmers would not accept it.

"No-till taught me to go straight to farmers' fields rather than stay on the research farm, where it was declared a dead end," recalled Dr. Malik. "We found that farmers did accept it. For them, seeing is believing. If they see high productivity and profitability, they'll adopt it right away."

Science Awards: Partner, Support, Publish and Communicate

The awards reported on preceding pages 10-11 were among eight conferred by the CGIAR at its 2004 Annual General Meeting in Mexico City. Especially notable for scientific excellence in the global battle against hunger, poverty and environmental degradation was the WorldFish Center, which won three awards.

The **Outstanding Partnership Award** went to Community-based Fisheries Management, coordinated by WorldFish. This partnership empowers Bangladeshi communities to make well-informed decisions on the sustainable use and management of fisheries. Including 11 nongovernmental and private organizations, the partnership engages more than 23,000 households living near 113 bodies of water. New fish sanctuaries in 49 of them have, along with voluntary fishing hiatuses, helped boost fish diversity by a third. Key to success has been a collaborative approach that taps the diverse range of skills found in partnership organizations.

The **Outstanding Scientific Support Team Award** honored the people behind FishBase, the world's premier database and information system on fisheries, hosted by WorldFish. Overcoming institutional challenges to network around the globe, the FishBase support team of biologists, computer programmers and web developers expanded the system's coverage from the original goal of 250 species to 28,585 species without compromising quality, utility or accessibility. The team has produced over 50 publications, posters and presentations and conducted courses strengthening capacity in Africa, the Caribbean and the Asia-Pacific region. More than 450 publications have cited FishBase, whose website receives over 11 million hits per month.

WorldFish nominated the winner of the **Outstanding Journalism Award**, Natasha Loder, for her article *The Promise of a Blue Revolution*. Published in *The Economist* on 9 August 2003, the article reports on aquaculture's potential for sustainably meeting ever-higher global demand for fish. "Commercial agriculture has developed over centuries; large-scale commercial aquaculture is little more than 30 years old," Ms. Loder wrote. "New technologies, new breeds and newly domesticated species of fish offer great hope for the future. They promise a blue revolution in this century to match the green revolution of the last."

Winning the **Outstanding Communications Award** was the Smallholder Dairy Project, jointly implemented by the International Livestock Research Institute, Kenyan Ministry of Livestock and Fisheries Development, and Kenya Agricultural Research Institute. The project developed an innovative communication strategy that helped raise awareness among key policymakers and so reform East Africa's dairy sector (see page 29).

Finally, the **Outstanding Scientific Article Award** went to *Enhanced iron and zinc accumulation in transgenic rice with the ferritin gene*. The paper reported in the journal *Plant Science* on the critical work by the International Rice Research Institute toward developing rice able to help conquer iron-deficiency anemia, which afflicts billions of people worldwide.

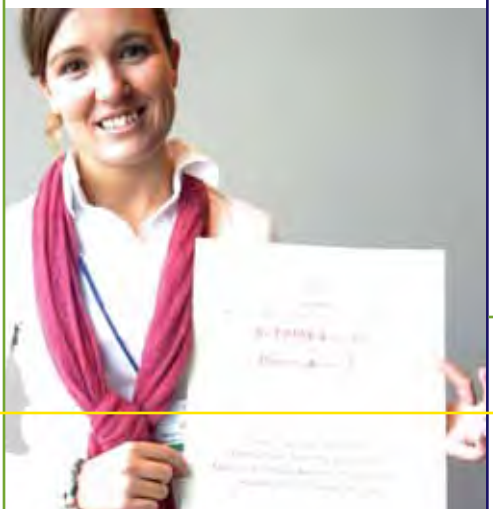
These awards celebrate scientific excellence in the global battle against hunger, poverty and environmental degradation

Anisul Islam received the Outstanding Partnership Award on behalf of Community Based Fisheries Management for its work in Bangladesh.

Christine Casal received the Outstanding Scientific Support Team Award on behalf of those who created and maintain the FishBase fisheries database and information system.

Natasha Loder received from Ian Johnson the Outstanding Journalism Award for her article *The Promise of a Blue Revolution*, which informed readers of *The Economist* about aquaculture.

Hezekiah Muriuki received from Mr. Johnson the Outstanding Communications Award on behalf of the Smallholder Dairy Project for its work guiding policy reform in East Africa.



Marta De Vasconcelos received the Outstanding Scientific Article Award as lead author of eight who report on the health-giving potential of transgenically biofortified rice.

Monty Jones, co-winner of the World Food Prize

World Recognition

The 2004 World Food Prize went to Monty Jones for pioneering the development in the mid-1990s of the new rices for Africa (NERICAs). The Sierra Leonean rice breeder was based at the time in Côte d'Ivoire at the Africa Rice Center (WARDA), a Future Harvest Center of the CGIAR. Dr. Jones shared the US$250,000 prize with Yuan Longping of China, recognized as the father of hybrid rice. The award is given annually by the Iowa-based World Food Prize Foundation (www.worldfoodprize.org).

tribute to cgiar members

The 64 Members of the Consultative Group on International Agricultural Research (CGIAR) provide the human, technical, intellectual and financial resources that enable the Future Harvest Centers of the CGIAR to bring the benefits of modern science to poor people. It is the Members' core support and dedicated commitment to science that allows Center scientists to undertake the complex and often long-term research that has the most potential to deliver real benefits with global applications. Without this valuable support, food production would be lower, environmental damage would be more severe, and malnutrition would afflict many millions more children.

Each year, in tribute to the Members, the annual report highlights two CGIAR Members' engagement with the CGIAR. This year, we describe the extensive and effective joint work program with the CGIAR maintained by the International Fund for Agricultural Development and the enduring strategic support of Mexico.

The Center stories that follow also pay tribute to the Membership while recounting the power of science to bring about positive change. Each achievement is the result of Members' support. As these few examples provide only a glimpse of the innovative work underway at the CGIAR Centers, readers are encouraged to find more information by exploring the websites, annual reports and other publications of individual CGIAR Centers.

Amplifying these research achievements is the strength of our partnerships, which embrace the public and private sectors, civil society organizations, farmers, and the scientific communities of industrialized and developing countries.

African Development Bank

Arab Fund for Economic and Social Development

Asian Development Bank

Australia

Austria

Bangladesh

Belgium

Brazil

Canada

China

Colombia

Commission of the European Community

Côte d'Ivoire

Denmark

Arab Republic of Egypt

Finland

Food and Agriculture Organization of the United Nations

Ford Foundation

France

Germany

Gulf Cooperation Council of the Arab States

India

Indonesia

Inter-American Development Bank

International Development Research Centre

International Fund for Agricultural Development

Islamic Republic of Iran

Ireland

Israel

Italy

Japan

Kellogg Foundation

Kenya

Republic of Korea

Luxembourg

Malaysia

Mexico

Morocco

Netherlands

New Zealand

Nigeria

Norway

OPEC Fund for International Development

Pakistan

Peru

Philippines

Portugal

Rockefeller Foundation

Romania

Russian Federation

South Africa

Spain

Sweden

Switzerland

Syngenta Foundation for Sustainable Agriculture

Syrian Arab Republic

Thailand

Turkey

Uganda

United Kingdom

United Nations Development Programme

United Nations Environment Programme

United States of America

World Bank

IFAD and the CGIAR: An Effective Partnership

Since its inception in 1977 as a specialized agency of the United Nations, the International Fund for Agricultural Development (IFAD) has supported agricultural research that generates pro-poor technologies with impact. Its loan and grant programs have improved the livelihoods of the rural poor by building on readily adoptable opportunities for income diversification based on increased productivity, value addition, market access and other complementary strategies. IFAD has pioneered approaches that now find wide relevance in national poverty-reduction strategies and international plans that harness science and technology to achieve the Millennium Development Goals.

IFAD's current Strategic Framework identifies equitable access to productive natural resources and technology as a strategic objective for enabling the rural poor to overcome poverty. The Fund's grant policy aims 1) to promote pro-poor research on innovative approaches and technological options to enhance field-level impact and 2) to build the pro-poor capacities of partner institutions including community-based organizations and nongovernmental organizations. These objectives have contributed to the enrichment of appropriate pro-poor technology options as well as supported reform of pro-poor research governance.

Regarding agricultural research and development led by the Consultative Group on International Agricultural Research (CGIAR), IFAD's investments have supported the generation and diffusion of sustainable agricultural technologies through participatory approaches in resource-poor and disadvantaged environments. In its first 26 years, IFAD committed US$130 million to 94 CGIAR-led research initiatives. Strong evidence exists that these investments are among the most cost-effective contributors to reducing rural poverty. They have had widespread impact on small-scale agriculture throughout the developing world and have helped focus the System's attention on priority issues of concern to the rural poor and on traditional crops and commodities grown in difficult environments. IFAD has supplemented its grant support with a strong advocacy role in CGIAR forums to address issues within IFAD's mandate.

> Investments have supported the generation and diffusion of sustainable agricultural technologies through participatory approaches in resource-poor and disadvantaged environments

IFAD is active in the CGIAR Executive Council as a Cosponsor and has contributed to the dialogue on CGIAR reform and its programmatic and organizational alignment for enhanced effectiveness and efficiency. Indeed, all of the CGIAR-led research supported by IFAD — focused as it is on developing sustainable agricultural technologies to address rural poverty — directly facilitates the CGIAR reform agenda. A promising analytical perspective is offered by the Institutional Learning and Change Initiative that IFAD supports with like-minded CGIAR partners. IFAD's support for CGIAR research has evolved towards a systems approach from an original focus on commodities and biophysical technologies appropriate to poorer farmers. This includes 1) developing methodologies for actively involving farmers in all stages of the research process within a framework that empowers rural communities, 2) environmental sustainability, 3) multi-disciplinarity,

4) multi-institutional partnerships and wide stakeholder participation, 5) gender-equity issues, and 6) technology validation and diffusion.

IFAD is the lead facilitating agency for establishing the Global Forum on Agricultural Research. It has led many initiatives that foster a progressive paradigm shift in agricultural research and development towards holistic, knowledge-intensive agriculture that mobilizes the knowledge and experience of scientists and small-scale farmers alike in innovative partnership. Furthermore, IFAD-financed loans, and the systematic linkages that research programs establish with them, provide both a platform for disseminating research outputs and the field context in which downstream research can be designed and adapted.

Rodney D. Cooke
Director
International Fund for Agricultural Development

A Diverse Harvest of Innovation

RICE research by the International Rice Research Institute in Asia developed varieties that resist diseases and pests, mature early, offer high yields, and so have had a major impact, particularly in India and Bangladesh.

WHEAT AND BARLEY research by the International Center for Agricultural Research in the Dry Areas (ICARDA) for farming systems in Central and West Asia and North Africa led to several drought-tolerant, high-yielding varieties being tested and adopted by farmers in at least 12 IFAD-supported projects.

MAIZE AND SORGHUM research by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the International Center for Tropical Agriculture (CIAT by its Spanish acronym) on the mixed cultivation of maize and sorghum with leguminous crops led to successful sorghum varietal selection and seed provision for high altitudes, as well as broadly improving low-input rainfed production by poor farmers in Latin America.

FABA BEAN research by ICARDA led to dramatic yield increases in IFAD-financed and other projects, thereby contributing to self sufficiency in Egypt.

PIGEONPEA research at ICRISAT developed ICPH8, the world's first hybrid pigeonpea successfully bred for poor farmers.

CASSAVA research at CIAT and the International Institute of Tropical Agriculture (IITA) in Latin America and Africa identified and developed elite populations of cassava varieties for smallholder farms in drier subtropical areas. These successfully addressed drought tolerance, yield and dry-matter content, disease and pest resistance, and low content of toxic cyanogenic glycosides.

POTATO research by the International Potato Center led to white potato technology successfully adopted by small-scale farmers in North and West Africa, as well as the development of innovative diffused-light storage of seed potatoes and true seed-based potato production.

PLANTAIN research under small-farm conditions by IITA, a largely uncharted field of research, developed varieties resistant to black sigatoka disease, which has been crucial for safeguarding the future of plantains within African farming systems.

AGROFORESTRY development was first attempted in the Sahelian semi-arid lowlands through farmer participatory research led by the World Agroforestry Centre. IFAD also supported IITA as it moved development of **ALLEY FARMING** technology from research stations to farms.

FARMER-MANAGED IRRIGATION SYSTEMS are an innovation first supported by IFAD for small-scale irrigation schemes.

BIOLOGICAL CONTROL research that developed effective techniques, and facilitated their large-scale application through national institutions in Africa, is perhaps IFAD's best-known success. The Fund's support led to successful biological control of the destructive **CASSAVA MEALY BUG**, which had caused considerable damage to food crops in sub-Saharan Africa. IFAD's support for research by IITA and the International Centre of Insect Physiology and Ecology on the biological control of **CROP BORERS** in sorghum, maize and cowpeas had a profound beneficial impact on the production of poor farmers in Africa.

Mexico and the CGIAR: Collaborating to Combat Poverty

Mexico possesses very important biodiversity, as within its territory are found 10 percent of the world's major plants, more than 40 percent of which are endemic. This wealth has benefited agriculture in Mexico as well as in many other countries, as Mexico is the center of genetic diversity and domestication of several crop species of great importance to mankind such as maize, beans, sweetpotato and hot peppers, among others.

In congruence with this diversity, Mexico has been active in international cooperative efforts promoting development and has participated in mechanisms and institutions addressing agriculture, fisheries and rural development issues. Good examples of this are Mexico's participation in key international forums such as the Consultative Group on International Agricultural Research (CGIAR) and its collaboration with some of the Future Harvest Centers of the CGIAR. In particular, Mexico has hosted the International Center for the Improvement of Maize and Wheat (CIMMYT) since its foundation in 1967.

Joint activities with CIMMYT have been fruitful, enlisting science to support poor maize and wheat farmers in low-income countries so that they can develop more profitable, productive and sustainable maize and wheat production systems.

A highly successful example of collaboration is quality protein maize (QPM), whose research and development owes much to the participation of the Mexican scientist Evangelina Villegas. Obtained through conventional techniques of genetic improvement, QPM is now planted in 25 countries. It contains 20-30 percent more protein than ordinary maize and as much as twice the essential amino acids. QPM is therefore a food that will help to reduce malnutrition in impoverished communities in Mexico and many other countries.

Among national objectives for rural development, some are general in scope, such as the eradication of extreme poverty, and others are more specific, focusing on technological advances to increase agricultural productivity at reduced cost, to achieve or preserve competitiveness in open markets.

According to information available in 2004, there are 25.6 million people living in rural areas of Mexico, or 24.6 percent of the total population. National Employment Survey 2004 data show the agricultural sector employing 16.4 percent of the labor force and producing 5.3 percent of the Mexican gross domestic product. Productivity in the sector is thus less than a third as high as that of the national economy as a whole. Nowadays, 71.8 percent of agricultural producers are devoted to cultivating basic grains, while 7.1 percent produce coffee and 3.7 percent grow sugarcane.

In 2002, the Secretariat of Social Development classified 36 percent of rural households as poor on the basis of their income available for basic food consumption and health and educational services. The situation is particularly delicate in zones populated by indigenous people and households headed by women

Quality protein maize is a food that will help to reduce malnutrition in impoverished communities in Mexico and many other countries

and the elderly. This shows how important it is to link, in a more efficient manner, scientific research with the productive sector — and particularly with small-scale producers — with the aim of inducing economic impact that benefits the inhabitants of rural areas.

Despite the diverse accomplishments of the CGIAR Centers, achieved jointly with their partners in national agricultural research systems, it is imperative to widen the scope of the work performed by these Centers on scientific issues linked to socioeconomic issues, and to strengthen the linkages between scientific processes and their application in the productive sector. Particular attention should be paid to linkages with the poorest producers and so allow them to achieve higher development and a better standard of living.

While it is important to be mindful of the importance of science as an instrument for development, it is nonetheless also evident that scientific issues must be addressed within the framework of state policies and programs. In this regard, combating poverty and fairly distributing income constitute fundamental tasks with potential for development. At the same time that Mexico encourages working together with the CGIAR and its Centers, it also extends important efforts in several other fields affecting rural poverty. Mexico has reinforced its institutional structure and improved the regulatory framework for the agricultural sector, for example by promulgating laws promoting sustainable rural development and biosafety.

Mexicans emphasize the importance of reducing the gap between existing natural resource management and the possibilities for improvement that science provides according to the requirements of producers, especially less favored ones. This should be done in such a way that improvements can be incorporated to create better capacity to compete in international markets as well as provide food for domestic consumption.

Victor Manuel Villalobos Arámbula
Coordinator of International Affairs,
Ministry of Agriculture, Livestock, Rural Development, Fisheries and Nutrition, Mexico

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Four varieties of New Rice for Africa specially bred for the lowlands are released.

Africa Rice Center Extends Upland Breakthrough to Lowlands

The original New Rice for Africa (NERICA) varieties were bred for the rainfed uplands of sub-Saharan Africa. Now the Africa Rice Center (WARDA) is developing new rice varieties for the African lowlands.

Called Lowland NERICAs, the new varieties are being developed in close partnership with national programs in West Africa through the West and Central Africa Rice Research and Development Network. These new varieties are poised to have an even bigger impact than upland NERICA because the lowlands, where rice is grown in bunded fields that are flooded for at least part of the growing season, offer great potential for sustainably intensifying rice farming in Africa.

However, lowland ecologies, which cover 20-50 million hectares in West Africa alone, pose a huge challenge for rice researchers because of their heterogeneity and such production constraints as lack of water control, iron toxicity, weeds, rice yellow mottle virus, African rice gall midge, stemborers and nematodes.

NERICA is a name (trademarked by WARDA in 2004) that is well known as a product whose rice varieties have been a breakthrough in the uplands. Less well known is that NERICA is also a technological process. At the heart of the technology is the successful crossing of two species of cultivated rice — *Oryza glaberrima* from Africa and *Oryza sativa* from Asia — to produce fertile plants that combine the best traits of both parents. From the Asian parent come high yields, from the African parent the ability to thrive in the challenging environments of Africa. A team of researchers from WARDA and its national partners are now successfully applying NERICA technology to breed hundreds of new varieties suitable for the various niche ecologies of the African rainfed and irrigated lowlands.

At the Africa Rice Center, Moussa Sié, a lowland-rice breeder, and Kouamé Miézan, an irrigated-rice breeder, have used the NERICA technology, in close partnership with national programs in West Africa, to cross varieties of African rice specifically selected for their resistance to lowland stresses with Asian varieties of proven popularity that are susceptible to these stresses. As with upland NERICA, breeding the new rice for African lowlands has posed a formidable scientific challenge because the two rice species evolved separately over millennia. Overcoming hybrid sterility requires careful backcrossing with *O. sativa* until fertility is restored.

Now available to farmers is a new plant type adapted to African lowland stresses. It offers a yield potential of 6-7 tons per hectare, responsiveness to nitrogen fertilizer, a growth duration of 120 days and acceptable plant height. About 60 varieties of lowland NERICA have been selected by farmers in several African countries through participatory varietal selection, an approach that successfully accelerated the dissemination of the upland NERICAs.

> The new Lowland NERICA varieties are poised to have a big impact because the lowlands offer great potential for sustainably intensifying rice farming in Africa

CIAT Probes the Roots of Higher Fertilizer Efficiency

The forage grass *Brachiaria humidicola* holds the key to more efficient crop use of nitrogen fertilizer.

International Center for Tropical Agriculture (CIAT)
Headquarters: Cali, Colombia
www.ciat.cgiar.org

Researchers at the International Center for Tropical Agriculture (CIAT by its Spanish acronym) and the Japan International Research Center for Agricultural Sciences (JIRCAS) are working to exploit a rare biochemical phenomenon that promises to make nitrogen fertilizer far more efficient to use, reducing costs, water pollution and greenhouse gas emissions.

Chemicals released from the roots of an African grass widely grown in South American pastures triggers biological nitrification inhibition (BNI). This slows the conversion of ammonium — the form of nitrogen in most commercial fertilizers — first into nitrite and then into nitrate and nitrous oxide. Nitrate is crucial to crop growth, but most of it leaches away, often to pollute streams and groundwater, and nitrous oxide is a powerful greenhouse gas. Slowing nitrification to a rate compatible with good crop growth would both reduce fertilizer needs and lessen agriculture's impact on the environment.

In 1982, a scientist at CIAT noticed that soil under the forage grass *Brachiaria humidicola* had more ammonium and less nitrate than expected. This observation eventually led CIAT and JIRCAS to collaborate on BNI research. The joint project, formally launched in January 2002, aims to get to the bottom of the BNI phenomenon and put it to practical use. The incentive to control nitrification is strong. Aside from the threat to the environment and human health, the direct cost of nitrogen loss in cereal production alone is US$16.4 billion per year.

Recent advances are promising. The JIRCAS team has perfected a test that identifies and measures the BNI trait. Joint work by JIRCAS and CIAT in 2004 showed that substances exuded from *B. humidicola* roots inhibit nitrification in soil and that the effect is long-lasting. JIRCAS has identified the chemical compound responsible for BNI in *B. humidicola* shoots and is working on identifying the compound released from the roots. JIRCAS researchers G.V. Subbarao and Osamu Ito believe that unraveling the mechanisms of BNI in *B. humidicola* will help in developing "smart" nitrogen fertilizers that do not undergo rapid nitrification.

Slowing nitrification to a rate compatible with good crop growth would both reduce fertilizer needs and lessen agriculture's impact on the environment

In 2004, the CIAT team used the JIRCAS assay to screen 10 accessions, or plant samples, of *B. humidicola* from the Center's seed bank, discovering wide genetic variability with regard to nitrification inhibition. "We found three accessions of *B. humidicola* that have significantly greater capacity for NI than the standard cultivar Tully," reported Marco Rondón, a biogeochemist with CIAT's Tropical Soil Biology and Fertility Institute. Screening of more *B. humidicola* accessions and other grass species, as well as some crops, is underway at CIAT and JIRCAS. A field study is in progress in Colombia to further verify and characterize the BNI phenomenon.

Apart from conventional breeding to enhance BNI, researchers hope to isolate, sequence and clone BNI genes from *B. humidicola* and introduce them into field crops through genetic transformation. Building "fuel efficiency" right into the very genomes of major crops has enormous potential to cut both production costs and agriculture's share of greenhouse gas emissions and nitrate pollution of water.

The popular "fruit book" integrates traditional knowledge with research generated by 90 Brazilian scientists.

CIFOR Composes An Extraordinary Poem To Amazonia

Rural communities complain that scientific research is an extractive enterprise like logging and mining. Researchers take data but rarely share their findings with local folk. In the Brazilian Amazon, Patricia Shanley and Gabriel Medina, scientists from the Center for International Forestry Research (CIFOR), are determined that the results of their research on forest fruit trees and medicinal plants be returned to forest communities and so guide vital livelihood decisions.

After working with villagers for more than a decade, Dr. Shanley designed a 300-page book that can be "read" without letters. *Frutiferas e Plantas Úteis na Vida Amazônica* (Fruit Trees and Useful Plants in the Lives of Amazonians) integrates traditional knowledge with research generated by 90 Brazilian scientists. The "fruit book," as it is known, helps forest dwellers understand the real value of their forests, so they know which trees to sell and which to protect.

One illustration shows loggers offering villagers 2 reais (less than US$1) for an entire *bacuri* tree, the value of just a few *bacuri* fruit. Another shows a villager receiving $15 dollars for a mahogany tree as a cigar-smoking executive pays $10,000 for a boardroom table and chairs set. Ecology, nutrition and forest management are presented through pictures, farmers' stories, jokes, music and lore.

The question that prompted the research behind the book was posed by villagers along the logging frontier: "Is our forest worth more for its fruit, fiber, medicines and game, or for its timber?" Dr. Shanley discovered that the answer was elusive, as forest species critical to local livelihoods had received scant research attention. Tropical fruit production is highly variable, and little was known about the market or subsistence value of forest products. Over a 5-year period, hunters and the research team mapped fruit tree species over 3,000 hectares. Three communities weighed all of the fruit, fiber, game animals and medicines they consumed in 1993-94 and again after eight logging episodes in 2003-04.

With the book incorporated into an adult literacy initiative, villagers now learn better negotiation skills and improved forest management as they learn to read

"The book has helped us to recognize the value of our fruit, fiber and medicinal plants," commented Bene, an Amazonian hunter from the Capim River, at a book launch in December 2004. "We no longer sell trees to loggers for nothing."

Brazil's Ministries of Environment, Health, Culture and Education support the book's dissemination, as does *Fome Zero*, the presidential anti-hunger campaign. The Land Titling Bureau has incorporated the book into its PRONERA adult literacy initiative, so villagers now learn negotiation skills and improved forest management as they learn to read. By the end of 2004, over 1,000 literacy trainers knew how to use the book to reach an initial target of 14,000 adults. Nationally, the fruit book is helping to refocus forestry training toward livelihoods and non-timber forest products.

In the preface, Brazilian Minister of the Environment Marina Silva states: "This book is an extraordinary poem to Amazonia…providing information which is fundamental to realizing the dream of socially and environmentally just development." Beyond Amazonia, the book shows how science can empower rural people in the struggle against hunger and poverty.

If left unchecked, stem rust caused by *Puccinia graminis* could cause the loss of wheat worth US$9 billion or more.

CIMMYT

International Maize and Wheat Improvement Center (CIMMYT)
Headquarters: Mexico City, Mexico
www.cimmyt.org

CIMMYT Rallies to Halt Resurgence Of Stem Rust in Wheat

A new and virulent strain of stem rust from eastern Africa poses a great threat to world wheat production, according to Nobel Laureate Norman Borlaug. "If left unchecked," warned Dr. Borlaug, "it could cause the loss of at least 60 million tons of grain worldwide, worth US$9 billion or more, and threaten the food security and livelihoods of millions of smallholder farmers who cannot afford fungicides to combat the disease."

To mobilize scientific and financial resources to hold the new threat at bay, the International Maize and Wheat Improvement Center (CIMMYT by its Spanish acronym) has launched the Global Rust Initiative. "The key aim is to provide farmers with new, high-yielding varieties that resist this new race of stem rust, as well as other types of rust diseases," explained John Dodds, CIMMYT's deputy director general of research. "Participants will also help to re-establish a global warning and tracking system, revitalize international germplasm testing and training networks, and build broad, durable partnerships."

Scientific evidence, particularly the movement of yellow rust from the eastern African highlands to Asia during 1986-98, suggests that wheat lands in South Asia constitute a common epidemiologic zone connected to eastern Africa. Tests show that the new rust strain attacks many wheat varieties popular in these and neighboring regions. Prevailing winds could carry spores to Central and South Asia and eventually around the world, ravaging the harvests of hundreds of millions of farmers.

Dr. Dodds said the International Center for Agricultural Research in the Dry Areas will play a key role in the new initiative. Other partners will include national agricultural research systems, advanced research institutes, private companies, and non-governmental and civil society organizations. The Rockefeller Foundation, the Agricultural Research Service of the US Department of Agriculture, and the Sasakawa Africa Association have provided emergency support to CIMMYT to commence stem rust screening of global wheat collections in eastern Africa, in collaboration with the Kenya Agricultural Research Institute and the Ethiopian Agricultural Research Organization. Other donors and partners are discussing intermediate-term responses.

Wheat is grown on more than 200 million hectares worldwide and is a source of food and livelihoods for hundreds of millions in developing countries. Until the advent of science-based agriculture, world wheat harvests were held hostage by rapidly evolving fungal pathogens, among the most damaging of which were rusts. Modern breeding combined with the free international exchange of experimental wheat lines resulted in the development and wide distribution of wheat varieties able to resist rust pathogens for several decades. One result was that stem rust began to be seen as less threatening, and many wheat-breeding programs in developing countries stopped screening for rust resistance.

"The current crisis is a wake-up call about the continuing and potentially devastating impact that rust pathogens can have on susceptible cereals, especially for a staple food like wheat," Dr. Borlaug cautioned. "Plant breeders and pathologists still have time to screen for resistant genotypes and to get the varieties into farmers' fields, but there is no room for complacency."

We still have time to screen for rust-resistant genotypes and to get the wheat varieties into farmers' fields, but there is no room for complacency

All participating farmers increased the area planted to improved sweetpotato varieties in the project's second year.

CIP Makes Sweetpotato Grown for Pigs Sweet Indeed

A simple but sophisticated technology is having a significant impact on livelihoods in China and Southeast Asia, where pork is a key source of protein. Most of the pork comes from poor backyard pig producers, many of whom grow sweetpotato for feed.

Pigs convert feed into meat very efficiently, and they like sweetpotato. However, pig nutrition on small farms is generally poor, and postharvest crop losses are high because the roots and vines store poorly. To make the sweetpotato edible, farmers must chop and boil the vines and leaves for 2 hours, which is labor intensive and time consuming, especially burdening women. It also uses precious fuel.

A technology developed by the International Potato Center (CIP by its Spanish acronym), by which pig feed is made from sweetpotato using ensilaging and local feed supplements, effectively increases productivity, according to research in Vietnam and Papua Province, Indonesia. CIP and its national agricultural research partners bred new varieties of sweetpotato that produce more dry matter and prolific vines and roots, resulting in at least 25 percent improvement in root yield. All farmers who planted an improved variety increased the area planted to it in the second year and established multiplication plots to ensure that they had enough planting material.

Farmers easily learn the simple ensilaging system and how to use feed supplements. As silage, the roots, vines and foliage can be stored as high-quality feed for up to 6 months. They need not be cooked, and the same amount of feed produces more meat. "Significant gains in productivity in smallholder pig production are possible with a modest investment in research and extension," observed Keith Fuglie, leader of CIP's Impact Enhancement Division.

This highly effective technology is a key element in work on sweetpotato-based pig-production systems in the uplands of China's Sichuan Province. Scientists from the Sichuan Animal Science Academy put improved sweetpotato varieties, developed by the Sichuan Academy of Agricultural Sciences with CIP, high on the list of options they offer farmers — together with CIP ensiling technology. This initiative of the International Livestock Research Institute is underway in Tianle and five other villages about 170 kilometers northeast of Chengdu.

Most farmers in Tianle are very poor, with an average per capita income of less than US$100 per year. Livestock contributes up to 80 percent of total farm income. The new technology has dramatically improved their prospects of a better life. "Last year I produced enough roots of the new variety not only to ensile and reserve seeds for this year's planting," said Liang Dongshen, one of the farmers, "but also to give 100 kilograms as presents to my friends and even to sell 500 kilograms."

This means that more pigs can be raised. "Last year Tianle village sold 300 pigs," reported village leader Liang Bo. "This year we sold 380 in the first quarter alone."

The technology is being extended in China with support from the Asian Development Bank, and to eastern Indonesia with help from the Australian Centre for International Agricultural Research.

Pig feed made from sweetpotato using silage and local feed supplements effectively increases the productivity of pig farmers in China and Southeast Asia

Research to improve olive cultivation and water harvesting makes marginal environments more productive.

International Center for Agricultural Research in the Dry Areas (ICARDA)
Headquarters, Aleppo, Syrian Arab Republic
www.icarda.org

ICARDA Conserves Water and Soil Under Olive Trees

The semi-arid areas of Central and West Asia and North Africa (CWANA) are harsh environments, often sloping and rocky with poor, shallow soils. Olive trees (*Olea europaea* L.) are well suited to these marginal environments. They have been grown in the region for over 5,000 years and remain of major importance to the livelihoods of rural communities.

Although 36 percent of the world olive area is in CWANA, the region contributes only 16 percent to global olive production. By contrast, southern Europe accounts for 72 percent of production, derived from only 55 percent of the area. Harsh climatic conditions and poor management practices explain the low productivity in CWANA. The International Center for Agricultural Research in the Dry Areas (ICARDA) is working with Syrian farmers and national agricultural research partners on simple techniques for managing soil and water in olive groves in marginal areas. ICARDA uses two complimentary approaches: farmer-participatory research and controlled experiments.

The Khanasser Valley in northwestern Syria has poor soils and annual rainfall of only 220 millimeters. The lower slopes of degraded hills are traditionally used for extensive grazing or barley cultivation. To secure their household needs for olive oil, farmers have converted this marginal land to olive orchards, despite it being too dry for the crop. Working with farmers, ICARDA is evaluating a range of Syrian olive cultivars for adaptation to this area, as well as techniques for harvesting water and reducing runoff, such as furrow-enhanced, V-shaped microcatchments to capture runoff. In stony or sloping groves, where tillage and machine operations are impossible, permanent water-harvesting structures are under consideration. ICARDA's research in 2004 showed that the structures can contribute 100 liters of water per tree each year, cutting summer irrigation costs by 10 percent.

> Olives have grown in semi-arid areas of Asia and Africa for over 5,000 years, but the harsh climate and poor management practices keep productivity low

Afrin, also in northwestern Syria, is a hilly area with relatively good rainfall totaling 500-600 millimeters per year. Olives are the primary source of income. Farmers plow up and down sloping land because plowing along the contour is not possible with a tractor. This causes soil erosion, which is aggravated by the sparse canopy cover resulting from the farmers' severe tree pruning. To address this land-degradation problem, ICARDA, in cooperation with farmer groups, is implementing an integrated land-management research program.

A participatory experiment with Afrin olive farmers compares the effect of moderate annual pruning with severe pruning every second year. Moderate pruning maintains good canopy cover and ensures satisfactory olive production. Reducing tillage and leaving natural grass strips to grow along the contours between the trees decrease rainwater runoff. Also, intercropping with vetch improves soil fertility, reduces soil erosion and provides feed for livestock.

Farmers and researchers are working closely to facilitate quick adoption of the recommended practices. This research is helping to improve olive production in marginal dry areas of Syria and the livelihoods of the rural poor. As northwestern Syria is similar to other dry, marginal environments, ICARDA plans to scale out the research results to other areas of CWANA.

Hagaz, the project's first pearl millet variety resistant to downy mildew, outyields a traditional Eritrean cultivar.

ICRISAT Millet Partnership Is the Pearl of Eritrea

Pearl millet (*Pennisetum glaucum*) is grown in Eritrea on more than 80,000 hectares, mainly by small farmers in the lowlands and foothills. It is the second most important cereal in the country after sorghum. Farmers grow traditional landraces, which have many preferred traits but provide modest yields and, in general, are susceptibile to downy mildew.

Downy mildew disease, caused by the fungus *Sclerospora graminicola*, is a major production constraint for most of the semi-arid tropics. The disease is widely distributed in Eritrea. In 1999 and 2000, 30-50 percent of the plants in most pearl millet areas surveyed in the Anseba and Gash Barka regions were infected with downy mildew. The disease causes major yield reductions, estimated to be as high as 30 percent in Anseba in 2000.

The Eritrean pearl millet variety Hagaz, released in 2004, is the first product of a type of partnership that the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) sees as a model for its future work in Africa. The partnership links ICRISAT with the Eritrean National Agricultural Research Institute. It began in 1998 when Negusse Abraha, an Eritrean millet breeder, did his dissertation research at ICRISAT for his masters degree in plant breeding.

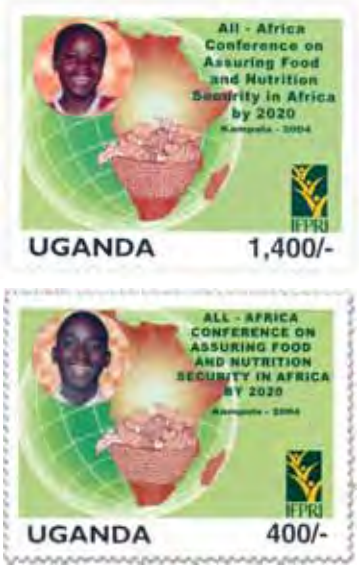
When Mr. Negusse returned to Eritrea, ICRISAT helped him to develop a breeding program designed to improve Eritrean landraces and to breed new varieties. The Eritrean Millet Program made crosses between selected local landraces, which were locally adapted and valued by farmers, and ICRISAT varieties and populations that provided disease resistance and a higher yield potential. The Program has enjoyed generous funding initially from the Danish International Development Agency and, since 2002, from the Syngenta Foundation for Sustainable Agriculture, including funding of technical support activities by ICRISAT such as visits to the breeding nurseries and on-farm trials, equipment, supplies and advice.

Hagaz, bred from a cross between the Eritrean landrace variety Tokroray and the ICRISAT variety ICMV221, was identified from the first set of 25 population crosses, made in 2000, for its superior grain yield and downy mildew resistance. It has an infection rate of 1 percent, against 38 percent for Tokroray. In on-farm trials conducted in 2001 and 2002, the cumulative mean grain yield across all environments at 41 sites in Anseba and Gash Barka showed that Hagaz was clearly superior to the local landrace.

The development of Hagaz, which is named after the location where the crosses were first made, has proceeded in parallel with the expansion of the Eritrean Millet Program itself. Beginning with plant breeding at the research station, the Program advanced to on-farm trials run collaboratively with the extension service, and then to the production of foundation seed to support the production of certified seed by small farmers. The Program's success is a tribute to a small but effective partnership joining three organizations that share the common objective of providing Eritrean farmers with the technologies to improve their livelihoods.

Millet breeders crossed selected local landraces, which were locally adapted and valued by farmers, with Institute varieties that provided disease resistance and a higher yield potential

Uganda issued special stamps to carry the messages of the groundbreaking all-Africa conference around the world.



IFPRI Catalyzes African Food and Nutrition Security

Some breakthroughs take place in the laboratory or the test plot, others in the minds of people. In 2004, the International Food Policy Research Institute (IFPRI) facilitated an all-Africa conference that brought unprecedented attention to the linked issues of hunger and malnutrition in Africa, the continent's most fundamental challenge. "Assuring food and nutrition security in Africa by 2020: Prioritizing actions, strengthening actors and facilitating partnerships" took place in Kampala, Uganda, in April 2004. It was facilitated by IFPRI through its 2020 Vision Initiative, cohosted by the government of Uganda, and cosponsored by more than a dozen organizations.

The conference had enormous scope. More than 500 participants came from 51 countries to discuss how to catalyze change and action to assure food and nutrition security in Africa. The sessions took stock of the African food and nutrition situation and identified institutional and political strategies and solutions. Participants examined how to strengthen key actors and facilitate partnerships between them.

Participants included policymakers and advisors, parliamentarians, key actors in nongovernmental and community-based organizations, business leaders, heads of regional organizations, farmers, researchers and academics, directors of international agencies, and the media. Keynote addresses, plenary sessions and parallel sessions featured more than 110 speakers, chairs, panelists, moderators and rapporteurs. Speakers included the Ugandan, Nigerian and Senegalese heads of state, one former head of state, one current and one former first lady, two Nobel Prize winners and several World Food Prize laureates. Several heads and senior staff from Centers spoke or attended, and Kanayo F. Nwanze, director general of the Africa Rice Center, served on the conference advisory committee. The 3 days of discussions were lively and intense, informing and energizing participants to catalyze action.

> The conference identified institutional and political strategies and solutions to strengthen key actors and facilitate partnerships between them

Several follow-up activities have spread the word about the outcomes achieved. In addition to generating broad media coverage at the time, the conference has led to many publications, including briefs, discussion papers and a comprehensive proceedings volume. Uganda issued a special postage stamp to carry the conference messages around the world.

The advisory committee summarized conference recommendations in *A Way Forward*. This document, distributed at the end of the conference, and the conference proceedings have been shared extensively with decision makers and other stakeholders throughout Africa. The advisory committee members took the lead in briefing the three attending African heads of state, and President Yoweri Kaguta Museveni of Uganda briefed other African heads of state.

Committee members have mainstreamed the results in their own networks and forums, briefing African regional organizations such as the Economic Community of West African States and the Common Market for Eastern and Southern Africa. Conference results served as input to the work of the Commission for Africa.

IFPRI

International Food Policy Research Institute (IFPRI)
Headquarters: Washington, D.C., United States of America
www.ifpri.org

IITA
Research to Nourish Africa

Plantain and banana growers need clean planting material and appropriate methods for reducing nematode infestation.

IITA Offers Clean Start For Bananas and Plantains

Most farmers of bananas or plantains in Africa have a few hundred plants on a small field. Plants produce few suckers, or secondary shoots, and natural regrowth is slow. This makes material for planting scarce. So, when soil fertility is depleted or nematodes infest the field, farmers carry contaminated planting materials from the old field to a new site. This need not be the case. Available technology can increase the suckering rate to produce large quantities of pest-free planting material.

Promoting clean planting material and appropriate methods for reducing renewed nematode infestation is a cornerstone of a research program pursued by the International Institute of Tropical Agriculture (IITA) in support of plantain and banana growers.

Commercial seedling production by private individuals and nongovernmental and community-based organizations has already begun in Cameroon and Nigeria

The biology of the plant determines regeneration. Before flowering, the mother plant uses a form of hormonal control called apical dominance to suppress the development of lateral buds that would otherwise develop into suckers. Suppressing apical dominance breaks this dormancy.

IITA has developed methods that can increase sprouting to 9-14 suckers per year. This is done by manipulating the meristem, from which grow the leaves that form the pseudostem, or false trunk, of the banana "tree," which is actually a very large herb. Manipulation consists of either cutting down the entire pseudostem or cutting a window through the meristem. The foliage will then stay alive for about 3 months. These field techniques suit smallholder farmers who need small quantities of suckers.

The detached-corm method is suitable for enterprising farmers who want to produce commercial quantities of planting material. It works by activating latent buds under high humidity. The corms, or underground stems, of preflowering or harvested plants can be used, as can suckers from field-induced multiplication. As many as 100 more seedlings can be produced by this method than under field conditions. Scarring the lateral buds increases the number of seedlings by a factor of 2-10. Plantlets thus produced are, like tissue-cultured seedlings, uniform and less prone to post-establishment stress. This method requires a modest investment to set up humidity chambers and weaning facilities.

Adoption prospects for the detached-corm method are very high with the emergence of commercial production. This has already begun in Cameroon and Nigeria, where it is undertaken by private individuals and nongovernmental and community-based organizations. Selling suckers can be almost as lucrative as selling bunches.

These new technologies are user-friendly and offer high rewards for investment in extra labor or low-cost infrastructure. Joseph Ilesanmi is one farmer IITA works with to demonstrate the new technology. A resident of the town of Ajaye in the Nigerian state of Ekiti, Mr. Ilesanmi recalled his own reluctance to begin. "I felt half-hearted about using part of my farm for the experiment," he admitted. "I thought it wouldn't work. But what has come out of it is unbelievable."

ILRI

Until recently, officials ignored smallholder dairying, which creates two full-time jobs for every 100 litres of milk produced.

International Livestock Research Institute (ILRI)
Headquarters: Nairobi, Kenya; Addis Ababa, Ethiopia
www.ilri.org

ILRI Research Supports Pro-poor Dairy Policy Shift

An award-winning 8-year collaboration has helped millions of Kenyans beat poverty and malnutrition. It has done this through research on the country's small-scale dairy workers. Modest dairy enterprises, comprising households with one or two milk cows and young men with bicycles who hawk raw (unpasteurized) milk, account for 85 percent of the milk marketed in Kenya. This is an astonishing figure considering that per capita milk production and consumption in Kenya are among the highest in the world, and that Kenyan milk comprises 70 percent of total dairy production in eastern and southern Africa.

Smallholder dairying creates regular incomes for hundreds of thousands of poor Kenyans and creates two full-time jobs for every 100 liters of milk produced. Informal dairying thus dwarfs Kenya's modern dairy sector, yet this vast informal milk sector was, until recently, virtually ignored by national dairy policy, which viewed the trade as illegitimate.

Scientists conducting the Smallholder Dairy Project combined scientific research and expertise in government policymaking, international development and social activism to bring about a pro-poor shift in dairy policy. The project was led by Kenya's Ministry of Livestock and Fisheries Development, jointly implemented by the Kenya Agricultural Research Institute and the International Livestock Research Institute, and largely funded by the British government's Department for International Development. These organizations succeeded in putting into practice action research by working closely with government and regulatory bodies, the private sector, civil society organizations, and the country's formal and informal milk sectors.

The Smallholder Dairy Project developed technologies such as disease-resistant fodder varieties, research-based guidelines for milk hygiene, and a milk container affordable to the poor. Of greater import were the proposed national policy changes scientifically supported by project research and now being written into the Kenya Dairy Act. These promise to create an enabling policy environment for micro-sized dairy enterprises.

Project data show that almost all households in Kenya boil milk before consuming it, indicating that raw milk presents no substantial public health hazard. This reliable information helped establish small dairy producers and milk traders as successful and credible agents in the eyes of Kenyan dairy policymakers and regulators, who are now, in the words of the permanent secretary of the livestock ministry, "mainstreaming the raw milk market." The new policies will, for example, allow Kenya's 1.8 million informal dairy workers to be licensed and thus brought into the formal economy for the first time.

The project is helping to harmonize regional dairy policies through networks such as the Eastern and Central Africa Program for Agricultural Policy Analysis under the Association for Strengthening Agricultural Research in Eastern and Central Africa. And the project's approaches are proving useful beyond the region, such as in the northeastern Indian state of Assam. Small-scale dairying occupies 97 percent of the dairy market there and so has the potential to lift millions out of poverty.

New policies will allow Kenya's 1.8 million informal dairy workers to be licensed and thus brought into the formal economy for the first time

International Plant Genetic Resources Institute (IPGRI)
Headquarters: Rome, Italy
www.ipgri.org

Knowledge of the banana genome will facilitate improvement of this usually sterile cultivar through genetic transformation.

IPGRI Pools Resources On the Banana Genome

Bananas, especially cooking bananas and plantains, are vital staple foods and sources of income for hundreds of millions of people in developing countries. Diseases constantly threaten production, yet conventional breeding for resistance is constrained because most cultivars are sterile. Meanwhile, genetic transformation has been slowed by a lack of basic knowledge of the banana genome. Unable to command the sort of resources that enabled researchers to sequence the rice genome rapidly, banana scientists are pooling their resources in the Global Musa Genomics Consortium, which now comprises a score of member organizations from 15 countries.

Coordinating the Consortium is the International Network for the Improvement of Banana and Plantain program of the International Plant Genetic Resources Institute. Its step-by-step approach is starting to pay off with an improved understanding of the banana genome.

Cultivated bananas originated in different ways from two wild species. The dessert and cooking bananas that are the staple food in the highlands of East and Central Africa are seedless triploid derivatives of *Musa acuminata*. Most other cooking bananas and plantains, also seedless, descend from crosses between *M. acuminata* and *M. balbisiana*. Bacterial artificial chromosome (BAC) libraries derived from sterile cultivars and fertile diploid *M. acuminata* and *M. balbisiana* are a basic shared resource of the Consortium.

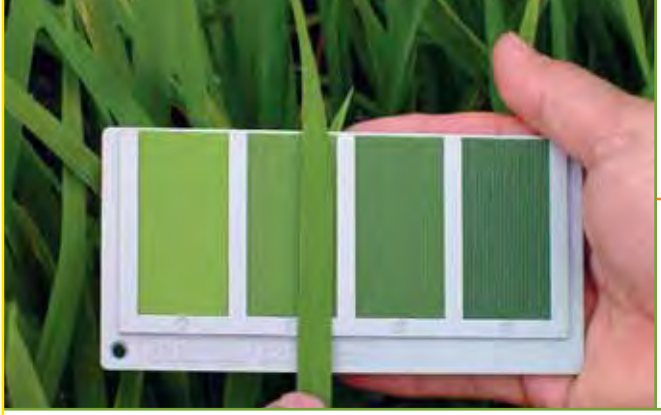
BAC clones sequenced by Consortium partners show that the *M. acuminata* and *M. balbisiana* genomes are very similar. There is also some microsynteny with rice, meaning that stretches of the *M. acuminata* genome contain the same genes, in the same order, as stretches of the rice genome.

Although the banana genome is relatively small, its chromosomes are difficult to distinguish from one another. At the Institute of Experimental Botany in the Czech Republic, where the Consortium's Musa Genome Resource Center is located, fluorescence in situ hybridization studies with labeled BAC clones and DNA probes now permit the identification of all 11 chromosomes of *M. acuminata*. The possibility of localizing BAC clones from *M. acuminata* on chromosomes of *M. balbisiana*, and vice versa, opens the way for comparative physical mapping. This will permit analysis of chromosome behavior and segregation during evolution and in-breeding programs.

The Institute for Genomic Research (TIGR) recently sequenced the ends of some 3,000 BACs. This allowed researchers to match *Musa* sequences against those of other plant species already in databases. Comparison with the rice genome indicated three possible syntenic matches to each of *Musa* chromosomes 4 and 10, and one to chromosome 8. In the next stage, TIGR will use whole-genome shotgun sequencing to gain broader insights into the overall organization of the banana genome.

Although this research has a long way to go, the Consortium has made considerable progress with limited resources. Its members actively participate in the Generation Challenge Program, which is developing a common set of markers for better characterization of banana genetic resources, and support further genomics studies comparing banana and rice. The end result will be improved banana varieties better able to withstand pests and diseases.

The Global Musa Genomics Consortium has made progress toward understanding disease-resistance in bananas and plantains



IRRI

Fertilizers are most efficient when applied in amounts that complement naturally occurring nutrients.

International Rice Research Institute (IRRI)
Headquarters: Los Baños, Philippines
www.irri.org

IRRI Tailors Nutrient Management To Crop Need

Rice farmers have long used leaf color as a subjective sign of their crops' nitrogen status. To help them monitor it objectively, and so better synchronize nitrogen applications to the plants' changing need, the International Rice Research Institute and the Philippine Rice Research Institute developed, from a Japanese prototype, a leaf color chart. The chart's color panels are veined to reflect light as rice leaves do, to ensure a close match. Pasted on the back is a simple instruction sheet in the local language.

Simple, easy to use and costing less than US$1 each, the leaf color chart is an excellent tool for crop nitrogen management. In the decade to 2004, more than half a million leaf charts were distributed to farmers, mostly in Asia but also in Africa and Latin America. Accompanying the spread of the charts has been knowledge of site-specific nutrient management (SSNM).

The nutrients rice plants need come mainly from soil, crop residues and irrigation water. However, these naturally occurring, indigenous nutrients are typically insufficient to meet the needs of rice grown for high yield. Nitrogen, phosphorus and potassium are the nutrients rice requires in the largest quantities. SSNM offers farmers an effective approach for feeding these supplements to rice, as and when the crop needs them. Applying nutrients at optimal rates and times improves their uptake and so maximizes the value of the harvest per unit of fertilizer invested, while reducing fertilizer runoff and pollution.

The SSNM approach uses nutrient-omission plots to determine the phosphorus and potassium fertilizer requirements for a given soil type or rice-growing area. Farmers calculate the deficit between the crop's need, determined by the yield in a plot of rice grown with abundant fertilizer, and the indigenous supply, determined in plots with one nutrient not supplemented. The optimal rate of supplementation fills this deficit and includes sufficient phosphorus and potassium to prevent soil depletion arising from their removal in grain and straw. Farmers practicing SSNM supply all phosphorus fertilizer in one early dose because it is vital for young plant growth. Potassium, on the other hand, is needed later to improve grain filling and resistance to diseases and lodging, so farmers often apply a second dose at early panicle initiation.

In 2003-04, SSNM was evaluated and promoted with farmers at diverse locations in tropical and subtropical Asia, each typical of an intensive rice farming area of more than 100,000 hectares. Results indicate that many irrigated rice paddies receive excess nitrogen during early crop growth, when crop demand for it is small, and insufficient nitrogen at later growth stages such as panicle initiation, when demand is large. Some rice farmers do not supply enough potassium fertilizer. Excess early nitrogen and insufficient potassium fertilizer can make rice more susceptible to diseases and insect pests. Improved management of nitrogen and potassium fertilizer through SSNM reduces disease and insect damage, thereby curtailing the need for costly pesticides.

Applying nutrients optimally improves their uptake and the value of the harvest per unit of fertilizer invested, while reducing runoff and pollution

International Water Management Institute (IWMI)
Headquarters: Battaramulla, Sri Lanka
www.iwmi.cgiar.org

IWMI Illuminates Water-borne Health Risk in Rice

Cadmium contamination stems from irrigation water drawn from a river that passes through a mineralized zinc deposit.

Cadmium contamination of crops from industrial run-off or natural mineral deposits poses a serious threat to human health. Consuming cadmium-tainted crops like rice over the long term is known to cause irreversible kidney dysfunction. In addition, high levels of heavy-metal contamination can influence the long-term sustainability of soil and water resources, as well as negatively impact trade and the economy. Many reports on the health effects of cadmium have emerged from Japan, China and Southeast Asia, where rice lands have become contaminated with cadmium by irrigation water tainted by natural causes or discharges from mines, smelters and associated facilities.

The Southeast Asia regional office of the International Water Management Institute (IWMI) and the Royal Thai government's Department of Agriculture and Land Development are carrying out an in-depth assessment of cadmium contamination of rice and associated rotation crops in Thailand. The study, which began in 2001 and continues in 2005, is taking place in an area of the Thai-Myanmar border where exposed deposits of zinc are mined. Cadmium is often an accessory mineral in base-metal deposits.

Initial studies showed that rice has a propensity to accumulate in the grain high concentrations of cadmium but nutritionally insignificant amounts of zinc and iron. Maize grown on similarly contaminated sites does not accumulate cadmium to the same extent. The difference is associated with the cycles of wetting and drying often observed in paddy rice production.

Results from grain surveys in the area showed that rice grain harvested from 2,000 hectares of land contained cadmium levels that exceeded international norms. The contamination of the paddy fields stemmed from suspended sediments in irrigation water drawn from a river that passes through the mineralized zinc deposit. Researchers developed a simple but effective risk-assessment model that predicts cadmium distribution within a cascading irrigation system, and this is being used to predict — without extensive, labor-intensive soil sampling — the degree of contamination in irrigated fields.

> The study outcomes have underpinned the government's response to the cadmium-contamination crisis and led to the development of comprehensive action plans

IWMI and its Thai partners identified and zoned high-risk fields within the affected communities. The study outcomes have underpinned the government's response to the crisis and led to the development of comprehensive action plans. In the short term, these have included confiscating and destroying over 7,000 tons of contaminated rice, paying US$1.5 million to 600 farm households as compensation for crop losses, and instituting a ban on growing crops for human consumption in highly contaminated areas. For the long term, adjusting cropping patterns and growing non-food crops are among the practices being promoted in the affected areas. These measures will minimize the potential long-term health risks associated with cadmium contamination.

It is important to note that the study areas are small, isolated and regionally distinct, and that cadmium concentrations found in rice grain samples collected from this study area are not indicative of the Thai rice harvest as a whole.

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

Fertilizer trees allow Estere Banda, a widow in central Malawi, to grow enough maize to feed her family without food aid.

World Agroforestry Trees Spin Fertilizer From Air

World Agroforestry Centre (ICRAF)
Headquarters: Nairobi, Kenya
www.worldagroforestrycentre.org

The fertilizer tree concept developed at the World Agroforestry Centre was among a number of appropriate technologies highlighted in the recent report *Investing in Development: A Practical Plan to Achieve the Millennium Development Goals.* Jeffrey Sachs, Millennium Development Goals special advisor to the United Nations secretary-general, noted that fertilizer trees could play a major role in boosting food production and restoring Africa's degraded farmlands. This would contribute to achieving the goal of eradicating poverty and hunger.

Fertilizer trees can capture more than 100 kilograms of atmospheric nitrogen per hectare and transfer it to the soil. At those levels, farmers can readily double or triple their maize production without buying expensive mineral fertilizer.

Since the late 1990s, the technology has spread from just a few hundred farmers, who began village-level testing of the trees in eastern and southern Africa, to an estimated 200,000 maize farmers. The farmers recognize that fertilizer trees do much the same job as conventional fertilizers — improving soil fertility — but accomplish it using natural processes at a fraction of the cost. While World Agroforestry Centre researchers acknowledge that mineral fertilizers have a major role to play in African agricultural development, these products are frequently beyond the reach of the rural poor and are often unavailable even when subsidized by the government.

The significance of the fertilizer tree concept is that it enables a farm family to produce its own nitrogen and cycle other nutrients from deep within the soil with no outlay of cash. Fertilizer trees can be viewed as small fertilizer factories conveniently placed in the fields where the fertilizer is needed. They are also a one-time investment. Once the trees are established, seed multiplication and extension activities can be left in the hands of local communities.

While no one type of fertilizer tree fits all ecologies or production systems, demand is especially high for a leguminous species euphoniously called *Gliricidia sepium* or sometimes quickstick. Starting in the late 1980s, a particularly productive and robust variety of *Gliricidia* was introduced to Africa from Central America and tested. While the amount of fertilizer it produces is equal to that of other fertilizer trees species, its major advantage is that it grows back year after year despite severe pruning. This enables it to be planted and sustained at high density in a grid pattern. Before a maize crop is planted, the *Gliricidia* is trimmed right down to the ground surface so it will not compete with the maize.

Selected by cooperating farmers, *Gliricidia* performs well on both heavy and sandy soils and is widely adaptable. The nitrogen content of the foliage is 3-4 percent and provides a high-quality fertilizer that is readily taken up by cereal crops. Another important attribute is that *Gliricidia* produces lots of firewood. This reduces pressure on surrounding forests and woodlands, as well as saving families the time and labor they would otherwise need to invest in gathering firewood and carrying it back to the farm.

Fertilizer trees can be viewed as small fertilizer factories conveniently placed in the fields where the fertilizer is needed

Aquaculture farmers trebled their fish production and earned a return of more than double their investment.

WorldFish Helps Rice Farmers Diversify Production

The WorldFish Center has worked in Bangladesh since 1989, focusing mainly on small-scale aquaculture and participatory management. Collaboration with the Bangladesh Fisheries Research Institute over the past 15 years has seen the development and testing of many transferable aquaculture technologies.

The ongoing Development of Sustainable Aquaculture Project (DSAP), funded by the US Agency for International Development and other Members of the Consultative Group on International Agricultural Research, aims to improve Bangladeshi smallholders' livelihoods by helping them take advantage of improved ways to farm inland water resources. While continuing applied research on aquaculture technologies, DSAP trains local NGOs and their extension staff to disseminate to large numbers of smallholders improved aquaculture technologies, integrating aquaculture and agriculture by culturing fish in rice fields, for example, and demonstrating the advantages of polyculture over monoculture. The project also provides some training support to aquaculture-related small businesses such as hatchery owners, managers and seed sellers.

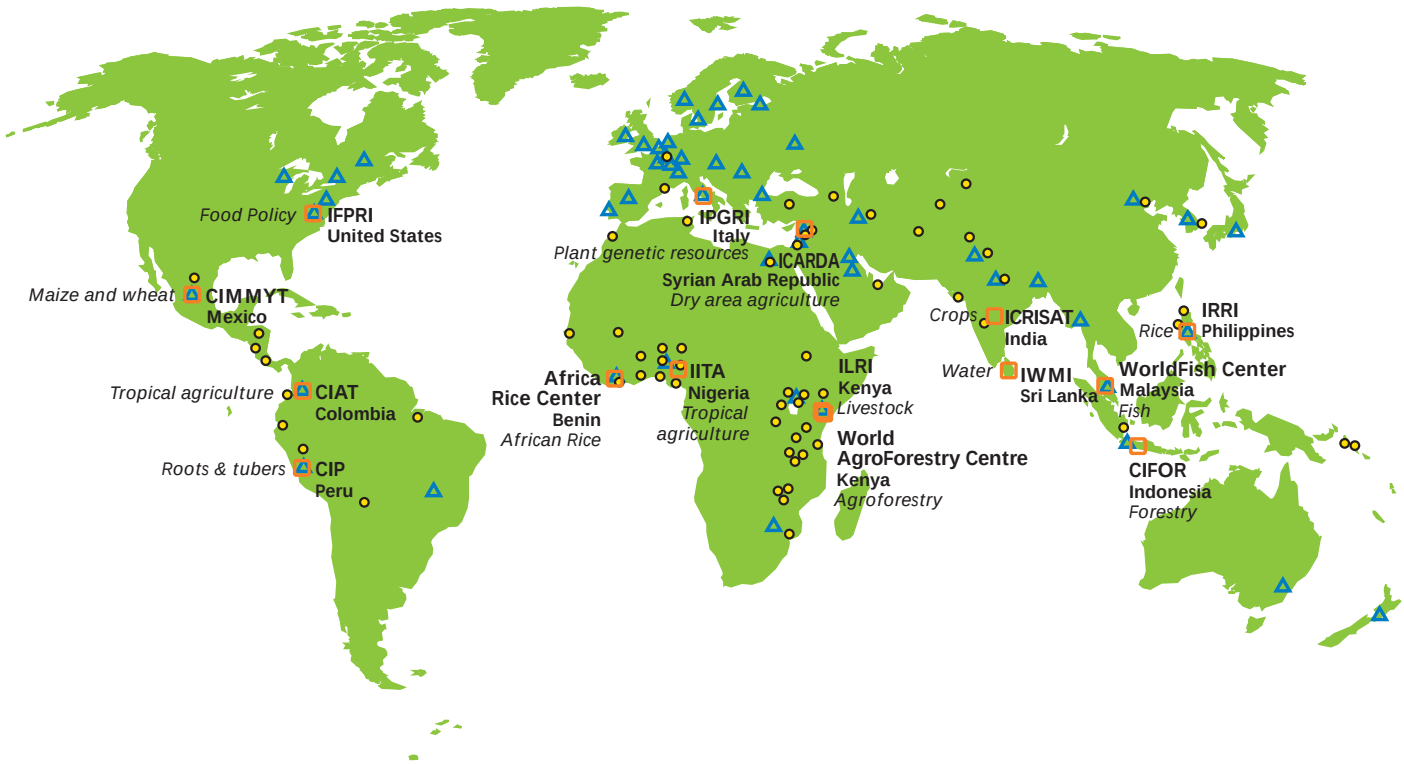
DSAP implemented more than 43,500 aquaculture demonstrations between 2000 and 2004 and is implementing 11,300 new demonstrations in 2004-05. The project has provided training to 517 extension workers from 48 NGOs and training support to 477 staff members from over 170 NGOs during the same period. In 2003, aquaculture demonstration farmers produced average harvests of 2,460 kilograms of fish per hectare in ponds, nearly tripling the production level that existed before the project. Economic analysis showed that each Bangladeshi taka invested in fish culture resulted in a gross benefit of 2.29 takas in ponds and 2.03 takas in paddies.

The project improves Bangladeshi smallholders' livelihood by helping them take advantage of improved ways to farm inland water resources

The story of Shafiqul Islam illustrates the project's operations and benefits in human terms. He lives in a household of 13 family members in a remote village in the Mymensingh District of Bangladesh. Having heard about DSAP through the Social Association for Rural Advancement (SARA), an NGO, he attended the aquaculture foundation training course. There he learned about profitable methods of fish culture in rice fields and income diversification by growing fruit and vegetables on the surrounding dikes.

Mr. Islam made a small ditch in a corner of his 0.22 hectare plot. A field assistant from SARA visited regularly and provided technical advice. With the help of his brothers, Mr. Islam transplanted the high-yielding rice variety BRRI Dhan-28, collected papaya seedlings and planted gourd seeds on the dikes. When the rice plants were a month old, he stocked his paddies with fingerlings of local fish species such as *rohu, katla*, common carp, silver carp and *sharputhi*.

Three months after planting, the family was able to start collecting leafy vegetables and gourds for household consumption and to market. They harvested 298 kilograms of rice, 74 kilograms more than in previous years. They started harvesting fish, some to eat and some to sell. After deducting expenses for the rice-field preparation, fertiliser, transplantation, fish stocking and vegetable cultivation, the net profit in 2003 from the rice-fish and dike cropping was 10,940 taka, or US$170. This was considerably more than Mr. Islam had made in previous years.



a global cgiar

Placement markers are approximate and indicate city locations, not worldwide offices.

- CGIAR Members
- CGIAR Supported Centers
- CGIAR Regional Offices

the spirit of innovation

Performance Measurement: Towards Objectively Assessing Achievement

A worldwide trend is propelling organizations in both the private and public sectors toward greater accountability and transparency. In keeping with this trend, the Consultative Group on International Agricultural Research (CGIAR) has designed a Performance Measurement (PM) System. Lessons learned from a pilot exercise using performance data for 2004 will guide further refinement of the PM System. The pilot uses eight performance indicators: four refer to results of the work of each Center, and four refer to the Centers' potential to perform (see box below).

The pilot PM System will complement existing monitoring and evaluation instruments within the CGIAR, such as the periodic external program and management reviews and Center-commissioned external reviews. It will be linked closely to the CGIAR Science Council's annual evaluations of Center medium-term plans. The PM System is designed to serve multiple purposes, but the primary objective is to promote and enhance Center performance and accountability. It will be an important tool for performance management used by the Centers to stimulate learning and change and serve as an input to decision-making by CGIAR Members and the CGIAR System.

The following sample of results from the pilot PM System illustrates aspects of the institutional and financial health of the CGIAR Centers in 2004.

Performance Measurement Indicators

Results
- Outputs
- Outcomes
- Impacts
- Stakeholder perceptions

Potential to perform
- Quality of research and managerial staff
- Quality and relevance of programs
- Institutional health (diversity, culture of learning and change, governance)
- Financial health

Institutional Health is assessed in the PM System by measurement of diversity, culture of learning and change, and governance.

Diversity is one of the key assets of the CGIAR, the basis for research and management excellence. As the CGIAR seeks to be a model of excellence in attracting and retaining a diverse staff, it is vital to include measures of diversity in the PM System. Table 1 on page 38 shows two indicators of diversity tracked by the PM System: the percentage of Center management positions occupied by women, and the percentage of internationally recruited staff (IRS) representing the most prevalent nationality.

A Culture of Learning and Change is key to continued success in meeting the rapidly changing contexts in which international agricultural research is practiced. Learning-oriented organizations are characterized by best practices such as 1) investing in staff training, 2) monitoring staff attitudes to understand better the factors that contribute to staff satisfaction at the work place, and 3) having effective monitoring and evaluation mechanisms that are aligned with research planning and management processes.

The following results provide some indicators of this important facet of institutional health:
- In some Centers the number of days invested in training IRS per annum is as high as 8 training days per IRS. One third of the Centers indicated 3-4 days of training per IRS.
- In 2003-04, nearly half of the CGIAR Centers conducted staff satisfaction surveys.
- In 2002-04, CGIAR Centers completed more than 35 Center-commissioned external reviews. Such reviews are a vital mechanism to help Centers better understand their strengths and weaknesses in specific programmatic and managerial areas.

Center Governance focuses on Board leadership composition, Board practices such as orientation and self-assessment, and the Board's engagement with the Center's strategic business. Some illustrative results:

- Board self-assessment has become a common practice by Center Boards to fine-tune Board practices and allow for changes in Board structure.
- More than half of the Centers have achieved balanced North-South composition in their Board leadership (chair, vice chair and Board committee chairs). All 15 Centers' Boards have achieved an even balance in the number of members from the South and the North.
- Six Center Boards have reached gender-balanced leadership composition, three Boards have 21-40 percent of Board leadership positions occupied by women, and six Centers have fewer than 21 percent of Board positions occupied by women.

Financial Health is measured in the PM System in terms of short-term solvency (liquidity) and long-term financial stability (adequacy of reserves).[1] Figures 1 and 2 show Centers' results for these two indicators.

[1] Short-term solvency is defined as current assets plus long-term investment minus current liabilities divided by per-day operating expenses excluding depreciation; long-term financial stability is defined as unrestricted net assets less net fixed assets divided by per-day operating expenses.

Figure 1 **Short-term Financial Solvency (Liquidity)**

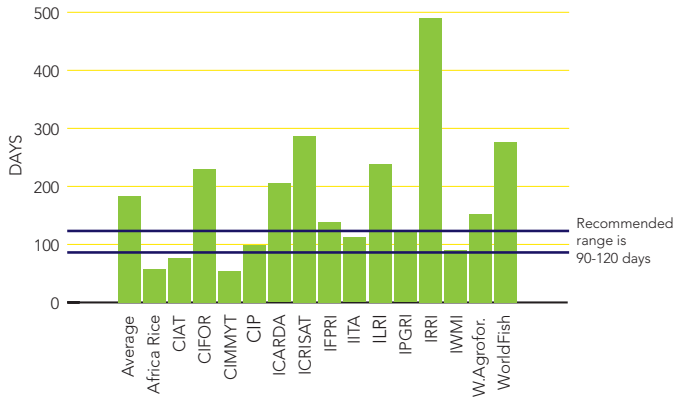


Figure 2 **Long-term Financial Stability (Adequacy)**

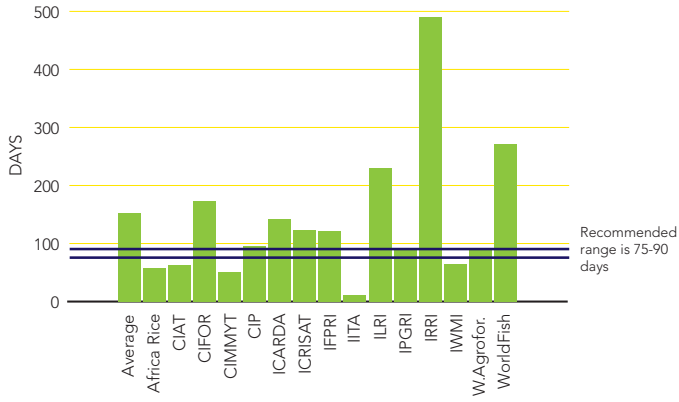


Table 1 **Diversity Measures in the CGIAR Performance Measurement System (2004)**

	Center management positions occupied by women (%)	IRS from the most prevalent nationality (%)	Most prevalent nationality
Africa Rice Center	14	11	Burkina Faso/Nigeria[1]
CIAT	14	19	Colombia
CIFOR	14	20	USA
CIMMYT	20	19	USA
CIP	25	18	Peru
ICARDA	4	9	Syria
ICRISAT	8	15	India
IFPRI	33	38	USA
IITA	10	12	Nigeria
ILRI	25	14	UK
IPGRI	32	12	USA
IRRI	0	21	USA
IWMI	50	15	France
World Agroforestry Centre	8	14	USA
WorldFish Center	30	26	Australia
Average	**20**		

[1] In case of the Africa Rice Center 11% of IRS come from Burkina Faso and 11% from Nigeria.

CGIAR Challenge Programs: Gaining Momentum

Challenge Programs (CPs) elevate the significance and impact of research conducted by the Consultative Group on International Agricultural Research (CGIAR) and its partners. They do so by organizing high-impact research that targets issues of overwhelming global or regional consequence and helps achieve the Millennium Development Goals. The CGIAR approved the first pilot CPs in October 2002. Two pilot CPs — Water and Food and HarvestPlus — completed their second full year of operation at the end of 2004. A third CP, Generation, completed its inception phase in mid-2004.

October 2004 saw the approval and launch of the **Sub-Saharan Africa CP**, the first regular (non-pilot) CP. To address three prime constraints to transforming agriculture in sub-Saharan Africa — the failure of agricultural markets, inappropriate policies and natural resource degradation — CP stakeholders adopted the "integrated agricultural research for development" paradigm. In line with the pilot CPs, the Sub-Saharan Africa CP has pursued inception-phase activities that are largely organizational such as establishing a program steering committee, recruiting a program coordinator, and organizing pilot learning teams and other structures.

The **Water and Food CP** aims to create research-based knowledge and methods for increasing the productivity of water for food and livelihoods. In June 2004, a core portfolio of 33 projects, led by 18 institutions and involving over 150 partners, became operational in nine benchmark river basins. On CGIAR Science Council advice, CP management decided to formulate additional projects to refine research strategy towards innovation and delivery of global public goods. These special projects aim to develop a scientific framework for evaluating both potential impact and potential for scaling up.

The following are selected early results:

- A project led by the International Rice Research Institute allowed farmers in a saline-affected area of Bangladesh to grow rice in the dry season for the first time using freshwater stored on-farm;
- A project led by the International Water Management Institute enabled a multi-partner approach toward identifying in the Limpopo and Mekong basins the critical requirements for using the same water for drinking, hygiene and small-scale horticulture; and
- Farmers in the Volta basin in Ghana and Burkina Faso participated in field trials of a project, led by the International Crops Research Institute for the Semi-Arid Tropics, that showed the benefits of integrated soil, water and nutrient-management and improved their understanding of land degradation.

The **HarvestPlus CP** seeks to reduce micronutrient malnutrition by harnessing agricultural and nutrition research to develop nutrient-dense staple crops. The crop-improvement component of the CP has:

- identified rice genotypes with 300-400 percent higher levels of iron;
- screened over 2,400 wheat entries for iron and zinc, identifying wheat lines with 80-100 percent higher zinc content for subsequent testing in international micronutrient trials;
- identified maize germplasm sources with provitamin A content that is 200-275 percent above average; and
- deployed two biofortified bean varieties (high in zinc and/or iron) in eastern and central Africa.

The CP is fast-tracking germplasm distribution of orange-fleshed sweetpotato high in provitamin A, beans high in iron and wheat high in zinc.

On biotechnology and nutritional genomics, the CP identified four major quantitative trait loci that affect carotenoid synthesis in the grain of the model species *Arabidopsis thaliana*. This will advance understanding of fundamental processes and facilitate improving carotenoid levels in HarvestPlus crops. HarvestPlus is also working to develop Golden Rice with improved provitamin A content based on bacterial genes alone (not daffodil) to avoid possible co-suppression in later generations.

On impact and policy, the CP developed models that enabled quantification of the potential benefits of biofortification, such as combating iron and zinc deficiency.

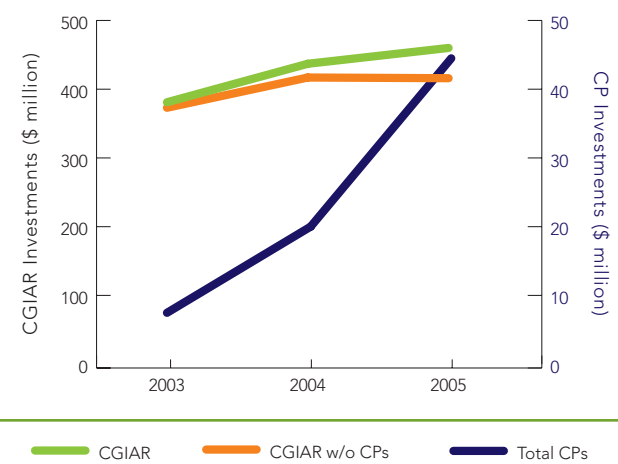
The **Generation CP** aims to use advances in molecular biology to exploit global crop genetic resources and develop a new generation of plants that meet farmers' needs. Key Generation CP activities in 2004, by subprogram, included:

- starting molecular analysis of genetic diversity for a first tier of 11 crops;
- developing a coordinated strategy for using genetic materials that show attributes of drought tolerance, and formulating a common phenotyping framework for comparison across species;
- validating pre-existing linked markers and further developing and identifying molecular markers for drought tolerance;
- designing an information-exchange platform; developing plans for interoperability, infrastructure and a central registry; reviewing integrated germplasm and crop information systems; and creating tools and databases to support the other subprograms; and
- developing fellowship and travel-grant programs for national agricultural research systems and undertaking in commissioned research projects hands-on training activities to build capacity and enable delivery.

Lessons Learned from Pilot CPs In 2004, the CGIAR Science Council and the CGIAR Secretariat conducted a joint study[1] to synthesize lessons learned from the pilot CPs regarding program development and implementation. The key findings are as follows:

- The pilot CPs are generating new funding from traditional sources (CGIAR Members) and new sources that probably would not otherwise have materialized. In 2004, the CPs generated incremental funding of about US$33 million. Overall projected growth in CP investments — 191 percent in 2004 and 63 percent in 2005 — is driving the growth of investment in the CGIAR as a whole (Figure 1).
- Competitive grants are effective in opening the System to new suppliers of research services. A future review should enable the CGIAR to assess more fully the level of engagement of non-CGIAR centers as research suppliers in the CPs.
- Sound oversight is key to reducing the transaction costs in developing and implementing the CPs.
- Each CP should create and adopt a governance structure that is best suited to its needs. However, governance parameters for CPs should clearly spell out how to address key issues on management, legal and administrative matters.
- CPs must have explicit priorities around which partnerships and projects are developed with a clear focus on strategic research goals and the comparative advantage of the CGIAR. The priorities must be set with a focus on research and research methodology that provide international public goods applicable across targets.
- Partnerships should be determined by the nature, scope and scale of the problems and the research needs.
- CPs must have clearly defined boundaries built on existing programs, and they must focus on the added value of the research.

Figure 1 **Trends of Investments in the Pilot Challenge Programs Relative to Those in the Total Research CGIAR Agenda**



[1] The full report can be found at http://www.cgiar.org/pdf/agm04/agm04_cp_lessons.pdf.

CGIAR System Office: Initiatives Strengthen Practice and Collaboration

The Consultative Group on International Agricultural Research (CGIAR) System Office continuously strives to improve its service to the CGIAR and the Centers. In 2004, the System Office launched a number of innovative initiatives to improve business processes and strengthen collaboration. These initiatives fell into several key areas, as summarized below.

The CGIAR Secretariat, Science Council Secretariat, Future Harvest Alliance Office and Marketing Group undertook a number of **Collaborative Communications and Resource-Mobilization Activities** to further streamline efforts in this area. These included 1) a Centers and Members Day at the 2004 Annual General Meeting, 2) enhancement of the Science Council website including a new section on CGIAR impacts, 3) targeted communication campaigns such as briefings for new European accession countries, and 4) training in resource mobilization for Center communications and resource-mobilization staff.

The Internal Audit Unit (IAU) expanded its support to Centers by developing **Risk-Management Systems**. It shared a *Good Practice Note on Center-wide Risk Management* with all Centers and initiated the development of guides on risk inventories and analyses for particular aspects of Center operations. In this context, the Central Advisory Service on Intellectual Property provided special services that helped Centers to explore the risks associated with intellectual property rights, intangible assets and their legal aspects. This expanded the IAU's work in facilitating the exchange of knowledge and experiences related to intellectual-property management. As a result, Centers are advancing their Center-wide risk analyses, using formats and methodology developed with IAU assistance to support the preparation of Board statements.

The **Monitoring and Evaluation System** for CGIAR Centers underwent major enhancement. The Science Council and CGIAR Secretariats jointly worked on a new monitoring and evaluation process for Centers, including the development of a pilot CGIAR performance measurement system. This custom-designed system responds to the worldwide trend in both the private and public sectors towards greater accountability and transparency (see page 37).

Investment in human resources and development will benefit the System by **Building Leadership, Management Skills and a Diversity-Positive Work Environment**. The Strategic Advisory Service on Human Resources (SAS-HR) works with the Gender and Diversity Program and the CGIAR Secretariat to support Centers in this endeavor.

In its first year, SAS-HR launched four inter-Center initiatives: Top Level Leadership Development Program, Strategic Staffing, Performance Management and PeoplePower (a shared online human-resources database and workspace for HR practitioners).

The Gender and Diversity Program developed a new strategic plan for 2005-08 in extensive consultation with the CGIAR leadership, Center staff and other System Office units. The cornerstone of G&D's new strategy is to support the Centers' achievement of their own 1-, 3- and 5-year goals for policy, practice and staffing. G&D's work with Centers in 2004 focused on women's leadership, expanding the mentoring program and providing vigorous support for diversity-positive recruitment. In addition, G&D introduced two new spouse-employment services.

Based on the results of a needs assessment, the CGIAR Secretariat organized a new leadership

Investment into human resources and development will benefit the System by building leadership, management skills and a diversity-positive work environment

Units Serving the System

1. Central Advisory Service on Intellectual Property
2. CGIAR Secretariat
3. Chief Information Office
4. Future Harvest Alliance Office
5. Gender and Diversity Program
6. Internal Auditing Unit
7. Science Council Secretariat
8. Strategic Advisory Service for Human Resources

development program at Harvard Business School. The first course took place in December 2004 in Boston, and participants comprised senior CGIAR managers.

A major investment approved in 2004 seeks to strengthen the development and application of **Information and Communication Technologies** (ICT) and **Knowledge Management** (KM) practices. This ICT-KM program aims to develop tools to strengthen the effectiveness of CGIAR work. The Chief Information Office, a System Office unit, monitors the implementation of 15 projects that fall under three main thrusts: ICT for Tomorrow's Science, Content for Development, and A CGIAR Without Boundaries. More details on the program are available at http://ictkm.cgiar.org/.

Additional efforts use KM tools to simplify how the CGIAR works. In this regard, a new collaborative website of the CGIAR Center Directors Committee was established with help from the Future Harvest Alliance Office, the newest System Office unit. The site helps to facilitate discussions and the sharing of documents and information among Center directors. In addition, it serves as an archive to enhance the institutional memory of the Center Directors Committee. A shared calendar feature that consolidates Center and System Office activities further promotes information sharing.

KM tools also guided the major revamp of the CGIAR Contacts Database. Contact information on the CGIAR roster of experts is now only a mouse click away at http://cgsec2.cgnet.com/cgiarcontacts/default.htm. The database, managed by the CGIAR Secretariat, serves as a portal for accessing expertise and receiving nominations for appointment to Center Boards, external review panels and other System-level positions. The database is set up to receive nominations year round.

The full *Annual Report of the System Office* can be found at http://www.cgiar.org/soar/2004/index.html.

Silverio Gonzalez (far left) accepted the Outstanding Innovative Partnership Program Award for the work of the Colombian Federation of Plantain Producers to control moko disease in bananas. Ruben Paso Cedeño accepted the Outstanding Potential Innovative Partnership Award for the work of the Central American Indigenous and Peasant Coordinator of Communal Agroforestry to help Guatemalan and Nicaraguan communities better manage forest resources.

Innovation Marketplace: Expanding Partnerships with Civil Society

In mobilizing science for poor farmers, the Consultative Group on International Agricultural Research (CGIAR) recognizes the need for partnership with civil society organizations (CSOs). Interacting with farmers, farmer and producer associations, and community-based organizations helps scientists to incorporate views of end users in their work. CSOs work closely with the Centers in designing and implementing research programs and activities that aim to improve farmers' livelihoods. Nearly 300 CSOs, many with locally active development programs, have been partners with Centers over the years.

To expand cooperation with CSOs and to benefit from CSO insights, the CGIAR has hosted an Innovation Marketplace for 2 consecutive years.

The Innovation Marketplace 2004 acknowledged and promoted CGIAR Centers' current partnerships with farmers groups and CSOs in Latin America, as well as encouraging the development of further innovative approaches to research and development. It took place during the CGIAR's 2004 Annual General Meeting in Mexico City and was both a competition and an exhibition. The Latin American Center for Rural Development (RIMISP by its Spanish acronym), a Chilean NGO, coordinated outreach to CSOs across Latin America.

Two winners were selected from among nine examples of innovative partnership. In addition, participants at the Annual General Meeting voted a third People's Choice Award. The three winners received US$10,000, and all exhibitors received a cash prize of $1,000.

Outstanding Innovative Partnership Program Award The winning Colombian Federation of Plantain Producers (FEDEPLATANO by its Spanish acronym) works to control moko disease, a bacterial wilt affecting bananas, with the International Center for Tropical Agriculture and the Colombian Institute of Agricultural Research. Among the more promising weapons in the emerging moko-management arsenal is a bio-pesticide that does double duty as an organic fertilizer. The liquid is produced inexpensively on-farm by composting a part of the plantain plant that farmers routinely discard after harvesting.

FEDEPLATANO is one of several public and private stakeholder groups that form the Club del Moko, a broad alliance working on the diagnostics of the *Ralstonia solanacearum* bacterial pathogen and the design and testing of disease-control measures. To date, Club del Moko has provided four major benefits to farmers. First, new methods of disease control now protect 4,000 hectares in Colombia's Quindío Department, dramatically reducing disease incidence and crop losses. Second, local plantain growers have made the rural environment safer by eliminating the use of chemical pesticides. Third, reduced reliance on agrochemicals has helped farmers cut their production costs. Finally, the club has enhanced local capacity for rural learning and innovation by engaging more than 1,000 farmers in participatory research and technology validation and training several thousand more farmers and agricultural technicians in moko control.

Outstanding Potential Innovative Partnership Program Award The winning Central American Indigenous and Peasant Coordinator of Communal Agroforestry (ACICAFOC by its Spanish acronym) develops self-sustainability systems to help communities better manage forest resources and take control of their livelihoods. ACICAFOC works in partnership with the Center for International Forestry Research,

Roberto Validivia accepted the People's Choice Award for new livelihood-enhancing agricultural technologies developed in Peru by the Center for Research on Natural Resources and the Environment.

The organizations have played a significant role in bringing peace and stability to the management of large areas of forest in conflict-weary Guatemala and Nicaragua

the Association of Forest Communities of Petén (ACOFOP by its Spanish acronym) in northern Guatemala and the Farmer to Farmer Program (PCaC by its Spanish acronym) in Siuna, northern Nicaragua.

These community-based organizations' self-directed efforts have played a significant role in bringing peace and stability to the management of large areas of forest in Guatemala and Nicaragua — forests damaged by conflict and corruption in the late 1980s and early 1990s following years of civil war and unrest. With peace and stability have come more sustainable forestry management practices and better livelihoods for those communities working with the organizations.

People's Choice Award The winning Center for Research on Natural Resources and the Environment (CIRNMA by its Spanish acronym) is a CSO in Puno, Peru, that works in partnership with the International Potato Center (CIP by its Spanish acronym) and the Peruvian National Institute of Agrarian Research (INIA by its Spanish acronym) to develop new farming technologies by combining biological and socioeconomic research. CIRNMA supports small producers in the Altiplano (high plains) of the Andes with new development opportunities that improve the livelihoods of rural people. For CIRNMA, collaborative research with CIP has encouraged small producers' projects such as the Quinoa Project in the Peruvian Altiplano.

The Quinoa Project includes the creation of a for-profit company that specifically handles the traditional grain *quinoa*, buying it from farmers, processing it and making contacts for sale both in Peru and abroad. The *quinoa* processing plant can hold up to 100 tons of the grain at a time. Its 16 employees carefully shepherd it through the processing steps, from removing a bitter residue formed on the grain to protect it from the intense Altiplano sun to packaging it for sale. In 2004, the plant processed 20 tons of organic *quinoa* — the facility, like the farms where the *quinoa* is grown, having received official organic certification. CIRNMA pays participating farmers an average of 50 US cents per kilogram of *quinoa*, or nearly double the production cost and two-thirds more than most local traders pay.

Innovation Marketplace competition entries were judged on the significance of the program for developing the research capacity of the CSO partner, the influence of the CSO partnership on research conducted by the CGIAR and the national agricultural research system, the relevance of the CSO partnership to the adoption and/or adaptation of research results, the originality of the approach, and its potential for replication and scaling up in other contexts.

Selecting the two winning programs other than for the People's Choice Award was an expert panel of jurors comprising Sebastiao Barbosa of the Brazilian Agricultural Research Corporation, Usha Barwale-Zehr of the Mahyco Foundation, India (and chair of the CGIAR Private Sector Committee), Franklin Moore of the US Agency for International Development, and Jonathan Wadsworth of the UK Department for International Development.

The Innovation Marketplace showed how collaboration between CSOs and CGIAR Centers helps improve the livelihoods of poor people living in rural areas.

For more information on CSO activities, please visit www.cgiar.org/csos/index.html.

executive summary

of the 2004 cgiar financial results: improvement in the aggregate

The 2004 financial results reported here are based on the audited financial statements of the 15 Centers and four Challenge Programs supported by the Consultative Group on International Agricultural Research (CGIAR). The aggregation, analyses and reports, including this summary, were produced on behalf of the CGIAR Secretariat by the team from the International Center for Tropical Agriculture — Jorge Peña, Yenny Andrade and Yofred Gallego, led by Juan Garafulic, director of finance — working in close collaboration with the CGIAR Secretariat.

Executive Summary of the 2004 CGIAR Financial Results: Improvement in the Aggregate

Members of the Consultative Group on International Agricultural Research (CGIAR) support the CGIAR Centers and programs of their choice. Each Center receives and spends funds autonomously. The 2004 financial outcome[1] discussed here is an aggregation of the audited financial statements of the 15 Centers and the four Challenge Programs supported by the CGIAR.

The review and aggregation of the financial statements have been done according to fiduciary management and reporting standards approved by the CGIAR to guide the Centers in these areas. Additional information on financial compliance is contained in the box at right.

CGIAR's 2004 Financial Goals

As in past years, the CGIAR's financial goals in 2004 were to mobilize sufficient resources to enable it to implement its work program for the year and maintain its strong financial position. The financial goal for 2004, approved at the CGIAR 2003 Annual General Meeting, was to implement an approved work program costing $408 million,[2] of which $392 million was forecast from Members, $11 million from Center income and $5 million from Center reserves.

Overall Financial Outcome

The overall 2004 result shows that the CGIAR surpassed these targets. Total expenditures, including those for Challenge Programs, were $425 million, or 4 percent above the approved target. Member contributions (grant and contract income) amounted to $437 million, which was supplemented by $16 million in Center income, for total financing of $453 million. The result was a surplus of $28 million,[3] which was added to reserves. Overall, the CGIAR's financial position grew stronger by the end of the year as

Compliance with Financial Guidelines

The Centers are institutions governed by their respective boards of trustees. To ensure transparency and consistency in financial practices and the presentation of financial information, the Centers are required to follow financial guidelines issued by the CGIAR Secretariat. Developed with the input of Center finance personnel and external financial experts, these guidelines aim to bring the CGIAR's financial practices into conformity with those generally accepted worldwide.

As part of the annual review of substantive financial performance for a second year, a peer group of finance directors has reviewed the 2004 externally audited financial statements of the Centers to assess their compliance with CGIAR accounting policies and reporting guidelines, and to validate the analysis underpinning the CGIAR financial report. The guidelines (*CGIAR Accounting Policies and Reporting Practices Manual*) were recently updated to adopt international financial reporting standards. The peer review also made a number of recommendations to promote best practice in fiduciary management and financial reporting.

Another mechanism to strengthen accountability within the CGIAR is an initiative to strengthen internal auditing within the System by providing strategic internal audit advice and services to the Centers. The Internal Audit Unit is now part of the System Office. In 2004, three Centers joined the consortium, bringing to 13 the number of Centers participating in this initiative.

confirmed by both short-term and long-term financial indicators. Table A summarizes the approved CGIAR program and the outcome for 2004 by its major components. Highlights of the System's 2004 financial performance are shown in table 1 (page 51), with comparative information for the previous 4 years.

CGIAR Contributions

The year 2004 showed a further increase in aggregate contributions to the System. CGIAR contributions totaled $437 million compared with $381 million in 2003, an increase of $56 million, or 15 percent. Unrestricted contributions totaled $195 million compared with $169 million in 2003, an increase of $26 million or 15 percent. This resulted mainly from the increase from the United Kingdom and its decision to convert previously restricted contributions to unrestricted. Restricted contributions totaled $242 million compared with $211 million in 2003, an increase of $31 million or 15 percent. Of this increase, $11 million was due to Challenge Programs. Restricted contributions to the CGIAR divide into three levels. The least restricted are programs (e.g., Challenge Programs, Systemwide and Ecoregional Programs), which are followed by targeted contributions (e.g., geographic), and the most restricted are projects (usually requiring line-item reporting). In 2004, program-restricted contributions amounted to $20 million, targeted were $24 million and projects were $198 million.

Fifty-nine of the 64 CGIAR Members[4] contributed $397 million (up from $354 million in 2003), and the remaining $40 million came from a broad range of sources including non-member foundations, NGOs and developing countries. Table 2 (page 52) provides a schedule of contributions for 1972-2004 by Member.

As shown in Figure 1 (page 48), the increase in contributions in 2004 came mainly from three Member groups: Europe increased its contributions by $20.5 million (13 percent), North America by $10.3 million (14 percent), and developing countries by $4.2 million (34 percent). Many of the European Members make their contributions in euros and other national currencies, which Centers then convert into US dollars. In 2004 these currencies appreciated against the dollar, though at a slower pace than in 2003.[5] International and regional organizations increased their contributions by $2.7 million (4 percent), Pacific Rim by $1.6 million (6 percent), and foundations by $1.4 million (12 percent). Non-members increased their contributions by $15 million (59 percent).[6]

The increase in contributions from Europe[7] came mainly from the United Kingdom ($8.9 million, or 34

Table A **Summary of 2004 CGIAR Approved Program vs Actual Outcome**
(millions of US dollars)

		Approved at AGM03			Actual Outcome
Expenditures			**Expenditures**		
Center	Programs	386	Center	Programs	406
	Challenge Programs	22		Challenge Programs	14
			Partners	Challenge Programs	5
Total expenditures		**408**	**Total expenditures**		**425**
Financing			**Financing**		
Member funding			Member funding		
Center programs		370	Center programs		418
Center Challenge Programs		22	Center Challenge Programs		14
			Partners Challenge Programs		5
Subtotal Member funding		**392**	**Subtotal Member funding**		**437**
Center income		11	Center income		16
Center reserves		5			
Total financing		**408**	**Total financing**		**453**
			Savings/reserves		**28**

percent), Germany ($3.7 million, or 32 percent), Italy ($2.8 million, or 64 percent), Switzerland ($2.5 million, or 16 percent), Netherlands ($1.7 million, or 9 percent), Sweden ($1.0 million, or 7 percent), Austria ($0.9 million, or 113 percent) and Ireland ($0.8 million, or 31 percent). In North America the increase came from Canada ($11.6 million, or 56 percent). The net increase in contributions from the Pacific Rim came from Australia ($1.5 million, or 21 percent), New Zealand ($0.4 million, or 56 percent) and Korea ($0.3 million or 25 percent).

Contributions from developing countries increased from $12.4 million in 2003 to $16.6 million in 2004. Within this group Nigeria became the largest contributor, although Colombia and India continued to be important as well.

Fifteen contributors accounted for approximately three-quarters of contributions for the research agenda in 2004, two more than in 2003. The United States, contributing $54.2 million, was the single largest contributor, followed by the World Bank ($50 million) and the United Kingdom ($35.3 million). The United States and World Bank held the same rankings in 2003, when the United Kingdom ranked fourth.

Resource Allocation

Total CGIAR expenditures in 2004 (including for Challenge Programs) of $425 million were 8 percent higher than in 2003. Resource allocation at the Centers is largely made at the project level and established by a logical framework. The following paragraphs summarize, at the System and Center level, resource allocations by object of expenditure, output and region.

Distribution among Centers Figure 2 shows the distribution of expenditures by Center in 2004.[8]

Expenditures by Object[9] Overall personnel costs represented 45 percent of total expenditures in 2004, compared with 46 percent in 2003, as shown in figure 3. Total staffing decreased from 7,902 to 7,791 due primarily to reductions at CIMMYT, Africa Rice and ICARDA.

Outputs Illustrative allocations by the five CGIAR outputs — germplasm improvement, germplasm collection, sustainable production, policy, and enhancing national agricultural research systems (NARS) — for 2004 are shown in figure 4. These ratios have remained fairly stable over the 5-year period of 2000-04.

Allocations by Region Illustrative allocations by region appear in Figure 5 (page 50). Expenditures in sub-Saharan Africa increased from $180 million in 2003 to $199 million in 2004, or from 45 percent of the total to 47 percent. Allocations in Asia for 2004 increased by $10 million to $135 million while levels for Latin America and the Caribbean and for Central and West Asia and North Africa remained approximately constant at $54 million and $37 million, respectively.

Center Perspectives

The growth noted at the System level reflects a range of outcomes at the individual Centers. Contributions increased for 12 Centers compared with 14 in 2003. Three of the increases (for IPGRI, CIP, and IFPRI) were over 20 percent. Six (for ICRISAT, IRRI, IITA, CIMMYT, CIAT and ILRI) were between 10 and 20 percent.

Figure 1 **CGIAR Funding**
Millions of US dollars

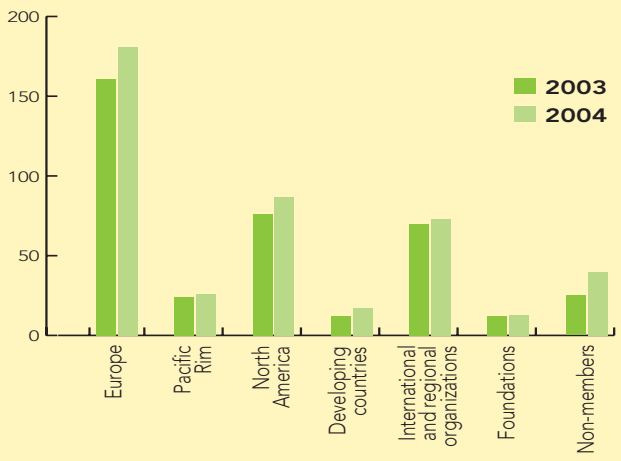


Figure 2 **Expenditures by Center**
Millions of US dollars

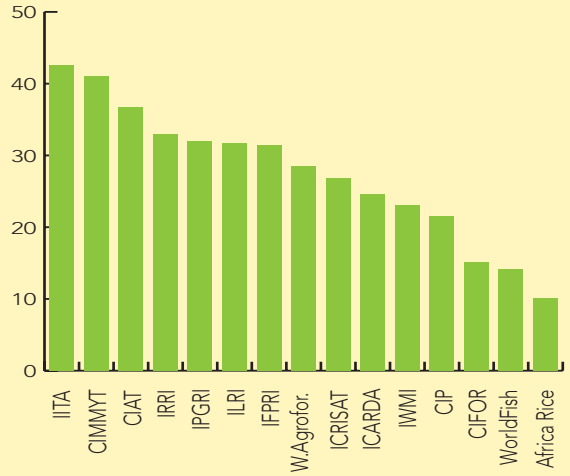


Figure 3 **Expenditures by Object**

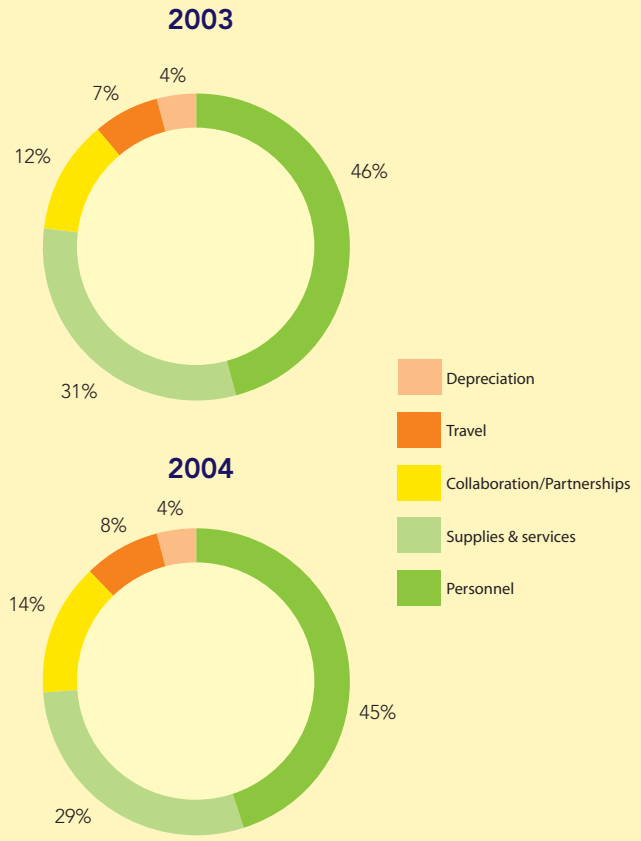
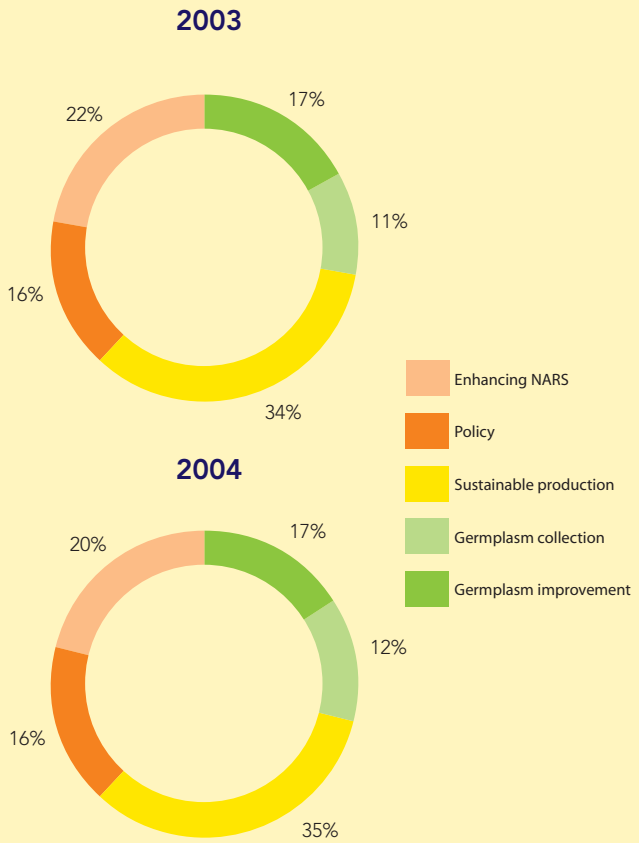


Figure 4 **Expenditures by Output**



Three (for World Agroforestry, CIFOR and IWMI) were under 10 percent. Only three Centers experienced lower contributions. These were WorldFish and ICARDA (each by 2 percent) and Africa Rice (3 percent).

Operational results (contributions and Center income minus expenditures) show that 14 Centers ended the year with surpluses compared with 13 in 2003. As a percentage of total expenditures, three Centers (ICRISAT, IRRI and ILRI) had operational surpluses above 10 percent, five Centers (IPGRI, WorldFish, IFPRI, World Agroforestry and CIP) had surpluses of 5-10 percent, and six Centers (Africa Rice, IITA, CIMMYT, IWMI, ICARDA and CIAT) had surpluses below 5 percent. Only one Center, CIFOR, incurred a deficit. Operational surpluses are the main source from which CGIAR Centers build up reserves.

Table 3 (page 53) provides 2004 and 2003 results of operations by Center and for the System as a whole including results for that portion of Challenge Programs implemented by CGIAR partners. Table 4 (page 54) provides an overview of the System's finances (revenues and expenditures) for 2004.

Table 5 (page 54) summarizes the System's overall financial position for the years 2000 to 2004.

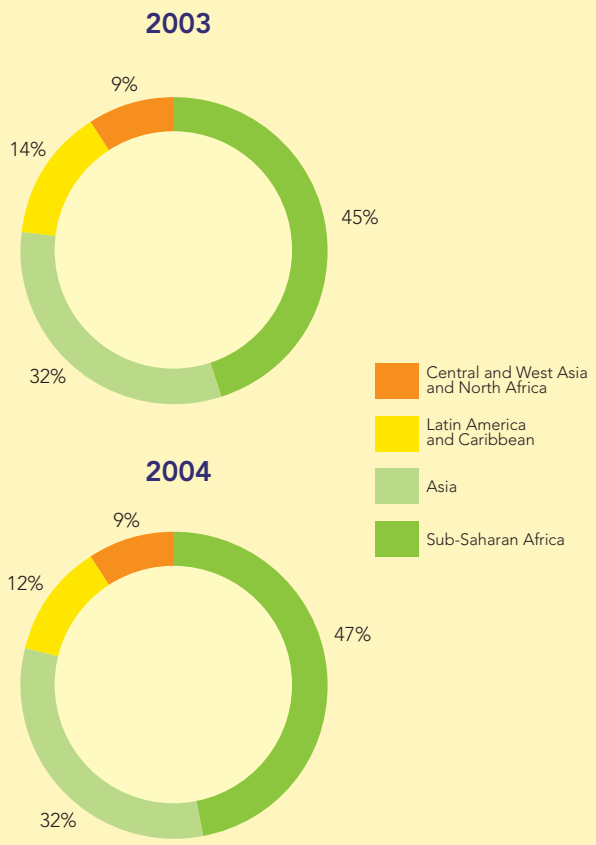
Centers continue their efforts to ensure long-term financial health through full cost budgeting of their restricted projects and other financial management measures.

Summary of Challenge Programs

The Challenge Programs' second full year of implementation was 2004. The data and discussion on Challenge Programs include the Sub-Saharan Africa Challenge Program, which was approved[10] at AGM04.

In 2004, Members and non-members made available $37 million for Challenge Programs compared with $18 million in 2003. Of the $37 million for 2004, $19 million was spent[11] (compared with $8 million in 2003), leaving a balance of $18 million for future implementation.[12] Table 6 (page 56) summarizes Challenge Program resources and expenditures.

Figure 5 **Allocations by Region**



Conclusion

The 2004 results confirm improvement in CGIAR finances in the aggregate. As in the last several years, however, there has been significant variability among the 15 Centers on a number of financial health indicators, suggesting a need for continued vigilance at both the Center and System level. The six Centers[13] whose indicators were borderline or below CGIAR recommended targets in 2003 showed improvement in 2004, though there is still room for improvement for four of them.[14]

Significant variability among the 15 Centers on a number of financial health indicators suggests a need for continued vigilance at both the Center and System level

[1] The results are reported in US dollars.
[2] Of which $386 million was for Center programs and $22 million for the Water and Food CP and HarvestPlus CP. The work program and budget of the Generation CP was still being developed at AGM03 when the 2004 CGIAR Financing Plan was approved. The Sub-Saharan Africa CP was approved at AGM04 with a budget of $2.1 million for 2005.
[3] About $4 million of this was special support for transforming ISNAR into a program.
[4] For presentation purposes, Members are divided into four distinct groups: industrialized countries (24), developing countries (24), foundations (5), and international and regional organizations (11). Industrialized countries are further divided along geographical lines into three subgroups: Europe, North America and Pacific Rim. Two new Members joined in 2004: Gulf Cooperation Council and Turkey.
[5] The impact of foreign exchange gains on 2004 contributions was about $4 million compared with $9 million in 2003.
[6] Most of this increase is attributed to the Bill & Melinda Gates Foundation's support for the HarvestPlus CP.
[7] As indicated in footnote number 5, a portion of the increase was due to foreign exchange gains.
[8] Although aggregate 2004 CGIAR results include figures for ISNAR (for the period 1 January to 31 March), the Center is not shown in this figure of individual Center comparison.
[9] The new CGIAR Accounting Guidelines introduced Collaboration/Partnerships as a fifth object of expenditures. The 2003 data were restated for comparability.
[10] Aggregate CGIAR 2004 results include figures for Generation CP and SSA-CP, which were not included in the program approved at AGM03.
[11] $14 million of Challenge Program components were implemented by Centers and $5 million by CGIAR partners.
[12] With a 2003 balance of $10 million, the cumulative balance for Challenge Programs at year-end was $28 million.
[13] These were CIAT, CIMMYT, IPGRI, IWMI, World Agroforestry and Africa Rice.
[14] CIAT, CIMMYT, IWMI and Africa Rice.

Table 1 CGIAR Program and Resource Highlights / 2000-2004[1]

ACTUAL	2000	2001	2002	2003	2004
Center income (millions of US dollars)					
Agenda funding	331	337	357	381	437
(of which percent unrestricted)	50%	43%	44%	44%	45%
Center earned income	14	16	14	17	16
Total revenue	**345**	**353**	**371**	**398**	**453**
Member funding (millions of US dollars)					
Europe	128	131	147	161	181
Pacific Rim	45	38	26	24	26
North America	54	57	66	76	87
Developing countries	13	13	12	12	17
International and regional organizations	64	64	69	70	73
Foundations	9	12	13	12	13
Non-members	19	23	25	25	40
Total	**331**	**337**	**357**	**381**	**437**
Top three contributors	World Bank United States Japan	United States World Bank Japan	United States World Bank United Kingdom	United States World Bank European Commission	United States World Bank United Kingdom
Staffing (number)					
Internationally recruited staff	1,017	1,013	1,060	1,065	1,063
Support staff	7,649	7,477	6,699	6,837	6,728
Total	**8,666**	**8,490**	**7,759**	**7,902**	**7,791**
Agenda program expenditures by output[2]					
Germplasm improvement	18%	18%	18%	17%	17%
Germplasm collection	10%	10%	10%	11%	12%
Sustainable production	35%	36%	35%	34%	35%
Policy	15%	14%	15%	16%	16%
Enhancing NARS	22%	22%	22%	22%	20%
Total (millions of US dollars)	**339**	**355**	**381[3]**	**395[3]**	**425[3]**
Object expenditures					
Personnel	49%	49%	49%	46%	45%
Supplies/services	39%	40%	40%	31%	29%
Collaboration/partnerships				12%	14%
Travel	7%	7%	7%	7%	8%
Depreciation	5%	4%	4%	4%	4%
Regional expenditures					
Sub-Saharan Africa	42%	43%	43%	45%	47%
Asia	32%	31%	33%	32%	32%
Latin America and the Caribbean	17%	16%	15%	14%	12%
Central and West Asia and North Africa	9%	9%	9%	9%	9%
Result of operations (System level) (millions of US dollars)	**6.6**	**(1.7)**	**(9.6)**	**3.2**	**28**
Center financial information					
Net assets excluding fixed assets (millions of US dollars)	105	100	96	127	156
Liquidity indicators					
Working capital (in days of expenditures)	112	129	125	151	170
Current ratio	1.7	1.9	1.8	1.8	1.9
Adequacy of reserves indicator					
Net assets excluding fixed assets (in days of expenditures)	119	107	96	124	145
Fixed asset indicators					
Capital expenditure (millions of US dollars)	14.9	15.9	9.3	9.7	15.5
Capital expenditure/depreciation	93%	104%	65%	63%	90%

[1] Some information has been restated for clarification.
[2] Starting in 2003 the research agenda is presented in terms of output.
[3] Includes System Office, CGIAR Committees, and disbursements for FARA and Millennium Ecosystem Assessment.

Table 2 CGIAR Funding to the Research Agenda by Member Group 1972-2004
(millions of US dollars)

Members	1972-1999	2000	2001	2002	2003	2004	Total
Europe							
Austria	19.5	1.8	2.1	0.2	0.8	1.7	26.1
Belgium	78.8	4.7	4.5	4.9	6.4	7.0	106.3
Denmark	122.5	11.0	10.6	10.2	9.1	8.2	171.6
European Commission	235.3	22.3	21.7	24.5	27.2	26.3	357.2
Finland	33.1	1.5	1.5	1.5	1.7	1.9	41.2
France	66.7	6.0	6.0	7.8	7.6	6.3	100.4
Germany	268.2	10.2	12.3	10.5	11.6	15.3	328.1
Ireland	9.8	0.8	1.5	2.1	2.6	3.4	20.1
Israel						0.1	0.1
Italy	98.7	3.2	3.7	4.1	4.4	7.2	121.4
Luxembourg	3.4	1.3	0.8	0.8	0.7	0.6	7.5
Netherlands	163.6	13.7	12.2	17.0	19.2	20.9	246.7
Norway	97.4	7.7	8.3	10.4	11.2	11.7	146.7
Portugal	1.1	0.4	0.3	0.3	0.0		2.1
Spain	13.2	1.2	1.2	1.3	2.3	2.3	21.5
Sweden	132.2	9.4	9.2	10.7	13.6	14.6	189.7
Switzerland	214.3	18.3	15.7	16.0	15.6	18.1	298.0
United Kingdom	211.3	14.9	19.2	24.8	26.4	35.3	331.9
Subtotal	**1,769.1**	**128.4**	**130.8**	**146.9**	**160.5**	**181.0**	**2,516.6**
North America							
Canada	285.7	11.4	11.6	10.7	20.9	32.5	372.8
United States	910.7	42.1	45.4	54.9	55.5	54.2	1,162.9
Subtotal	**1,196.4**	**53.5**	**57.0**	**65.6**	**76.4**	**86.7**	**1,535.6**
Pacific Rim							
Australia	102.5	8.5	7.2	7.3	7.3	8.8	141.6
Japan	463.0	34.6	29.2	17.1	15.0	14.4	573.3
Korea, Republic of	5.4	0.9	1.1	1.1	1.2	1.5	11.3
New Zealand	1.1	0.5	0.7	0.7	0.8	1.2	5.0
Subtotal	**572.0**	**44.5**	**38.2**	**26.2**	**24.4**	**25.9**	**731.2**
Developing countries							
Bangladesh	0.5	0.3	0.2				1.0
Brazil	3.4	0.4	0.4	0.9	0.3	0.2	5.5
China	7.2	1.0	0.9	1.0	1.0	1.0	12.0
Colombia	12.3	2.3	2.5	2.5	2.3	1.9	23.8
Côte d'Ivoire	0.7	0.1	0.1	0.0			0.9
Egypt, Arab Republic of	4.9	1.4	1.3	0.8	0.5	0.6	9.5
India	11.8	0.8	0.8	1.0	1.3	1.4	17.1
Indonesia	2.2	0.2	0.3	0.2	0.2	0.2	3.2
Iran, Islamic Republic of	12.2	1.7	1.7	0.9	1.2	1.0	18.7
Kenya	0.9	0.1	0.3	0.2	0.3	0.6	2.4
Malaysia						0.0	0.0
Mexico	7.0	1.8	1.3	0.9	0.7	1.6	13.3
Morocco					0.5	0.5	1.0
Nigeria	14.1	1.0			1.5[1]	4.6	21.2
Pakistan	0.7	0.2	0.6		0.1	0.2	1.8
Peru	0.7	0.2	0.6	0.9	0.4	0.6	3.5
Philippines	6.5	0.4	0.2	0.2	0.2	0.4	7.9
Romania							
Russian Federation	0.2						0.2
Saudi Arabia	5.0						5.0
South Africa	1.6	0.6	0.5	0.8	0.8	0.8	5.1
Syrian Arab Republic	0.5		0.5	0.6	0.5	0.5	2.5
Thailand	0.9	0.1	0.1	0.1	0.1	0.2	1.5
Turkey						0.0	0.0
Uganda		0.3	0.3	0.6	0.6	0.3	2.1
Subtotal	**93.3**	**12.9**	**12.6**	**11.6**	**12.4**	**16.6**	**159.3**
Foundations							
Ford Foundation	54.3	2.6	2.7	1.3	0.8	0.9	62.6
IDRC	31.7	2.3	2.5	2.4	1.9	2.9	43.7
Kellogg Foundation	4.0		0.2	0.3	0.3	0.4	5.1
Rockefeller Foundation	50.3	4.0	6.3	7.5	7.8	8.5	84.4
Syngenta Foundation				1.4	1.1	0.8	3.3
Subtotal	**140.3**	**8.9**	**11.7**	**13.0**	**11.9**	**13.3**	**199.1**
International and regional organizations							
ADB	16.5	6.0	6.9	6.5	6.0	5.0	46.9
AfDB	15.7	1.2	0.3	0.6	0.2	0.4	18.3
Arab Fund	13.9	1.7	1.6	1.0	0.8	1.2	20.2
FAO	1.1	0.2	0.4	1.8	2.0	1.5	6.9
Gulf Cooperation Council						0.1	0.1
IDB	168.7	1.4	0.5	0.5	0.3	0.3	171.7
IFAD	56.1	5.8	6.6	5.8	5.7	6.2	86.2
OPEC Fund	14.1	0.2	0.4	0.2	0.3	0.5	15.7
UNDP	152.7	1.8	1.6	1.5	1.1	1.1	159.7
UNEP	3.5	0.7	0.7	1.3	3.6	6.6	16.4
World Bank[2]	705.8	45.0	45.0	50.0	50.0	50.0	945.9
Subtotal	**1,148.1**	**64.0**	**64.0**	**69.3**	**69.9**	**72.7**	**1,488.0**
Non-members	47.4	19.2	23.1	24.8	25.4	40.4	180.2
TOTAL	**4,966**	**331**	**337**	**357**	**381**	**437**	**6,810**

[1] 2003 revised for correction.
[2] Before 2002 excluded support allocated to the CGIAR Secretariat.

Table 3 Results of Operation by Center/2003-2004
(millions of US dollars)

	2003					2004				
Center	Member funding	Center income	Total revenue	Expenditures	Result	Member funding	Center income	Total revenue	Expenditures	Result
Africa Rice	10.7	0.3	11.0	10.1	0.9	10.4	0.1	10.5	10.1	0.4
CIAT	32.0	1.0	32.9	32.9	0.1	36.3	1.0	37.2	36.7	0.5
CIFOR	13.6	0.2	13.8	13.6	0.2	14.8	0.2	15.0	15.1	(0.1)
CIMMYT	36.2	2.0	38.3	37.5	0.7	41.2	1.3	42.5	41.1	1.4
CIP	18.0	0.4	18.4	17.6	0.9	22.3	0.3	22.6	21.5	1.1
ICARDA	25.4	0.8	26.2	26.2	0.0	24.8	0.5	25.3	24.6	0.7
ICRISAT	23.2	1.4	24.6	24.0	0.6	27.7	2.3	30.1	26.8	3.3
IFPRI	26.5	0.7	27.2	26.5	0.7	32.8	0.8	33.6	31.4	2.2
IITA	36.6	1.3	37.9	37.7	0.2	42.8	1.5	44.3	42.6	1.7
ILRI	29.5	1.6	31.1	31.0	0.1	32.9	2.1	34.9	31.7	3.2
IPGRI	27.9	0.2	28.1	28.3	(0.3)	34.8	0.0	34.8	32.0	2.8
IRRI	27.3	4.8	32.1	28.8	3.3	32.4	4.1	36.4	32.9	3.5
ISNAR [1]	8.3	0.3	8.5	12.8	(4.3)	5.8	0.4	6.2	2.4	3.8
IWMI	22.1	0.2	22.3	23.0	(0.7)	23.6	0.2	23.8	23.1	0.7
World Agroforestry	27.3	0.7	27.9	27.4	0.5	29.7	0.5	30.2	28.5	1.8
WorldFish	14.5	1.4	15.9	15.5	0.3	14.3	0.9	15.2	14.1	1.0
Subtotal	**379.0**	**17.2**	**396.2**	**393.1**	**3.2**	**426.5**	**16.1**	**442.6**	**414.6**	**28.0**
System level										
System Office and committees	7.0		7.0	7.0		9.0[5]		9.0	9.0	
Unallocated Member funding [2]						0.5		0.5		0.5
Subtotal	**386.1**	**17.2**	**403.2**	**400.1**	**3.2**	**435.9**	**16.1**	**452.1**	**424.0**	**28.5**
Less inter-Center activities [3]	(5.2)		(5.2)	(5.2)		(4.7)		(4.7)	(4.7)	
TOTAL	**380.9**	**17.2**	**398.1**	**394.9**	**3.2**	**431.3**	**16.1**	**447.4**	**418.9**	**28.5**
Plus Challenge Programs [4]						5.3		5.3	5.3	
TOTAL CGIAR PROGRAM	**381**	**17**	**398**	**395**	**3**	**437**	**16**	**453**	**425**	**28**

[1] 2004 results are for the period January 1 to March 31.
[2] From Morocco.
[3] Inter-Center activities netted out at the System, not Center, level to maintain the integrity of Center accounts.
[4] Challenge Program components implemented by CGIAR partners.
[5] Increase over 2003 reflects mainly special transitional support to the Science Council.

Table 4 **Center Finances / 2004**
(millions of US dollars)

	Allocations						Revenue										
Center	Germplasm improvement	Germplasm collection	Sustainable production	Policy	Enhancing NARS	Total expenditures	Europe	Pacific Rim	North America	Developing countries	Intl & regnl organizations	Foundations	Non-members	Inter-Center activities	Total funding	Center income	Reserves Addition (+)/ Draw(-)
Africa Rice	1.9	1.0	3.9	1.0	2.3	10.1	5.0	1.9	1.2	0.3	1.5	0.2	0.2		10.4	0.1	0.4
CIAT	11.3	5.4	12.4	2.0	5.5	36.7	11.9	1.6	8.8	2.3	6.4	2.2	2.7	0.3	36.3	1.0	0.5
CIFOR		2.7	7.8	3.4	1.2	15.1	9.0	1.3	1.4	0.2	1.4	0.5	0.8	0.1	14.8	0.2	(0.1)
CIMMYT	12.9	5.9	11.0	1.9	9.4	41.1	10.4	5.1	10.4	2.2	6.9	3.0	2.2	0.9	41.2	1.3	1.4
CIP	5.8	2.4	8.0	2.1	3.2	21.5	13.1	1.1	2.9	0.4	1.9	0.7	2.1	0.1	22.3	0.3	1.1
ICARDA	4.7	3.8	11.4	1.2	3.5	24.6	10.0	1.1	4.5	1.7	4.8	0.1	2.3	0.5	24.8	0.5	0.7
ICRISAT	7.3	1.6	10.2	3.4	4.3	26.8	10.1	1.4	5.0	0.9	6.0	0.9	3.2	0.2	27.7	2.3	3.3
IFPRI		7.8	1.2	13.7	8.6	31.4	12.1	1.0	9.1	0.4	4.5	1.1	3.6	0.9	32.8	0.8	2.2
IITA	8.0	1.4	16.2	6.4	10.6	42.6	13.6	0.4	15.7	4.4	3.3	0.5	4.8	0.1	42.8	1.5	1.7
ILRI	2.4	2.1	20.2	4.0	3.1	31.7	16.9	0.7	7.6	0.7	3.9	0.7	1.8	0.7	32.9	2.1	3.2
IPGRI	5.3	9.3	4.7	3.4	9.3	32.0	17.3	1.6	3.1	0.8	5.6	1.1	4.8	0.4	34.8	0.0	2.8
IRRI	8.0	4.0	10.6	3.8	6.5	32.9	14.6	5.7	5.6	0.6	2.9	0.7	2.2	0.0	32.4	4.1	3.5
ISNAR				1.1	1.3	2.4	1.6		0.5		3.5	0.0	0.1		5.8	0.4	3.8
IWMI			9.6	8.1	5.4	23.1	12.7	1.2	2.5	0.7	5.6	0.3	0.6	0.1	23.6	0.2	0.7
World Agroforestry	1.5	3.0	10.0	6.6	7.4	28.5	15.3	0.9	5.8	0.2	3.1	1.2	2.9	0.3	29.7	0.5	1.8
WorldFish	0.9	0.1	7.8	3.9	1.4	14.1	7.2	0.9	2.7	0.4	2.3	0.1	0.7	0.0	14.3	0.9	1.0
Subtotal	**70.0**	**50.5**	**144.9**	**66.0**	**83.1**	**414.6**	**181.0**	**25.9**	**86.7**	**16.1**	**63.7**	**13.3**	**35.1**	**4.7**	**426.5**	**16.1**	**28.0**
System level																	
System Office and Committees						9.0					9.0				9.0		
Unallocated Member funding [1]										0.5					0.5		0.5
Subtotal	**70**	**51**	**145**	**66**	**83**	**424**	**181.0**	**25.9**	**86.7**	**16.6**	**72.7**	**13.3**	**35.1**	**4.7**	**435.9**	**16.1**	**28.5**
Less inter-Center activities						(4.7)								(4.7)	(4.7)		
TOTAL	**70**	**51**	**145**	**66**	**83**	**418.9**	**181.0**	**25.9**	**86.7**	**16.6**	**72.7**	**13.3**	**35.1**		**431.3**	**16.1**	**28.5**
Plus Challenge Program	1.8	1.8	0.3	0.6	0.9	5.3							5.3		5.3		
TOTAL CGIAR PROGRAM	**72**	**52**	**145**	**67**	**84**	**425**	**181**	**26**	**87**	**17**	**73**	**13**	**40**		**437**	**16**	**28**

[1] From Morocco.

Table 5 **CGIAR System Financial Position, 2000-2004**
(thousands of US dollars)

	2000	2001	2002	2003	2004
Assets					
Current assets					
Cash and cash equivalents	151,327	142,339	149,076	201,662	237,047
Accounts receivable:					
Members	60,823	63,346	72,864	87,768	69,717
Employees	3,499	2,498	3,078	2,797	3,594
Others	13,576	13,342	14,864	14,527	17,147
Inventories	6,506	6,040	4,447	4,165	4,540
Pre-paid expenses	3,069	3,265	3,673	3,262	2,994
Other current assets	5,248	3,515	3,327	4,567	16,924
Total current assets	**244,048**	**234,345**	**251,329**	**318,748**	**351,963**
Non-current assets					
Net property, plant and equipment	98,074	89,058	77,172	79,585	78,433
Investments	25,728	33,495	41,828	37,838	34,985
Others assets					3,012
Total non-current assets	**123,802**	**122,553**	**119,000**	**117,423**	**116,430**
Total assets	**367,850**	**356,898**	**370,329**	**436,172**	**468,393**
Liabilities and net assets					
Current liabilities					
Accounts payable:					
Members	56,658	54,078	78,749	110,925	115,904
Employees	5,369	12,020	11,877	13,805	12,435
Others	29,804	29,192	34,177	47,181	49,216
Accruals and provisions	48,259	47,223	42,377	28,925	24,294
Total current liabilities	**140,090**	**142,513**	**167,180**	**200,836**	**201,849**
Long-term liabilities	**24,899**	**25,814**	**27,906**	**25,876**	**30,486**
Total liabilities	**164,989**	**168,328**	**195,086**	**226,712**	**232,335**
Net assets					
Unrestricted					
Unrestricted net assets *excluding fixed assets*	104,787	99,512	96,039	126,820	155,539
Fixed assets	98,074	89,058	77,172	79,585	78,433
Unrestricted net assets	**202,861**	**188,570**	**173,211**	**206,405**	**233,972**
Restricted			**2,032**	**3,054**	**2,086**
Total net assets	**202,861**	**188,570**	**175,243**	**209,459**	**236,058**
Total liabilities and net assets	**367,850**	**356,898**	**370,329**	**436,172**	**468,393**

Table 6 Summary of Challenge Programs 2004
(millions of US dollars)

Funds Available	HarvestPlus	Water & Food	Generation	SSA	Total
Denmark	0.9	0.4			1.3
European Commission			6.0	0.9	6.9
European Commission[1]			5.2		5.2
France		2.7			2.7
Germany		0.4			0.4
Italy				0.6	0.6
Netherlands		0.7		1.5	2.2
Norway		0.4		0.6	1.0
Pioneer			0.1		0.1
Sweden	0.1				0.1
Syngenta Foundation			0.0		0.0[2]
United Kingdom	0.5	2.3	4.7	1.1	8.5
USA		0.1			0.1
World Bank	2.5	2.5	3.1		8.1
Total[3]	**3.9**	**9.4**	**19.1**	**4.7**	**37.1**

Expenditures	HarvestPlus		Water & Food		Generation		SSA		Total	
	Center	Others	Center	Others	Center	Others	Center	Others	Center	Others
CIAT	1.0		0.2		0.4				1.5	
CIMMYT	0.7				2.0				2.6	
CIP	0.4		0.1		0.4				0.9	
ICARDA	0.1		0.1		0.2				0.4	
ICRISAT	0.3		0.1		0.5				0.9	
IFPRI	1.6		0.1						1.7	
IITA	0.2		0.4		0.3		0.1		1.0	
ILRI							0.3		0.3	
IPGRI	0.0				1.0				1.0	
IRRI	0.4		0.7		0.7				1.9	
IWMI			2.0						2.0	
WorldFish			0.2						0.2	
Total[3]	**4.5**	**2.4**	**3.9**	**1.9**	**5.4**	**1.1**	**0.4**		**14.3**	**5.3**
		6.9		**5.8**		**6.5**		**0.4**		**19.6**
2004 Balance	**(3.0)**		**3.6**		**12.6**		**4.3**		**17.5**	
2003 Balance[4]	**8.0**		**1.8**		**0.1**		**0.6**		**10.5**	
Cumulative balance	**5.0**		**5.4**		**12.7**		**4.9**		**28.0**	

[1] For 2003.
[2] Amount is $0.015 million rounded to one decimal place.
[3] Totals may not add up due to rounding.
[4] 2003 balance includes major contributions from the Bill & Melinda Gates Foundation, Netherlands, Switzerland and Norway.

who's who in the cgiar in 2004

The CGIAR Members

as of December 2004

Countries	Representatives	Cooperating Institutions
Australia	Peter Core	Australian Centre for International Agricultural Research
Austria	Marcus Heinz	Federal Ministry of Finance
Bangladesh	M.A. Hamid Miah	Ministry of Agriculture
Belgium	Luc Sas	Ministry of Foreign Affairs
Brazil	Clayton Campanhola	Ministry of Agriculture and Food Supply, EMBRAPA
Canada	Bruce Montador	Canadian International Development Agency
China	Lijian Zhang	Ministry of Agriculture
Colombia	Luis Arango-Nieto	Ministry of Agriculture and Rural Development
Côte d'Ivoire	Kassoum Traore	Ministry of Agriculture and Animal Resources
Denmark	Finn Norman Christensen	Ministry of Foreign Affairs, DANIDA
Egypt, Arab Republic of	Badawi El-Tantawi	ARC, Ministry of Agriculture and Land Reclamation
Finland	Ulla-Maija Finskas	Ministry of Foreign Affairs
France	Denis Despreaux	Ministry of National Education and Research
Germany	Hans-Jochen de Haas	Federal Ministry of Economic Cooperation and Development
India	Mangala Rai	Ministry of Agriculture, ICAR
Indonesia	Hadi Pasaribu	Ministry of Agriculture and Forestry
Iran, Islamic Republic of	Ali Ahoonmanesh	Ministry of Agriculture
Ireland	Brendan Rogers	Department of Foreign Affairs
Israel	Nachman Paster	Ministry of Agriculture
Italy	Gioacchino Carabba	Ministry of Foreign Affairs
Japan	Hayato Nakajima	Ministry of Foreign Affairs
Kenya	Wilfred Mwangi	Ministry of Agriculture and Rural Development
Korea, Republic of	Kyung-Han Ryu	Ministry of Agriculture
Luxembourg	Georges Heinen	Ministry of Finance
Malaysia	Saharan Anang	Malaysian Agricultural Research and Development Institute
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Acronyms and Abbreviations

ACICAFOC	Asociación Coordinadora Indígena y Campesina de Agroforstería Comunitaria Centroamericano (Central American Indigenous and Peasant Coordinator of Communal Agroforestry)
ACOFOP	Asociación de Comunidades Forestales de Petén (Association of Forest Communities of Petén), Guatemala
ADB	Asian Development Bank
AE	Alliance Executive (Executive of the Alliance of the Future Harvest Centers of the CGIAR)
AFDB	African Development Bank
AGM	Annual General Meeting of the CGIAR
BAC	bacterial artificial chromosome
CBC	Committee of Board Chairs of the CGIAR
CDC	Center Directors Committee of the CGIAR
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture), Colombia
CIFOR	Center for International Forestry Research, Indonesia
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo (International Maize and Wheat Improvement Center), Mexico
CIP	Centro Internacional de la Papa (International Potato Center), Peru
CIRNMA	Centro de Investigación de Recursos Naturales y Medio Ambiente (Center for Research on Natural Resources and the Environment), Peru
CP	Challenge Program of the CGIAR
CSO	civil society organization
CWANA	Central and West Asia and North Africa
DANIDA	Danish International Development Agency
DSAP	Development of Sustainable Aquaculture Project, Bangladesh
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Research Corporation)
ExCo	Executive Council of the CGIAR
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
FEDEPLATANO	Federacion de Productores de Platano (Federation of Plantain Producers), Colombia
G&D	Gender and Diversity Program of the CGIAR
GRPC	Genetic Resources Policy Committee of the CGIAR
IAU	Internal Audit Unit of the CGIAR
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Areas, Syria
ICRAF	World Agroforestry Centre, Kenya
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India
ICT-KM	Information and Communication Technologies and Knowledge Management
IDB	Inter-American Development Bank
IFAD	International Fund for Agricultural Development

IFPRI	International Food Policy Research Institute, United States
IITA	International Institute of Tropical Agriculture, Nigeria
ILRI	International Livestock Research Institute, Kenya and Ethiopia
INIA	Instituto Nacional de Investigación Agraria (National Institute of Agrarian Research), Peru
INRA	Institut National de la Recherche Agronomique (National Agricultural Research Institute), Morocco
IPGRI	International Plant Genetic Resources Institute, Italy
IRRI	International Rice Research Institute, Philippines
IRS	internationally recruited staff of CGIAR Centers
ISNAR	International Service for National Agricultural Research, Netherlands
IWMI	International Water Management Institute, Sri Lanka
JIRCAS	Japan International Research Center for Agricultural Sciences
MTP	medium-term plan
NARS	national agricultural research systems
NERICAs	New Rices for Africa
NGO	nongovernmental organization
OECD/DAC	Organisation for Economic Co-operation and Development/Development Assistance Committee
OPEC	Organization of Petroleum Exporting Countries
PCaC	Programa de Campesino a Campesino (Farmer to Farmer Program), Nicaragua
RIMISP	Centro Latinoamericano para el Desarrollo Rural (Latin American Center for Rural Development), Chile
SARA	Social Association for Rural Advancement, Bangladesh
SAS-HR	Strategic Advisory Service on Human Resources of the CGIAR
SIDA	Swedish International Development Cooperation Agency
SPIA	Standing Panel on Impact Assessment of the CGIAR
SPME	Standing Panel on Monitoring and Evaluation of the Science Council of the CGIAR
SPMS	Standing Panel on Mobilizing Science of the CGIAR
SPPS	Standing Panel on Priorities and Strategies of the CGIAR
SSA	Sub-Saharan Africa
SSA-CP	Sub-Saharan Africa Challenge Program of the CGIAR
SSNM	site-specific nutrient management
TIGR	The Institute for Genomic Research
UK	United Kingdom
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
US, USA	United States of America
WARDA	Africa Rice Center (West Africa Rice Development Association), Benin

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