

Centro Internacional de Agricultura Tropical



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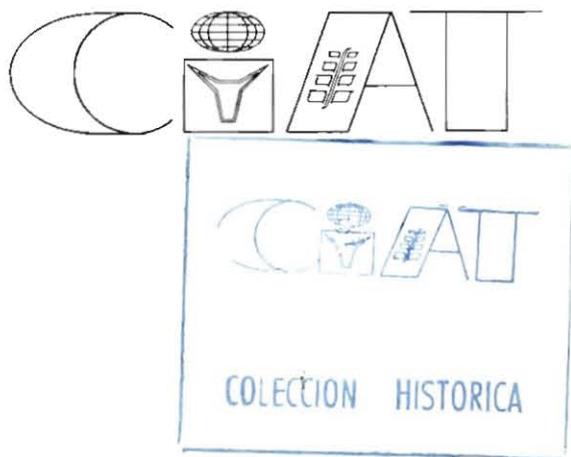
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Proceedings

10th Anniversary

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Centro Internacional de Agricultura Tropical



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Proceedings

10th Anniversary



SERVICIOS REFERENCIALES Y BIBLIOGRAFICOS

Centro Internacional de Agricultura Tropical
CIAT
Apartado Aéreo 6713
Cali, Colombia

March 1984
1400 cc., English; 1100 cc., Spanish

Printed in Colombia

Correct citation:

Centro Internacional de Agricultura Tropical. 1984. Proceedings 10th Anniversary. Cali, Colombia. 92 p.

Cataloguing information:

1. Centro Internacional de Agricultura Tropical — Anniversary. 2. Agriculture — Research — Congresses, conferences, etc. 3. International agricultural cooperation — Congresses, conferences, etc. I. Centro Internacional de Agricultura Tropical.

CIAT is a nonprofit organization devoted to the agricultural and economic development of the lowland tropics. The government of Colombia provides support as host country for CIAT and furnishes a 522-hectare site near Cali for CIAT's headquarters. In addition, The Colombian Foundation for Higher Education (FES) makes available to CIAT a 184-hectare substation in Quilichao and a 73-hectare substation near Popayán; the Colombian Rice Growers Federation (FEDEARROZ) also makes available to CIAT a 30-hectare farm—Santa Rosa substation—near Villavicencio. CIAT also co-manages with the Colombian Agricultural Institute (ICA) the 22,000-hectare Carimagua Research Center in the Colombian Eastern Plains and carries out collaborative work on several of ICA's experimental stations in Colombia; similar work is done with national agricultural agencies in other Latin American countries. CIAT is financed by a number of donors represented in the Consultative Group for International Agricultural Research (CGIAR). During 1983 these CIAT donors were the governments of Australia, Belgium, Canada, France, the Federal Republic of Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, and the United States; the World Bank; the Inter-American Development Bank (IDB); the European Economic Community (EEC); the International Fund for Agricultural Development (IFAD); the OPEC Fund for International Development; the Ford Foundation; and the Rockefeller Foundation. In addition, special project funds were supplied by various of the aforementioned donors plus the W. K. Kellogg Foundation, the German Agency for Technical Cooperation (GTZ), the International Fertilizer Development Center (IFDC), the United Nations Development Programme (UNDP), and the International Development Research Centre (IDRC).

Information and conclusions reported herein do not necessarily reflect the position of any of the aforementioned entities.

Foreword

The dedication of the CIAT facilities ten years ago marked the beginning of a new era. Five years of intensive efforts involving negotiations, agreements, election of a Board, recruitment of staff, development of research and training programs, and a major construction effort had been completed. Now with the new buildings and equipment in place there was great hope that rapid progress would be made in the accomplishment of the Center's bold and noble objectives.

These 10th Anniversary celebrations honored the people and organizations who helped make this hope a reality. During the week of October 10, 1983, we welcomed back some of the pioneers who built this Center, along with the representatives of the national research systems, with which the Center has been developing its cooperative programs, and representatives of the organizations that are funding these operations. We wished to recognize the contributions of the founders, seek the advice of our collaborators, and thank our donors. We wished them to share with us the wonder and excitement of the results now coming out of the programs they helped us build on the solid foundations laid by dedicated men and women ten years ago.

Through these Proceedings of the 10th Anniversary, we now share with you a record of these days of celebration.

We have included in these pages the complete texts of the messages presented during the Symposium and the formal Acts of Commemoration, as well as the program, a summary of the activities from a previously published issue of *CIAT International*, a photo collage of memories, and several examples of the multitude of articles that appeared in the Colombian press.

The work in the years ahead will surely be challenging; but there will also be moments like this when we will be able to meet and join in the common satisfaction of having committed our lives to such a humanistic enterprise.



John L. Nickel
Director General

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Overview of the Week's Events



Reprint:

CIAT INTERNATIONAL

Report of Research and International Cooperation

On 12 October 1983, CIAT celebrated the 10th anniversary of the inauguration and dedication of the facilities at Palmira, Colombia.

The week-long set of activities brought together employees and staff, members of the Cali and Palmira area, national program leaders and government officials, founders, and representatives of the international donor community in a tribute to and evaluation of CIAT's contribution to the application of modern agricultural science in alleviating the world's hunger. In addition, those who conceived, founded, and implemented CIAT were honored.

At the Acts of Commemoration, John L. Nickel, Director General, acknowledged the vision of the founders of the Center with the following statistics of the results of CIAT's labors:

Many farmers now have bean varieties with higher yields and the need for fewer applications of pesticides. They now have available new varieties and agronomic practices that triple cassava yields. Rice yields have increased by 50% in more than 20 countries. New pastures are opening a totally distinct horizon in the development of this continent's frontier. National research institutions have been strengthened by 2500 professionals who have received training at the Center. . . Nevertheless,

there are still people dying of hunger, and they are dying needlessly. . . Therefore, this is not simply a commemoration of the inauguration of these buildings but a call to all of us for renewed dedication to the enormous task we have in front of us.

CIAT was born in 1967, when the original proposal written by Lewis M. Roberts, then of the Rockefeller Foundation, and Lowell S. Hardin, formerly of the Ford Foundation, was accepted by those two organizations and the Colombian government, then under the leadership of President Carlos Lleras Restrepo. The first years, under founding director Ulysses J. Grant, were a period of building resources. Headquarters facilities were in "El Porvenir," a small group of buildings on land provided by ICA, the Colombian National Agricultural Research Institute, and programs were disciplinary, in the suggested crops of a legume for human consumption, forage legumes and grasses, and limited work in rice and maize through collaborative programs with the already existing IIRI and CIMMYT.

By 12 October 1973, CIAT had moved into the uniquely designed "arches" of CIAT-Palmira headquarters, which have become a symbol of its support and strength. On 19 November 1974, John L. Nickel was named Director General.

The programs have reorganized into multidisciplinary teams of scientists working as partners in research with trained scientists in the national programs. In 1969, the programs included rice, swine and beef cattle production; in 1971, the cassava program was initiated, and in 1972-73, the bean program. All were production-system oriented. Today, CIAT has worldwide responsibility for beans and regional responsibilities for tropical pastures, rice, and cassava. The Seed Unit serves all four commodities. There are now 92 senior scientists from 24 countries and 1200 support staff, mostly Colombians. Crop and resources research is conducted at the CIAT-Palmira headquarters, as well as at the four substations in Colombia (beans at Popayan and Quilichao, rice at Santa Rosa, pastures and cassava at

Continued on p.2



Centro Internacional de Agricultura Tropical (CIAT)

Anniversary Edition

Continued from p. 1

Carimagua) and in the networks of regional trials throughout Latin America, Asia, and Africa.

With the strengthened capacity of researchers in the national programs, CIAT is now fast approaching the stage in which the firmly established international research networks become international research programs of mutually independent factors.

Participants at the 10th anniversary celebrations included 36 representatives of

national programs in Latin America, Africa, and Asia; 14 founders; 11 representatives of collaborating institutions on the world and regional levels; 10 CIAT donor agencies, 13 members of the Board of Trustees; and governmental, civil, and ecclesiastical authorities in Colombia.

Events included the National Consultation Workshop (Monday and Tuesday); Founder's Banquet (Tuesday); Symposium on the Challenge of Agricultural Research in the Tropics (Wednesday); Acts of Commemoration of the 10th Anniversary (Wednesday); and

field trips to the Quilichao, Popayan, Carimagua, and Palmira research stations (Thursday and Friday).

The consensus at the end of the week was that, although CIAT is living up to the expectations of its creation, now is no time for complacency. International research institutions still have a tremendous responsibility in helping feed the millions of hungry people in the world.

The 10th anniversary celebration was simply an occasion to stop and look back, look ahead, and renew vigor for the next day of work.★

Consultation Workshop: 10–11 October

National Program Leaders Convene at CIAT

Thirty-six leaders of national agricultural research programs in Latin America, Asia, and Africa participated in the Consultation Workshop, along with international donors, in the discussion of the direction and impact of CIAT's research. In addition, CIAT Program Coordinators and Administration briefed them on the present research of each of CIAT's commodities.

The welcoming speech by John Nickel contained a description of CIAT's international cooperation strategy, which he summarized by the words *complementarity, cooperation, and consultation*.

"No one institution, especially the IARCs, can do it alone," he stressed. To alleviate hunger and poverty, he said, it is necessary to work together in a complementary fashion, while exploiting the comparative advantage of each organization. Cooperation basically takes the form of a research network of collaboration and outposting of liaison staff; and consultation stresses the importance of national research leaders advising and counseling on CIAT's goals, achievements, and future plans.

Gustavo Nores, Director of Resources Research and International Cooperation, CIAT, discussed commodity research networks, their importance, foundations, and characteristics of operation. Douglas R. Laing, Director of Crops Research, CIAT, spoke about decentralization as a key factor for collaborative research and presented some background, achievements, and ideas for decentralization activities and strategies.

Representing the national program leaders, Jesús Moncada de la Fuente, Director General of the National Institute of Agricultural Research (INIA), Mexico, addressed the role and expectations of national institutions in collaborative research. In a paper presented by Angel Ramos, Moncada recalled that national programs work on producer problems, mostly of regional importance.



"We have neither the time nor the resources to explore other scientific aspects, no matter how interesting or important they may appear to be," said Moncada. "That is why collaborative projects are or should be an important component in achieving technological advances. . . . [We benefit from] using technology generated at the international centers and adapting it to the conditions of our ecological areas; using germplasm of various species; and having our human resources trained [by the centers]. National programs, such as INIA, provide their infrastructure, resources, and personnel to consolidate cooperative programs of mutual benefit."

Moncada pointed out that it was important to *do* together, neither agency trying to boss the work, and to design mechanisms to bring closer those who generate knowledge. He showed interest in aspects such as water management and drought studies. Finally, he recommended that national programs stress generation, diffusion, validation, and regional transfer of production technologies, and that the international centers generate consolidating knowledge that explores the frontiers of science. This should be made, he said, without overlooking the socioeconomic component and the multidisciplinary mechanisms of efficiency.★



CIAT scientists (*top*) were briefed on national program activities and needs for collaborative research. Participants also had the opportunity to meet in informal discussions: Armando Samper, Gustavo Barney, Jorge Ortiz Méndez (*middle*) and Pat Barnes McConnell, M. Sall, Renovat Baragengana (*bottom*).

Recent Special Donations Recognized



Kellogg Auditorium in Process: James Richmond, Vice-President of the Kellogg Foundation, assisted in unveiling the mock-up of the new 200-seat W.K. Kellogg auditorium, recently funded at US\$500,000.

"It was one key item from the master plan that we had not been able to build," said John Nickel in his speech thanking the Kellogg Foundation. He reported that final plans are ready to seek bids for the construction and building will start very soon. The work will be a remodeling of the present amphitheatre into a facility with related furniture and audiovisual equipment to hold major international conferences and similar events.

(Left to right: Warren Baum, John Nickel, Richmond, and Rodrigo Lloreda.)



Electronmicroscope Received from Japanese: "You may find it surprising that an international center striving for excellence in agricultural research would have gone for 10 years without an electronmicroscope," said John Nickel while thanking the Japanese Government, represented by the Ambassador to Colombia, The Honorable Hiroshi Nagasaki, for their recent donation of an electronmicroscope worth over US\$120,000.

The microscope can magnify up to 200,000 times, compared to current microscopes used at CIAT which magnify about 2000 times. The microscope will be administrated by the virology section of the Bean Program, although its use will be open to all programs in the Center for virology and plant pathology research.

(Left to right: Nagasaki; John L. Nickel; Francisco Morales, bean virologist, CIAT; and K Aoyagi, technician from JEOL, Japan.)

Plaques Unveiled



A plaque was presented by the National Agricultural Research Programs of Latin America and the Caribbean to the Colombian Government and the CGIAR for their support of CIAT.

(Left to right: Rodrigo Lloreda, Colombia's Minister of Foreign Relations; Doris Eder de Zambrano, Governor, Valle del Cauca; Eduardo Alvarez Luna, Agricultural Research and Development Director, Alimentos del Fuerte S.A., México; and José Prazeres Ramalho de Castro, Executive Director, EMBRAPA, Brazil.)



Another plaque distinguishing Carlos Lleras Restrepo, who contributed to the creation of CIAT as then president of Colombia, was presented by CIAT.

(Left to right: Armando Samper, CIAT founder and Chairman Emeritus of the Board of Trustees; Lloreda; and John L. Nickel.)

CIAT INTERNATIONAL

partado Aéreo 6713
Bogotá, Colombia

Cynthia L. Garver, Editor
Rodrigo Ferreros, Writer
Alexandra Walter, Production Editor
Carlos A. Rojas, Graphic Artist
CIAT Graphic Arts, Printing

CIAT International is published four times a year to highlight results of research in progress and international collaboration. CIAT is a nonprofit organization devoted to the agricultural and economic development of the lowland tropics, financed by a number of donors represented in the Consultative Group for International Agricultural Research (CGIAR). During 1983, these CIAT donors are the Rockefeller Foundation, the Ford Foundation, the World Bank, the Inter-American Development Bank, the European Economic Community, the International Fund for Agricultural Development, the OPEC Fund for International Development, and the governments of Australia, Belgium, Canada, France, the Federal Republic of Germany, Japan, the Netherlands, Norway, Spain, Switzerland, the United Kingdom, and the United States. In addition, special project funds are supplied by these various donors and the Kellogg Foundation, the International Development Research Centre, and the United Nations Development Programme.

Information and conclusions reported herein do not necessarily reflect the position of any of the aforementioned agencies, foundations, or governments.

Acts of Commemoration: 12 October

Formal Acknowledgment of Support for Center Operations

Representatives from the World Bank, the UNDP, FAO, the Colombian government, and CIAT participated in the observance of the commemoration of the inauguration and dedication of CIAT's facilities on Wednesday evening.

After special unveiling of recent donations (see box p. 5) as a thanks to all of CIAT donors, John L. Nickel opened the formal events by recognizing the support and assistance of the founding and donor agencies.

Warren Baum, Vice President of the World Bank and Chairman of the CGIAR, provided an overview of CGIAR and explained CIAT's conception and current mandate. He expressed his wish to see more of the research network that is being woven, recognized his privilege to have served in the cause, and thanked CIAT and the Colombian government for their commitment.

William T. Mashler, Senior Director of UNDP's Division for Global and Interregional Projects, reviewed the history of CIAT and the contribution that UNDP is making to the system, from about \$0.5 million in 1971 to some \$8 million annually by 1983. He spoke about the importance of technical cooperation between developing countries and increasing the networking of research, and described UNDP's involvement in it. He concluded by thanking John L. Nickel and Reed Hertford, Chairman of CIAT's Board of Trustees, for their work at and for CIAT, and the Colombian government for its support to the enterprise.



"[CIAT's] donors... fund our core budget of almost US\$20 million per year, for our international operations. ...In a few words, we are extremely thankful for these generous donations..."

—Reed Hertford, Chairman, CIAT's Board of Trustees

Hertford explained how the Board of Trustees carries on its work to ensure a responsible direction. He noted that the Board felt responsible to the donors, Colombia, the CGIAR, CIAT personnel, and the national research programs. Collaboration with the latter was highlighted as

particularly important in the process of transferring agricultural development.

Emilio Trigueros, Latin America representative of FAO, spoke on behalf of the institution's Director General and Assistant Director General. He acknowledged the cooperation taking place between FAO and CIAT and the importance of training and strengthening national research capacities even with the present budget cuts. He noted some of CIAT's achievements and congratulated the Center and Colombia for hosting it.

Rodrigo Lloreda, Colombian Minister of Foreign Affairs, reminisced about the years of formation of CIAT, eloquently applauded the work CIAT is doing, and spoke of the urgency to work for the needy (see story p. 6).★



William Mashler (speaking, left photo) reviewed UNDP contributions. (Left to right: Reed Hertford, Rodrigo Lloreda, John Nickel, Doris Eder de Zambrano, Mons. J.M. Escobar, Warren Baum, Emilio Trigueros.) Warren Baum (speaking, right photo) explained CIAT's mandate within the CGIAR system. (Left to right: Mashler, Hertford, Lloreda, Nickel, de Zambrano).



Symposium—The Challenge for
Agricultural Research: 12 October

National Leaders and International Donors Stress Need to Continue



A highlight of the celebration of the 10 years of CIAT's present plant was the day-long symposium on the challenge and role of agricultural research in tapping the potential of the lowland tropics.

In welcoming the participants, CIAT Director General, John L. Nickel, paralleled the 1983 symposium to one that was held 10 years ago. "On that occasion," he said, "renowned international personalities . . . addressed a group of scientific and political leaders from around the world on this important subject . . . Now, 10 years later, it seems appropriate to continue on a similar theme. . . ."

Lewis M. Roberts one of the two co-authors of the 1967 position paper that conceptualized CIAT, presided over the meeting. Lowell S. Hardin, the other co-author, in an address entitled "CIAT as originally conceived and CIAT today," spoke about the reasons that moved their institutions (Rockefeller and Ford Foundations) to launch what he termed "the CIAT experiment."

Hardin described the project's rationale, the reasons for its shaping, and its evolution, and defined the limitations encountered in the process of development as the region's heterogeneity, the need to benefit the poorer farmers, and the need to optimize scientific talent and resources allocation. CIAT's research is already impacting on the whole of society, and Hardin recommended that more investment be made in assessing that impact. He presented three puzzles for consideration: (1) How far should a research institution go into promoting adoption of the technology it generates?

(2) How far should it go in decentralizing research? and (3) What role should research play in the small- versus large-farm problem? Hardin concluded that CIAT is not becoming an "ossified institution that the world is littered with," as John Knowles, then president of the Rockefeller Foundation, warned in the inauguration symposium.

In a presentation titled, "The role of agricultural research in economic development," Laurence D. Stifel discussed the proposition that biological science is an efficient source of economic growth, although agriculture had earlier been considered a "stagnant backwater" in the process of development. He described the expansion of expenditures in research by third world countries and described the impact that CGIAR-oriented research is producing in the third world. He pointed to what he called "second-generation problems" of science-based technology, including the issue of social equity in the distribution of benefits, the rising cost of maintenance research, and the difficulty of attracting adequate funding to sustain and expand the benefits of agricultural research.

"One can now confidently say that a quiet revolution in agriculture has begun in the Third World that is likely to have more dramatic effect on more human beings than any revolution that has gone before."

—Richard Critchfield, quoted by Laurence Stifel.

In the latter part of his presentation, Stifel spoke about the current trends in agricultural research and highlighted the importance that genetic engineering, now in its early stages, may have in future varieties improved through DNA and gene manipulation methods. He recommended that the CGIAR system sharpen its research priorities to justify the continued flow of resources to this field and cited the necessity for investing more in agricultural research.

Roberto Junguito, former Minister of Agriculture of Colombia and now Ambassador of this country to the European Economic Community, gave a presentation entitled "Why developing countries should invest in agricultural research," describing the importance that agriculture has in the process of economic development and justifying biological research for developing third world countries. He described some of the barriers that impede third world countries in investing more heavily in research despite the high returns on the investment. And he referred to the problem of appropriation of the benefits of research and how the international research center scheme is useful for providing economies of scale and optimizing resources allocation by individual countries, especially for those food crops that are grown for domestic consumption. After an economic justification of the centers, Junguito concluded by pointing out some of the advantages of international centers and urged governments and institutions to provide the centers with the resources necessary to fulfill their goal.★

Colombian Government Sends Message of Support and Friendship

The Colombian government has supported CIAT since its beginnings in 1967. President Carlos Lleras Restrepo actively assisted in the Center's founding; President Misael Pastrana Borrero pledged the country's friendship in a tree-planting ceremony on CIAT grounds during the inauguration ceremonies in 1973; and President Belisario Betancur sent a message of support during the 10th anniversary celebration in 1983.

"The Colombian government totally supports the research carried out at CIAT in the search for improved nutritional conditions for low-income groups in Latin America and the Caribbean," said Rodrigo Lloreda Caicedo, Minister of Foreign Relations, who as governor of the Valle del Cauca in 1968 participated in land acquisition for CIAT facilities.

At the Acts of Commemoration, Lloreda, representing President Belisario Betancur, described CIAT's founding and honored Lleras Restrepo for his determination in making the project a reality. He defined CIAT as a "scientific enterprise of wide economic projection" and a "technological effort of deep social content."

Lloreda pointed out that CIAT has been a pioneer in carrying out a philosophy of providing low-input, technical know-how in the crops that most contribute to the dietary balance of tropical countries. He said that this work is being done "quietly and effectively, like a good seed, which is silently spread and after some time it sprouts splendorous." In addition, he said:

In a world where 25% of the population are affected by some degree of malnutrition and 10% are chronically affected by it, it is



CIAT Receives Merit Award from the Colombian Government: On behalf of the Colombian President, Belisario Betancur, the Minister of Foreign Relations, Rodrigo Lloreda Caicedo (*speaking above*), decorated CIAT with the merit award, *Orden al Mérito en el Grado de Cruz de Plata* (*right*), upon consideration of "...its contribution to agricultural development of Colombia, the impulse that it has given to agroindustrial production, and its work in training a great number of researchers..." The decoration of award took place during the commemoration ceremonies on October 12.



stimulating to know that not all research efforts are aimed at producing weapons or satisfying luxurious appetites, but that there are also men and institutions that occupy themselves with the basic needs of the human being.

In criticizing the great expenditures (over \$600 billion) that are made in the world for purposes of war, Lloreda reported that this figure exceeds the total foreign debt of developing countries and surpasses all the direct and indirect aid of private and public

agencies budgeted for world development organizations.

He recalled the need for developing countries to exchange technical and institutional experiences with countries of similar development status.

Lloreda concluded with the message of friendship and support from Colombian President Betancur to CIAT and its donors, particularly those represented at the 10th anniversary celebrations. ★

CIAT International
Apartado Aéreo 6713
Cali, Colombia

Program of Activities



Program

Program Overview

Monday

10 Oct.

Consultation Workshop on research and international cooperation

Tuesday

11 Oct.

Consultation Workshop (cont.)

Banquet in honor of CIAT's founders

Wednesday

12 Oct.

Symposium: The challenge for agricultural research in the tropics

Acts of Commemoration of the 10th Anniversary

Thursday

13 Oct.

Field trip to Quilichao and Popayan substations

or individual consultations at CIAT headquarters

Friday

14 Oct.

Field trip to Carimagua National Research Center:

or Field trip to Palmira headquarters

or individual consultations at CIAT headquarters

Consultation Workshop

Welcome: CIAT's philosophy of research and international cooperation

John L. Nickel
CIAT

Expectations and role of national institutions in collaborative research

Jesús Moncada
INIA, México

International cooperation between national institutions and CIAT

Gustavo A. Nores
CIAT

Presiding

Efraín Pinto
ICTA, Guatemala

Research in field beans, progress and future plans
Discussion

Aart van Schoonhoven
CIAT

	<i>Presiding</i>	José Ramalho EMBRAPA, Brasil
Research in cassava, progress and future plans <i>Discussion</i>		James H. Cock CIAT
	<i>Presiding</i>	Alfredo Montes INIPA, Perú
Research in rice, progress and future plans <i>Discussion</i>		Joaquín González CIAT
	<i>Presiding</i>	Fernando Gómez ICA, Colombia
Research in tropical pastures, progress and future plans <i>Discussion</i>		José M. Toledo CIAT
	<i>Presiding</i>	Emilio Madrid INIA, Chile
Training: The need for a concerted plan to strengthen national research programs <i>Discussion</i>		Fernando Fernández CIAT
Seeds: A vehicle for delivery of technology <i>Discussion</i>		Johnson E. Douglas CIAT
Information services: An essential mechanism in the communication with national institutions <i>Discussion</i>		Susan C. Harris CIAT
	<i>Presiding</i>	Eduardo Alvarez
Decentralization: A key factor in collaborative research <i>Discussion</i>		Douglas R. Laing CIAT
	<i>Presiding</i>	John L. Nickel CIAT
General discussion on the role of CIAT in relation to national and regional programs		

Founders' Banquet

<i>Master of Ceremonies</i>		Armando Samper Chairman Emeritus of the Board
Recognition of founders		John L. Nickel CIAT
Cutting of the anniversary cake and toast to the founders		
Statement on behalf of CIAT founders		Ulysses J. Grant Founding Director General of CIAT
Statement on behalf of the Government of Colombia		Gustavo Castro The Honorable Minister of Agriculture of Colombia

Symposium: The Challenge for Agricultural Research in the Tropics

Opening remarks	John L. Nickel CIAT
	<i>Presiding</i> Lewis M. Roberts
CIAT as originally conceived and CIAT today: mandate, objectives and achievements	Lowell S. Hardin Purdue University
The role of agricultural research in economic development	Laurence D. Stifel Rockefeller Foundation
	<i>Presiding</i> Reed Hertford Board of Trustees
Why developing countries should invest in agricultural research	Roberto Junguito Ambassador of Colombia to CEE
Closing remarks	Reed Hertford Board of Trustees

Commemoration Ceremonies

Special Events

	<i>Presiding</i> John L. Nickel CIAT
Recognition of recent special contributions W. K. Kellogg Auditorium	James Richmond W.K. Kellogg Foundation
Electronmicroscope	Hiroshi Nagasaki His Excellency The Ambassador of Japan to Colombia
Unveiling of plaque presented to CIAT by the national agricultural research programs of Latin America and the Caribbean	
Unveiling of plaque presented by CIAT to Carlos Lleras Restrepo, Ex-President of Colombia	

Formal Act of Commemoration

Welcome	John L. Nickel CIAT
Salutory addresses	Warren Baum World Bank
	William Mashler UNDP

Words of appreciation

Reed Hertford
Board of Trustees

Address on behalf of the President of the
Republic of Colombia

Rodrigo Lloreda
The Honorable
Minister of Foreign
Relations

Field Trips

Quilichao

cassava
beans
tropical pastures

James Cock
Shree Singh
Rainer Schultze-Kraft

Popayán

beans
cassava

Marcial Pastor-Corrales
Clair Hershey

Carimagua

tour of station
introduction
cassava (one stop)
tropical pastures (four stops)

Gustavo A. Nores
José M. Toledo
Guillermo Cedeño

Palmira

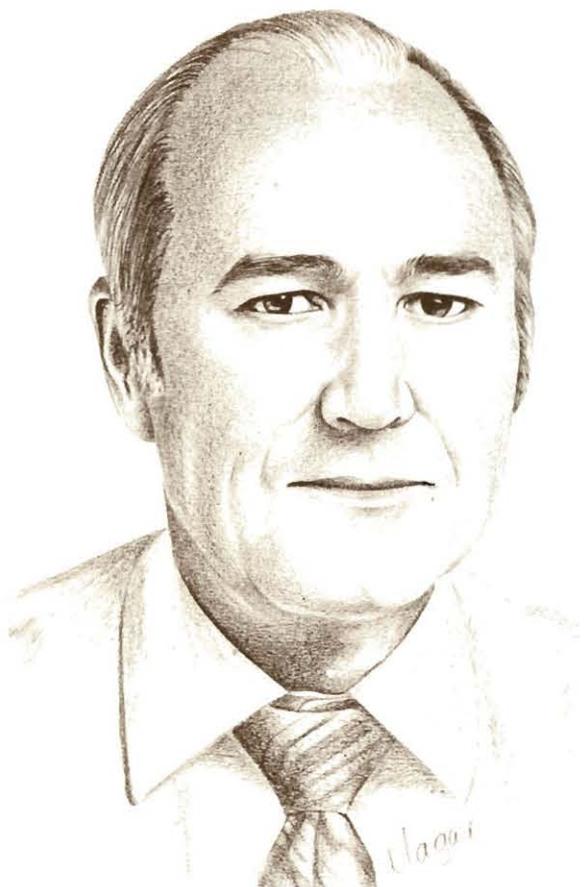
field tour
farm
greenhouses
Seed Unit
Genetic Resources Unit
laboratories

Douglas R. Laing
Alfonso Díaz

**Symposium:
The Challenge
for Agricultural Research
in the Tropics**



Welcome to the 10th Anniversary Symposium



John L. Nickel
Director General, CIAT

Ten years ago, one of the principal acts in the inauguration of the CIAT facilities was a one-day symposium on the Potential of the Lowland Tropics. On that occasion, renowned international personalities: Galo Plazo, Paulo Alvim, Raul Prebisch, Benjamin Viel, Armando Samper, and Lewis Roberts addressed a distinguished group of scientific and political leaders from around the world on this important subject.

In the intervening years, the results coming from the cooperative programs in CIAT and national and regional research organizations have amply demonstrated that this potential can be utilized for the benefit of mankind.

Now, ten years later, it seems appropriate to continue on a similar theme. Once more we have the pleasure of having many distinguished personalities present, and three leaders in the field of international agriculture have kindly agreed to make major presentations describing the challenge and the role of agricultural research in tapping this potential.

On behalf of my colleagues, and in my own personal capacity, I wish to thank all of you for taking the time to attend this important event, and particularly to thank our three speakers who have made a special effort to develop these themes and papers which, I am confident, will serve not only as a highlight of these commemoration activities but also, in subsequent printed form, as an important reference source for agricultural economists and agricultural research scientists around the world. It is my honor and privilege to ask Lewis Roberts,

one of the participants in the first symposium and co-author of the paper which first conceptualized the idea of an international center for tropical agriculture, to preside at the first session of this symposium.

CIAT as originally conceived and CIAT today: mandate, objectives, and achievements



Lowell S. Hardin

Professor, Agricultural Economics,
Purdue University

In 1966, as member of The Rockefeller Foundation, co-authored with Lewis M. Roberts (Ford Foundation) the proposal which led to the creation of CIAT

As I interpret my assignment, my task is to comment on the CIAT of yesterday, today, and tomorrow. While I will refer to many other institutions as well, I shall focus on CIAT and the national programs with which it works so closely.

This Center and a sister institution, the International Institute for Tropical Agriculture (IITA) in Nigeria, were conceived in the mid-1960s. Those of us who were involved saw these initiatives as experiments to test a different type of international center. Each of these new institutions would deal with several commodities, not focus exclusively on one or two. Systems would be stressed. No tested blueprint for international centers of this type existed. But if the underlying concepts were reasonably correct, the payoff could be great.

In 1967 the Government of Colombia, the Rockefeller Foundation, and the Ford Foundation, soon joined by the Kellogg Foundation, agreed to launch the CIAT experiment. We would move beyond the talking stage to learn by doing. With the coaching of national institutions and the best help we could find, we would put the concepts to test. We suspected that several of these concepts would not stand up over time. But without trial and error, we did not know which ones they were.

Now the CIAT experiment has been underway some 15 years, ten years since major facilities were in place. Today we recognize those individuals and institutions that launched this experiment and sustain it with their intellectual and financial resources. I join my colleagues in a salute to

all who are participants in CIAT's ongoing work.

We seek to give substance to this recognition by reflecting on the wisdom embodied in the guiding concepts. We can now ask, which of the original working propositions are being verified? What impact are the joint national institution—CIAT initiatives having? What implications can be drawn from the lessons we have learned?

What follows are selected observations that, I hope, have a bearing on the above questions. In no sense, however, is this a comprehensive assessment. In the early years I had the good fortune to have a seat at the CIAT table. As a trustee I was then, in one sense, a participant in the CIAT experiment. Before these buildings were dedicated, however, my direct involvement ceased, and since 1972 I have been a distant but interested observer. It is from this perspective that I shall comment on why, to my view, CIAT came into existence. This will identify some of the underlying concepts that were involved. Then I will briefly trace the evolution of CIAT's mandate. I will highlight a few of the Center's substantial accomplishments and identify what seem to me to be some unsolved puzzles. Finally, I will examine some of the implications that the CIAT experiment appears to hold for tomorrow.

Why CIAT?

The case advanced for creating an international research and training center to serve the lowland tropics (1) contained the following now-familiar rationale.

In the vast tropical areas of the world, food production is barely keeping pace with burgeoning population growth. Hunger and malnutrition are pervasive global problems. Until population growth rates moderate, food production needs to increase at an unprecedented pace.

In the tropical Americas, food crop yields and rates of animal production are generally low. Most of the efforts to transfer higher yielding technologies to the tropics from temperate zones have been unsuccessful. Much of the tropical agricultural research

that has been done has focused on export crops. Where modern scientific research has systematically addressed tropical food crop production problems, promising results are being achieved. Thus, scope appears to exist for economically increasing the productivity of presently cultivated lands.

Scope also exists for bringing new areas into cultivation. These are the under-used, almost empty lands on the agricultural frontiers. On these acid, infertile soils, mostly in remote areas devoid of infrastructure, the sun shines and the rains fall. In the tropical Americas, an estimated 850 million hectares, or 42 percent of the land area, is in this category (2). If not soon then later greater production will likely be required from these resources. But because some of these areas include fragile ecosystems, wrong approaches to their development and use can produce lasting damage. Therefore, it is important to accelerate the search for more intensive systems of use—systems that can be profitably managed on a sustained yield basis.

The foregoing was only a part of the rationale for CIAT's creation, however. Already, by 1966, the investment made in the International Rice Research Institute (IRRI) appeared to be yielding high returns. The Mexico-centered wheat improvement program of the International Center for Maize and Wheat Improvement (CIMMYT) was scoring exciting successes. Thus, the Rockefeller and Ford Foundations could see encouraging results emerging from their sponsorship of the international rice and wheat work. If crops that had been researched as much as rice and wheat responded to concerted scientific efforts, perhaps the gains with long-neglected tropical food staples could be equally great.

Further, it was felt that in Latin America and in Asia development assistance efforts to increase agricultural production through investment in extension were disappointing. There was a growing conviction that extension efforts were found wanting because improved, adapted production technologies were unavailable. Research, it

was hoped, would provide extension with new, powerful materials and technology to disseminate.

In addition, Colombia, due to its latitude and topography, offered a wide variety of ecological and production systems. Suitable locations could be found within the country for field research appropriate to an institution serving tropical Latin America and the Caribbean. Besides, Colombia had an extended history of close working relationships with Rockefeller and Ford Foundation people and programs. A substantial degree of mutual trust, understanding, and good will existed. Hence a Colombian location for the Center seemed logical for both scientific and institutional reasons.

Thus, CIAT was created because of concern about present and future food supplies. This was to be a production acceleration effort. Elements of a new and promising model for such work existed in the international wheat and rice programs. Collectively, the founding partners felt that they could mobilize the required resources. The hour was already late. It was time to get to work.

The Evolution of CIAT's Program

Our original proposal (1) for the Center dealt with the suggested program of work in terms of strategy, geography, ecology, and commodities. CIAT, we said, would complement national research systems by focusing on selected, relatively neglected food crops and ruminant animals. It would work in close collaboration with national programs in all that it did. The target regions specified were the lowland tropics in the Americas. Suggested crops included at least one food legume, forage legumes and grasses, and limited work on rice and maize through cooperative programs with IRRI and CIMMYT. We left the door open to later consider root crops, vegetables, and tropical fruit crops.

Our suggested livestock program was equally ambitious. The beef cattle work would involve nutrition, animal health, and husbandry systems.

This extensive array of suggested activities was not a mandate. The Center's management and board were to sort out and implement the precise program of work.

Naive as it now seems, we thought that such an ambitious program could be accomplished with:

- 23 senior plus 18 junior specialists.
- 200 to 250 hectares of land.
- US\$4–5 million for station development, buildings, and equipment.
- US\$3–4 million annual operating budget once the Center was up to speed.

Some research and training were begun in 1967. This early start was made possible by the Colombian Agricultural Research Institute (ICA) which generously opened its Palmira Station to a growing nucleus of as yet homeless CIAT staff members. Initially, Founding Director U. J. Grant and the first Board of Trustees specified CIAT's program more nearly in terms of scientific disciplines than by commodities. Professional staff members were hired into one of four groups: plant sciences, animal sciences, service disciplines (economics, engineering, biometrics), and training and communication. Station development, laboratory and service facilities, and training were planned to conform to this model. In fact, under the leadership of Francis Byrnes, two rather general 12-month training courses for production specialists were launched in 1969, one for crops and the other for livestock. Thus, in structure, the center more nearly resembled a university faculty of agriculture with its experiment station than the CIAT we know today.

The initial structure was retained for only a short time. By the early 1970s, CIAT was well on its way to a complete move away from such a disciplinary organization to a commodity-based, multidisciplinary approach. First the rice, swine (added in 1969), and beef programs were split out. Then the cassava program was started in 1971, followed by beans in 1972–73. All were viewed as production-system programs. By 1976, the five commodity programs were judged sufficiently advanced to decentralize

the training and conferences unit into the commodity model as well.

Three additional landmark changes were made in the evolution of CIAT's present program. The swine program was phased out (1975–79), and the multifaceted beef program was sharply narrowed and focused by transforming it into the tropical pastures program. Major emphasis was directed to developing improved, legume-based pastures for specific target areas—acid, infertile soil regions—such as the “Llanos” of Colombia and Venezuela and the “Cerrados” of Brazil (2). Concurrently, the functions of the small farms systems program were redefined and transferred to the commodity teams (3).

The CIAT experiment to test concepts was working. When initial perceptions were not verified by experience, changes were made. Organization by disciplines had been shifted into a commodity structure, each with its multidisciplinary team. Consolidation had produced the CIAT commodity programs of today: beans, global mandate; cassava, the Americas and Asia; rice and tropical pastures, the region. To them has been added a cross-commodity component, the seed unit (4). Having consolidated its base program, CIAT is now moving into Asia and Africa. In addition, CIAT is hosting collaborative regional projects with international institutions that involve maize, sorghum, soybeans, potatoes, plant genetic resources, and phosphorus (5).

What prompted this rapid evolution of program and organization? Hindsight suggests that a genuine concern for improving the well-being of the less advantaged as well as biological and institutional factors were involved. In my judgment they included:

- **The region's heterogeneity.** The extraordinary diversity of the region's ecological, institutional, economic, and social conditions became ever more apparent. The location specificity of key problems and workable solutions had to be faced head-on.
- **The less advantaged.** CIAT's management

and board believed that the Center's program should be targeted to yield special benefits to needy groups (6). The groups they singled out are the large numbers of small-scale, resource-poor farmers and low-income consumers. Thus beans and cassava were emphasized because they are so important to these producers (7). These commodities are also major components of the diets of the region's less affluent. So also are rice and, to a surprising extent, beef and milk (8).

- **Critical mass.** A minimum mix of talent, associated resources, and institutional linkages was required for rapid progress in solving problems. Such a critical mass could best be assembled by mobilizing it around an individual commodity. This in turn limited the number of commodities the Center could accommodate.
- **Comparative advantage.** CIAT is a very small component of the agricultural research universe. One of its prime functions is to complement and help strengthen national research institutions. What CIAT can do best includes work with germplasm banks and test nurseries; networking; mobilizing and sharing relevant information and specialized talent. These functions can be effectively organized along commodity lines.
- **Program-budget considerations.** Initially CIAT's financial support came from a small number of donors who had close and frequent personal contacts with the Center. As of necessity the number of donors increased, relationships became more formalized (9). This process was accelerated with the creation of the Consultative Group for International Agricultural Research (CGIAR) in 1972. Then followed the Technical Advisory Committee (TAC), systematic program-budget submissions, and external reviews. The processes of planning, budgeting, and evaluating were conducive to the adoption of a commodity structure. More importantly, this method of program presentation helped individual donors understand just what their contributions would pay for (10).

In my view, the above evolutionary process has been conducted with care, thoughtful analysis, and broad consultation. Although there was not always full consensus, the hard decisions were responsibly made.

Accomplishments and Impact

It is relatively easy to count the products of CIAT's activities. The numbers are impressive. Genetic materials evaluated, crosses made, and tests analyzed are in the thousands. More than 2200 professionals have participated in training at CIAT. Scores of publications and audiotutorials have been produced. Research stations are kept running in four places including co-managing the 22,000-ha ICA unit at Carimagua, a distant and isolated location. Relationships with national programs have been deepened and strengthened.

By anyone's standards these are extraordinary accomplishments. But the question that matters is this. What difference does all of this activity make? Activities are a means to an end, not an end in themselves. That is why we seek to measure impact in terms of changes in the lives of people—changes that are associated with what CIAT does.

Difficult as precise assessment is, donors, quite properly to my view, want to know what their investments are producing. Their investments are substantial. The core resources (exclusive of the land and special projects) that will have been invested in CIAT in the last 16 years, 1968 through 1983, total (11):

● Senior staff time		655 person years
● Expenditures on capital, 1983	U.S.\$	31.5 million
● Operating costs, 1983	U.S.\$	190.5 million

In 1973 the core operating budget (converted to 1983 U.S.\$) was 8.7 million. This year the operating budget will have more than doubled to about U.S.\$ 19 million. Scientific accomplishments are cumulative but so are expenditures. What can be said about CIAT's cumulative impact?

As I see it, CIAT's work is having an impact in four interrelated areas. But the further

down the list one goes, the more difficult measurement becomes.

First are the changes in food output and resource productivity that are associated with the improved technology actually in use by farmers. In this category, for example, is the production from the more than 50 improved rice varieties (all based on CIAT-developed lines) released by 15 national programs in the region (12). These varieties and associated improved cultural practices were the product of national program-CIAT-IRRI collaboration. Their use is estimated to have increased yields in the irrigated sector 43%, or 1.2 tons/ha. Here in Colombia the average yield of irrigated rice rose even more sharply—from 3 tons/ha in 1968 to 5.2 tons/ha in 1980 (13). The resulting larger output caused real prices to decline. As a consequence, the low income families, large consumers of rice, captured much of the benefits (14).

I have obviously chosen the rice illustration because it is the earliest and most advanced of the CIAT programs. However, in the region the value of the increased production of this one commodity alone is so great that it far exceeds the total investment in CIAT since 1968.

Other CIAT programs have a greater distance to go. Advanced bean, cassava, and pasture technologies developed in the CIAT commodity networks are now in the pipeline. In Costa Rica, Cuba, Guatemala, and Honduras, for instance, improved bean varieties have reached the farmer level. Throughout the bean network countries, large areas are being devoted to the production of improved seeds. In Cuba, application of the CIAT-developed package has been a major factor in doubling national cassava production over the past five years. But for the most part, the influence of CIAT's work on yields and total production of crops other than rice is not yet detectable in available national statistics. In CIAT's words, "this technology is beginning to have a real and measurable impact on the quantity and quality of food staples in Latin America and other parts of the developing world" (15). To

me this self-assessment is a fair description of what is happening.

The second area of impact is in the opening of new technical horizons for productivity changes. For example, a major contribution of CIAT's pastures work is to unlock the door to previously unknown or unevaluated germplasm. This germplasm included forage grasses that are now doing well on farms in the poor acid soils of the target ecologies in the savannas. It also included forage legumes currently being released in Brazil, Colombia, and Peru. Access to these materials has helped to energize the whole tropical pastures network.

Third is CIAT's catalytic impact on the growth and productivity of national research and educational institutions. This comes through the two-way flow of ideas and materials. The indispensable element is capable people. Development of human capital is costly. Once partially developed, it is fragile. These people need institutions in which to work, and the capacity to contribute to and receive from the larger worldwide scientific community. CIAT's training and communication programs catalyze and undergird this ongoing process. Especially reinforcing are the thriving commodity networks in rice, beans, and pastures. Equally important, the Center helps sustain continuity of effort when national programs encounter periods of adversity. Also, once higher levels of productivity are achieved, CIAT's contributions through maintenance research can be critical.

The fourth and final impact area is in CIAT's contributions to changing public perceptions. This has to do with understanding what is required for agriculture to maximize its contributions to economic growth and human welfare. Important food and agricultural decisions are made not only by the Ministry of Agriculture but also by the Ministries of Finance, Planning, and Trade and the Central Bank. Actions taken by the other ministries may be fully as helpful (or limiting) as are those of agriculture. CIAT's work is an input into the shaping of public opinion. For example, its concrete products may help

alter perceptions concerning the usefulness of careers in agriculture. Or, at another level, what CIAT does may have an impact on governmental decisions as diverse as support to research or price policy.

As the above reflects, my observations on CIAT's impact are heavily speculative and intuitive. More definitive assessments are needed. It is my view that CIAT and its sister institutions should increase their investments in impact assessment. Greater accuracy in measuring benefits relative to costs is needed: (a) to help CIAT decide which activities to add or delete; and (b) to help CIAT's donors justify the support they are asked to provide.

Commendable progress is being made in this direction. For example, in presenting its plans for the 1980s CIAT estimated anticipated social benefit/cost ratios. At a 10% discount rate these ranged from 8 to 1 for beans to 15 to 1 for tropical pastures (16).

Three Unsolved Puzzles

When I reflect on CIAT's experiences, many unsolved puzzles come to mind. I want to think with you about three of them: (a) tradeoffs between research and development; (b) how far to decentralize; and (c) the small versus large farm problem.

One can turn the first puzzle into this question: How far should CIAT go into development activities? Take the case of cassava. If a stronger commercial feed market could be developed, the production of the crop might become much more attractive. For use in milled feed formulation, the bulky perishable has to be dried and transported. The feed industry is casually interested but unwilling to undertake the assembly and processing. Groups of producers might perform these intermediate steps. Other organizations are unable to provide the technical assistance and leadership required. CIAT has some know-how in the technical areas of chipping and drying and the Center could gear itself up in the business management aspects of such operations. Potential producer groups seek CIAT's help. To what extent should the Center's limited resources be diverted to these market development tasks?

Or take the somewhat parallel case of the production and marketing of seeds. If seed of certified quality is not available to the farmer, much of CIAT's work is naught. In several developing countries the seed industry, be it public or private, is uneven in quality and unreliable in performance. National programs want CIAT to help. But helping to eliminate the seed bottleneck is not primarily a research task. Will a CIAT commitment to the development of a viable seed industry weaken or strengthen the Center's research productivity?

My second puzzle is that of how far CIAT should go in dispersing its staff and decentralizing its activities.

One of our initial working propositions was that CIAT could develop germplasm that was broadly adapted across rather diverse environments. At that time we probably did not fully understand why improved wheat and rice cultivars had been adopted so widely. History suggests that this is largely because they were bred for production environments that existed or could be created (e.g., by irrigation, fertilization) on a large scale across the tropics (17). CIAT's target areas include widely diverse production situations. Options for economically altering most of these production environments are limited. Under such conditions, a single genotype has a minimal chance of being optimally adapted over many regions.

Consumer preferences further complicate the prospect that a single genotype will be widely adopted. Take beans, an extreme case. Brazil wants its beans small, black or cream in color. In the Andean zone beans must be large and red, while in Central America the preference is for small red ones. Preferences extend on through an amazing number of size and color patterns. So CIAT's breeding-improvement program works with 16 basic commercial bean groups, each with its seed size and grain coat color specified.

CIAT's experience in farming systems research is also instructive on the decentralization issue. From 1973-75 the Center had an agricultural or small-farms systems program. Why was it discontinued?

Because the areas served are so diverse that it was impossible to develop improved whole-farm systems that were widely relevant. So CIAT decided to concentrate on generating better commodity components which could then be integrated into whole-farm systems via local institutions. On-farm research on commodity systems was continued, but the focus was shifted to component technology which rarely includes the whole farm.

Throughout the agricultural development community today farming systems projects are burgeoning. To my view this spurt in activity is in part a reaction to centralized research—a push to get researchers off their experiment stations and onto farms.

Furthermore, in today's international center system, CIAT has responsibilities outside of Latin America and the Caribbean. These include cassava in Asia and beans worldwide. The production of cassava in Indonesia and of beans in east Africa, for example, can best be served by posting CIAT staff members there.

In his foreword to *CIAT Report 1983* (12), Director Nickel emphasizes decentralization through networking. And CIAT's long range plan calls for significant increases in outposted staff.

In view of the foregoing, is the concept of retaining a minimum critical mass at headquarters still valid? It was with this idea in mind that a multimillion dollar investment has been made in CIAT's facilities. If funding for more positions is not available, should the Center shrink the headquarters team so that more staff members can be outposted?

Now we come to CIAT's role in raising the income of the small relative to the large farmer, my third puzzle. This is a widely publicized issue, especially by the critics of the green revolution. CIAT has addressed this issue frontally in choosing its commodity mix. Beans and, to a lesser extent, cassava are small-farmer crops.

What can output-increasing, unit-cost-reducing technology do for the small farmer who produces the same commodities as the large operator? It can raise his income. Not

as much though as it increases the earnings of the large operator—even if the technology is scale neutral. So the absolute gap between the income of the small farmer and that of the large farmer widens. I therefore conclude that biological technology is a blunt instrument for redressing skewed income distributions. Institutional changes, as in land tenure arrangements, seem to hold more promise. Nevertheless, many believe that it is the small farmers, not the larger operators, that the Center should be helping. For this to happen, the technology CIAT generates needs to be such that its benefits are almost exclusively captured by the small farmers. Here then is my puzzle. How, for example, can CIAT scientists design bean or cassava technology that will not be adoptable by large farmers? Or, put another way, is this a puzzle CIAT should be trying to solve (18)?

I have outlined the above puzzles in overly simplified form. By now you know that my purpose was not to suggest solutions but to illustrate the tradeoffs that are involved in the choices CIAT makes.

Concluding Observations

When CIAT was formed, I thought the Center might work itself out of a job in 20 years or so. I was wrong. I did not then appreciate the role that CIAT and its sister centers would come to play in the collection, conservation, and diffusion of genetic resources. Nor did I then recognize how important it was to link national researchers directly into what was to become a well-articulated international system. At the hub of these networks the centers perform key strategic functions in which there are important economies of scale. They help establish crop and animal research

agendas. They assist in mobilizing the talent and resources needed for the maintenance research that is required to protect production gains once they are achieved. They serve as a reliable source of materials and information. And, fortunately, they are a stable resource for training and continuity in regions where political fragmentation and instability are not uncommon (19).

These are among the reasons why my earlier judgment was in error. Now I believe that, were the center system to disappear, a responsible world would have to reinvent it, so essential are the functions it performs.

The foregoing is not to suggest that there is cause to relax in self-satisfaction. Institutions, like crops, have their own breeds of pests and pathogens. They have self-serving names like bureaucracy, complacency, and insensitivity. These diseases can be fully as deadly to an institution as is an uncontrolled outbreak of blast to a rice crop.

Perhaps this is what John Knowles, then President of the Rockefeller Foundation, had in mind when he spoke from this platform ten years ago today. He challenged CIAT not to take itself or its fine new buildings too seriously. He said, “the world is littered with ossified organizations that have forgotten that they are means to an end and not ends in themselves” (20).

Recently I had the opportunity to spend three weeks here with CIAT staff members and visiting scientists. I encountered only a few institutional pests and pathogens. Clearly the Center is not becoming ossified. Rather, to my not unbiased view, CIAT is a more robust and thriving institution than I had dared dream it would become.

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2. CIAT (Centro Internacional de Agricultura Tropical). 1982. CIAT report 1982. Cali, Colombia. p. 68; pp. 68–72.
3. Dillon, John L.; Plucknett, Donald L.; Valleys, Guy; and Mahler; Philippe J. 1977. TAC farming systems research stripe review. Notes from a visit to CIAT, April 18–22, 1977. TAC Secretariat, Food and Agricultural Organization of the United Nations, Rome. pp. 7–9. This review team regarded CIAT's decision as “obviously a correct one and in our view, with hindsight, inevitable.”
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5. The collaborating institutions are CIMMYT (maize); the International Sorghum and Millet Collaborative Research Support Project (INTSORMIL), which works jointly with the International Center for Research in the Semi-Arid Tropics (ICRISAT); the International Soybean Program (INTSOY); the International Potato Center (CIP); the International Board for Plant Genetics Resources (IBPGR); and the International Fertilizer Development Center (IFDC).
6. Nickel, John L. In press. Resource-efficient agriculture for the tropics. A research strategy for generating improved crop production technology for low-resource farmers. Submitted to *Scientific American*. In presenting his proposed strategy, Nickel draws heavily on the CIAT experience.
7. CIAT (Centro Internacional de Agricultura Tropical). 1983. Trends in CIAT commodities. Internal Document, Economics 1.8 Cali, Colombia. p. 59; p. 157.
8. See CIAT in the 1980s. pp. 23–24 and appendices 8 and 9. In part, CIAT economists state, “consumer budget data from ten Andean cities showed that 15–30% of food expenditures by families in the lowest-income categories were for beef and milk. Sugar and rice were also consistently important items. Other subregionally important commodities in food budgets of the urban poor were wheat products, maize, beans, cassava and potatoes, but with none being dominant.”
9. A sense of the ever-increasing complexity of relationships with donors is reflected in the following numbers. In 1969, CIAT received its support from only three outside sources; the Rockefeller, Ford, and Kellogg Foundations. In contrast, the financial statement for 1982 shows that 13 donors made contributions to the core budget; five additional donors made restricted core grants, and eight more donors funded special projects. Thus, in 1982 CIAT received support from 26 different governments, development banks, foundations, and agencies.
10. Core programs and budget requests are presented to all members of the CGIAR and discussed in that forum. However, annually, each donor determines the amount it will grant to CIAT (and/or other centers). Thus, the CGIAR provides a multilateral forum, but the grants are bilateral.
11. CGIAR (Consultative Group for International Agricultural Research). 1981. Program budget analyses 1974–1983, CGIAR Centers. CGIAR Secretariat, World Bank, Washington, D.C., November 5, 1981, summary tables. Also, data from CIAT financial statements. In current US\$, the total capital input is 15 rather than 31.5 million, and total operating costs are 125.5 million rather than 190.5 million.
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15. CIAT (Centro Internacional de Agricultura Tropical). 1983. 1984–1985 program and budget. Cali, Colombia. p. 416.
16. As is inevitable in calculations of this type, several assumptions were made. Hence the report (4) carries a full explanation of the methodology used in arriving at these estimates.
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18. For a thoughtful discussion of several of the issues involved in this puzzle, see: Douglas Pachico. 1982. Bean technology for small farmers in Latin America. Discussion Paper. Centro Internacional de Agricultura Tropical, Cali, Colombia.
19. See, for example: Ruttan, Vernon W. 1982. Agricultural research policy. University of Minnesota Press; Minneapolis. p; 143. The author states that, in his judgment, the international agricultural research system should be viewed as a permanent feature of the global agricultural development infrastructure. He goes ahead to identify and discuss a substantial range of problems that the international center system faces if it is to fulfill this role.
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The role of agricultural research in economic development



Laurence D. Stifel

Vice-President, The Rockefeller Foundation

Second author:

Gary H. Toenniessen

Assistant Director, Agricultural Sciences, The Rockefeller Foundation

When CIAT's facilities were inaugurated ten years ago, there were dire predictions that food production would fall dangerously behind population growth throughout much of the developing world. In contrast, the record of the last decade has been one of impressive progress. Food production in the developing countries has grown faster than in the developed countries, and food availability per capita has improved in Latin America and Asia. Much of this success is attributable to the creative efforts of the scientists of national and international agricultural research institutions.

But this is no time for complacency. The International Food Policy Research Institute projects massive food deficits for many Third World countries by the end of this decade. Little progress has been made in reducing the number of people who go to bed hungry every night. Whole populations in some parts of Africa today face near-famine conditions. Sub-Saharan Africa, in fact, has been the primary exception to the impressive record of the last decade. Africa's food production problems are compounded by such severe policy and management inadequacies that technological advances may not be able to play as prominent a role there as in other developing areas.

Hunger and malnutrition, ultimately, are caused by poverty, much of it centered in rural areas. Moreover, the lack of rural purchasing power and a plentiful food supply retard the growth of the industrial sector as well. We now realize that industrial and agricultural progress are critically interdependent. A dynamic expanding rural economy provides the best opportunity for

the poor to increase their income and to conquer hunger; it is the least expensive source of new employment; and it has a multiplier effect that stimulates overall economic prosperity. To reduce poverty and to speed development, we must sustain and intensify present efforts to accelerate agricultural production.

Historically, increased food production has been obtained by bringing more land into cultivation. In the past several decades, however, with growing pressure on land, growth in agricultural output has increasingly resulted from higher output per unit of land. Augmenting the productive capacity of land is a key to meeting the Third World's food needs. New technologies to improve yields include superior crop varieties, improved agronomic practices, mechanization, and irrigation. The subject of this paper is biological and social research, designed to create new knowledge and technologies to increase production on present farmland and to bring marginal land into sustained production. Although it is only one factor in generating agricultural growth, improved technology is an essential prerequisite.

This paper will focus on the growth of national agricultural research systems, the establishment of the Consultative Group on International Agricultural Research (CGIAR), and recent discoveries in the biological sciences, that open new vistas of possible technological advance for the future.

Agricultural Research in the Developing Countries

Theodore Schultz laid the intellectual foundations for the proposition that the application of biological science to peasant agriculture is an efficient source of growth; he and his associates demonstrated that rates of social return on agricultural research, were unusually high and greater than on alternative forms of public investment. But it was the heralding of the Green Revolution in rice and wheat and the awarding of the Nobel Peace Prize to Norman Borlaug of the Rockefeller Foundation in 1970 that dramatically changed the image of agriculture from that of stagnant backwater

to a vital source of potential economic growth.

Although defining different categories of agricultural research is always somewhat arbitrary, it is useful to distinguish among basic research that expands frontiers of knowledge without regard to possible application, applied research designed to produce new technology, and adaptive research to modify technology to suit the local natural and cultural environment. Because of the wide variability among small agroclimatic regions in the tropics, the ultimate payoff requires location-specific research to adapt technology to local conditions. This must embrace social science research to assure that technology is congruent with the practices of the farmer and the conditions under which she or he operates.

There has recently been an enormous expansion of agricultural research in the developing countries after an initial, premature emphasis upon agricultural extension. The simple transfer of existing technology developed for temperate conditions had priority in the 1950s because it implied rapid results and was less costly than building a research system to produce relevant technology. But as awareness grew that extension without relevant technology was empty, the global balance of expenditures has now shifted from agricultural extension to agricultural research. Research expenditures as a percentage of agricultural GDP increased from 0.3% in 1975 to over 0.5% at present, the 1985 target suggested by participants at the World Food Conference. The number of agricultural scientists in the developing countries doubled in the 1970s and now exceeds the number in the United States and Europe combined. Third World expenditures on agricultural research and numbers of scientists are well ahead of internationally accepted planning targets.

Nevertheless, national research systems are at very different stages in the development of their capabilities. The distribution of research spending is highly skewed toward a few of the larger

developing countries: Argentina, Brazil, India, Mexico, and Nigeria account for two-thirds of total expenditures. The few most advanced countries already have effective articulation with regional and international research organizations, well-equipped central research stations linked to small regional units for adaptive and on-farm research, growing numbers of skilled scientists, and graduate educational facilities where training and research are integrated and mutually reinforcing. More frequently, however, systems suffer from inadequate facilities and support services, poor management, fragmentation of effort, instability of funding, and expensive dependence on foreign graduate training. In most cases, the growth of national systems has been recent; many of their scientists are relatively young and inexperienced. According to Borlaug, 20–25 years are required to train and provide research experience for a sufficiently large number of young scientists and technicians to effectively staff a national research organization. This suggests that the full impact on production from the rapid build-up of national systems in the 1970s cannot be expected until the latter part of this decade and beyond.

The Consultative Group on International Agricultural Research

The growth of national research systems over the past decade was stimulated by the spectacular breakthroughs in rice and wheat technology in the 1960s. Building on its cooperative country programs of the 1940s and 1950s, the Rockefeller Foundation, joined by the Ford Foundation, set up the first two international agricultural research institutes in the 1960s, IRRI and CIMMYT, where the seeds of the Green Revolution were planted. The rapid spread of these high-yielding cereal varieties in Asia and Latin America is familiar history. Within little more than a decade, over a third of all rice and wheat land in the developing countries was planted with high-yielding, semi-dwarf varieties. Modern rice varieties are now estimated to add some \$3–4 billion annually to the value of world rice production. This experience confirmed that an independent

international center, with a critical mass of scientists, multidisciplinary in composition, and with adequate research support, could realize genuine economies of scale in the development of valuable new genetic materials when linked to receptive national programs.

In order to extend the dramatically successful model of the international center beyond the limits of American foundations' financial resources, a group of donor agencies, led by the UNDP, FAO, and the World Bank, created the CGIAR in 1971. It provides two attributes seldom possible under foreign assistance projects—stable, long-term funding and a decentralized structure that permits scientific autonomy at the institute level. Funding for the network of CGIAR centers rose sixfold during the next eight years; then growth finally tapered off and the first financial constraints were placed on expansion and operation of the system. The 36 donor members of the CGIAR are expected to provide \$165 million this year to support the work of over 600 senior scientists from 40 countries in the 13 research institutions that presently constitute the system. This cadre, only about 2% of the agricultural scientists working in the Third World, is now carrying out research on major crops and livestock products that feed most of the developing world's population.

The two primary purposes of the CGIAR system are (1) to conduct applied research to create improved agricultural production technologies and (2) to strengthen national agricultural research capacities.

The international centers have a comparative advantage over most countries in producing plant genetic materials with superior characteristics because of the diversity of their breeding materials and their critical mass of scientists. They serve as an important bridge between the basic research in more advanced countries and adaptive research in each developing country. Research results can now be fed into a global network that transmits new technologies where they are needed. But the early breakthroughs in rice and wheat technology were facilitated by two special

conditions. First, CIMMYT and IRRRI could draw upon a large pool of unexploited information resulting from decades of research on these crops in the north. Second, their wide adaptability under irrigation meant that early expansion did not depend upon time-consuming adaptive research capacity at the national level. Neither of these conditions pertains to such important tropical crops as cassava, millet, legumes, and upland rice. Research to produce new technologies for these crops in heterogeneous environments can be expected to require more time and to produce only incremental gains rather than the revolutionary breakthroughs realized with the cultivation of irrigated cereals.

The second objective of the international centers is to strengthen national agricultural research systems. National systems are the central component of the worldwide agricultural research network, for they have the ultimate responsibility for the adaption and extension of research to farmers' fields. It should be noted that scientific work at the national level must not be inferior to that at the level of the CGIAR centers, for the research to adapt technology requires the same level of competence as to invent it. The centers serve to strengthen national systems in three ways.

First, training. According to my Rockefeller Foundation colleagues who worked in our cooperative program in Mexico, the training of skilled agricultural scientists there was more important than the development of new varieties. The target was not a new technology; the target was the indigenous capacity to produce a continuing stream of new technology. The international centers, accordingly, offer a rich diversity of programs to train national agricultural scientists, technicians, and extension specialists to absorb and apply improved technology in their respective countries. While all agree that the CGIAR training record is one of its most important accomplishments, as budgets tighten, this area is one of the least painful to cut. The system should examine carefully the adequacy of secure, long-term support for its training functions.

Second, the centers contribute to building national systems by means of international networks and special projects of technical assistance and collaborative research. Because the growing extent of this off-campus activity risks possible diversion of the centers from their central research mandate, the CGIAR set up a new institute, ISNAR, in 1981 with the explicit purpose of strengthening national agricultural systems.

Finally, by increasing the stock of applied research, the international centers increase the potential returns from investment in national research. Nations cannot be "free riders" in the utilization of the benefits. Investment in national research capacity—at increasing levels of sophistication—is required to gain access to this knowledge and adapt it to the country's own resource and cultural environments.

The CGIAR system has been a unique and effective institutional innovation. According to the conclusions of a recent external review of the system, "It is evolving in a manner that allows flexibility in responding to needs and exploiting opportunities, it fosters a highly efficient and professional approach, it permits increasing participation by individuals from developing countries, it provides bridges across national boundaries to bring the results of research to bear on the problems of world agriculture, and to harness the resources of the industrialized countries in support of research directed to the food needs of the developing countries."

Second-Generation Problems

Almost 15 years ago, Clifton Wharton alerted us that the Green Revolution could bring a cornucopia of benefits for the Third World or a Pandora's box, whose very success would produce subtle and more difficult problems. After stressing the enormous benefits of science-based technology in agriculture, we now turn briefly to some of the second-generation problems that have emerged—the issue of social equity in the distribution of benefits, the rising cost of maintenance research, and the difficulty of attracting adequate funding to sustain and expand the benefits of agricultural research.

After the initial advances of science-based agriculture in the 1960s, there was intense criticism that the new technologies were bypassing the majority of poor farmers and heightening the inequitable distribution of income in rural societies. Some warned of the danger that the Green Revolution might foment a red revolution. The emotional rhetoric of the time has calmed somewhat now, and the mounting evidence of social science studies permits assessment of the social repercussions of the high-yielding varieties.

We must distinguish between the distribution of benefits within a single agroclimatic region and among several regions. Within a reasonable range of land size, the improved technologies are scale-neutral for all farms within that region. Farm size per se has not been a constraint, for example, on either the adoption of the high-yielding grain varieties or on the growth in productivity. In fact, however, small farmers have lagged behind because of their lower ability to take risks and more limited access to credit, fertilizer, and other inputs. While the adoption of new technology does not directly mitigate the poverty of landless laborers or farmers with poor-quality holdings, the creation of a buoyant rural sector does enhance economic opportunities for everyone in the region.

On the other hand, there has been a marked increase in the disparity among regions, for most of the new varieties are not well suited to the less productive environments, especially those without assured water supply. Governments have given priority to food self-sufficiency over rural income generation. There has been a drive for high yields in the better endowed areas. The large numbers of farmers on resource-poor land practicing a stagnant agricultural technology demonstrate too clearly that it is simpler to solve the problem of food than the problem of poverty.

In response to this second-generation problem, the CGIAR has revised its initial priorities and is increasingly focusing on resource-poor areas and resource-poor farmers in all areas. ICARDA, for example, is

developing technologies for low-rainfall areas of the Near East; CIAT is working on upland rice, beans, and cassava, crops important to the incomes and diets of the poor; IRRI is increasing attention to rainfed areas in spite of their lower yield potential. In research on neglected crops and areas, studies of farming systems have been useful in defining the need for technologies not dependent on purchased inputs beyond the means of poor farmers and the importance of crop intensity over yield. But small-scale farmers are just beginning to receive tangible benefits from the early research on these stubborn problems.

Another second-generation problem is the rapid rate of technology obsolescence in the tropics and the heavy burden of maintenance research. The natural enemies of plants continue to evolve—pathogens mutate, insects adapt to formerly resistant varieties and develop resistance to pesticides. In many cases the positive attributes are lost in a relatively short period of time. Expensive maintenance research to stabilize host resistance is necessary on a continuing basis just to stay even. Extensive monoculture acerbates the risks. The IRRI rice variety IR36 is a substantial improvement over the varieties that were the basis of the Green Revolution in rice; grown on over 11 million hectares, it is the most widely planted food crop in the history of world agriculture. Because a major breakdown of resistance of IR36 could have catastrophic consequences, IRRI devotes as much as half of the funds available for germplasm improvement to maintenance research. While the high cost of varietal obsolescence is a function of success, it also is diverting substantial funds from the central purpose of advancing the frontiers of new technology.

A third unexpected consequence of the Green Revolution is the spread of unrealistic expectations concerning the ease and rapidity of transforming traditional agriculture. The Green Revolution is a hard act to follow. This is particularly true of recent research focused on poor farmers and marginal lands. In contrast to the need for increased funding to tackle these difficult

problems and cover maintenance research needs, there are signs of lagging interest by donors and national governments alike. The plateauing of donor funding for the CGIAR has caused a reduction in budgets for the centers and a revision of plans to serve national systems. Forced by depressed global conditions to cut budgets, national leaders, discouraged by the slowness of practical results, have reduced the rate of research expansion. And this is occurring just when breakthroughs in the more basic biological sciences offer the promise of providing agricultural research with powerful new tools and capabilities.

Frontiers of Agricultural Research

Agricultural research is a dynamic process. It must respond to changing food needs while simultaneously capitalizing on an ever-expanding base of scientific knowledge and technological capability. The scientific frontiers of biology are currently advancing at a rapid pace; some believe a biological revolution is underway that presents long-term opportunities for substantial increases in agricultural productivity. The Rockefeller Foundation is seriously exploring how it can help assure that farmers in developing countries receive benefits from these advanced new technologies as they become available.

Modification of the genetic composition of plants in order to improve agronomic characteristics has been one of the major successes of agricultural research. One of the promising aspects of the "new biology" is the elaboration of potent new technologies for genetic manipulation in plants and other organisms. While still in an early developmental phase, these techniques should allow for further and more precise changes in the genetic composition of plants, certain of which may involve interspecies and even interkingdom genetic transfers that would not be possible using conventional technologies.

Our investigation into plant biochemistry, physiology, and other fundamental plant sciences has traditionally been neglected, in part because plant breeders often do not need to understand

the mechanisms responsible for the traits they manipulate. The genetic engineers, however, are much more dependent upon fundamental knowledge of how plants function at the molecular and cellular levels. Fortunately, the new tools of molecular genetics have greatly enhanced the ability of scientists to generate the necessary knowledge, as well as provide mechanisms for its application to plant genetic improvement.

The potentially most powerful of the new technologies is referred to as "directed genetic engineering." It uses recombinant DNA techniques, or what the popular press often refers to as "gene splicing." Practical application is still far from a reality; but as problems are encountered, they can be systematically addressed because each step is a precise and predictable process based on discrete reproducible chemical events. Much of the current research involves testing and evaluating genetic transfer that may have significant agronomic value. Plant breeders and agronomists can play a key role in development of genetic engineering by helping to identify lines of investigation where molecular genetic manipulations have the potential for making important contributions to agriculture. In addition, the germplasm collections held by the international agricultural research centers will be a valuable source of useful genes for the genetic engineers, just as they are for plant breeders.

The international agricultural research centers can be the principal route by which such new technologies are applied to the needs of farmers in developing countries. It is important that the centers have access to and take advantage of these technologies as they become available; this may require that they develop additional capabilities and new institutional linkages.

How long will it be before we can expect plant genetic engineering to have a significant impact on crops growing in the field? Many plant breeders are doubtful that significant production results will soon be forthcoming from genetic engineering techniques, but unless risk capital is available

now from sources such as foundations to support such research, the information may not be available for public purposes when it is needed.

In a recent survey at the University of Minnesota, plant breeders, geneticists, and molecular biologists were asked to predict the contributions that various technologies would have on corn yields in the United States through the end of this century. Emerging biotechnologies were expected to add 1.7 bushels per acre per year by the year 2000—compared to an increase of only 1.0 bushel from conventional plant breeding techniques.

Together, these highly complementary techniques can bring in a new era of plant genetic improvement. Because of the existence of a worldwide agricultural research network, of which CIAT is an integral part, this new era could bring substantial benefits to food producers and consumers throughout the world.

Conclusions

In conclusion, I am reminded of Richard Bradfield's observation. "There are many interesting research problems. Some of them are important."

There is an urgent need today to sharpen research priorities at all levels of the global system, if we are to justify the continued flow of scarce economic resources to agricultural research.

- Nations need national research strategies and policies that encourage the use of new technologies.
- The centers must reconcile the competing demands on their resources, as is so thoughtfully described by Lowell Hardin in his case history of CIAT. As a principle, the centers should devolve activities to the national level as early as possible and reorient their programs and restructure their staff in accord with their ever-changing comparative advantage vis-a-vis national systems.

The CGIAR itself is experiencing a period of consolidation that is testing the durability of this unique and effective institutional

innovation. The rapid growth in funding over the past decade contributed to an atmosphere of vitality and dynamism, which will be difficult to maintain in a period of budgetary austerity. Across-the-board cuts obscure and postpone decisions that the CGIAR management must make in order to accommodate the changing needs of national systems.

It was initially thought the CGIAR system might gradually be phased out of existence as national systems developed sufficient research capabilities of their own. It now seems clear there is a permanent role for the CGIAR as part of the global agricultural infrastructure, if it is able to focus on specialized but changing activities that complement national systems, for example, the conservation and utilization of germplasm; specialized training and networking; strategic research on defined problem areas; and the transfer of new techniques for plant and animal improvements that may be derived from scientific breakthroughs in molecular biology.

In spite of the progress of the past decades, we are still underinvesting in agricultural research. Agriculture's role is still underestimated.

We have explained why the Green Revolution was a unique phenomenon. It is more significant that, in the words of Richard Critchfield: "One can now confidently say that a quiet revolution in agriculture has begun in the Third World that is likely to have more dramatic effect on more human beings than any revolution that has gone before."

Sustaining this quiet revolution requires resources, but, more critically, it depends on agricultural scientists at CIAT and elsewhere, who, representing many nations, creeds and races, have dedicated their lives to the advancement of knowledge in the service of mankind around the world.

To all of you, both past and present, who have made this institution possible, we salute your accomplishments and we urge you to persevere in the crucial task of feeding the world's swelling population.

Why developing countries should invest in agricultural research



Roberto Junguito Bonnet

Ambassador Designate from Colombia
to the EEC

*As Minister of Agriculture of Colombia
from 1982–1983, ex officio member of
CIAT's Board of Trustees*

Second author:

Jorge García García

Advisor to the

Minister of Agriculture of Colombia

Introduction

The present work analyzes the importance of investing in agricultural research for the development of agriculture and the economic growth of the lesser developed countries. The importance of agriculture and its role in economic development is evident for some people but not to others. For that matter, before analyzing the convenience of assigning resources to agricultural research, it is necessary to give reasons to support the selection of agriculture; in the first part of the paper such justification is presented. To justify the importance of the agricultural sector, it is not sufficient to debate the allocation of resources for research; that is why in the second part of the paper the arguments that support such a decision are analyzed. Even though the reasons for investing in agricultural research are numerous and convincing, there seems to exist an inferior resource allocation to that desirable; the reasons for that underinvestment are considered in the third part of the paper. To attain an allocation of part of the investment funds to agricultural research and in the desirable amounts requires a design of financing and organization schemes that permit breaking the barriers that block that allocation. The fourth part of the paper considers this problem and suggestions are made for creating those schemes.

Importance of the Agricultural Sector

For developing countries, the most important sector in the economy is agriculture. Several reasons for this importance include: agriculture's share of the aggregated value (14–37%); the

proportion of the population that lives in the fields (55–79%) and which receives income from agricultural activities (45–70%); the contribution of agriculture to currency generation (27–37%); the amount of food supply for both urban and rural populations; and the capital accumulation that results from the savings generated by this sector (1).

Even though the importance of this sector is obvious, the economic policies of the lesser developed countries are prone to discriminate against agriculture, thereby discouraging food production (2). As a result, agriculture's contribution to the economic development of poor countries has been less than it could have been, so that a high proportion of the world population still lives in primitive conditions without enjoying the material benefits of economic progress.

The agricultural sector normally loses its relative importance in economic development, which partially explains why agriculture is not stimulated. It is believed that if that loss of importance is stimulated, it will be possible to leap over phases of the development process and thus more quickly arrive at superior levels of industrialization. That loss of relative importance of agriculture does not justify an unfavorable treatment to the sector, however, because that would reduce the growth of other sectors and affect the process of industrialization.

Ideas and their interpretations about the agricultural sector and the development process have also contributed to discrimination against agriculture. Some people think that agriculture has not utilized or has underutilized certain resources (for instance, the work force) (3) and that it is necessary to transfer the excess available resources to the urban sectors. This can be accomplished by placing high taxes on agriculture, which promotes capital accumulation in the industrial sector (4). Another view holds that to partially benefit from the technological change taking place in rich countries, it is necessary to industrialize the poor ones (5). In short, to reap the benefits of economic progress, it is necessary to transfer resources from

agriculture to the urban sectors where, it is thought, they will be more productive. But these ideas have not proven to be true, and the experience of countries that tried to industrialize at the expense of agriculture does not seem to support the idea that it is possible to reach economic development by skipping phases in the industrialization process (6).

In using a model based on the impetus and growth of the industrial sector, the lesser developed countries decided, overtly or not, to generate less aggregated domestic value, therefore becoming more dependent on foreign resources for their inputs (raw materials, intermediate goods, and capital goods). A development strategy based on agriculture, on the other hand, would have meant greater use of domestic resources vs. lesser need for imported inputs and probably would have generated a higher growth rate, because of the particular characteristics of agriculture (7).

The lack of encouragement to agriculture brought about an "expelling" of resources from the agricultural sector to the urban sector and reduced agricultural production to levels inferior to those that would have resulted otherwise (8). The urban sector was unable to employ the resources coming from agriculture, and the agricultural sector demand for industrial products was lower than what it could have been under other conditions. In other words, the decrease in relative importance of agriculture had a negative impact on the otherwise positive links between the two sectors (9).

From time immemorial, the process of economic growth has brought with it a reduction in the relative importance of the agricultural sector. This process has freed resources from the agricultural sector to be employed in the industrial sector (e.g., work force and capital). But to support the growth of the urban sector and to keep an adequate supply of food and inputs for the industry, it has been necessary to continuously raise the productivity of the factors applied in agriculture by developing technology. The need to resort to these technological innovations has varied through time, so when expansion of agriculture could be

achieved by increasing the cultivated area it was not so necessary to introduce technological innovations. When expansion of the cultivated area was only possible through increased costs of production (because less-fertile or harder-to-reach lands would be used), then the emphasis was shifted to improving management and cultivation practices. When this phase was over, the emphasis was put on reducing productivity differentials between regions and countries. This trend resulted in a recommendation for an obvious policy: provide extension service to farmers, teach them the more advanced technologies, and make them more "efficient." The shortcomings of this new approach were clear when the results of extension vs. productivity and production were compared. Because agricultural production could not be increased much by expansion of the cultivated area and the available technologies from productive regions could not be easily transferred to other regions, it was determined that technologies specific to those other regions must be developed (10).

The point that needs to be emphasized is that a liberation of resources from agriculture will only contribute to economic growth if the productivity of the resources that remain in agriculture is raised. This goal requires developing technologies adequate to the natural conditions of each country. A development strategy that ignores technological change for agricultural development will certainly have less success than the one that takes it into account. This point of view may be accepted without argument by a great number of people, especially those working in agricultural research. Nevertheless, there seems to be an important number of people to whom agricultural research does not seem to be justified by proof. They ask: Why should lesser developed countries invest in agricultural research? The answer to this question is the subject of the next section.

Why Should Lesser Developed Countries Invest in Agricultural Research?

Research uses scarce resources and produces knowledge. Therefore, to budget for research, it is possible to evaluate the

decision in economic terms, as any other investment decision. If that investment is to give returns, it must be true that the benefits are superior to the costs (both values measured and concentrated all in one moment of time). In other words, the internal rate of return of agricultural research must be higher than the opportunity cost of capital in the economy (11). According to this criterion, investing in agriculture has given very high returns.

Table 1 shows calculated rates of return for agricultural research for different commodities and countries. It is surprising that the returns of agricultural research exceed the rate of return of capital by factors of two to ten for both rich and poor countries (12). These results are independent of the product and of the revenue level of the country. Although studies measuring the return of agricultural research have been criticized for overestimating the benefits, the increasing sophistication and detail in measuring costs and benefits seem to have overcome that problem and, in certain cases, there has been a tendency to underestimate the benefits (13). The evidence suggests that it is a good business for society as a whole to invest in agricultural research and that it contributes to an increase in both the income level and the economic well-being of the country doing that investment.

High rates of return as a justification for investing in agricultural research are debated by those who say that since knowledge is a factor of free availability and use by both rich and poor countries, it does not make sense for the poorer ones to invest in something that will be freely available to them anyway. Though attractive, the latter argument implicitly assumes that technology may be easily incorporated and adapted from one region to another, regardless of its origin, and without needing capable and trained native personnel to receive the technology that is generated in other countries. In certain cases, the importation of foreign technology has worked because the ecological conditions of both exporting and importing countries were similar (such is the case of the United States and Europe, Australia and Argentina), but this similarity

does not always exist. Even if importation is feasible, imported varieties need an adaptation process that requires an already established scientific capacity to carry out their adoption and use. Another important reason for the lesser developed countries to have their own capacity for research is that it will permit a selection of the most convenient technology from the “menu” of available technologies in order to avoid, because of lack of knowledge, being sold technologies inadequate for their conditions. To sum up: Agricultural research in the developed countries cannot substitute for the effort of the lesser developed ones to create a technology suitable for their own natural and economic conditions (14).

The economic development process is essentially dynamic and produces changes in the relative prices of the factors and end products, which, in turn, cause a change in the proportion of use of each factor. Thus, the most expensive factors (the scarcer ones) are usually used less intensively and may be substituted for factors or inputs that are less expensive replicates of the scarcer ones. As resources availability is different for countries and regions, the answer to changing needs caused by price changes must be different.

To successfully face changing needs, it is necessary to rely on an adequate research infrastructure capable of facing the challenge. No country is interested in developing technologies for the specific needs and economic conditions of other countries. Therefore, each country must develop a research system and a group of institutions that can efficiently manage and resolve their own problems (15).

Weak national agricultural research institutes impede scientists in knowing and solving the problems faced by farmers at the farm level (16). In addition, scientists located in foreign institutions cannot have a permanent interaction with the country farmers to help resolve their problems. This is why it is necessary to create and support strong national research institutions to cope with their own specific challenges.

Also, there are certain crops that are not internationally commercial or which are

grown under the specific natural conditions of a specific country. Probably no country other than the one that produces those items will be interested in this research. Thus, in order to reap the benefits of the research in those products, those countries must have a research system of their own.

During the second half of the 20th century there has been an outstanding increase in world trade of agricultural and manufactured products. In the process, some countries have lost their export capacity while others have gained an export line they did not previously have. Countries that initially imported a certain product have substituted that importation and have even become exporters of that same product, either through greater domestic production or through engaging in goods with similar features. These changes sometimes occur due to technological developments and other times due to pricing policies. When comparative advantages between countries were acquired by means of technological advancements, the pricing policies in the countries that lose their comparative advantage probably did not permanently counteract the comparative advantages of the newcomers. To recoup and maintain their competitiveness, countries must introduce new technologies that will permit a reduction of unit prices. Some commodities produced in the tropics have substitutes that are grown in the temperate zones, so we should not dismiss the possibility of important technological advancements in the temperate areas that allow a substitution of products from the tropical areas (17). For this reason, and to maintain the lead in the export market, an adequate level of agricultural research is necessary.

As pointed out before, the economic policies of lesser developed countries usually sap stimulus to agriculture in relation to nonagricultural production. Agricultural research allows a reduction of costs and an increase in the level of production, thereby counteracting adverse policies (18). Although assigning funds for research does not justify hostile treatment to agriculture and does not destroy the distortion in relative prices created by those policies, it

compensates, in part or in whole, for the income reduction in the sector (19).

The lack of agricultural research causes certain expenses that are not directly felt because the country does not pay them visibly. But those costs may be high in terms of the benefits that may be lost. These benefits are of two types: the first are those that could have been received from other people's research, from which only those countries that have a system of their own can benefit; the second includes the size of the benefits lost due to the time lag—the absolute size of the loss keeps growing as time goes by. The longer that initiation of research is delayed, the later the benefits from it will be received (20).

An argument closely related to the former point refers to the process of growth and accumulation in an economy. Factor quantity and quality are basic sources of economic growth. An important production factor, if not the most important, is scientific know-how. Knowledge accumulated by investing in human capital and research is a crucial determinant of higher incomes in both rich and poor countries. Part of this knowledge may be transmitted from developed to lesser developed countries; for this, it is necessary to invest in education. On the other hand, for that part of knowledge that cannot be transmitted, it is necessary to invest in "local" or "native" research. The amount of generated knowledge will be directly related to the stock of available knowledge, which is also a function of the investment made in research. The acquisition and generation of knowledge, therefore, presupposes an investment in agricultural research.

A point outside economic cost-benefit considerations but present in general economic policy decision-making, particularly in agriculture, includes the political pressures that some countries exert on those to whom they sell food (21). How much risk does a country run by depending on another for supply of its main foods? It may be a costly risk, economically and politically. National autonomy has its own costs and benefits and to attain it a price has to be paid. In the case of food, autonomy

can be reached by producing internally with obsolete and costly technologies, or creating new ones for reducing costs. As investment in agricultural research is highly profitable, it is obvious to think of it as the most efficient manner to increase food production. The experience of India is a good example of the goals that can be reached through agricultural research, and there is no reason to believe that other lesser developed countries cannot do the same.

The previous reasoning indicates the advisability of investing in agricultural research. Nevertheless, the prevailing high rates of return to investment in it are an evident sign of underinvestment. In a competitive market where resources move to the more profitable ventures, a massive flow of resources toward agricultural research would be expected. Yet, such flow of resources is not to be found and, in some cases, the budget for agricultural research has been reduced. The next section explains the reason why that flow does not take place and describes the factors that block it.

Barriers to a Greater Investment in Agricultural Research

Knowledge is the basic product of an investment in research. This knowledge can be reflected in mechanical technology—tending to use more machinery and less labor—and in biological and chemical technology, where the trend is to use less land per unit of production. In certain cases, researchers can appropriate the benefits of their own technological developments, while in other cases they cannot, because the knowledge may be easily transferable (22). If people can reap the benefit of their own inventions, they will be motivated to do the research; if such individual benefit does not exist, the motivation disappears. Since the actual situation is that an important part of technological research produces knowledge that is easily transferable, it is only natural that the amount of resources devoted to that end will be below the socially desirable levels.

Those who, in part or in whole, reap the benefits of the agricultural research done by others, without footing the bill, receive a

benefit of positive externality. If there were in existence an institutional mechanism that allowed those who generate the benefits to appropriate them, the amount of resources devoted to research would be optimal. However, up to now, countries, farmers, and enterprises have not been interested in establishing that mechanism and thus community interest for investing in agricultural research has been lacking. In this case, then, the international centers of agricultural research provide a good mechanism for a reduction in underinvestment in agricultural research. In principle, benefits could be more easily traced back to their sources: the number of beneficiaries would be relatively small and the contribution of each country to total cost financing could be related in accordance with benefits received (23). The centers, devoid of profit aims, may devote an important part of their resources to develop technologies with wide application and adaptability.

The problem of research benefits appropriation relates to underinvestment in agricultural research because of the existence of externalities that cannot be appropriated by those who generate them. If these externalities were distributed among a reduced group of people, benefits to research would be nearer to the desired optimal level. On the whole, research benefits are distributed among producers and consumers, who are a rather heterogeneous group of people, difficult to group institutionally. In addition, they are numerous, and although the total research benefit may be high, the benefit for each individual consumer is small, so the amount in which each consumer is willing to contribute to finance investigation would be limited. However, the costs for institutionally organizing consumers for their contribution to research financing would be so high that the intent would not be justified.

Producers, however, are fewer in number so, in principle, mechanisms could be designed to allow research financing by relating it to the benefits produced by new technologies. The ease with which producers could appropriate such benefits would

depend, among other things, on the product's nature and the economic policy. In products destined for domestic consumption, research benefits would be gained more by consumers than by producers and for those destined for the external market or competition with imported goods, producers would be the main beneficiaries (24). In the former, it is difficult, if not impossible, to retrieve research costs through voluntary or forced contributions linked to research benefits. In the latter case, commercial goods channeled through international trade, the beneficiaries would be the producers. These would probably be a relatively small group, and to organize them institutionally, in guilds or trade unions, should not be a very complex or costly task, a fact that perhaps would allow a financing system for research in which it is feasible to expect farmers' contributions. The Colombian experience is positive in this respect, so that we find farmers' associations that, among other things, coordinate research work with the Colombian Agricultural Research Institute (ICA) and the International Center of Tropical Agriculture (CIAT); they also directly finance research in the product that interests them. There are farmer contributions to rice, banana, sugar, and coffee research.

The government could take into its hands the financing of research and assign resources of the general investment budget to agricultural research when it is impossible to retrieve research costs linked to the benefits of research. However, the high return rates of agricultural research persist, and governments continue to provide insufficient resources. Why? There are several reasons that might explain this seeming irrationality.

First, government budgets are limited and their funds must be assigned among many sectors to cope with needs in areas of common interest. It is difficult to present to the community a budget with priorities for agricultural research in face of the pressing needs of other sectors. In this case, the fact of the high return of investment in research, although pertinent, probably would not

bring great support to such allocation.

Second, if the research process is to succeed, it calls for a *continuous* flow of resources during several years. Budget limitations make this difficult. At the same time, these conditions of continuity and a required amount of resources help explain the subinvestment discussed earlier.

Third, the benefits of long-term agricultural research are not immediately evident, neither at the end of the research nor during the process. This impedes funding for the initial and developing phases of a project. The cornerstone of a building may be laid, and the first tree in a reforestation project may be planted, but the beginning of a research program in genetic improvement of rice is less perceptible and thus more difficult to inaugurate.

Fourth, research may fail, in that it may not produce positive results; this seeming failure, however, may create new knowledge that will eliminate future errors or reduce future costs. Many people will consider that resources invested in such research have been wasted. Investing funds in the construction of tangible works is perceived as permanent, but that is not the case of investment in research.

Fifth, the belief that agricultural technology may be imported and the real need is merely to disseminate results gives greater importance to extension activities than to research in assigning budgetary resources (25). Moreover, extension work is visible and is perceived as activities on behalf of the farmer; this is not the case with research. Organizations and institutions with international technical assistance do emphasize extension work in their outreach programs; this exerts pressures on the lesser developed countries to place an excessive amount of resources in such institutions, compared to their investment in research.

Sixth, the uncertainty about the impact of technology in distribution of benefits among producers and consumers, among large and small landowners, and among landlords and field workers is an element that explains underinvestment in research by governments. Highly rewarding research

projects that do not have clearly channeled benefits to groups deemed worthy of them by the current authority probably will not be undertaken.

Seventh, the centralized institutional organization of research systems can also explain underinvestment. Centralized systems may not spread these benefits to regions; this reduces regional political support and diminishes possible pressure for greater resource allotment to regional research stations.

The above-mentioned factors help to explain the seemingly irrational behavior of governments. Nevertheless, we should remember that because permanence in political power is short-lived, the discount rate applied by rulers in the evaluation of investment projects developed during their administrations is higher than the social discount rate. In this manner, long-term projects with greater seeming risk are penalized, as are investments in agricultural research.

Finally, underinvestment may also be explained by the physical and human demands that must be fulfilled in developing efficient research projects. Generally, lesser developed countries have an inadequate physical infrastructure and a reduced number of qualified people who can efficiently manage the research programs. Also, a number of required resources are not available in these countries.

Institutional Organization and Financing Schemes

Subjects relating to importance that the agricultural sector may and should have in the economic development process have been analyzed in the preceding sections. These include the role and convenience of investing in agricultural research as a tool to achieve agricultural development and the barriers that reduce or prevent countries to achieve agricultural research parity. This final section explores the institutional and financial avenues that exist for surpassing the barriers.

In spite of the different historic roots, agricultural research shows a trend toward

integrated national research systems in the world, which comprise the following aspects: institutional research; national research councils; technical committees of commodities; farms and specialized research centers with various autonomy degrees; financing schemes; systems of coordination and contracting with the private sector and, particularly, with universities; participation of farmers in decision-making; and control and surveillance schemes, independent or attached to agricultural ministries of each country (26).

Although there are similarities among national research systems, they differ in education; research and agricultural extension; the degree of decentralization; federalization and autonomy in the different farms; mixture of basic and applied research; and, finally, financing mechanisms and the participation of both the public and the private sectors in them (27). The point to be stressed in the context of this report is that those differences are necessary and they should be established with precision in view of the aims that agricultural research is to accomplish in each country, and the barriers that each has for achieving more adequate financing levels.

For instance, how to overcome the trend to underinvest in agricultural research as a result of the "very high political discount rate" that authorities place on certain long-term activities and with results that cannot be easily "inaugurated"? An alternative that has been increasingly adopted by countries instead of a regular budgetary allowance for agricultural research financing is to resort to long-term credit (28). In the end, political authorities in charge of public treasury and credit sources can be persuaded with the argument that payment for the loans will be made by the future generations because they are the ones who will eventually benefit from the research results.

How should research institutions and their financing mechanisms be organized to distribute financial burdens according to the benefits that farmers and consumers will receive from research? It has been previously mentioned that the economic literature is crystal clear in pointing to

producer benefits of lesser costs and greater production and income in those lines, as exports, where the elasticity-demand price for each individual country is very high, and to consumer benefits of products with inelastic demand, as the traditional foods of local production. In this respect, it is logical to propose that research in export items should be financed with producer contributions while domestic consumption items should be financed with ordinary budget allocations coming from present and future taxes on the community.

How should research and its financing be organized to achieve results that adequately mirror the relative importance that countries place on the economic benefits of research in their development plans, as compared to the income distribution benefits? In previous sections it was indicated that a possible barrier to investing in agricultural research was the government's fear that the allocation of resources to that end perhaps would not achieve the desired effect on income distribution. People responsible for agricultural research development and management must be aware that the budgetary allowance for research has a great impact on the redistribution of income when a commodity discrimination is made (bananas vs. cassava, for example). If a country determined its research efforts only according to the economic benefits, greater allocation would be made to those commodities that have higher return rates, with the goal of equalizing those returns among different items. Nevertheless, it is common for countries to adopt priority schemes that place high relevance on meeting their development targets in agriculture, such as food production prior to export, or the government may give preference to intensive labor activities or those performed by the small farmers (29).

Correspondingly, it is logical to give more autonomy and voice to producing enterprises and farmer organizations in the centers that they are directly or indirectly supporting and which do research on commodities such as the export lines. The responsibility of the State should be greater

in the research for those commodities for domestic consumption.

These are obviously mechanisms to avoid underinvestment from fear of adverse redistributive effects. Another form or mechanism to benefit the poorer levels of farm work is the extension work for disseminating knowledge, an aim that has guided rural development programs.

Lack of adequate regional benefits may also be a cause of underinvestment in agricultural research. Economic literature has widely debated how government and political groups bestow a specific value on the regional benefits of public investment. The question to be answered by each country is how to build up the national research system, in terms of location of its experimental farms, in order to get adequate political support in budget allowances from the different fields of government (national, departmental, and municipal).

In this respect, experience indicates that highly centralized systems (as is the case of the United States and Brazil) have coexisted with very decentralized ones (as in Japan and the majority of Third World countries). Such a structure is mainly linked with historical grounds, the country's size, and the political structure. Likewise, analysis of regional research organizations shows coordination problems and poor resources allowance in extremely decentralized systems, as well as lack of political and financial support in the very centralized ones (30). Also, there are many examples of inefficient research structures because of political pressures known as "pork barrel legislation" (31). Thus there does not seem to exist a single rule, or a more adequate one, to organize agricultural research in each country, but it must be stressed that regional systems organization has to consult many aspects to achieve political and trade union support in resources allowances.

A last question, perhaps the most difficult to solve even conceptually, is how to design institutional and financial mechanisms to avoid underinvestment because the benefits spill over to other countries who appropriate at, no cost to them, knowledge and technologies developed by others. It is easy

to recommend, but difficult to carry out, joint research programs among countries who are expected to benefit from them. It is also easy to suggest that the international centers do the research for those products with an enormous number of beneficiaries. Theoretically, the international centers scheme, by centralizing research and providing continuity to it, avoids the collective underinvestment that arises when each individual country does not invest enough. The fear is that other countries will receive part of the benefits at no expense, or they underinvest with the hope that others will do the research so that they will later freely benefit from it. An institutional scheme of that sort, however, would call for a mandatory system of international contribution, in which each country would provide resources in proportion to the benefits it could effectively draw from the research.

A pragmatic scheme to organize research through international centers which, at the same time, solves the problem of individual contributions of each country according to benefits is the one formed by the Consultative Group on International Agricultural Research and its network that links the national research agencies (32). Under this system, nine international research centers have been coordinated (IRRI, CIMMYT, IITA, CIAT, CIP, ICRISAT, ILRAD, ILCA, and ICARDA), and four international research/support institutions (IBPGR, IFPRI, ISNAR, and WARDA) have been founded. These help achieve important economies of scale and prevent the underinvestment that would arise because of the spillovers if research were left exclusively in the hands of individual countries.

And, what is more important, the procedure of tight contact among researchers and research groups in a network accomplishes two purposes. First, it establishes a mechanism to create and keep running research and development, with the drive and continuity needed by the different commodities (33). Second, it is an efficient method to link, without compulsory contributions, research programs of developing countries, by each contributing

resources that are much lower than if the expense were undertaken independently by the country.

The international center system and their research network solves, to a great extent, the problem of underinvestment in agricultural research in those items with big spillovers to several countries of the world.

This solution is reached through international institutions that do not have the traditional bureaucratic hierarchies or the political costs as do those depending on the United Nations system. Furthermore, participation by each individual country is based on its sovereign decision, and its

financial contribution is a function of the benefits that each perceives it will receive from joint research. Yet, behind the success of this institutional scheme there is the need to provide the international centers with the basic financial resources, in the required amount and continuously. This financing challenge is now being met by the more developed countries who have greater paying power.

Acknowledgments

The authors wish to thank Gustavo A. Nores, Douglas Pachico, and John Lynam for their ideas, suggestions, and valuable comments on topics analyzed in this work.

Table 1. Summary of studies on return of agricultural research.

Study	Country	Commodity	Time period	Annual internal rate of return (%)
Index Numbers				
Griliches, 1958	USA	Hybrid corn	1940–1955	35–40
Griliches, 1958	USA	Hybrid sorghum	1940–1957	20
Peterson, 1967	USA	Poultry	1915–1960	21–25
Evenson, 1969	South Africa	Surgarcane	1945–1962	40
Barletta, 1970	Mexico	Wheat	1943–1963	90
Barletta, 1970	Mexico	Maize	1943–1963	35
Ayer, 1970	Brazil	Cotton	1924–1967	77+
Schmitz and Seckler, 1970	USA	Tomato harvester, with no compensation to displaced workers	1958–1969	37–46
		Tomato harvester, with compensation of displaced workers for 50% of earnings loss		16–28
Ayer and Schuh, 1972	Brazil	Cotton	1924–1967	71–110
Hines, 1972	Peru	Maize	1954–1967	35–40a 50–55b
Hayami and Akino, 1977	Japan	Rice	1915–1950	25–27
Hayami and Akino, 1977	Japan	Rice	1930–1961	73–75
Hertford, Ardila	Colombia	Rice	1957–1972	60–82
Rocha and Trujillo, 1977		Soybeans	1960–1971	79–96
		Wheat	1953–1973	11–12
		Cotton	1953–1972	None
Pee, 1977	Malaysia	Rubber	1932–1973	24
Peterson and Fitzharris, 1977	USA	Aggregate	1937–1942	50
			1947–1952	51
			1957–1962	49
			1957–1972	34
Wennergreen and Whitaker, 1977	Bolivia	Sheep	1966–1975	44
		Wheat	1966–1975	-48
Pray, 1978	Punjab (British India)	Agricultural research and extension	1906–1956	34–44
	Punjab (Pakistan)	Agricultural research and extension	1948–1963	23–37
Scobie and Posada, 1978	Bolivia	Rice	1957–1964	79–96
Pray, 1980	Bangladesh	Wheat and rice	1961–1977	30–35

—continues

Table 1. Continuation.

Study	Country	Commodity	Time period	Annual internal rate of return (%)
Regression Analysis:				
Tang, 1963	Japan	Aggregate	1880–1938	35
Griliches, 1964	USA	Aggregate	1949–1959	35–40
Latimer, 1964	USA	Aggregate	1949–1959	not significant
Peterson, 1967	USA	Poultry	1915–1960	21
Evenson, 1968	USA	Aggregate	1949–1959	47
Evenson, 1969	South Africa	Sugarcane	1945–1958	40
Barletta, 1970	Mexico	Crops	1943–1963	45–93
Duncan, 1972	Australia	Pasture Improvement	1948–1969	58–68
Evenson and Jha, 1973	India	Aggregate	1953–1971	40
Clíne, 1975 (revised by Knutson and Tweeten, 1979)	USA	Aggregate	1939–1948	41–50c
		Research and extension	1949–1958	39–47c
			1959–1968	32–39c
			1969–1972	28–35c
Bredahl and Peterson, 1976	USA	Cash grains	1969	36d
		Poultry	1969	37d
		Dairy	1969	43d
		Livestock	1969	47d
Kahlon, Bal, Saxena, and Jha, 1977	India	Aggregate	1960–1961	63
Evenson and Flores, 1978	Asia-national	Rice	1950–1965	32–39
			1966–1975	73–78
	Asia-international	Rice	1966–1975	74–102
Flores, Evenson, and Hayami, 1978	Tropics	Rice	1966–1975	46–71
	Philippines	Rice	1966–1975	75
Nagy and Furtan, 1978	Canada	Rapeseed	1960–1975	95–110
Davis, 1979	USA	Aggregate	1949–1959	66–100
			1964–1974	37
Evenson, 1979	USA	Aggregate	1868–1926	65
	USA	Technology oriented	1927–1950	95
	USA	Science oriented	1927–1950	110
	USA	Science oriented	1948–1971	45
	Southern USA	Technology oriented	1948–1971	130
	Northern USA	Technology oriented	1948–1971	93
	Western USA	Technology oriented	1948–1971	95
	USA	Farm management research and agricultural extension	1948–1971	110

Source: Ruttan, Vernon. 1982. *Agricultural Research Policy*. University of Minnesota Press, Minneapolis, Minn. pp 20–26

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- see: Cavallo, Domingo and Mundlak, Yair. 1982. Agriculture and economic growth in an open economy: The case of Argentina. Research Report 36. International Food Policy Research Institute (IFPRI), Washington, D.C.
7. In speaking about the cost of inputs used per production unit, we are referring to the input per unit of gross production.
 8. The discouragement of agriculture is evident if we examine the terms of domestic exchange between the agricultural sector and the rest of the economy and between them and the international terms of exchange. The pertinent question would be: how many tons of, for example, rice or coffee, would be necessary to acquire a certain product, cars for example, in the domestic market and how many in the international market?
 9. The reason for this last statement is simple. When the absolute and relative size of the agricultural sector is reduced, its demand for industrial products is reduced as well, and they are produced at a higher cost because of a reduction in the scale of operation. This creates costlier inputs for agriculture, which make it lose competitiveness and discourage development and adoption of more modern technology, which produce higher yields.
 10. For a detailed description of what may be considered general models of agricultural development, see: Hayami, Yujiro and Ruttan, Vernon. 1971. *Agricultural development: an international perspective*. Johns Hopkins Press, Baltimore, Md., U.S.A. pp. 27-43. A summary of these models is found in: Ruttan, Vernon. 1977. *Induced innovation and agricultural development*. *Food Policy* (Aug.):198-202. Also: 1982. *Agricultural research policy*. University of Minnesota Press, Minneapolis, Minn., U.S.A. pp. 20-26.
 11. The criteria for present value and internal rate of return do not necessarily lead to the same investment decisions. Nevertheless, throughout this paper it is assumed that conditions exist for the internal rate of return to be a good indicator of an advisability or not for an investment to be made.
 12. The rate of return to capital estimated for a group of developed and lesser developed countries normally fluctuates between 5 and 10 percent, with only a few countries outside these limits. For an analysis of the estimates of the rates of return to capital in several developed and lesser developed countries, see: Harberger, Arnold C. 1977. *Perspectives on capital and technology in less-developed countries*. Paper presented at the Annual Meeting of the Association Of University Teachers of Economics, Swansea, Wales, March 19, 1977. Mimeograph.
 13. For an analysis of the problems in evaluating investment in agricultural research, see: Schuh, G. Edward and Tollini, Elio. 1979. *Costs and benefits of agricultural research: The state of the arts*. World Bank, Washington, D.C. pp. 1-13, 24-35. For a commentary on the exactitud of estimating rates of return to investment in agricultural research, see (10) Ruttan, V. (1982). pp. 252-254.
 14. The importance of having scientific capacity even if it is only to adapt imported technology is not exclusive to the agricultural sector. The industrial sector also needs this capacity and its existence is what has facilitated that technology initially acquired, which at first did not respond to the signs of the market in the importer country, be adapted in such a way that the technology finally used adapts itself to the economic conditions prevailing in each country. A discussion of this point is found in: Ramírez, Manuel. 1982. *Comentarios a la ponencia: Cambio técnico en el sector agropecuario de América Latina: Un intento de interpretación*. In: Ministry of Agriculture/Department of Planning/COLCIENCIAS. 1982. *Memorias del primer seminario sobre investigación y desarrollo tecnológico en el sector agropecuario colombiano*. Bogotá. pp. 167-170.
 15. Resolving the problem of "subsistence technology" should not be confused with the promotion of self-sufficiency in technology, because trying to substitute importation in the field of technology has the same economic implications as substituting importations in other fields. It is evident that there are institutions with comparative advantages in the execution of basic and applied research that can nurture with their results national agricultural research entities.
 16. For an analysis of the benefits of decentralizing within an agricultural research system, see Evenson, Robert E.; Waggoner, Paul E.; and Ruttan, Vernon W. 1979. *Economic benefits from research: An example from agriculture*. *Science* 205(14): 1101-1107.
 17. Sugarcane is a typical example of products from tropical areas that can be substituted by those countries in temperate areas if important technological advances are made in sugar beet production. In the same way, olive oil (temperate zone) competes in demand against palm oil (tropical zone).
 18. Scobie, Grant M. 1979. *The demand for agricultural research: A Colombian illustration*. *American Journal of Agricultural Economics* 61(3):541.
 19. The best policy would evidently be to eliminate discrimination against agriculture and to have agricultural research.
 20. A point related to this matter has to do with the implications of investing research resources in amounts inferior to the optimal. Estimates of the cost that such a decision represents in the United States indicate that for every dollar that the government withdraws from agricultural research, from \$1.50 to 3.00 are lost in net benefits. White, Fred C. and Havlicek, Joseph Jr. 1982. *Optimal expenditures for agricultural research and extension: implications of underfunding*. *American Journal of Agricultural Economics* 64(1):53-54.
 21. There is no doubt that food is used as a political weapon or as a tool to win wars. The history of humanity so demonstrates and there is no reason to believe that the future will be any different if circumstances are similar to the past. The role of food as a political weapon and as a war tool is well known and adopted. About the interrelation between commercial policy and external policy, see, among others, Cooper, R.N. 1972/73. *Trade policy is foreign policy*. *Foreign policy* (Winter 1972/1973) No. 9, and Maddock, R. T. 1978. *The economic and political characteristics of food as a diplomatic weapon*. *Journal of Agricultural Economics* (January). pp. 31-41.
 22. In general, those who develop mechanical technology reap the benefits, while others than those who created it can reap the benefits of the knowledge produced in biological technology.
 23. The problem of distribution of costs and benefits is more complex than what is presented. This presentation is an over simplification but it is good for illustrating the nature of the solutions that could be implemented in case that each country contributed according to its participation in total benefits.
 24. The products that go to the internal market may be noncommercial because of economic policies. Such has been the case of rice in Colombia, as it was not allowed to be exported when this commodity could compete in

- the international markets. On the other hand, the benefits of research will go entirely to the producers of commercial commodities when the country is very small in the international context and cannot affect the international prices by its exportation of same.
25. See Evenson, R. and Kislev, Y. 1975. *Agricultural research and productivity*. New Haven: Yale University Press, 1975.
 26. A good review about the structure of the national research systems in Brazil, England, Germany, India, Japan, Malaysia, and the United States is presented in (10) Ruttan, V. (1982). pp. 45–108.
 27. See (10) Ruttan, V. (1982). pp. 109–112.
 28. This point is presented, among others, in the work of Trigo, E. y Piñeiro, M. *El financiamiento de la investigación agropecuaria*. International Federation of Agricultural Research and Development (IFARD) paper presented at the Second Meeting for Directors of National Systems of Agricultural Research of Latin America and the Caribbean. Madrid, Spain, September 1982.
 29. See, for example, the articles by Chaparro, F. et al. 1982. *Prioridades de investigación y asignación de recursos en agricultura: el caso colombiano*; Drillon, J.D. and Librero, Aida R. 1982. *Definición de prioridades de investigación para la agricultura y los recursos naturales en Filipinas*; Idachaba, F.S. 1982. *Prioridades en la asignación de recursos para la investigación agrícola: la experiencia nigeriana*; and Paz, L. 1982. *Metodología para la definición de prioridades de investigación sobre productos agrícolas*. In: Daniels, Douglas and Nestel, Barry (comps.). 1982. *Asignación de recursos para la investigación agrícola*, International Development Research Centre. Ottawa, Canada.
 30. See (10) Ruttan, V. (1982).pp.45–108. Also: Schulz, T.W. 1979. *The economics of research and agricultural productivity*. International Agricultural Development Service, New York, N.Y. Occasional Paper.
 31. See Hadwinger, D.F. 1982. *The politics of agricultural research*. University of Nebraska Press. Ch. 7–8.
 32. See CGIAR Secretariat. 1981. *Report of the review committee*. Consultative Group on International Agricultural Research, Washington, D.C. (September). pp. 62–66.
 33. Nores, G. *Collaborative activities of the Centro Internacional de Agricultura Tropical (CIAT) with national and regional agricultural research institutions in the Caribbean: Proposed strategy*. Workshop on Agricultural Research Policy and Management in the Caribbean, Trinidad (September 26–29, 1983). pp. 11–13.

Acts of Commemoration



Acknowledgment of CIAT's donor support

John L. Nickel

Presentation of the Kellogg Auditorium

The facilities that were inaugurated here ten years ago were provided by three American foundations: the Kellogg Foundation provided funds for the training and conference facilities, including these rooms and offices around us, as well as the related dining and conference housing and training accommodation facilities; the Kresge Foundation provided funds for the library and documentation facilities; and the Rockefeller Foundation provided the funds for all the rest.

Since that time, a number of other buildings have been constructed through the contribution of many donors. However, the need for one key item included in the original master plan for the Center, which we have never been able to construct so far, has become increasingly apparent. This is a major auditorium in which the larger conference events sponsored by CIAT, as well as many other similar events sponsored by other organizations in the Center, can be adequately accommodated. As the nature of the programs of CIAT have evolved over the past years, the need for this amphitheater has diminished. These plans were developed for a major remodelling of this facility to turn it into a first class auditorium which would very adequately and efficiently provide outstanding conference facilities for up to 200 participants. The Kellogg Foundation has generously agreed to provide over one-half million dollars to finance the construction and related furniture and audiovisual equipment involved. Final plans are ready to seek bids for the construction, and we hope to begin

building soon. I wish to gratefully acknowledge this contribution of the Kellogg Foundation and consider this a symbolic act of gratitude to all of the many donors represented here for your very large and major contributions to the various CIAT facilities, as well as the ongoing operational costs of the Center.

Russell Mawby, President of the Kellogg Foundation, one of the pioneers in the founding of CIAT, was planning to be here on this occasion but recent urgent matters have kept him away. I am very pleased that James Richmond, Vice President, is here to represent the Foundation. I would like to ask him to say a few words.

Presentation of the Electron Microscope

You may find it surprising that an international center striving for excellence in agricultural research would have gone for ten years without an electron microscope. This reflects the basic CIAT philosophy of field-oriented research, with the use of sophisticated equipment only when absolutely necessary. Thus, in the early years, virology work was largely done in the field and greenhouse, with the aid of laboratory equipment such as ultracentrifuges for the development of diagnostic screening techniques, using electron microscopes at institutions in Cali and Bogotá when necessary.

However, as the importance of viral diseases, both as a production constraint and as a key limitation in the international movement of plant material, has become increasingly evident, we have found it essential to have this tool in our Center.

However, we had not budgeted for this important and expensive development. We mentioned this dilemma to the Ambassador of Japan when he kindly visited us last year. He did not forget this need when he left CIAT but energetically intervened on our behalf with the Japanese Government and was able to obtain a special addition to the already large Japanese contribution to CIAT's core budget to finance the purchase of this excellent piece of equipment. I wish, on behalf of CIAT and the people it serves, to thank the Government of Japan and,

personally, The Honorable, Hiroshi Nagasaki, Ambassador of Japan to Colombia, for this contribution. In doing so, I also wish to thank all donors for the many pieces of equipment essential to our work we have been able to buy with their contributions.

I invite Mr. Nagasaki to make a statement and then to cut the ribbon inaugurating this new facility, after which the Bean Program virologist, Francisco Morales, will demonstrate the equipment.

Welcome to the Acts of Commemoration

John L. Nickel

The Honorable Rodrigo Lloreda Caicedo, Minister of Foreign Affairs of Colombia, and Mrs. Lloreda Caicedo; Doris Eder de Zambrano, Governor of the Department of Valle del Cauca; His Excellency the Ambassador of Japan; Dr. Reed Hertford, Chairman of CIAT's Board of Trustees; all major, civil, military, and ecclesiastic authorities; General Secretary of the Ministry of Foreign Affairs; Ex-Ministers of State; Dr. Warren Baum, Representative of the World Bank; Dr. William Mashler, Representative of UNDP; Dr. Emilio Trigueros, Representative of FAO in Colombia; Foreign Vice-Ministers of Agriculture; representatives of donors entities; directors of international agricultural research institutes; officers of CIAT; ladies and gentlemen; my dear friends and colleagues:

On behalf of the Board of Trustees and staff of the Centro Internacional de Agricultura Tropical, and in my own name, I am deeply honored, and very pleased, to welcome all of you to this act of commemoration of the 10th anniversary of the dedication of CIAT's facilities.

This Center, established by the joint goodwill and action of the Rockefeller, Ford, and Kellogg Foundations, and the Colombian Government 15 years ago, and these facilities inaugurated on this date ten years ago, are dedicated to the application of the fruits of modern science to contribute to the alleviation of hunger and poverty. To accomplish these noble objectives, a large number of national governments, international financial institutions, and intergovernmental bodies have joined the

original donors in financing this large enterprise.

We are delighted and encouraged that so many personages have honored us with their presence at this act. Among you are representatives of the donor organizations, which finance CIAT's activities; officials of the Colombian Government, which has over the years so generously hosted and supported this center; representatives of the Palmira and Cali communities that have accepted scientists from 22 countries with such generosity and hospitality; representatives of the national research institutes, with whom we cooperatively carry out our work; and some of the pioneers, who gave so much of themselves to build this Center and its programs. A hearty welcome and heartfelt thanks to you all!

During the ten years since Misael Pastrana Borrero, then President of the Republic of Colombia planted a symbolic tree and dedicated these excellent facilities, great progress has been made in the economic development and agricultural production in the tropical developing world. Increasing attention has been given to agricultural development and agricultural research. Food production and productivity has increased in many countries as the result of these investments and the dedicated efforts of many people around the world. Yet, many, far too many, people are still deprived of one of the most basic human rights—enough food to meet their minimum requirements. Poverty and hunger still rob a large proportion of our fellow human beings of hope and dignity.

The progress made in CIAT since these

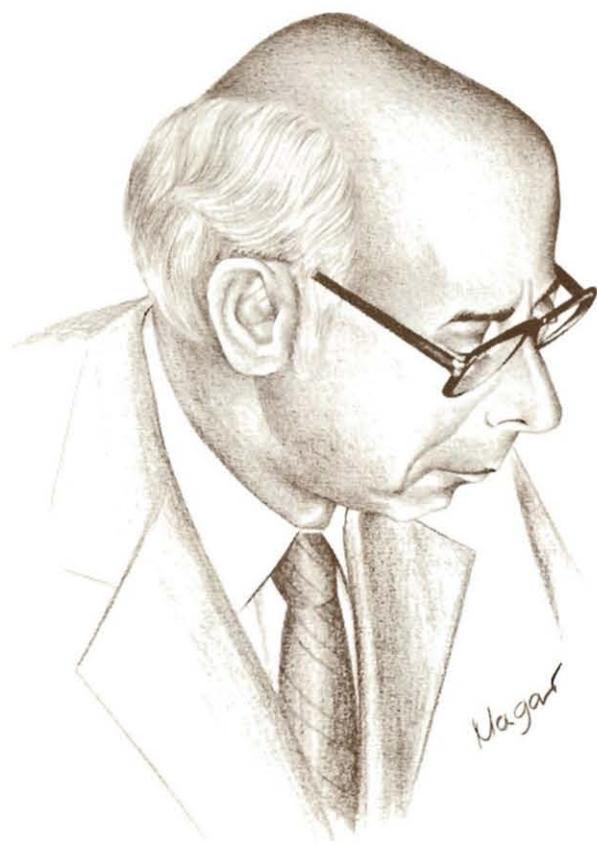
facilities were inaugurated has demonstrated that the vision of those who founded this Center can be realized. Many farmers have now, in their lands, new bean varieties which not only yield more but require fewer pesticide applications. New varieties and agronomic practices to triple cassava yields have been made available. Rice yields have been increased by 50% in over 20 countries and have doubled in Colombia. New pastures are opening a totally new horizon for development of the frontiers of this continent. National research institutions have been strengthened by the 2500 professionals who have received training in the Center. But the battle is not won. Even as we speak people are dying of hunger, and they are dying needlessly. Those who founded this center saw the potential of the tropics to produce abundantly to meet the needs of the people who live in this zone. However, to fully realize this potential and to eradicate hunger and poverty will require accelerated and well-focused efforts of centers like this, and national research programs, as well as bold political will by national leaders.

This then, is not just a commemoration of the inauguration of these buildings but a call

to renewed dedication of all of us to the enormous task ahead.

When this Center was founded, only two other international centers existed: the International Rice Research Institute in the Philippines and the International Center for Maize and Wheat Improvement in Mexico. The concept which the Rockefeller and Ford Foundations have developed, and demonstrated, by those initial centers and then by CIAT was soon thereafter recognized as being of immense global significance and requiring much broader action, and financial support, than could be carried out by the initial centers and the initial donors. Thus, one of the most important organizations of our time, the Consultative Group for International Agricultural Research, was founded. This organization is cosponsored by three international agencies: the World Bank, the United Nations Development Programme and the Food and Agricultural Organization of the United Nations. I am delighted that high level representatives of these agencies are here today and invite them each to address this gathering on behalf of their agencies.

Message from the CGIAR: the international system of agricultural research



Warren C. Baum
Chairman, CGIAR
Vice-President, World Bank

Representing the World Bank, co-sponsor of the CGIAR

Mr. President, Members of CIAT's Governing Board, Dr. Nickel, and Members of the CIAT family:

I am truly delighted to be here today in Colombia and to take part in the celebration of CIAT's first decade of operations. It is a double pleasure for me since I am here in two capacities. As a Vice President of the World Bank, I am representing that institution as one of the three cosponsors of the Consultative Group on International Agricultural Research—the CGIAR as we call it— of which CIAT is an integral part. Also in my World Bank capacity I am pleased to note and acknowledge the long and mutually beneficial relationship that exists between the Government of Colombia and the World Bank. In my other capacity, as Chairman of the Consultative Group, I would like to spend a few minutes focusing on that wider system of international agricultural research which now comprises 13 centers.

The CGIAR was founded in 1971 with the purpose of bringing the resources of modern biological and socioeconomic research to bear on the long neglected possibilities of agricultural progress in the tropics and subtropics, where nearly all the developing countries lie. The research and training programs undertaken by ten of the international agricultural research centers that are supported by the CGIAR seek to provide the developing countries with superior varieties of essential crops and improved farming systems for the production of food, plants and animals. The other three centers are concerned with research on food policy issues of importance

to the developing world, with the conservation of the world's plant genetic resources, and with the strengthening of national agricultural research programs. Together the 13 centers provide one of the most effective tools that the development community has devised for helping to raise agricultural production in the Third World.

Funds for these centers are provided by about 36 contributing members comprising countries, both developed and developing, international and regional aid organizations, and private foundations. Their total support in 1983 for the core programs of these centers is likely to reach \$160 million. This figure compares with contributions of just over \$25 million ten years ago. Among the contributing members to the system are two Latin American countries, Brazil and Mexico. I mentioned that the World Bank is one of the sponsors of this system; the other two are the Food and Agriculture Organization and the United Nations Development Programme, both of which are also represented here.

Today we are celebrating a decade of CIAT's operations—but let me be slightly indiscreet and point out that, in fact, CIAT is hiding her true age. In strictly legal terms, CIAT was established in 1969 and shares the distinction with three other centers of having predated the CGIAR system. Much of the credit for the vision, the wisdom, and the faith behind the establishment of the four original centers must go to the foundations that were instrumental in their creation. In CIAT's case we are indebted to the Rockefeller and Ford Foundations. However, that vision, wisdom, and faith had to be matched by the foresightedness of governments who were willing to be host countries to these international agricultural research centers, because of their unswerving belief in the value of scientific research in agriculture.

I am particularly pleased today to be able to express anew the Consultative Group's gratitude to President Carlos Lleras Restrepo, who initiated a process that has received the continued support of Colombian governments throughout the ensuing

decade. As host country, Colombia has always been prepared to do whatever was necessary to facilitate CIAT's work. In this connection I have been very pleased to know that the government of Colombia has just renewed its commitment to CIAT—and to the wider system of which CIAT is a part—by expressing its intention of updating the legal instruments by which CIAT operates as an international agricultural research center within Colombian territory.

Colombia's varied land resources and microclimates make it one of the favored countries of the world in terms of its agricultural base—as is much of Latin America compared to other regions of the world. However, the importance of CIAT's mandate in Latin America is apparent, when one considers the disturbing fact that only the River Plate countries in Latin America have been able to increase food production sufficiently to keep up with increases in demand. Therefore, CIAT's concentration on beans, cassava, rice, and tropical pastures deals with commodities that are of vital interest to the agricultural systems of all the countries of Latin America and the Caribbean. I would remind you, and I am sure you are very much aware of this, that CIAT's work is not, of course, limited to the Latin American region, since, within the CGIAR system, it has the global mandate for beans and cassava. CIAT, therefore, operates programs related to beans and cassava in Africa and Asia, as well as in Latin America.

The theme of multinational, multi-regional, multisystem links in agricultural research—what we now call networking—is the subject of the Consultative Group's annual report this year. In its simplest terms, networking implies the linking of individuals or institutions with a shared purpose. In the case of the CGIAR, it implies formal or informal international arrangements through which the participants receive mutual benefits. Interestingly CIAT is one of several centers within the system that some years ago highlighted the importance of networking in its long-range plans. In fact CIAT expects that most of the additional staff that will be recruited during the rest of this

decade, will be working in regional cooperative arrangements.

Within the CGIAR, we like to think that CIAT and the other centers in the system have established a network that comprises some of the most eminent scientists, the most dedicated researchers, and the most progressive research institutions. We do, however, have more objective measures of how the outside world regards the centers and the system. Several years ago and prior to the formation of the CGIAR, CIMMYT, which is established in Mexico and is one of the three Latin American centers (along with CIAT and the International Potato Center in Peru) that are supported by the CGIAR, was the recipient of a Nobel Peace Prize. It was given to Norman Borlaug for his work on improved high-yielding varieties of wheat. This year one of our oldest centers, the International Rice Research Institute in the Philippines, was awarded the prestigious Third World prize for its work on the IR36 variety of rice. A few years ago, the CGIAR system as a whole was awarded the first King

Baudouin International Development Prize for its significant contribution to the development of the Third World, and to the solidarity and good relations between the industrialized countries and the countries in process of development. Individual scientists within the centers have received awards and recognition that are too numerous to mention here.

Let me close with a personal comment. The celebration of CIAT's decade of operations coincides with the close of my decade as Chairman of the Consultative Group. During these ten years I have seen this international system grow and prosper. It has been a singular privilege to be closely associated with a system that is so vital, so excellent, and so critical in the battle to reduce the hunger that plagues so many millions of the world's poorest human beings. I salute CIAT for its dedication to this cause, and the Government of Colombia for its sustained support to CIAT and through CIAT to the Consultative Group. Thank you.

Message from UNDP: technical cooperation among developing countries



William T. Mashler

Senior Director, Division for Global and Interregional Projects, UNDP

Representing the United Nations Development Programme, co-sponsor of the CGIAR

I am greatly honored to have been asked to speak as the representative of UNDP at this very important and special occasion. Following on the extraordinary successes of research on wheat and rice in Mexico and the Philippines through the work of CIMMYT and IRRI, respectively, the Rockefeller and Ford Foundations were encouraged to establish comparable international centers in other parts of the developing world. In 1967, they jointly took the initiative to establish the Centro Internacional de Agricultura Tropical (CIAT) in Colombia to focus on the lowland tropics of the Western Hemisphere and the International Institute of Tropical Agriculture (IITA) in Nigeria to deal with crops and farming systems of the African humid tropics. Thanks to the foresight and vision of these two great American institutions, which originally founded and supported international agricultural research for the benefit of the developing countries, the validity of the concept of international cooperation in agricultural research was fully demonstrated. These initiatives subsequently led to the establishment of the Consultative Group on International Agricultural Research (CGIAR), which through the present 13 centers is giving support to a worldwide system of international agricultural research which is the main backup factor to national research organizations in the developing countries. It is a tribute to the members of the CGIAR, comprising developed and developing countries and private foundations and organizations, for the generous contributions they have made over the years not only through material but equally

importantly the moral support they have given to this unique enterprise.

In partnership with other cosponsors and members of the CGIAR, UNDP has been an enthusiastic supporter of the CGIAR system from the beginning, and I have been in the fortunate position of channelling UNDP's strong support to CIAT and virtually all the other centers. UNDP's financial contribution has increased from \$500,000 in 1971 to over \$7.7 million in 1983. I sincerely believe that the CGIAR system is one of the best demonstrations of what can be done through international cooperative undertakings to improve human lives. This becomes particularly poignant in the present-day world marked by conflicts and the constantly widening gap between some 500 million well-nourished inhabitants of this globe and over 1.5 billion who lack the minimum essentials of life, including access to production resources.

CIAT is considered to be one of the "mature" centers, and the international community always expects major breakthroughs in research, having become so used to the spectacular accomplishments of IRRI and CIMMYT. CIAT, however, has had to deal with research on a whole array of commodities—beans, cassava, rice, beef, and milk under frequently unfavorable agroecological conditions. Accentuating this problem has been the challenge of having to confront socioeconomic considerations relative to small landholdings with limited resources where it is difficult to produce an early discernible impact. Yet, CIAT's achievements to date are indeed very impressive. Typical examples are: development of disease- and insect-resistant varieties of beans which have been successfully grown in Guatemala, Honduras, Nicaragua, Costa Rica, Bolivia, and Cuba; the dramatic increases in yields of cassava ranging from 20 to 30 tons per hectare; development of tissue culture techniques for propagation of cassava; germplasm evaluation and adaptive research on tropical pastures (grasses and legumes) suited for infertile and acid soils affected at times by aluminum toxicity; the phenomenal yield increases of rice in Colombia; development

of successful cooperative networks with national programs to maximize the impact of technology generated at CIAT and elsewhere; and training of developing country personnel at various levels in the fields of CIAT's mandate.

It is indeed a matter of great satisfaction that such encouraging results have been obtained by CIAT in the last six to seven years, and it is even more gratifying to note that the research is not carried out as an isolated activity, but in full collaboration with national programs, many of which have been substantially strengthened as a result of these cooperative endeavors. Such activities, like those of other international centers supported by the CGIAR, represent a true example of what we in UNDP call technical cooperation among developing countries (TCDC)—that is, the pooling together of the knowledge, skills, experience, and other resources of developing countries themselves for a concerted and cooperative attack on common problems in association with the international community as a whole. The research, training, and cooperative programs of CIAT are a valuable mechanism for fostering intercountry collaboration which would facilitate the strengthening of national institutions, and thereby build solid bases for TCDC. Research, production and training programs, and workshops and conferences for developing country scientists to share experiences and knowledge have been an integral component of such TCDC.

To those men and women who are deeply involved in this great scientific and humanitarian enterprise I pay a very special tribute.

UNDP has had the good fortune of being associated with CIAT in these types of projects, firstly through the project sponsored by our Latin America Bureau, "Agricultural Production," and more recently through our global project, "Technology Transfer on Root and Tuber Crops," which is being implemented by CIAT in close association with CIP and IITA. Additionally, with UNDP's support, CIAT has also made an important contribution to rice improvement in Latin America through the

UNDP-sponsored International Rice Testing Program of IRRI in collaboration with CIAT. The IRTP is truly the finest example of technical cooperation among rice scientists throughout the world.

I am confident that CIAT's existing networks will be further strengthened in the ensuing years so that the technology developed at CIAT and at national programs will be rapidly transferred for productive use by the resource-poor farmers.

Twelve years after the creation of the CGIAR we all like to think that we have met a need that was obvious and absolutely essential. Whatever its successes — past, present and future — we all must face the fact that this important and still young beginning is only part of a major endeavor which must be vigorously maintained and ultimately expanded. To have succeeded is one thing; to keep succeeding through imaginative expansion of concomitant research needs at all levels is the task which we who were part of the beginning will have to pass on to those who follow us. This unique effort is not an end in itself. It is the means toward the end of ensuring that the specter of privation, of hunger and neglect, will hopefully be diminished and ultimately purged from our midst. Such conditions are unacceptable in this day and age when the potential for the improvement of the human condition is in large measure available to us. The scientific community needs the support to carry on its tasks from those of us who represent governments, international organizations and other entities which ultimately have the responsibility to provide the means to sustain their efforts.

Between this tenth anniversary of the dedication of the new facilities of CIAT and its twentieth in 1993 that support base needs to be assured—in financial and moral

commitments. All of us have and the many others who are a part of what we like to call the international community—and I stress the word community—have a sacred duty to play our personal part to make this collective commitment a reality. Only by this means can we ensure what are essential ingredients of the attainment of human rights and peace. Failure to do so is, to my way of thinking and my principles as one who serves the public weal, totally unacceptable. This great occasion offers an opportunity to reiterate the efficacy of our commitment. Let us all share it for the sake of present and future generations.

Cooperation in science and technology transcends national and political boundaries. Scientists at CIAT and of the other centers representing developed or developing countries have joined hands in the common endeavor to create a better future for the peoples of the world. We are grateful to John L. Nickel, the Director General, under whose inspired leadership CIAT has made its mark on an important segment of agriculture. Special thanks are due to his predecessors who laid the groundwork for much of what CIAT has accomplished in the recent past. I wish to pay tribute to Reed Hertford, the Chairman of the CIAT Board of Trustees, who through the collective wisdom and experience of the other distinguished members of the Board, has played an important role in molding and guiding the work of the Institute.

Special gratitude and appreciation goes to the Government of Colombia for the active cooperation and support which has been extended to CIAT from its inception.

In conclusion, let me convey to CIAT and its entire staff our very best wishes for continued success in the accomplishment of their noble goals.

Message from FAO: joint projects are most encouraging



Emilio Trigueros

Representative for Latin America, FAO

Representing the Food and Agriculture Organization, co-sponsor of the CGIAR

On behalf of the Director General of FAO, Edouard Saouma, I am delighted to join you today in the celebration of the 10th Anniversary of the inauguration and dedication of CIAT headquarters facilities. Due to other pressing commitments, Dieter Bommer, Assistant Director General of the Agriculture Department in FAO, had to cancel his planned visit to CIAT to participate in person on this memorable occasion; he sends his regrets and hearty congratulations for a job well done.

Those who spoke before me have amply elaborated on achievements of CIAT. It is our pride and pleasure to be one of the co-sponsors of the CGIAR and to have been closely associated with CIAT's activities since its inception.

CIAT has been exemplary among the other CGIAR institutions in its innovativeness and pragmatism. The Board of Trustees, the management, and the entire staff of CIAT should be congratulated for their foresightedness, resoluteness, and receptivity. Under the dynamic leadership of the Director General, John Nickel, the institute has greatly contributed to the resolution of the major problems of poverty and hunger in Latin America through the development and transfer, in collaboration with national institutions, of improved technologies for cassava, rice, beans, and tropical pastures.

FAO has carried out a number of successful joint activities with CIAT with regard to human resources development and technical cooperation networks in particular. Examples include the organization

of several regional courses on food legumes in Central America and the Caribbean and assistance by CIAT in the research on beans and cassava in all FAO/Latin America and the Caribbean cooperative networks on food legumes and root and tuber crops.

FAO has obtained collections of *Stylosanthes* sp. with resistance to anthracnose from CIAT. At the same time, FAO provided a collection of *Andropogon gayanus* to CIAT. CIAT has also supplied large quantities of grasses and legumes that have subsequently been sent on to many of our field projects.

Furthermore, some of CIAT scientists working on biological nitrogen fixation have carried out consultancies for FAO on the BNF Program. There has also been close consultation between FAO and CIAT in the latter's attempts to develop an East and South Africa regional program for beans.

Therefore, while there is still room for improvement, cooperation between FAO and CIAT is good and the projects for the future are most encouraging.

Although the Latin America and Caribbean region is relatively ahead of the other developing regions with respect to the number and quality of trained scientific manpower, extensive needs for training, at both the technician and advanced degree levels, still exist in most countries. These obviously limit the extent and the effectiveness of collaboration with national research programs in the affected countries. It is recognized that despite the training of national scientists, opportunities in some countries may not facilitate the retention of good, trained manpower. Nevertheless CIAT plays a major role in strengthening national research capabilities in the commodities under its mandate, namely rice, cassava, beans, and tropical pastures.

In recent years, CIAT, along with most of the other IARCs, has had to cut down on the proportion of core budget funds spent on training activities due to financial stringencies. This was considered an inescapable short-term management decision. Thanks to the availability of special

project funds and other sources of funding for fellowships, this shortfall in core funding has not resulted in a drastic reduction in the number of trainees. It does, however, limit the decisions of who and when to train. Therefore it is crucial that a sizable component of the training program be supported from the core budget.

CIAT, of course is much younger than the other IARCs in the region. It also focuses on several crop commodities, all of which had little organized research done on them before CIAT came into being.

Nevertheless some breakthroughs in yield improvement have been made, particularly for cassava and beans, and good cooperation has evolved over the years between CIAT and national programs. The CICA varieties developed by CIAT and ICA-Colombia and other varieties developed by the national programs in Latin America using genetic material generated at CIAT are living examples of the close collaboration between CIAT and national institutions in the region. This should be sustained and further strengthened.

Mr. Chairman, your excellencies, the Board of Trustees, the Director General, and the entire staff of CIAT, the achievements of CIAT since 1969 are most encouraging. The strategies proposed for the 80s give us hope and high expectations. Your close cooperation with national research systems and development assistance agencies illustrates how you have closely adhered to the ideals and objectives of the CGIAR. You have been given a tough assignment. It is gratifying to see that you have so far tackled it with diligence and are already producing practical results.

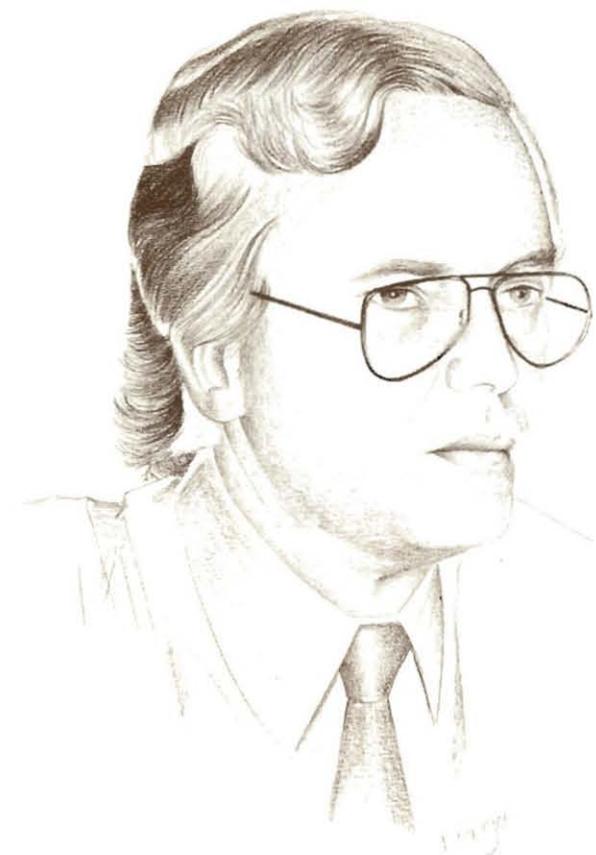
Last but not least, I wish to congratulate the government of Colombia for having had the foresight to host this international agricultural research center in its own country and facilitate its work. Colombia is thus providing an important service to the other countries of Latin America and to the world in fostering international agricultural research in support of research systems of developing countries.

Message from the Board of Trustees

Honorable Mr. Minister, colleagues from CIAT's Board of Trustees, representatives of the international donors and the national research programs. Dr. Nickel, and members of the CIAT family:

It is a great honor and responsibility for me, on this occasion, to represent CIAT's Board of Trustees, which is composed of 16 men and, I am proud to say, one woman. The Board is an international corps: four members are Colombian, three are from the United States, and one each is from the following countries: Japan, Mexico, Australia, Argentina, Jamaica, Germany, Venezuela, Canada, Brazil, and Kenya. Currently, as an American citizen, I am Chairman of the Board. My predecessor was German; his predecessors were distinguished Latin American agricultural scientists: Enrique Blair, ex-Minister of Agriculture of Colombia; Chico de Sola from El Salvador; Luis Crouch from the Dominican Republic; and Armando Samper, ex-Minister of Agriculture of Colombia, who is now Chairman Emeritus.

At present, the Board has three committees; each member works in at least one of them. The Executive Committee, which I chair, consists of seven members. This Committee coordinates the Board's activities and submits important subjects for its consideration. This week we held a meeting to discuss issues related to the upcoming external review of CIAT's programs. The program review will be conducted by a panel of nine respected scientists, and the administrative review of the present procedures and fiscal controls will be performed by three highly



Reed Hertford

Director, International Agricultural and Food Programs, Rutgers University

Chairman of CIAT's Board of Trustees since 1981

competent professionals. These reviews are made every five years and are very important for the Centers. In a way, it is as if CIAT unveils itself, totally revealing all its activities to the professional scrutiny of people outside the institution, who act as its judges and consultants.

There are two other major and permanent committees. The Financial and Accounting Committee, chaired by John Dillon from Australia and formed when I was named Chairman of the Board, establishes the appropriate policies for the financial matters of the Center. The whole responsibility for CIAT's research and international cooperation activities has been delegated to the Program Committee, chaired by Martín Piñeiro from Argentina.

If you have not previously heard me saying this, I would like to say it again: I am very proud of our Board, which has an outstanding reputation within the CGIAR system, because of the great dedication and hard work of its members; the responsibility and high degree of professionalism with which they carry out their activities; their independence; and their tradition of making brave decisions when it has been necessary.

As Board of Trustees, we are legally, morally, and financially responsible to many people and institutions. Whenever I think about to "whom" CIAT and we must be thankful for our high productivity during all these years, I first think of the donors, now a total of 21, who provide a core annual budget of almost US\$20 million for CIAT's international operations. I would not be honest enough if I only thanked them for giving us sufficient funds for our operations. In fact, CIAT has been under severe financial stress during the last years. Nevertheless, I want to thank the donors for two important reasons. First, because they have looked for ways of reducing our financial instability: they have very much taken into account that CIAT's programs cannot be suddenly terminated. Second, they have made every possible effort to preserve the autonomy and independence that we value so highly. Not one of the donors has sought representation in our Board nor interfered in the direction of our activities. In addition, the donors have

looked for mechanisms that adequately monitor the Center's activities without restricting its personnel or preventing them from developing their creative potential. In a few words, we are extremely thankful for these generous donations that provide our scientific autonomy and financial stability.

The Board of Trustees is also grateful to Colombia, because this country has supplied the land to us and has granted the Constitution Act of the Center, to which the Board of Trustees has sworn allegiance. The Government of Colombia has also given us the extraordinarily rich and productive cooperation of the Colombian Agricultural Research Institute (ICA). As you know, the general manager of that institution is a member of our Board of Trustees and has shared our responsibilities. My special appreciation goes to Colombia for this evidence of faith and trust and the continuous cooperation so generously given to us.

The third group to whom the Board of Trustees is grateful includes CIAT's personnel and its administration, which consists of 92 senior professionals from 24 countries, and 1200 employees, or support personnel, most of whom are Colombian. The fact that almost 70% of the budget, to which we dedicate most of our attention, is geared to support this great family generates our responsibility for establishing policies that help them realize all their potential. It might amaze some of you to know that this Board meets to discuss the positions and persons who will fill them. Perhaps no other subject receives so much attention in our meetings than those related to changes in scientific personnel. This is due to our belief that CIAT is a federation of individual efforts, so that one cannot be solely concerned for the well-being of the institution without taking into account each person's effort. The attention we have given to our personnel has been greatly rewarded and today I want to thank, on behalf of our Board of Trustees, each one of you for your dedicated, generous, and obviously successful work.

The fourth group to which the Board is grateful is the extensive Consultative Group system—the Secretariat of the Consultative

Group, the Technical Advisory Committee, the director generals of our 12 sister centers, the chairmen of the Boards of Trustees of those centers, and a great number of *ad hoc* and special review committees. These groups and institutions are working for us, and they are a permanent source of moral and financial support as well as of inspiration, advice, and organizational and intellectual challenge. The Board of Trustees is very proud of being a legitimate and integral part of the Consultive Group system.

Finally, there are the national programs. From our point of view, the national programs of agricultural research are the most important link between CIAT and the final results of the farmer's work, and the Board of Trustees considers this to be one of its major responsibilities. It is very wise that all of them had the chance to be here during this week, in order to review and discuss the best way to strengthen the collaborative links with CIAT. We, the Board of Trustees, are aware that these links are politically and professionally fragile. The discussions held here during the last two days have assured

my colleagues who participated in them that CIAT and the national programs have developed a relationship to the extent that each one is an equal. An equal in the political and intellectual sense of the word. It seems to me that CIAT is not directing, nor administrating, nor leading the way, but participating as an equal in the great enterprise of generating and transferring agricultural technology in the tropical areas of the world. The Board of Trustees is very thankful for and pleased with the national programs of agricultural research. The challenge of the future will be to maintain the advancements and the good wishes that you have shown in these two days. The link between CIAT and the national programs must progress and increase, and become more productive every day, in terms that can be quantified for national and international governments.

Finally I want to express again, equally and with the same amount of gratitude to each one of these five groups, my deep appreciation for your support.

Message on behalf of the Government of Colombia



Rodrigo Lloreda Caicedo
Minister of Foreign Relations, Colombia

At about this time ten years ago, under the presidency of Misael Pastrana, CIAT began its operations. Its research has significantly contributed to the improvement of key crops for an increasing number of countries in Latin America and on other continents. But this beautiful reality, CIAT, did not arise spontaneously: it was the result of persistent and enthusiastic work begun more than 15 years ago, by several institutions and persons whom we are honoring today.

On November 10, 1967, an agreement was signed between the Colombian Government and the Rockefeller Foundation to establish an international center of tropical agriculture in Colombia. The agreement was approved by the Colombian President on December 18 of the same year. In this way, CIAT became a legal entity as a private, nonprofit organization recognized by the Colombian state. From these first activities, it became possible to build and equip this center, located in the fertile savannas of the Cauca valley, which is open not only to scientists, technicians, and academicians from Colombia but also to those the world over.

In the last months of 1968, as governor of Valle del Cauca, I was appointed to participate in acquiring the land that CIAT's experimental fields would occupy. Since that time, with deep admiration, I have followed the development of this institution. I was witness to the interest shown by then-President Carlos Lleras Restrepo who contributed his creative capacity to the service of the project; his government widely supported this interest to help make CIAT a reality.

During the hardest times, which are usually in the initial stages, President Lleras' firm resolution was a decisive factor. CIAT is doing well by honoring, while making a tribute to its founders, this prominent Colombian statesman. His interest in carrying through this Center was not just a one-time event; the food problem has always been his concern, and he has supported the need for using new technology to transform the use of the land and put such land to the service of national development.

In this brief speech, I do not intend to list all the scientific advances obtained during the last decade. I feel it is more important to emphasize the practicality that led to the selection of beans, cassava, rice, and tropical pastures as the commodities for research focus at CIAT. Their choice was the result of a selective criterion that studied the possibilities of our environment and the needs of our people. This Center, then, is a scientific enterprise of wide economic projection and a technological effort of deep social content.

In a world where 25% of the people are affected by some degree of malnutrition, and 10% chronically suffer from it, it is reassuring to know that not all research efforts are oriented toward the production of sophisticated weapons or to satisfying luxurious desires, but that there are, as in CIAT's case, people and institutions busy working to improve the basic needs of humanity.

Out of respect to this audience, I do not want to mention all the comparative figures between military expenditures and social investments in the world. But I do want to recall that the total military spending calculated for 1983 is US\$600 billion, which exceeds the total foreign debt of all developing countries, is superior to all the direct and indirect financial assistance from public and private agencies including the International Monetary Fund, the World Bank, and the Inter-American Development Bank, and exceeds, by at least ten times, the budget of the international agencies dedicated to the eradication of human misery.

In view of these great distortions, certain institutions, such as FAO in *Agriculture, Horizons 2000*, report great population areas hopelessly condemned to hunger and propose a number of policies and plans to decrease these alarming figures. All the proposals are based on the need to modernize the production process. But this objective is only possible if internal policies are reviewed and the existing international structure is modified, so that the developing countries can be given the technical and financial means that will allow them to satisfy their own increasing food demands.

FAO's technicians demand that methods capable of adapting themselves to the realities of each country be used. This does not mean an indiscriminate transfer of technology, but the use of experiences that better adapt to the individual situation of each developing country. It has been this idea that led to cooperation among the developing countries. The so-called "south-south dialogue" is none other than the exchange of experiences, at technical and institutional levels, between countries in similar circumstances.

In many ways, CIAT has been a pioneer of this concept. From the beginning, its philosophy was to concentrate on the crops that contribute most to the dietary balance of a tropical country such as Colombia, where protein deficits and eating habits generate nutritional deficiencies. In a few years, the new varieties emerging from CIAT's laboratories and tested on the fertile plots at Palmira have spread throughout the Colombian geographic area and beyond. This has been a penetrating, creative, and practical endeavor. Every year, technicians from Colombia and the world arrive at this Center; they have the responsibility for diffusing the new findings. They have performed this task silently, but effectively. Their work can be likened to the propagation of a good seed which is silently sown and with time blossoms splendidly.

It is not surprising, then, that this institution, born from the will of a donor group and of a hospitable country, today wants to project itself as a multinational

agency to expand the fruits of its labor to an even greater area.

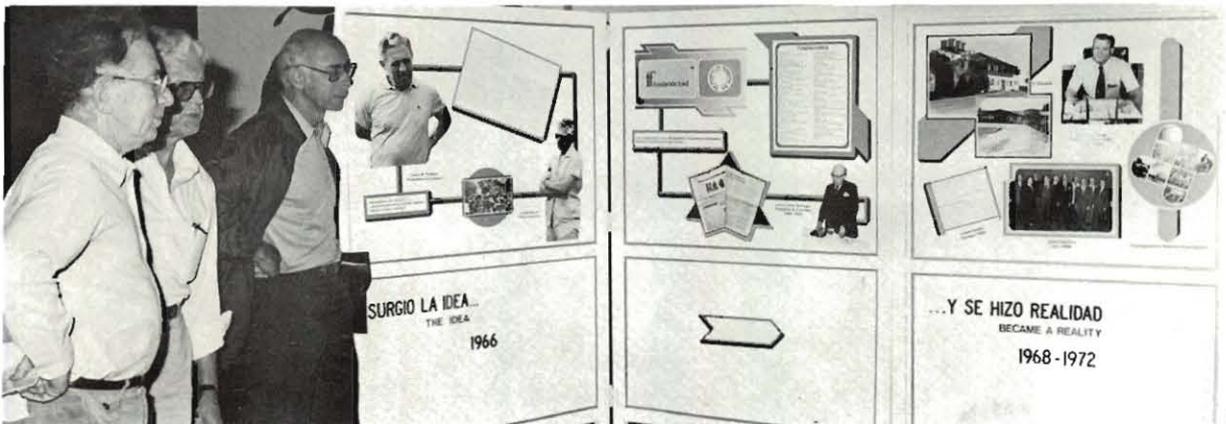
The Colombian President, Belisario Betancur, has asked me to represent him in this act and to transmit to these distinguished representatives of the organizations and institutions that offer its support to CIAT—the World Bank, UNDP, and FAO—a message of friendship and support. And to say to you that this institution, growing in Colombian lands, exists to serve all sister countries who, in the same way as we do, feel the anguish for creating a future that could be, and must be, better.

**The
Celebration
and its
Impact**





A photo remembrance



(1) John L. Nickel and Rodrigo Lloreda; (2) Maria Eugenia de Lloreda and Gustavo Nores; (3) Ana María de Londoño, Fernando Londoño, Kenichi Ogasawara, Hiroshi Nagasaki, Laura de Ochoa, and María Eugenia de Lloreda; (4) Warren Baum, Lowell Hardin, and William Mashler.



(5) Jorge García, Reed Hertford, and Roberto Junguito; (6) Participants in the Symposium; (7) Lewis Roberts, Laurence Stifel, and Lowell Hardin.

(8) John L. Nickel y Ulysses J. Grant; (9) Lowell Hardin, Jorge García, y Roberto Junguito; (10) Doris Eder de Zambrano, Monseñor J. M. Escobar, y Warren Baum; (11) Lewis Roberts; (12) Eduardo Alvarez Luna.





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(13) Electron microscope donation ceremonies; (14) Emilio Trigueros, William Mashler, Rodrigo Lloreda, Warren Baum, and John L. Nickel; (15) José Prazeres Ramalho; (16) Participants in the Acts of Commemoration; (17) Francis C. Byrnes, David Evans, Anthony Bellotti, and Peter Jennings; (18) Ulysses J. Grant, Virgilio Barco, and Robert Waugh.



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(19) John Pino and Ned Raun; (20) Armando Samper Gnecco; (21) Forrest F. Hill; (22) Jorge Ortíz, Ulysses J. Grant, Beatrice Grant, and Jean de Samper.



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(23) Employees' Day; (24) Annelies van Schoonhoven, Nirmala Singh, and Shree Singh; (25) Aston Z. Preston, William Tossell, and Douglas Laing, (26) Francis Byrnes and Forrest F. Hill.



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(27) Héctor Villalobos, Ofelia de Villalobos, and Evelyn Nickel; (28) Founders Banquet; (29) Raul Vera, Martín Piñeiro, and Mario Allegri.



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List of participants

Founders and Honorary Founders

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Program Officer, IADS (International Agricultural Development Service), *retired*

Ulysses J. Grant, United States
Program Officer, International Programs, Oklahoma State University and Mrs. Beatrice Grant

Lowell S. Hardin, United States
Professor, Agricultural Economics, Purdue University

Forrest F. Hill, United States
President, Ford Foundation, *retired*

Loyd Johnson, United States
Officer, IADS, *retired*

Jorge Ortíz Méndez, Colombia
Manager, Ortiz Arango y Cía.

Ned S. Raun, United States
Vice-President of Programs, Winrock International

Lewis M. Roberts, United States
Director, Agricultural Sciences, The Rockefeller Foundation, *retired* and Mrs. Betty Roberts

Armando Samper Gnecco, Colombia
President, CENICAÑA (Centro de Investigación de la Caña de Azúcar) and Mrs. Jean de Samper

Rafael Samper, Colombia
Proprietor, Clínica Samper Limitada

Robert K. Waugh, United States
Professor, International Programs, University of Florida

Board of Trustees

Eduardo Casas Díaz, México
Director, Postgraduate College, Escuela Nacional de Agricultura

Gustavo Castro Guerrero, Colombia
Minister of Agriculture

John Dillon, Australia
Head, Department of Agricultural Economics and Business Management,
University of New England

Fernando Gómez Moncayo, Colombia
General Manager, ICA (Instituto Colombiano Agropecuario)

Reed Hertford, United States
Chairman
Director, International Agricultural and Food Programs,
Rutgers University
and Mrs. Susan Hertford

Nohra de Junguito, Colombia
Director, Credit and Promotion Department, Banco de la República

Shiro Okabe, Indonesia
Vice-Chairman
Director, ESCAP/CGPRT (Economic and Social Commonwealth for Asia
and the Pacific/Regional Coordination Centre for Research and
Development of Coarse Grain, Pulses, Roots, and Tuber Crops)

John A. Pino, United States
Scientific Advisor, BID (Interamerican Development Bank)

Martín Piñeiro, Argentina
Agricultural Economist, CISEA (Centro de Investigación para el
Estado y la Administración)

Aston Z. Preston, Jamaica
Vice-Chancellor, University of the West Indies

Mariano Segura, Venezuela
Director, IICA (Instituto Interamericano para la Cooperación Agrícola)

William Tossell, Canada
Dean of Research, University of Guelph

Sister Centers

James Barnett, México
Head, Andean Region Services, CIMMYT (Centro Internacional de
Mejoramiento de Maíz y Trigo)

Mathew Dagg, Netherlands
Senior Research Officer, ISNAR (International Service for National
Agricultural Research)

Gonzalo Granados, México
Head, Collaborative Program with CIAT, CIMMYT

Dennis Greenland, Philippines
Deputy Director General, IRRI (International Rice Research Institute)

Miguel Holle, Italy
Representative for Latin America, IBPGR (International Board for Plant Genetic Resources)

Per Pinstrup-Andersen, United States
Program Director, Food Consumption and Nutrition Policy Program, IFPRI (International Food Policy Research Institute)

Mustapha Sall, Ethiopia
Director, International Liaison, ILCA (International Livestock Center for Africa)

Invited Guests

Argentina

Jorge Alberto del Aguila
National Director, INTA (Instituto Nacional de Tecnología Agropecuaria)

Barbados

John Percival Weldon Jeffers
Deputy Chief Officer, Research, Ministry of Agriculture

Belize

Jerónimo P. Cal
Executive Director, Caricom Farms Ltd., Ministry of Natural Resources

Bolivia

Rolando Paz Flores
Executive Director, CIAT (Centro de Investigación Agrícola Tropical)

Brazil

Mario Augusto Pinto da Cunha
Head, EMBRAPA/CNPMF (Empresa Brasileira de Pesquisa Agropecuaria/Centro Nacional de Pesquisa de Mandioca e Fruticultura)

Erycson Pires Coqueiro
Head, Department of Human Resources, EMBRAPA

Jose María Pompeu Memoria
Head, Office for International Cooperation, EMBRAPA

Jose Prazeres Ramalho de Castro
Executive Director, EMBRAPA

Burundi

Renovat Baragengana
Director, Institut des Sciences Agronomiques du Burundi

Chile

Emilio Madrid Cerda
President, INIA (Instituto Nacional de Investigación Agropecuaria)

Canada

Greg Spendjian
Senior Program Officer, CIDA (Canadian International Development Agency)

Colombia

José Vicente Ayerbe Chauz
Legal Advisor to CIAT

Mario Blasco Jamenca
Representative in Colombia to IICA (Instituto Interamericano para
la Cooperación Agrícola)

Jorge Claro
Adjunct Resident Representative, UNDP (United Nations Development
Programme)

Henry J. Eder
Business Executive, Ex-Director of CVC (Corporación Autónoma
Regional del Valle del Cauca)

Santiago Fonseca Martínez
Advisor, Agricultural Program, COLCIENCIAS (Instituto Colombiano de
Ciencias)

Ronald Gompertz
Specialist, Agricultural Sector, BID (Interamerican Development
Bank)

Roberto Junguito
Designated Colombian Ambassador to the EEC (European Economic
Community)

Rodrigo Lloreda Caicedo
Minister of Foreign Relations

Pablo Mendoza
National Director, Pastures Program, ICA (Instituto Colombiano
Agropecuario)

Jaime Navas Alvarado
Vice-Manager, Research, ICA

Hugo Li Pun
Program Officer, Crops and Animal Production Systems, IDRC
(International Development Research Centre)

Emilio Trigueros Molina
Representative in Colombia for FAO (Food and Agriculture
Organization)

Costa Rica

Willy Loria Martínez
Director, "Fabio Baudrit Moreno" Agricultural Experiment Station,
Universidad de Costa Rica

Cuba

Miguel Rodríguez Mayea
Vice-Minister of Agriculture

Dominican Republic

Leovigildo Bello Guerrero
Vice-Minister of Agriculture, Secretaría de Agricultura

Víctor Hugo Castellanos Domínguez
Sub-Director, Department of Agricultural Research, Secretaría de
Agricultura

Rafael Martínez Richeiz
Director, Department of Agricultural Research, Secretaría de
Agricultura

Ecuador

Julio C. Delgado Arce
Director General, INIAP (Instituto Nacional de Investigaciones
Agropecuarias)

Guatemala

Horacio Arturo Juarez Arellano
Technical Director, ICTA (Instituto de Ciencia y Tecnología Agrícola)

Carlos Efraín Pinto Minera
General Manager, ICTA

Haití

Jean Andre Víctor
Director General, ODVA (Organisme de Developpement de la Valle de
L'Artibonite), Ministry of Agriculture

Honduras

Wilfredo Díaz Arrazola
Director General for Agriculture, Secretaría de Recursos Naturales

Jamaica

Dinsdale McLeod
Deputy Director for Research and Development, Ministry of Agriculture

Japan

Hiroshi Nagasaki
Ambassador of Japan to Colombia

Kenichi Ogasawara
First Secretary to the Ambassador of Japan to Colombia

Kenya

Peter Kilonzi Kusewa
Director, National Dryland Farming Research Institute

México

Angel Ramos Sanchez
Sub-Director for Research in South Zone, INIA/SARH (Instituto
Nacional de Investigaciones Agrícolas/Secretaría de Agricultura y
Recursos Hidráulicos)

Nicaragua

Francisco Humberto Tapia Barquero
Director, Seeds, General Management of Agricultural Techniques,
INRA (Institut National de Recherches Agronomiques)

Panamá

Rodrigo Tarte
Director General, IDIAP (Instituto de Investigaciones Agropecuarias)

Perú

Wilfredo Caballero Armas
Head, Research Administration, INIPA (Instituto Nacional de
Investigaciones y Promoción Agraria)

Jorge Hugo Villachica León
Executive Secretary, REDINAA (Red de Investigación Agraria para la
Amazonía)

Thailand

Ampol Senanarong
Deputy Director General, Department of Agriculture

Trinidad and Tobago

Mannie Dookeran
Director, Ministry of Agriculture

United States

Clyde Applewhite
Chief, Division for the Regional Program and English-Speaking
Caribbean Countries, UNDP (United Nations Development
Programme)

Pat Barnes-McConnell
Director, Bean/Cowpea CRSP (Collaborative Research Support
Program)

Warren C. Baum
President, CGIAR (Consultative Group for International
Agricultural Research)

Frederick F. Hutchinson
President, BIFAD (Board for International Food and Agricultural
Development)

William Mashler
Director, Division of Global and Interregional Projects, UNDP
(United Nations Development Programme)

James Richmond
Vice-President, W.K. Kellogg Foundation

Laurence Stifel
Vice-President, The Rockefeller Foundation

Don Wadley
Deputy Agency Director, Food and Agricultural Bureau of Science and
Technology, USAID (United States Agency for International
Development)

K Yasutake
Technician, JEOL

Uruguay

Mario Allegri
Director, La Estanzuela Experiment Station, Centro de Investigaciones
Agrícolas "Alberto Boerger"

Venezuela

Luis Marcano
President, FUSAGRI (Fundación Servicio para el Agricultor)

Rafael Pérez Silva
Research Manager, FONAIAP (Fondo Nacional de Investigaciones
Agropecuarias)

Abelardo Rodríguez Voigt
General Manager, FONAIAP

Credits

Editors	<i>Alexandra Walter, Cynthia Carver</i>
Editorial Assistants	<i>Esperanza Castañeda, Maria Cristina Henao</i>
Translation	<i>Rodrigo Ferrerosa</i>
Portraits	<i>Julio César Martínez</i>
Photography	<i>Alvaro Cuéllar, Head; Guillermo Guzmán</i>
Graphic Arts	<i>Carlos Rojas, Head; Conrado Gallego Camilo Oliveros</i>

