



CIMMYT scientist and farmer
examining crops *Courtesy of CGIAR*

Sowing The Seeds of the Green Revolution

The Pivotal Role Mexico and International Non-Profit Organizations Play in Making Biotechnology an Important Foreign Policy Issue for the 21st Century

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Introduction

Biotechnology and the Green Revolution will be increasingly significant foreign policy issues in the next century. At issue is how will we feed ourselves? How will scientists, politicians, and agro-businesses make use of important new genetic discoveries that are currently bio-engineering new plant species and hybrids? Agriculture accounts for 80-90% of water usage, how will nations resolve their food and water shortages in the future when they share the same water source? Both President Jimmy Carter and Nobel Peace Prize winner, Norman Borlaug are working to raise public awareness on this topics. Their work points out the strategic relationship between food production, natural resources, and world peace. Their efforts are supported by new public information efforts such as Future Harvest and the Carter Center's Global 2000 program. In President Carter's words, "The first step toward peace is eradicating hunger. There can be no peace until people have enough to eat. Hungry people are not peaceful people."¹

The current international debate over these issues does not fall within traditional foreign North-South, East-West, or regional alliances. Instead, the parties are divided into: 1) those who believe that today's malnourished populations should acquire new farming technology in order to feed themselves and their families; 2) those who want to deter new technologies that destroy biodiversity and the environment; and 3) those who want to create new foods. The first group argues that world population has tripled since 1930 and will continue to grow reaching an estimated 8.3 billion by 2025 and possibly 10 billion by the end of the 21st century.² There simply will not be enough resources in some countries to feed their populations with today's technology.³ Therefore, new farming techniques must be developed and spread throughout the world, especially to underdeveloped regions. The second group includes a growing number of underdeveloped countries who want to ensure sustainable development, a term that incorporates preservation of biodiversity and traditional customs. This concept was defined in Agenda 21, a document drafted at the 1992 U.N. Earth Summit in Rio de Janeiro to provide an environmental action plan for the next century. Lastly, the third group encompasses the biotechnology industry, which is moving rapidly forward with new DNA experiments that are shaking the foundations of traditional agricultural science. Based on their new discoveries, food production is undergoing radical changes and it appears that this trend will only continue to accelerate.

As this article will demonstrate, historical precedent provides guidelines for resolving this international debate. The Green Revolution has been changing food production for over 50 years. It began in Mexico in the 1940's with funding from the Rockefeller Foundation. By the 1970's, the Rockefeller Foundation joined with other international non-profit organizations to create a number of international agricultural centers under the umbrella organization, CGIAR. Over the decades, these international centers developed a network of scientists, agriculturists, and policymakers with a track record of developing consensus with developing nations and environmentalists. While they were developing this consensus, they were also developing new plant hybrids using traditional, non-DNA methods that produced greater nutritional value.

During the 1990's, CGIAR has been undergoing a profound restructuring. It is challenged with finding new donors for its programs, redirecting its efforts in the Post-Cold War period, and assessing the new challenges created by biotechnology. Its history provides an interesting review of the timeline of the Green Revolution and offers some important perspectives, which may shape future events and the terms of the biotechnology debate.

What is the Green Revolution?

In the 1960's, "lifeboat" population experts predicted that the exploding world population in the underdeveloped would lead to drastic Malthusian events such as mass starvation in Asia. However, the catastrophes depicted in such best seller books as William and Paul Paddock's *Famine 1975! America's Decision: Who Will Survive?* and Paul Ehrlich's *The Population Bomb* were successfully diverted by innovative agricultural research experiments in the late 1960's and early 1970's that became known as the Green Revolution.⁴ The first phase of the Green Revolution resulted from research begun in Mexico. With support from the Rockefeller Foundation, in the 1960's Nobel Peace Prize winner Norman Borlaug spread the Green Revolution to Asia and around the world.

In the 1990's, the Green Revolution entered a second phase of development as agriculturists attempted to address the criticisms leveled against the first phase of the Green Revolution. Critics had stressed that the first phase only emphasized high-yield Western crops such as wheat and used chemical fertilizers that destroyed tropical ecosystems.⁵ Green Revolution agriculturists began diversifying in the 1970's as they dedicated new resources to rice experiments and tropical plants. They also worked diligently on seed preservation, biodiversity, and sustainable agriculture issues. In the 1990's, the explosion of gene-modified foods and the biotechnology industry shook the traditional perceptions of all professional agriculturists. Historian James Wilkie notes that these changes created new opportunities to produce and process food staples with greater amounts of nutritious vitamins, minerals, and proteins. As described in greater detail in this article, Grupo Maseca has been at the forefront of adding nutritional supplements to enrich tortillas and Norman Borlaug has been leading the way in the development of efforts to increase the quality content of protein in maize, known as QPM.⁶

Today, the way humans grow food is being radically changed by new discoveries underwritten by a growing multi-billion dollar biotechnology industry. Astounding new discoveries are occurring on a regular basis. For example, in June 1999, Israel announced the discovery of "super plants" with technology that can accelerate tree and plant growth by 50%. This same month, NASA launched plant research experiments aboard the Discovery shuttle testing the feasibility of producing plants engineered to produce human proteins and vaccines that can be eaten. The enormous changes created by these new discoveries are rapidly restructuring the food industry. The Biotechnology Industry Organization estimates that in the United States in 1998, 25% of the corn, 38% of soybeans, and 45% of cotton was gene-modified

and 33% of all dairy cows used a biotech hormone to increase milk production. Furthermore, the U.S. Grocery Manufacturers of America estimate that within a decade, "95% of all U.S. crops will probably be biotech."⁷

As a leading agricultural exporter, the United States is actively promoting the exportation of biotech or gene-modified foods around the world. It is firmly supported by other countries such as Argentina, Chile, and Uruguay that have developed their own strong biotech industries. According to Chilean delegates at the recent February 1999 Cartagena meeting of UNCED, "bioengineering is safe, proven and an environmentally sound technology with a myriad of benefits."⁸ As debate at this United Nations meeting demonstrated, the lack of agreement over bio-engineered foods is profound. Over 600 passages of the *Biosafety Protocol*, a document drafted at the 1992 U.N. Earth Summit in Rio de Janeiro to regulate trade in genetically modified organisms such as pest-resistant food and pharmaceuticals have not been ratified.⁹ Europeans do not necessarily agree with U.S. support for the biotechnology industry. European consumers are concerned that gene-modified foods will lead to health problems. These fears have prompted the international environmental movement to brand gene-modified foods as "Frankenstein foods" and their proponents "genetic imperialists."¹⁰

Mexico - The Site of the First Green Revolution Experiments

Mexico has been at the center of Green Revolution agricultural experiments for over 50 years. It is a tested leader in this field and therefore, well prepared to find progressive and innovative solutions to food production and sustainable development. Contemporary analysts may reason that this is because Mexico is a member of NAFTA and therefore poised to bridge the gap between the developed and underdeveloped worlds. However, history points to a much more complex relationship between the Mexican Ministry of Agriculture, the U.S. government, and such international non-profit organizations as the Rockefeller Foundation, CGIAR (the Consultative Group on International Agricultural Research), and CIMMYT (International Maize and Wheat Improvement Center).

U.S. Vice President Henry A. Wallace was involved in initial discussions that made Mexico the site for the first Green Revolution experiments. As a renowned agriculturist, Wallace was President Franklin D. Roosevelt's Secretary of Agriculture from 1933-1940. He followed in the footsteps of his father who had served as Secretary of Agriculture from 1921-1924 under Presidents Warren Harding and Calvin Coolidge. The Wallace family had a distinguished reputation for public service and agricultural expertise. They founded the hybrid seed company Pioneer Hi-Breed and for three generations published the popular *Wallace Farmer's Almanac*.¹¹ One of Henry A. Wallace's personal



U.S. Vice President Henry A. Wallace
En Guardia, Vol. 1, No. 9, 1942

projects was the creation of the Office of Foreign Agricultural Relations to categorize the many different types of plant hybrids around the world.¹²

During World War II, Nelson Rockefeller and Henry Wallace joined forces to pursue their mutual interest in agricultural research. Both men shared an unshakable belief that genetic research on climate and disease resistant hybrids could lead to a solution for world hunger. As head of the Office of Inter-American Affairs (OIAA), a special wartime agency for Latin America, Rockefeller was eager to implement President Roosevelt's "Good Neighbor Policy." In March 1941, OIAA coordinated Wallace's tour of Latin America.¹³ After reviewing Mexico's food production resources Wallace came to the conclusion that, "if anyone could increase the yield per acre of corn and beans in Mexico, it would contribute more effectively to the welfare of the country and the happiness of its people than any other that could be devised."¹⁴ Later that year, with Wallace's support, Rockefeller organized the creation of the Institute for Tropical Agriculture (ITA) to coordinate scientific research within the Western Hemisphere.¹⁵ ITA's primary project was to create a new Inter-American Institute of Agricultural Science.¹⁶ Unfortunately, the project was never fully successful as President Truman terminated ITA at the end of World War II.¹⁷

The Rockefeller family's personal and philanthropic interests in agricultural research increased after World War II. The family supported Henry A. Wallace's vision in a variety of ways. First, the Rockefeller Foundation established a Mexico field office to conduct agricultural experiments. Second, Nelson Rockefeller and a select group of former OIAA colleagues organized a non-profit organization, AIA to implement agricultural education programs and hybrid seed experiments. These Rockefeller projects became prime examples of President Truman's new "Point IV" policies.¹⁸ With the escalation of the Cold War, Truman announced that the U.S. would fight the expansion of Communism to Africa, Asia, and Latin America. "Point IV" called for the exportation of U.S. technical expertise and capital to the developing world stressing that the American private sector, *not* the U.S. government should play the leading role in transferring U.S. technology abroad.¹⁹



Dean Rusk

Rockefeller Foundation President (1952-60) and U.S. Secretary of State for U.S. Presidents John F. Kennedy and Lyndon B. Johnson (1961-69). Courtesy of the Lyndon Baines Johnson Library
NLJ, Austin, TX NLJ-WHPO-VN066

Although the Rockefellers' support for the Green Revolution was philanthropically motivated, it can not be fully separated from its Cold War context. Philip Coomb's 1964 book, *The Fourth Dimension Of Foreign Policy: Educational and Cultural Affairs* provides a well documented review of how U.S. philanthropic activities abroad aided in the fight against Communism.²⁰ Rockefeller Foundation President Dean Rusk was a prime actor in this movement. He incorporated Cold War ideology into the organization's original mission statement noting that the "well-being of mankind" now "depended on the developing

nations who lack the capital, trained leadership, educated people, and political stability."²¹ From 1961 through 1969, Dean Rusk would pursue this philosophy and Cold War agenda as Secretary of State for Presidents Kennedy and Johnson. Due to his influence, the Rockefeller Foundation's funding for international program funds tripled from \$6 million in 1955 to \$19 million in 1966.²² A large portion of this money went to providing for fellowships.²³ In addition to these changes, the foundation shifted its support to population studies, international relations, legal and political philosophy, institutional support for the arts, historical research, and agriculture.

The important role that the new agriculture program played within the Rockefeller Foundation's administrative structure is evident by the fact that two of its twelve Presidents have been agriculturists. As described in greater detail below, J. George Harrar was responsible for opening the Rockefeller Foundation's Mexico field office. After his tenure in Mexico from 1943 to 1952, he returned to headquarters to serve as Deputy Director for Agriculture from 1952 to 1955, Director for Agriculture from 1955 to 1959, Vice President from 1959 to 1961 and President of the foundation from 1961 to 1972. Under his guidance, the foundation joined in cooperation with other U.S. foundations and inter-governmental organizations to form CGIAR. In April 1998, Gordon Conway, became the twelfth President of the foundation.²⁴ An ecologist, he was an early critic of pesticide spraying. Several months before assuming his current position, he published *The Doubly Green Revolution, Food For All In The 21st Century*. This book describes his views on sustainable agriculture. He is a steadfast supporter of integrated pest management and believes that "genetically engineered, drought-tolerant and salt-resistant crops can 'green' huge areas of barren land where many of the world's poorest people eke out a living."²⁵ Since assuming the presidency, he has provided important leadership on international agricultural matters by calling for a global forum to discuss biotechnology as an important foreign policy issue for the 21st century.²⁶



Gordon Conway
Ecologist, university administrator and
current President of the Rockefeller
Foundation (1998-Present).
As a British citizen, he is the
first non-American
to serve in this capacity. Courtesy The
Rockefeller Foundation
www.rockfound.org

Rockefeller Mexico Field Office

In 1943, the Rockefeller Foundation signed a formal agreement with the Mexican Department of Agriculture to open a Mexico Field Office. This agreement was part of the Mexican government's policy between 1945 and 1965 to increase basic food production. At the time the agreement was signed, Mexico was importing wheat and corn. Wheat yields were particularly low and the use of fertilizer virtually



CIMMYT scientists and farmers
examining maize crops. Courtesy of CGIAR

unknown. The Rockefeller Foundation's goal was "to help Mexico to help itself" in solving its food problem.²⁷ The office was organized under the authority of the Mexican Department of Agriculture's newly created *Oficina de Estudio Especiales*. Its director, J. George Harrar served as Chief of Special Studies within the Mexican Department of Agriculture.²⁸

Research laboratories and greenhouses were opened at the Mexican National College of Agriculture in the Mexico City suburb of Chapingo. One of the Mexico Field Office's first projects concentrated on the collection and categorization of seeds from all over Mexico, North and South America. Experts in plant pathology, genetics, soil science, and entomology concentrated on crossbreeding seeds to create new hybrids. Their goal was to discover higher yielding crops. Experiments tested soil management, fertilizers, insecticides, fungicides, conservation measures, irrigation, farm machinery and seed varieties. By 1950, an investment of \$1.5 million dollars had produced eight new hybrid corn stocks. Using these new hybrids, Mexican corn production increased by 8% with 1.5 million new acres placed into cultivation.²⁹

The successful development of new corn hybrids prompted research on wheat, bean sorghums and soybeans. The wheat experiments and their chief agronomist, Norman Borlaug would become famous. Mexican wheat production, which had been historically limited to the state of Sonora and the Bajío region of Guanajuato, was plagued by rust and fungus problems. To combat these conditions, Rockefeller scientists adapted twelve rust-resistant varieties. In 1950, 1.2 million acres or 60% of the traditional national wheat acreage was successfully planted with these new rust-resistant strains.³⁰

In the process of this research, Borlaug achieved an important breakthrough - the development of a semi-dwarf variety that was insensitive to light. This trait would allow the Mexican semi-dwarf varieties to be exported around the world founding the basis of the Green Revolution. It allowed Mexico to triple its grain production in a matter of years.³¹ In essence, "it was the unusual breadth of adaptation, combined with high genetic yield potential, short-straw, a strong responsiveness and high efficiency in the use of heavy doses of fertilizers, and a broad spectrum of disease resistance that has made the Mexican dwarf varieties the powerful catalyst that they have become in launching the Green Revolution."³²



Norman Borlaug
working in wheat field

Borlaug developed the Mexican semi-dwarf varieties by growing different wheat hybrids in two different locations. One generation was cultivated close to sea level in Sonora at 28 degrees north latitude in the fall where the days were shorter. The second generation was sown near Toluca, at 18 degrees latitude and 2500 meters above sea level during the summer when days were longer. Special attention was given to cultivating high-yielding varieties. According to him, without the light insensitive and high-yield characteristics, "the successful transplantation of the Mexican varieties into Pakistan and India would have been impossible,

and the advent of the Green Revolution would almost certainly have been delayed many years." His work was noted for his insistence on using what he had available to make incremental progress. He continued making improvements each season. In his opinion, "scientific perfectionists who spend a lifetime searching for the unattainable in biological perfection might consequently, during a lifetime of frustration, contribute nothing to increasing food production."³³ This was *not* his method. Today at age 83, he continues to make improvements in laboratories and fields around the world.

In the 1950's and 1960's, the Mexico field office was used as a model for expansion. During this period, it trained a generation of Mexican agriculturists that would have significant influence throughout Latin America and the world. Starting in the mid 1940's, the Mexico field office trained 79 Mexican agriculturists. Of this initial group, 38 were given fellowships for postgraduate study in the United States at the universities of California, Kansas, Missouri, Minnesota, and Cornell. This education program was expanded so that by 1963, a total number of 550 Mexican interns had participated in agricultural research and training programs. This generation of Mexican scientists assisted with the development of plant hybrids at Colombia's National University's School of Agronomy in Medellín and an experimental station near Bogotá. In 1950, they helped create the Cooperative Colombian Agricultural Program devoted to maize, wheat, potatoes, forage grasses, and livestock research.³⁴ In 1955, they assisted Chile with the establishment of a similar program studying wheat and forage grasses known as the Cooperative Chilean Agricultural Program. In 1956, research spread to Asia when the Cooperative Indian Agricultural Program began working on maize, sorghum, and millet production.³⁵ Within Mexico, this generation created and staffed the new Mexican National Institute of Agricultural Research established in 1961.

AIA's Non-Profit Projects in Brazil and Venezuela

As the Rockefeller Foundation was making inroads in Mexico, Nelson Rockefeller set up his own non-profit organization to pursue similar work in Brazil and Venezuela. He wanted to continue projects he had started at OIAA during World War II. He joined with several former OIAA colleagues to create AIA (American International Association for Economic and Social Development). Their objective was to transfer technology and education. They hoped to rapidly modernize basic infrastructure and services so Latin America could attain a higher quality of living. They believed that if their efforts failed, the region faced the prospect that an exploding population would decrease the standard of living. As a major stockholder in Venezuela's Creole Petroleum, Rockefeller convinced Shell, Mobil, Gulf, and various other private donors to join him in underwriting AIA's projects between 1946 and 1968.³⁶



Nelson Rockefeller, 1944
Presenting his plans for economic development
at a meeting of the Inter-American Development
Commission in New York City.
EnGuardia, 1944

When Rockefeller closed AIA in 1968, it was because his projects were overlapping with USAID programs that were well funded by the Alliance For Progress. Rockefeller came to the conclusion that U.S. government foreign assistance projects were better equipped than private efforts to try to meet the infinite challenge of Latin American economic development.³⁷ His decision was based on the overwhelming financial resources the Kennedy and Johnson administrations committed to Latin America in order to keep it from being drawn into the Communist sphere of influence. In today's Post-Cold war period, Nelson Rockefeller's efforts serve as a historical case study of the private sector's involvement in agricultural development.

AIA's basic goal was similar to the Mexico field office's mission in that it sought to "help people help themselves." In Venezuela and Brazil, AIA worked in rural communities to create supervised farm credit programs, extension services, demonstration services, vocational training, agricultural research centers, agricultural clubs, and development studies. These projects centered on "the man, the girl and the jeep." The man was an agricultural extensionist, the girl was the home economist and the jeep was the only vehicle that could make it through the rough country roads. Operations gradually expanded to include cattle spraying, construction of a trench silos, and medical visits from a nurse, physician, and mobile truck stocked with medical supplies. AIA also constructed community centers where it organized 4-H agricultural service clubs and home economics training on nutrition and basic sanitation principles.³⁸

Nelson Rockefeller believed that farm credit programs could solve the problem of inefficient agricultural production. Under AIA's Brazilian and Venezuelan farm credit programs, private banks provided capital and AIA underwrote the loans guaranteeing repayment. These loans were to acquire basic new technical improvements such as better hoes, mechanized tractors, fertilizers, and hybrid seeds. AIA field personnel provided technical expertise to local farmers. In Venezuela, its farm credit system was known as CBR (*Consejo de Bienestar Rural*). It operated between 1948 and 1954 until restrictive Perez Jiménez banking laws forced it to shut down.³⁹ In Brazil, the farm credit program developed on a state by state basis. The first state program in Minas Gerais was known as ACAR (*Associação de Crédito e Assistência Rural*). It was so popular that it quickly spread to other states. Eventually the Brazilian government assumed AIA's financial responsibilities and placed all the state programs under the federal program EBATER (*Empresa Brasileira de Assistência Técnica Extensão Rural*).⁴⁰



Construction of Brasília, 1958
Arquivo Público do Distrito Federal, Brasília, Brazil



Fields outside of Brasília, 1970

Nelson and David Rockefeller were fascinated with the possibility of developing new plant species in Brazil. In the late 1950's, Brazilian President Juscelino Kubitschek commenced construction on Brasília, a new futuristic capital on the interior plateau of the state of Goiás. Anticipating that the new capital would need to farm on the surrounding uncultivated scrub-brush lands known as the *campos cerrados*, AIA established agricultural experimental research stations nearby. The challenge was to adapt traditional agricultural products to grow in the distinct aluminum toxic plateau soils.⁴¹ Executive Vice President John Camp believed that AIA could "demonstrate that these lands, with proper treatment by fertilizer and certain trace mineral elements can be made productive. The orderly opening up and development of this area offers new settlement prospects for several million families and corollary employment opportunities for millions more in related commerce and industry."⁴²

AIA's subsidiary the IBEC Research Institute (IRI) oversaw agricultural research projects on the *campos cerrados* in Goiás and the depleted coffee region of São Paulo state.⁴³ IRI experimented with weed control, labor use, irrigation, harvesting, chemicals, and mechanization.⁴⁴ The Goiás experimental station's experiments with phosphorous and lime fertilizers demonstrated that corn and other crops could be grown in the *campos cerrados*.⁴⁵ IRI employees were convinced that their work would result in groundbreaking research that would change the future.⁴⁶

IRI President Jerome Harrington went so far as to declare that his organization was "doing more work on the fertility problems than anyone else in Brazil."⁴⁷ As we now know, scientific research on the *cerrados* continued with few breakthroughs for the next 35 years. It was not until 1999 that Norman Borlaug could say, "the *cerrado* region of Brazil, a very large area long assumed to be infertile because of toxic soluble aluminum in the soil, may become a breadbasket, because aluminum-resistant crop strains are being developed."⁴⁸ Significant progress was made by researchers at the University of California at San Diego this year when they published their discovery of a gene that allows plants to detoxify heavy metals that are hazardous to human health and the environment.⁴⁹ These new findings have once again renewed interest in the viability of agriculture in the *cerrados* region.

CIMMYT - International Center for the Improvement of Maize and Wheat

Between 1959 and 1963, the Rockefeller Foundation's Mexico Field Office and the Mexican Secretariat of Foreign Relations worked together to internationalize ongoing wheat, maize and potato projects. The result was the creation of the International Center for the Improvement of Maize and Wheat (CIMMYT) in 1966. This new organization was located in El Batán on the outskirts of Mexico City. It received its original funding from the Rockefeller and Ford foundations, the Mexican government, USAID, United Nations Development Program (UNDP) and the Inter-American Development Bank (IDB).⁵⁰ As described in greater detail below, CIMMYT became one of the first four international centers to form CGIAR in 1971. In the nearly three decades since its creation, CIMMYT has developed a proven record of close collaboration with Mexican research institutions such as the Secretariat of Agriculture, Livestock, and Rural Development (SAGDR). It is currently organized into 5 major research groups - maize, wheat, economics, natural resources and biotechnology. Its official mission is the development of sustainable maize and wheat systems for the poor, a problem that it believes it can solve by improving germplasm with built-in tolerance and resistance to pests, diseases and environmental stresses.⁵¹

Norman Borlaug's initial wheat research projects conducted at the Rockefeller Foundation's Mexico Field Office were continued at CIMMYT. Borlaug was convinced that the expansion of his high-yield semi-dwarf wheat varieties throughout the world would solve world hunger problems. Between 1963 and 1965, as population experts were predicting mass starvation in India and Pakistan, Borlaug concentrated on convincing local, state and national agencies in these countries to switch to his high-yield Mexican wheat seeds.⁵² In the process of shipping his seeds to Asia from Mexico via Los Angeles harbor, Borlaug encountered numerous challenges including having his seeds held at the US-Mexico border and almost destroyed by the Los Angeles' Watts riots and a war between India and Pakistan.⁵³ In 1966, his book *Quiet Revolution in Wheat Improvement* received critical acclaim. He was awarded the Nobel Peace Prize in 1970 for his work in Mexico and Asia.

Borlaug's promotion of high-yielding Mexican wheat varieties over native plants such as lentils and rice caused controversy from the outset. During the first year's harvest in Kerala, India, hungry protesters rioted against a switch from rice to wheat. Borlaug argued that high-yield strains of indigenous plants simply did not exist and his Mexican wheat varieties were the best way to fight starvation. Wheat cultivation could produce the most food calories and it could be grown in nearly all environments. In 1969-70 approximately 6 million hectares in Pakistan and 14 million hectares in India were sown to Mexican varieties or their derivatives.⁵⁴ By 1974, India and Pakistan were on the way to becoming self-sufficient in food production. Due in great part to Borlaug's efforts, as the world added an additional 2 billion people to the global population between 1965 and 1990, food production kept pace and even exceeded demand.

During this period, the global daily per capita calorie intake increased from 2,063 calories to 2,495.⁵⁵

This first stage of the Green Revolution generated controversy because it involved the transfer of a whole new technology focused on producing plants with the highest yield possible. Some critics from developing countries decried wheat as a Western crop that uses enormous quantities of water and fertilizer. The only way to meet these demands was by developing irrigation and using organic or chemical fertilizers. Organic fertilizers require large livestock herds that eat a considerable portion of the harvest and chemical petroleum fertilizers destroy the environment.⁵⁶ Other critics protested against the pressure placed upon Third World governments to pass policies that give wheat farmers a relatively high price for their product, create special credit programs for wheat farmers, and promote the distribution of fertilizers, insecticides, weed killers and machinery.⁵⁷ As described in greater detail below, these criticisms have resulted in the modification of goals at CIMMYT and other international agricultural research groups.

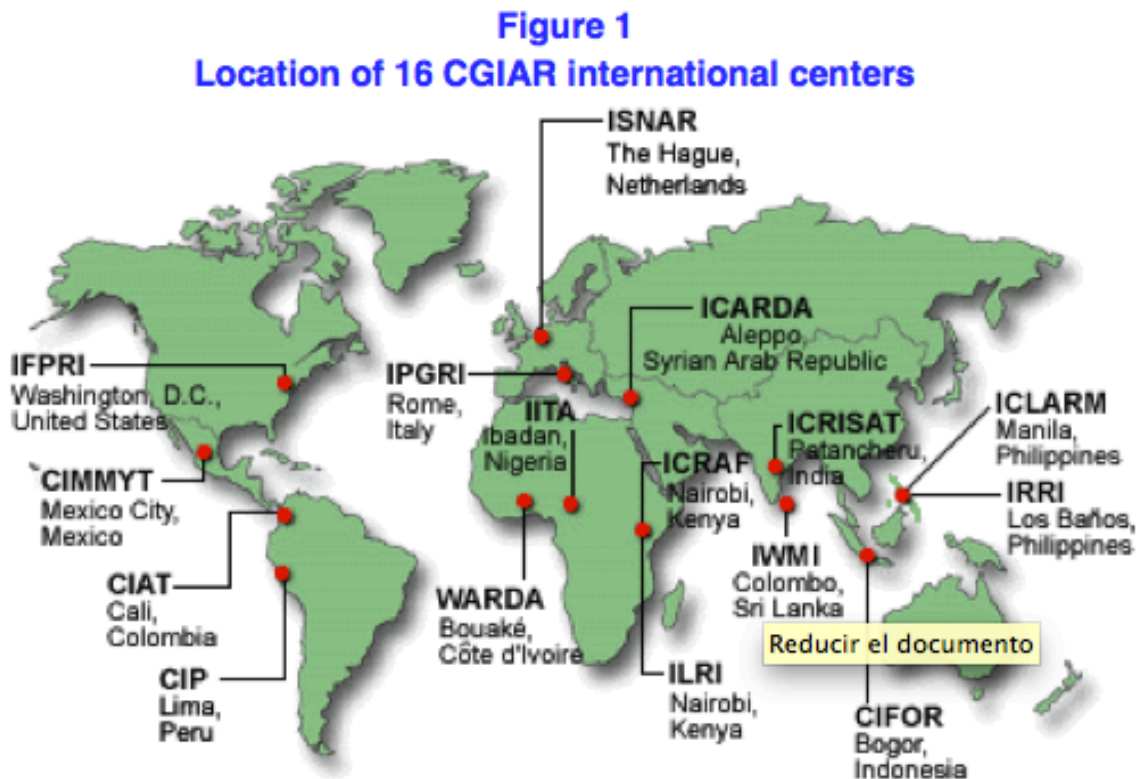
Aside from Borlaug's work, CIMMYT has been responsible for a number of other notable achievements. It has a long tradition of collecting seeds and preserving biodiversity. By the 1980's its wheat and maize germplasm accounted for approximately 80% of global production. Borlaug's original varieties were replaced with even more productive varieties that "require little or no pesticides because of their durable built-in resistance and increased efficiency in the use of soil nutrients, water and sunlight."⁵⁸ Today, more than 75% of the developing world's wheat area (excluding China) has been planted to semi-dwarf wheat developed by CIMMYT and its national agricultural research partners. Its world renown Wellhausen-Anderson Plant Genetic Resources Center provides long term storage for close to half a million seed samples including more than 6,000 endangered farmer-developed maize varieties. CIMMYT research has also helped to rescue numerous samples held in seed banks throughout Latin America and at the National Seed Storage Laboratory in the U.S. Its International Wheat Information System (IWIS) has set global standards by providing computerized data to researchers worldwide on 1.5 million genotypes of bread wheat, durum wheat and triticale. CIMMYT has trained over 8,000 researchers working in 80 different countries.⁵⁹

CGIAR and its International Research Centers

In 1968, the Rockefeller Foundation sponsored an important international symposium on "Strategy for the Conquest of Hunger." At the time, research was being conducted by four separate international centers including: 1) CIMMYT in Mexico for maize and wheat; 2) CIAT (the International Center For Tropical Agriculture) in Colombia for rice, bean, forage grasses and cassava; 3) IRRI (International Rice Institute) in the Philippines for rice; and 4) IITA (International Institute of Tropical Agriculture) in Nigeria to study the special foods and

ecosystems related to Africa. As a result of this 1968 symposium, Richard Demuth at the World Bank's Development Services Department called a meeting in May 1971 to discuss the rapid proliferation of scientific discoveries. A group of 28 governments, organizations, and observers agreed to the establishment of CGIAR (the Consultative Group on International Agricultural Research).⁶⁰

CGIAR was an umbrella organization initially created to coordinate the efforts of the four international centers. As Figure 1 and Table 1 depict, the number of international centers had increased from four to sixteen between 1971 and 1993. According to Lowell Hardin, a Ford Foundation officer in the 1970's who raised funds to expand CGIAR's international centers, donors made bilateral grants to individual centers. In other words, grants were written to CGIAR but they did not go into a general "pot" of resources. Instead, each donor maintained a bilateral relationship with the center it supported. CGIAR provided administrative support and management reviews.⁶¹ Today, the international centers facilitate the exchange of information between national agricultural research programs. For example, CIMMYT coordinates the flow of information between the Mexican and Indian government agricultural agencies regarding wheat and maize issues. IRRI coordinates between these same government agencies on rice issues.



Source: CGIAR [1999] <http://www.cgiar.org/centers.htm>

Table 1
CGIAR's 16 International Centers

Acronym	International Center	Location	Created
IRRI	International Rice Research Institute	Los Banos, Philippines	1960
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo	Mexico City, Mexico	1963
IITA	International Institute of Tropical Agriculture	Ibadan, Nigeria	1967
CIAT	Centro Internacional de Agricultural Tropical	Cali, Colombia	1971
CIP	Centro Internacional de la Papa	Lima, Peru	1971
WARDA	West Africa Rice Development Association	Bouaké, Ivory Coast	1971
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics	Petancheru, India	1972
ILRI	International Livestock Research Institute	Nairobi, Kenya	1973
IPGRI	International Plant Genetic Resources Institute	Rome, Italy	1974
IFPRI	International Food Policy Research Institute	Washington, D.C.	1975
ICARDA	Internacional Center for Agricultural Research in Dry Areas	Aleppo, Syria	1975
ICLARM	Internacional Center for Living Aquatic Resources Management	Manila, Philippines	1977
ICRAF	International Centre for Research in Agroforestry	Nairobi, Kenya	1977
ISNAR	International Service for National Agricultural Research	The Hague, Netherlands	1979
IWMI	International Water Management Institute	Colombo, Sri Lanka	1984
CIFOR	Center for International Forestry Research	Bogor, Indonesia	1993

Between 1960 and 1999, CGIAR's research agenda progressed through several different stages. In the 1960's, the original four international centers concentrated on rice, wheat, and maize. In the early 1970's, a second phase of research focused on plants in the tropics and semi-arid tropics, roots and tubers, livestock and pastures, cereals, and legumes. By the mid-1970's, work had expanded to genetic resources, plants in dry areas, and West African rice. In the 1980's, CGIAR concentrated on institutional strengthening and food policy. During this fourth phase, its mission was redefined to "increase sustainable food production in the developing countries in

such a way that the nutritional level and general economic well-being of the poor are improved." This approach emphasized protecting biodiversity, land, and water.⁶² In the 1990's, the organization entered a fifth stage focusing on agro-forestry and forestry, living aquatic resources, and natural resources management.⁶³

Today, CGIAR is globally renown for its genetic resources and its work related to biodiversity. It has one of the largest collections of plant genetic resources with more than 600,000 samples of over 3,000 crop, forage, and pasture species. Duplicates of these materials are provided to researchers around the world. This work is part of a global initiative that aims to promote "sustainable agricultural growth in developing countries, with special care devoted to issues such as ethics, safety, and the access of developing countries to biotechnology products."⁶⁴

Table 2

Evolving Forces and Philosophies, 1960s vs. 1990s

	1960s [Phase 1, Green Revolution]		1990s [Phase 2, Green Revolution]
1.	Communist Threat	1.	Post Cold War Complacency
2.	Fear of Famine	2.	Secure Food Supply
3.	Malthus Rediscovered	3.	Environmentalism
4.	Belief in Science	4.	Skepticism about Science, Biotechnology
5.	Public Programs, Institutions	5.	Privatization of Science, NGOs
6.	Target Growth, Income	6.	Sustainability, Equity, Poverty
7.	Technology Transfer	7.	Indigenous Knowledge
8.	Paternalistic Assistance	8.	Partnerships, Outsourcing
9.	Dedicated Donors	9.	Donor Fatigue
10.	Flexible Funding	10.	Impact Driven, Narrow Project Support

Source: Lowell S. Hardin, "Conceptual and Philosophical Bases for CIAT's Founding,"
30 Anniversary of the Foundation of CIAT 1967-1997 (Cali, Colombia: CIAT, 1998)

CGIAR's donors and members expanded over the years to include many developing nations and international NGOs (non-governmental organizations). Their participation and influence have modified CGIAR's budget and objectives. As Tables 1 and 2 outline, CGIAR's first four international centers were founded at the height of the Cold War. In the 1960's and 1970's, the objectives of the international agricultural research centers were closely tied to U.S. foreign policy objectives. Most notable was U.S. concern with the spread of Communism. Due to their anti-Communist stance, they received abundant financial support from U.S. foundations, the U.S. government and other developed countries eager to fight Communist expansion in the Third World.⁶⁵

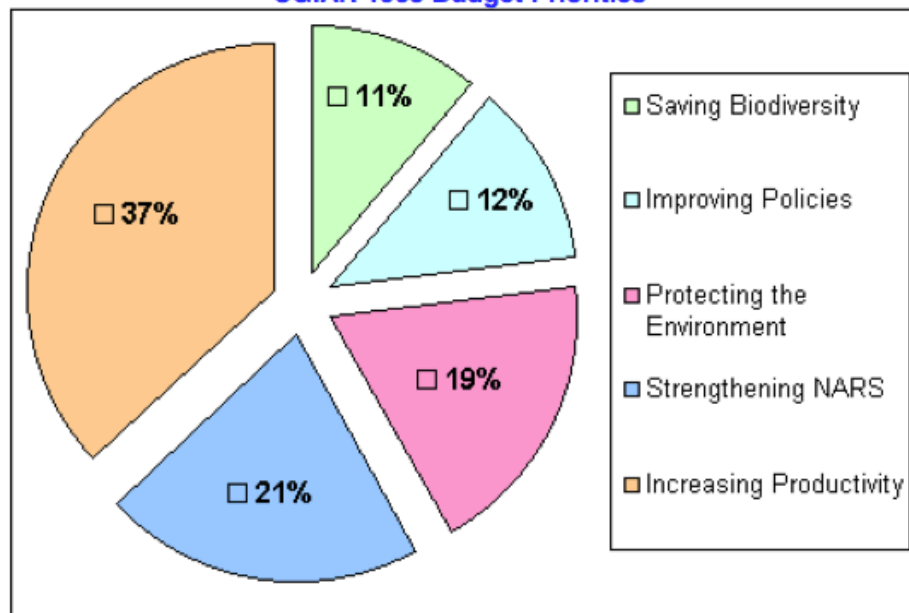


ITC gene bank.

Banana clones stored under slow growth conditions at reduced temperature (16 C) and low light intensity (2000 LUX).
Courtesy of IPGRI/INIBAP

Over the decades, CGIAR's priorities have changed drastically. Today, one of the key concerns is identifying donors interested in financing the second phase of the Green Revolution. In 1999, CGIAR's budget accounted for approximately 4% of total worldwide public funding for agricultural research. As Figure 2 depicts, the organization allocated its 1998 budget to five key goals: increasing productivity, integrating natural resource management, preserving biodiversity, improving national policies, and building capacity.

Figure 2
CGIAR 1998 Budget Priorities



CGIAR's New Programs: GFAR and Future Harvest

On the eve of the 21st century, CGIAR created two new organizations to reflect modifications made to its agenda since the 1992 U.N. Earth Summit. One of the most significant results of this meeting was the drafting of Agenda 21, an action plan defining important global environmental issues and developing a guide for government policies in the next century. Agenda 21 ignited heated debate between developed (North) nations and underdeveloped (South) nations. The South demanded an emphasis on sustainable development issues such as water pollution, air pollution, and the degradation of agricultural lands. Underdeveloped nations expressed their outrage at the excessive "luxury" consumption patterns of the developed North and defensively noted that their consumption was "survivalistic" and based on the need to eliminate poverty.⁶⁶

As the number of developing countries participating in CGIAR increased during the 1990's, the organization's mission statement changed to reflect their views. The creation of the following two campaigns reflect these changes. First, GFAR (Global Forum on Agricultural Research) is an initiative aimed at modifying CGIAR's administrative structure and scientific objectives. GFAR's mission is to mobilize the various players in the global agricultural research community and make them aware of the serious problems that will be posed by poverty, food security, natural resources sustainability in the next century.⁶⁷ Structurally, GFAR is designed to increase collaboration between CGIAR's international centers, national agricultural research systems (NARS), agricultural research institutes (ARIs), universities, and private enterprises. Currently the viability and success of GFAR depends on identifying new financial donors who are willing to underwrite its goals.⁶⁸

The second initiative is Future Harvest, a media campaign to develop public awareness of the important links between global peace, the environment, and agriculture. Future Harvest is a new public service that disseminates studies analyzing the relationship between agriculture, livestock, fisheries, forests, and public policy. Its environment, health, economics, and population experts prepare these studies. Future Harvest has also created a popular ambassador program, which enlists the support of such distinguished global leaders. These include: Oscar Arias Sanchez, President of Costa Rica from 1986-90 and 1987 Nobel Peace Prize winner; U.S. President Jimmy Carter, former governor and farmer from Georgia; Francine Cousteau wife of former Jacques Cousteau and as President of The Cousteau Society promoter of global water conservation; Robert S. McNamara, an early supporter of CGIAR as president of the World Bank, and former president of the Ford Motor Company, and U.S. Secretary of Defense; Her Majesty Queen Noor of Jordan an ardent supporter of environmental conservation, peace and conflict resolution, poverty alleviation, and women's and children's issues; and Dr. Muhammad Yunus, winner of the 1994 World Food Prize for his efforts to alleviate hunger in Bangladesh.⁶⁹

New Issues

The International Debate Over Gene-Modified Foods

The current international debate over gene-modified foods reflects a power struggle between international environmental groups and the biotechnology industry. Both groups have radically different perspectives on the use of resources and their responsibilities to future generations. The environmentalists protest the use of chemical fertilizers and new plant hybrids because of their fear that these will destroy the earth's ecosystem and biodiversity. They are particularly opposed to the transfer of new agricultural technology to Africa, a continent that has not begun to change its traditional farming techniques. Green Revolution agriculturists point out that the environmentalists would prefer to let people die of starvation rather than employ new technologies. They cite the case of Sub-Saharan Africa where people are dying of starvation while environmentalists campaign to ban Green Revolution activities.



Plants in Vitro
Regeneration of control and frozen meristem cultures of the
cv. Bluggoe, 6 weeks after cryopreservation.
Courtesy of IPGRI/INIBAP

The biotech industry has adopted a position on the extreme opposite of the political spectrum from the environmentalists. With the largest sector of the industry based in the United States, this group has been steadfastly moving forward under the general premise that bio-engineered farming is inevitable. Their products have been on the market for less than ten years, raising questions about long-term health safety. Operating in the global free-market, there has been little discussion regarding corporate responsibility for the radical social or health changes that will be created by adoption of this new technology may render. Simply stated, the objective of biotechnology proponents is to fill a market need as the demand for food increases with the surge in human population.

European consumers have been the most vocal in expressing concern about the rapid adoption of biotech food. A British poll taken in 1999 demonstrated that "85% of consumers want genetically modified foods to be segregated from organically grown products while 77% want the modified foods to be banned altogether." Without out public support, British farmers and food processors secured government approval to allow commercial planting of gene-modified crops under strict controls. British Biscuit, Cake, Chocolate and Confectionery Alliance (BCCA) views "gene-modified food as inevitable, several products are already in the food chain, and U.S. producers do not segregate traditional from gene-modified seed."⁷⁰ Lack of consumer opinion has generated a backlash – the BEUC (the European consumers' union) has organized a campaign to segregate gene-modified and organic food processing.⁷¹ European consumer opposition has encouraged U.S. environmentalists to sue the U.S. Environmental

Protection Agency for its failure to ban gene-modified crops.⁷² It appears that public protests in the United States will take a different course than in Europe. Historically, American consumers have felt protected by the watchdog efforts of both the U.S. Food and Drug Administration and the U.S. Department of Agriculture (USDA).⁷³ Currently, the USDA has not required testing for any gene-modified foods, noting that "they are not aware of any information that shows it is different from regular food."⁷⁴

On the international level, the United Nation's Food and Agriculture Organization (FAO) has remained neutral on the topic on biotechnology. In a January 1999 report issued on the topic, the FAO urged general caution. However, it also suggested that biotechnology could "provide solutions for some of the old problems hindering sustainable development and achievement of food security."⁷⁵ In light of the general lack of consensus on biotechnology issues, Rockefeller Foundation President Gordon Conway has provided vocal leadership on the topic. In his opinion, European consumer concerns may only serve to stop progress being made in the field.⁷⁶ As a solution, he has recommended the establishment of guidelines, testing and food labeling. In his opinion, "there must be a new culture, with appropriate systems and on-going institutional support, that provides careful monitoring, open reporting and transparency, and a place for public participation about the impact of plant biotechnology on human health."⁷⁷

Conway demonstrated his commitment to structuring the terms of the international debate on the biotechnology issue by meeting with Monsanto Company executives in June 1999. As the largest biotech plant producer in the world, Conway asked them to "treat the poor as equal partners in an honest dialogue. Acknowledge that you are concerned about returns on investment, market penetration, continued growth and other commercial issues. Admit that you do not have all the answers but set out those which you do have and commit to prompt, full and honest sharing of data as you get it."⁷⁸ In May 1999, Conway called for an international forum on the issue and the Rockefeller Foundation is dedicating resources to back his efforts.

Mexico and the Bt Corn Biotech Controversy

In the May 1999 issue of *Nature*, Cornell University entomology researchers reported that genetically modified Bt corn kills monarch butterfly larvae in laboratory tests.⁷⁹ Up until the release of this report, environmentalists had attributed the decline in the monarch butterfly population to excessive logging and pesticide use.

Monarch caterpillars originate in Canada and the United States where they are possibly being exposed to Bt corn. After hatching, millions of the monarch butterflies fly to the western forests of Mexico and Michoacan states for the winter months. They are not an endangered species, however Mexico, Canada and the United States are responsible for their protection under the ecological provisions of NAFTA (North American Free Trade Agreement) implemented in January 1994.⁸⁰

Cornell's findings are based upon initial laboratory tests. Under specific test conditions, "44% of monarch butterfly caterpillars that fed on milkweed leave dusted with Bt corn pollen died. Milkweed is the primary food source for these caterpillars." Cornell researchers admit that at this stage, their scientific conclusions are still tentative. According to Cornell entomology professor John Losey, "the study was conducted in the laboratory and, while it raises an important issue, it would be inappropriate to draw any conclusions about the risk to monarch populations in the field based solely on these initial benefits of Bt corn outweigh the potential risks. We can't forget that Bt corn has a huge potential for reducing pesticide use and increasing yields."⁸¹



Monarch Butterfly

Karen Obenhauser, Monarch Webpage [1999]
www.monarchwatch.org/gallery/photo/ad2.htm

Bt corn is gene-engineered by splicing genes from the bacterium *Bacillus thuringiensis* into the corn. The Cornell researchers stressed that it poses no known threat to humans or beneficial insects.⁸² However, French scientists at le Bouchet army research laboratories reported in the May 29, 1999 issue of *New Scientist* that Bt dried spores used on organic crops in Europe may be harmful to the human immune system.⁸³

Cornell researchers acknowledge that their next series of experiments with Bt corn and declining monarch caterpillars must replicate real-life conditions. This summer, they will be heading to U.S. and Mexico cornfields to conduct additional research.⁸⁴ Bt corn has been planted in Mexico on an experimental basis in certain regions since 1993.⁸⁵ The U.S. has been planting Bt corn in the Midwest cornbelt since 1996 and its popularity has increased steadily over the past 3 years. In 1996 it accounted for 400,000 corn acres with this figure jumping to 17 million acres or 21-25% of the total planted corn acreage in 1998.⁸⁶

The Cornell report has strengthened the activities of environmental groups such as Greenpeace Mexico, which has been active in organizing protests against genetically modified corn. According to this organization's spokesman Roberto Lopez, Mexico "is faced with a new form of domination - genetic imperialism." He has called on the Mexican government to "defend the country's genetic diversity and the more than 300 strains of corn in the country by declaring Mexico a 'center of origin' of corn in a similar way to France having sole rights to market wine known as champagne."⁸⁷

In response to the Cornell study and Greenpeace protests, the Biotechnology Industry Organization has publicly acclaimed the important benefits of Bt corn. According to this organization's spokesman, Dr. L. Val Giddings, "Whatever the threat to monarch butterflies posed by Bt corn pollen, we know it's less than the threat of drifting pesticide sprays."⁸⁸ Giddings noted that up until the publication of the Cornell's lab tests, the environmentalists themselves had concluded, "the primary threat to the monarch butterfly is the loss of crucial winter habitat in southern California and Mexico. Threats come from habitat degradation along

butterfly migratory routes, pesticides, and other human activities." Rhetorically, Giddings also added, "It's not an exaggeration to say more monarchs succumb to high-velocity collisions with car windshields than ever encounter corn pollen."⁸⁹

Mexico's Leadership on Quality Protein Maize (QPM)

Mexicans have long relied on corn as a food staple. As one of the most prolific and well known of the Green Revolution agronomists with over 50 years of field experience, Norman Borlaug has remained committed to developing new corn hybrids that yield corn ears containing high levels of protein. His non-DNA, traditional hybridization plant breeding experiments, known as the QPM (quality protein maize) project began over 35 years ago in Mexico at CIMMYT.⁹⁰ Political support and funding for the project languished until the 1990's. In spite of the lack of interest, Borlaug remained convinced that QPM represented an enormous benefit to the world's poor. International development agencies estimate that there are approximately between 1 and 2 billion chronically poor people who suffer from malnutrition due to lack of protein, iron, zinc, and vitamin A. A large portion of these people rely on maize for their nutrition. Maize provides protein but, it lacks adequate levels of two essential amino acids, lysine and tryptophan. QPM addresses these deficiencies by adding these two proteins into new corn hybrids. Borlaug is currently conducting similar experiments to enhance the nutritional content of wheat and triticale grain.⁹¹



CIMMYT Maize Germplasm
Courtesy of CGIAR [1999]

In the early 1990's, Borlaug moved his QPM experiments to Obatanpa, Ghana. Here, nearly 30,000 hectares of QPM were sown, accounting for more than half of commercial maize seed sales in Ghana in 1995. The Obatanpa project used experimental QPM seed from CIMMYT in Mexico. Agronomists were especially careful to include environmental concerns in their project criteria. For example, they relied upon crop pests and protecting stored grain and seed from insects. Their work was funded by the Carter Center's Sasakawa-Global 2000 campaign.⁹²

In 1997, the QPM project was able to expand its experiments due to renewed interest from research partners and donors. To fuel new discoveries, generous funding was acquired from the Nippon Foundation, Sasakawa Global 2000, the Sasakawa Africa Association, and World Vision. Experiments spread to China and Mexico. The Chinese estimate that 100,000 to 200,000 QPM hectares will be planted by the year 2000. Mexican Secretary of Agriculture, Ing. Romárico Arroyo Marroquín's goal is to cultivate more than 2 million hectares of QPM by 2000-2001.⁹³

Currently both CIMMYT and Mexico's INIFAP (National Institute of Forestry, Livestock, and Agricultural Research) are administering a new QPM "kilo por kilo" program which allows farmers to trade an equal amount of old maize seeds for new improved QPM seed. Earlier this year, CIMMYT sent QPM germplasm for testing in Brazil, Colombia, Ethiopia, Ghana, Guatemala, India, Mozambique, Thailand, and Zimbabwe, among other countries.⁹⁴ This trend represents the second time Mexican seeds have been spread throughout the world, changing traditional agricultural methods. Borlaug's QPM seeds are part of the Second Green Revolution.

Mexico's Promotion of Vitamin Enriched Tortillas

The Mexican Department of Agriculture has expressed interest in promoting the use of QPM in tortillas, the basic food staple of the Mexican poor. Enriching tortillas is not a new concept. In 1949, Roberto González Barrera, chairman of Grupo Maseca, pioneered the production of vitamin enriched corn tortillas and corn flour. According to historian James Wilkie, Barrera "launched the First Green Revolution in nutritious staple food production ' the result was an enriched, hygienically produced tortilla with a longer shelf life for Mexico's popular sector, for whom the tortilla was, and still is, a main item of consumption."⁹⁵

Robert González Barrera's enriched tortilla has become a lucrative Mexican export. Organized under the parent company GRUMA, Maseca is a publicly traded subsidiary. It is ranked as the number one producer of corn flour in Mexico. Barrera concentrated on global sales, opening production facilities in Costa Rica in 1972, the United States in 1976, Honduras in 1987, El Salvador and Guatemala in 1993, Venezuela in 1995 and the European Union in 1999.⁹⁶ GRUMA is very interested in QPM. However, it is not limiting its new potential product line to just QPM. It is currently testing a pilot product in Guanajuato, Mexico that adds soy protein to its corn tortillas. Approximately 7,000 families participating in this pilot project are receiving enriched soy tortillas along with other vitamin and mineral supplements. UNICEF supports this project. A scientific evaluation of this pilot program is currently being conducted by the independent research think-tank, Instituto Nacional de México Salvador Zurbirán.⁹⁷

CGIAR's International Centers Sow "Seeds Of Hope" In Central America

In November 1998, Hurricane Mitch destroyed the Nicaraguan and Honduran ecosystems. Today, both countries are assessing how they will rebuild their agricultural sector and transportation infrastructure, which was destroyed by approximately 70 percent. International aid workers are also working to help the two million people left homeless. The devastation ruined crops that were used for both food and seeds for future harvests. This included maize, bean, potato, coffee, rice, cotton, tobacco, sugar cane, sesame seed, pineapples, melons, and banana crops. The region is plagued by soil erosion that is damaging fields, irrigation

systems, and transportation infrastructure. In the export sector, Standard Fruit, estimates it will have to replant in new fields over the next two years at a cost of US\$70 to \$75 million. The Nicaraguan government estimates that it will have to spend US\$1 billion to restore its agricultural sector.⁹⁸

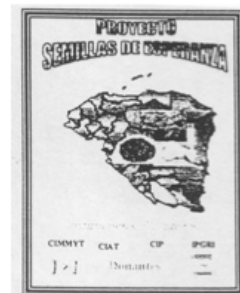
The governments of Nicaragua and Honduras have asked international assistance and relief agencies to help them rebuild their economies. The United States, European Union, United Nations, and many others are providing disaster relief. U.S. policymakers have concluded that they must provide aid for both humanitarian reasons and to stem the flow of refugees. Thousands fled to the United States after Hurricane Mitch and the Clinton Administration granted them amnesty for two months before requiring them to register with the I.N.S. (Immigration and Naturalization Services).⁹⁹ Approximately, half of the Central American agricultural work force lost their livelihoods due to the devastation.¹⁰⁰ International assistance experts and economists agree that rebuilding the agricultural sector is key to rebuilding the economic well being of the region.

As part of international relief efforts, four of CGIAR's international centers and Future Harvest have implemented a "Seeds of Hope for Central America" program. This is a two year \$2.5 million dollar project that will replenish seed stock and teach environmentally friendly agricultural techniques.¹⁰¹ The four CGIAR centers are CIAT, CIMMYT, CIP and IPGRI. Scientists at these centers based in Colombia, Mexico, Peru and Italy are currently locating, packaging, and shipping the millions of seeds needed to restore Nicaraguan and Honduran agriculture. Their goal is to provide a supply of seeds for the future.

Using its GIS (geographical information systems) database, CIAT first began with a "before and after" topographical comparison. It used its database to compare pre-Hurricane Mitch information on topography, rivers, drainage, soils, crops, roads and bridges with data compiled by satellites after the storm. This allowed CGIAR to identify the regions in the most need of assistance.¹⁰² Then, CGIAR scientists planted an initial crop of "foundation seeds" in January 1999. These were used to produce more seeds for the spring 1999 crop and future years.¹⁰³ All the seeds are new hybrid varieties resistant to disease and pests. Lastly, CIMMYT and CIP have introduced new innovative agricultural techniques including the reintroduction of the sweet potato. This is interspersed with corn in a single field to prevent soil erosion. It is also a good source of vitamin A.¹⁰⁴ Project goals also include reestablishing crop biodiversity and reducing dependency on food imports.¹⁰⁵



Seeds of Hope for Central America
World Bank Today, Feb. 1999



Seeds of Hope for Central America
25 lbs. packaging label, Courtesy of CIAT
headquarters, Cali, Colombia

Conclusion

In 1999, international non-profit organizations remain at the center of the Green Revolution debate. Organizations such as CGIAR and its affiliated international centers face a critical challenge of restructuring their budgets and administration to address the realities of the Post-Cold War period. Their new projects such as the "Seeds for Hope Project" require innovation and cooperation with other international organizations and NGOs. In the process, they must identify new donors who will support their new goals. To date, they have met this challenge by reaching out to developing nations and supporting new concepts such as sustainable development and biodiversity. In doing so, they have isolated themselves from a strong alliance with well-financed biotechnology companies. This industry has emerged as "doers" in the field whose well-financed R&D (research and development) budgets are underwriting spectacular new DNA discoveries of bio-engineered species. These discoveries differ from the initial Green Revolution experiments in that they transfer genetic material from one species to another. In other words, they will transfer fish or animal genes into the genetic make-up of plants. To date, Green Revolution agronomists have relied on more traditional hybridization methods such as cross-breeding within the plant kingdom and enhancing fertilization. The most clear-cut distinction in the international debate on the Green Revolution exists between the environmental and biotech positions. Developing nations and Green Revolution agronomists based at international non-profit organizations such as CGIAR are somewhere in the middle of these extremes. It remains to be seen whether these non-profits will be able to draw upon their past historical influence to successfully negotiate guidelines for future agricultural developments. They created and implemented the First Green Revolution from the 1940's through the 1990s. Will they oversee a Second Green Revolution and will include or exclude gene-engineering?

Over the fifty year course of the Green Revolution, Mexico has remained at the center of its latest discoveries. Initial experiments begun in the 1940's in Toluca and Sonora under the Rockefeller Foundation resulted in the first Green Revolution wheat hybrids. Norman Borlaug's QPM research to produce more nutritious corn continues this tradition in 1999. Much of Borlaug's innovative work has been conducted at CIMMYT, a world renowned resource for agriculturists working on food production and biodiversity issues. CIMMYT's seeds have been sown around the globe including initial Green Revolution harvests in Pakistan and India, new QPM seeds in Africa and China, as well as the latest international relief efforts to reconstruct the Central America's agricultural sector destroyed by Hurricane Mitch. Over the course of fifty years and numerous political administrations, Mexico's Department of Agriculture has demonstrated an eagerness to collaborate with international agricultural non-profit organizations in order to improve farming technology. As a result of affiliated educational training programs, Mexican agronomists have been at the forefront of spreading the Green Revolution throughout the world. Mexican public policy and education programs sponsored by the international non-profit organizations such as the Rockefeller and CGIAR have bonded these players together as leaders in the Green Revolution. This has created an opportunity for both to set historical

precedents that will continue to shape the international debate on this topic as biotechnology becomes an increasingly important and controversial foreign relations issue in the next century.

Endnotes

¹ Jimmy Carter, "First Step Toward Peace is Eradicating Hunger," *International Herald Tribune*, 17 June 1999, <http://www.futurehavest.org/news/jimmycarter.shtml>. For more on the Carter Center and its programs see http://www.emory.edu/CARTER_CENTER.

² The Washington D.C. based Zero Population Growth organization has designated October 12, 1999 as the day the world population is expected reach 6 billion. They have labeled this date as "Y6B." For more <http://www.zpg.org>.

³ Some experts are currently predicting that at this juncture, the Earth has already lost one-third of its natural capital - as measured by the health of its forest, freshwaters, and marine ecosystems. For more on this position see Worldwatch Report at <http://www.worldwatch.org> and Paymal Sampat, "The Worldwatch Report: Earth's Stocks Down by One-Third," *ENN*, 22 July 1999. Agriculture accounts for approximately 80-90% of water use and therefore plays a very important role in future world peace. According to Future Harvest, a new public awareness campaign, "in the next 25 years one-third of the world will face severe water scarcity, with devastating consequences for the environment, food production, human health, the world economy, and *peace*."

⁴ Paul R. Ehrlich, *The Population Bomb* (New York: Ballantine Books, 1968) and William and Paul Paddock, *Famine 1975! America's Decision: Who Will Survive?* (Boston: Little, Brown & Company, 1967). For additional books on this topic see Georg Borgstrom, *The Hungry Planet: The Modern World at the Edge of Famine*, 2nd ed. (New York: MacMillan, 1972); William and Elizabeth Paddock, *We Don't Know How* (Ames, Iowa: Iowa State University Press, 1973); E. C. Stakman, Richard Bradfield and Paul C. Mangelsdorf, *Campaigns Against Hunger* (Cambridge, Mass.: Belknap Press, 1967).

⁵ For more on the argument of Western co-dependency and its "national appetite for wheat" see John H. Perkins, *Geopolitics and the Green Revolution, What, Genes, and the Cold War* (Oxford: Oxford University Press, 1997); and Kenneth A. Dahlberg, *Beyond The Green Revolution: The Ecology and Politics of Global Agricultural Development* (New York: Plenum Press, 1979).

⁶ James W. Wilkie, "Revoluciones Verdes," *Uno Más Uno*, 13 June 1999.

⁷ "Is Your Breakfast Genetically Engineered?" *ENN*, 28 September 1998 and "Genetically Modified Food Offers Benefits But Is It Safe For Human Consumption' Biotech Food Raises A Crop of Questions," *Washington Post*, 15 August 1999, A1.

⁸ Frank Bajak, "Genetic Engineering Talks Hit Snag," AP, 16 February 1999; and Brian Halweil, "The Worldwatch Report: U.S. Derails Biosafety Protocol," *ENN* for Worldwatch Institute, 5 April 1999.

⁹ Interestingly, countries such as Austria, Luxembourg and Ethiopia have joined together insisting that they will not allow genetically engineered crops to devastate their rich biological diversity and cultural traditions. *Ibid.*

¹⁰ "Greenpeace Mexico Blasts U.S. 'Genetic Imperialism,'" *Reuters*, 21 February 1999. For more on this topic see Sandy Tolan, "Against The Grain: Multinational Corporations Peddling Patented Seeds and Chemical Pesticides Are Posed To Revolutionize India's Ancient Agricultural System. But At What Cost?" *Los Angeles Times* (10 July 1994, Times Magazine, 1).

¹¹ Today, Pioneer Hi-Bred International Inc. is a manufacturer of genetically modified Bt corn discussed in greater detail further in this article. Other manufacturers include Novartis AG and Monsanto Co. "Ecologists Urge Mexico About Corn," *AP*, 20 May 1999. For more on the Wallace family see Russell Lord, *The Wallaces of Iowa* (New York: Da Capo Press, 1972).

¹² For more on Wallace's foreign policy interests see J. Samuel Walker, *Henry A. Wallace And American Foreign Policy* (Westport, Conn.: Greenwood Press, 1976).

¹³ *News Of The Day*. Vol. 12, no. 224, Hearst vault material, HVMc1354r4, 37618, March 1941, UCLA Film Archives.

¹⁴ Raymond Fosdick, *The Story of the Rockefeller Foundation* (New York: Harper, 1952), 184-5. For more on Henry Wallace's agricultural research see John Morton Blum, ed. *The Price of Vision: The Diary of Henry A. Wallace, 1942-46* (Boston: Houghton Mifflin, 1973); Henry A. Wallace, *Corn And Its Early Fathers* (East Lansing, Mich.: Michigan State University Press, 1956); and José Domingo Lavín, *La industrialización de México; comentarios a los discursos de Henry A. Wallace* (Mexico: Ateneo Nacional de Ciencias y Artes de México, 1946)

¹⁵ This organization was set up as a separate public U.S. government non-profit organization affiliated with Rockefeller's OIAA. This was a unique legal structure used only the Rockefeller during World War II. It allowed him to channel funding from Roosevelt's Federal Emergency Fund into the project. Margaret Carroll, "The Rockefeller Corollary -- The Impact of Philanthropy and Globalization in Latin America," (Ph.D. diss., University of California, Los Angeles, 1999), 97.

¹⁶ OIAA provided \$500,000 for initial construction costs. The organization's permanent budget was to come from all members of the Pan American union. Letter from E. H. Robbins to Carl B. Spaeth, 25 August 1941, Regional Division, OIAA, RG 229, National Archives, College Park, MD; A Memo from William T. Thurman to Nelson Rockefeller transmitting a written report on the history of the Institute written by Kenneth Iverson, 9 Aug. 1944, Folder "Kenneth Iverson," RG 469, Still Photo Division, National Archives, College Park, MD.

¹⁷ The Institute for Tropical Agriculture (ITA) and the Pan American Union (the predecessor organization to the Organization of American States) agreed to construct a research institute in

Costa Rica. Construction issues delayed completion of the project until after the end of World War II. Unfortunately, by 1946 President Harry Truman had terminated OIAA's projects and shut down this wartime agency. With no support from the U.S. government, enthusiasm for the project evaporated and the project faltered. From 1958-1960, budget short-falls forced the Institute's Director Dr. Allee to search for outside funding sources from organizations such as Nelson Rockefeller's private non-profit organization AIA and the International Cooperation Administration (USAID's predecessor). In the 1960's President Kennedy's Alliance for Progress resuscitated the Institute as several USAID programs drew upon its experiences and resources.

¹⁸ Point IV derived its name from the fourth point in Truman's 1947 inauguration speech. For more on AIA and IBEC as role models for Point IV, see "IBEC-AIA in Brazil," 20 April 1950, Berent Friele, Folder 28, Box 1, AIA, Series P.R., RG 13, RF, Rockefeller Archive Center; and Beardsley Ruml, *Manual of Corporate Giving* (Washington: National Planning Association, 1952).

¹⁹ President Truman appointed Nelson Rockefeller to head the International Development Advisory Board (IDAB), which was responsible for studying the feasibility of implementing Point IV. Its summary report was entitled *Partners in Progress: A Report to President Truman by the International Development Advisory Board* (New York: Simon & Schuster, 1951).

²⁰ Philip H. Coombs, *The Fourth Dimension Of Foreign Policy: Educational and Cultural Affairs* (New York: Harper & Row for the U.S. Council on Foreign Relations, 1964).

²¹ Edward H. Berman, *The Influence of the Carnegie, Ford, Rockefeller Foundations on American Foreign Policy: The Ideology of Philanthropy* (Albany: State University of New York Press, 1983), 70 citing Francis X. Sutton, "American Foundations and the United States Public Diplomacy," 8, an address delivered before the Symposium on the Future of U.S. Public Diplomacy, Subcommittee on International Organizations and Movements, House Committee on Foreign Affairs, 22 July 1968. Dean Rusk was President of the Rockefeller Foundation from 1952-1960. He left this position to serve as President John F. Kennedy's Secretary of State. For more see Dean Rusk Papers, 1952-1962, Rockefeller Archive Center.

²² These calculations were proposed by historian Edward Berman after reviewing 1955-66 issues of the Rockefeller *Foundation Annual Report*. Berman estimates that in general, international programs received approximately one-third of all new grants. Berman, 67-75.

²³ At first, fellowships paid for study in the United States only. In the mid-1950's the Rockefeller Foundation began to expand its international education efforts. Vice President Kenneth Thompson headed the University Development Program. In 1955, its budget consisted of an annual disbursement of \$5 million for five years. In 1961, Rockefeller Foundation President J. George Harrar increased this to \$100 million over a ten year period. This program developed five universities including the Universidad del Valle in Colombia and others in the Philippines, Thailand, Nigeria and a regional center in East Africa. For more on the goals, objectives, successes and failures of the Rockefeller Foundation's University Development Program see Christiana Alafonyeka Tamuno, "The Roles Of The Rockefeller Foundation, Ford Foundation And Carnegie Corporation In The Development Of The University Of Ibadan, 1962-1978"

(Ph.D. diss. University of Pittsburgh, 1986); and Kenneth W. Thompson, *Higher Education for National Developments One Model For Technical Assistance* (New York: International Council for Educational, 1972).

²⁴ Gordon Conway is from Wales. He was a top aid official with the Ford Foundation in India and in 1992 became vice-chancellor of the University of Sussex.

²⁵ Gordon Conway, *The Doubly Green Revolution, Food For All In The 21st Century* (London: Penguin, 1997); and Book Review, *The Guardian*, 20 Nov. 1997.

²⁶ "Conway Calls For Global Forum On Biotechnology," *Rockefeller Foundation Press Release*, 19 May 1998.

²⁷ Norman Borlaug, "The Green Revolution: Peace and Humanity, A Speech On The Occasion of the Awarding of the 1970 Nobel Peace Prize (Oslo, Norway: 11 Dec. 1970).

²⁸ For primary sources on J. George Harrar's experiences in Mexico, and the organizational structure and impact of Rockefeller Foundation's Mexico Field Office see J. Harrar Papers, Rockefeller Archive Center; Mexico Field Office files, Series 6.13, RF, Rockefeller Archive Center; Erwin Levold, "RF Mexico Field Office and the Green Revolution," *Rockefeller Archive Center Newsletter* (Summer 1989), 10-11. For more biographical data on Harrar see Kathleen Teltsch, "J. George Harrar, 75, Ran Rockefeller Foundation," *New York Times* (20 April 20 1982) 29.

²⁹ Fosdick, 185. For more information on the history and impact of the agricultural research in Mexico see Joseph E. Cotter, "Before The Green Revolution: Agricultural Science Policy in Mexico (1920-1950)" (Ph.D. diss., University of California, Santa Barbara, 1994); Henry McBeath, Cleaver Jr., "The Origins of the Green Revolution." (Ph.D. diss., Stanford University, 1974); J. George Harrar, *Programa agrícola mexicana, una revista de los primeros seis años de actividad bajo los auspicios unidos del gobierno mexicano y la fundación Rockefeller* (New York: Leo Hart Co. for the Rockefeller Foundation, 1950); Pablo Enrique Muench Navarro, *Enfoques sobre el problema del cambio tecnológico en la agricultura*. (Chapingo, Mexico: Universidad Autónoma Chapingo, dirección de Centros Regionales, Maestría en Desarrollo Rural Regional, 1995; E.C. Stakman, Richard Bradfield and Paul C. Mangelsdorf, *Campaigns Against Hunger* (Cambridge: Harvard University Press, 1969); Deborah Fitzgerald, "Exporting American Agriculture: The Rockefeller Foundation in Mexico, 1945-1953," *Social Studies of Science* 16 (1986), 457-483; and Bruce H. Jennings, *Foundations of International Agricultural Research: Science and Politics in Mexican Agriculture* (Boulder, Colorado: West View Press, 1988).

³⁰ For more on the Mexico Field Office's wheat research and diversification into other areas of agricultural research see Laura González Martínez, *Respuesta campesina a la revolución verde en el Bajío* (México: Universidad Iberoamericana, Programa Institucional de Investigación en Análisis Regional, 1990).

³¹ "Time Magazine Recognizes CIMMYT's Borlaug For Contributions to Science" CIMMYT *Press Release*, Mexico City, 31 March 1999.

³² Norman Borlaug, "The Green Revolution: Peace and Humanity, A Speech On The Occasion of the Awarding of the 1970 Nobel Peace Prize (Oslo, Norway: 11 Dec. 1970) .

³³ Ibid.

³⁴ For more on Rockefeller Foundation agricultural experiments in Colombia see Carroll P. Streeter, *Colombia: Agricultural Change: The Men And The Methods* (New York: Rockefeller Foundation, 1972) and *30 Anniversary of the Foundation of CIAT 1967-1997* (Cali, Colombia: CIAT, 1998).

³⁵ Borlaug.

³⁶ During its 22 years in operation, total funding for all AIA projects amounted to \$14,524,000. The majority of this sum, 52.4% or \$7,605,000 came charitable contributions donated by the Rockefeller family and Foundation. This included support from the Rockefeller Brothers Fund. The second largest contribution category amounting to \$5,695,000 or 39.2% of total funding was donated by U.S. oil companies operating in Venezuela such as Creole, Shell, Mene Grande (Gulf), International and Mobil). Other corporations and individuals contributed 8.4% or \$1,224,000 to AIA's total funding. Margaret Carroll, "The Rockefeller Corollary -- The Impact of Philanthropy and Globalization in Latin America," (Ph.D. diss., University of California, Los Angeles, 1999), 176-77.

³⁷ In 1961, AIA Executive Vice President John Camp and his small AIA staff felt overwhelmed by the immense need for capital to underwrite Latin American development. According to Camp, "no one country, not even Brazil, could undertake this enterprise alone in the way it should be done. It will require the organization of an international development agency, cooperating with the affected countries on a regional basis." Letter from John R. Camp to Nelson Rockefeller, 24 Feb.1961, 9, Folder 6, Box 1, John Camp Papers, Series I, RG 4, Rockefeller Archive Center.

³⁸ Martha Dalrymple, *The AIA Story, Two Decades of International Cooperation* (New York: American International Association for Economic and Social Development, 1968), 1-29.

³⁹ Ibid, 98-115.

⁴⁰ "Rockefellers Guests In Brazil," *New York Times*, 13 Apr. 1956, 4; and Clifton R. Wharton, ed., *Subsistence Agriculture and Economic Development* (Chicago: Aldine, 1969).

⁴¹ For more on the concept of Brazilian westward expansion see Lewis Tambs, "March To The West: A Geopolitical Analysis Of Brazilian Expansion" (Ph.D. diss., University of California,

Santa Barbara, 1967). For more on Juscelino Kubitschek's plans for Brasília see Hélio Silva, *Juscelino, o Desenvolvimento, 1956-61* (São Paulo: Grupo de Comunicação Três, 1983).

⁴² Ibid, Letter from John R. Camp to Nelson Rockefeller, 24 Feb.1961. For more background on Camp's concept of developing the Brazilian interior see John Camp, "Tierras desaprovechadas los vastos campos cerrados del Brasil" *Americas* (Aug. 1963) 11-14.

⁴³ Legally, IRI's organizational structure and funding posed some unique challenges for Nelson and David Rockefeller. Initially, it was incorporated as a for-profit making subsidiary of IBEC. As AIA Board of Director, Lawrence Levy described it, "Nelson's main interest [was to see] IRI develop into something from which it might have some type of royalty in order that it could have continuing funds with which to maintain and expand its work in the non-profit field." In 1957, due to legal complications stemming from the fact that its research was underwriting rural development projects and not yielding profits in the open market, the Rockefellers decided to merge IRI into AIA. In 1963, IRI legally separated from AIA and IBEC to become its own legal entity in Brazil under contract with USAID. Letter from Lawrence H. Levy to John French re IRI - Coffee Flavor, 12 Nov. 1953, Folder 15, Box 2, Series B, NAR, RG 4, RF, Rockefeller Archive Center; and Box 2, AIA-IBEC, RF, Rockefeller Archive Center.

⁴⁴ "Companhia Agricola Fazendas Paulistas General Description of Property," RG 4 NAR, Series B, Box 2, Folder 15, Rockefeller Archive Center; John Griffing, "New Techniques in Coffee Production," 1 June 1956, RG 4, NAR, Series B, Box 2, Folder 2, Rockefeller Archive Center; and IRI, *1959 Progress Report*, Folder 61, Box 7, Series B, NAR, RG 4, RF, Rockefeller Archive Center.

⁴⁵ Camp, *Americas*, 13-14.

⁴⁶ For example, a 1951 internal report predicted that the unit would "perform a lasting and eminently valuable service to Brazil by turning the fading remnants of some destitute coffee area into a successful demonstration farm. Here the development and demonstration of new methods for handling coffee trees, soils and animals could point the way to restoration of Brazil's depleted agricultural assets and the sparing of its new areas." *AIA-IBEC Progress Report*, 3, Box 2, Series B, NAR, RG 4, RF, Rockefeller Archive Center.

⁴⁷ Letter from President Jerome Harrington to Researcher Jonathan Garst, 18 October 1961, Series B, NAR, RG 4, Rockefeller Archive Center.

⁴⁸ Gregg Easterbrook, "Forgotten Benefactor of Humanity," *The Atlantic Monthly*, January 1997, <http://www.theatlantic.com/atlantic/issues/97jan/borlaug/borlaug.htm>.

⁴⁹ These discoveries were reported in the 15 June 1999 issue of *European Molecular Biology Organization Journal*. For more on this topic see "Gene identified that detoxifies heavy metals," *ENN*, 22 July 1999.

⁵⁰ Borlaug, "1970 Nobel Peace Prize."

⁵¹ "CIMMYT Today," [1997], <http://www.cimmyt.cgiar.org/about/CIMMYTTODAY97.htm>

⁵² For more on predicts of mass starvation in India and Pakistan see Paul R. Ehrlich, *The Population Bomb* (New York: Ballantine Books, 1968).

⁵³ Easterbrook.

⁵⁴ This accounted for 55% of the lands under wheat cultivation in Pakistan and 35% in India.

⁵⁵ Easterbrook.

⁵⁶ Ibid.

⁵⁷ Borlaug, "1970 Nobel Peace Prize."

⁵⁸ "CIMMYT Today"

⁵⁹ "Better Wheat and Maize For a Hungry Planet," CIMMYT, <http://www.cgiar.org/impact/ciminp.htm>; and Borlaug, "1970 Nobel Peace Prize."

⁶⁰ "CGIAR History," [1999], <http://www.cgiar.org/history.htm>.

⁶¹ Lowell Hardin is an agricultural economist. He is professor emeritus and assistant director of the International Program on Agriculture at Purdue University. In the 1970s he worked for the Ford Foundation and prepared the initial prospectus for CIAT. For more on his experiences with CIAT and CGIAR see Lowell S. Hardin, "Conceptual and Philosophical Bases for CIAT's Founding," *30 Anniversary of the Foundation of CIAT 1967-1997* (Cali, Colombia: CIAT, 1998).

⁶² "CGIAR History."

⁶³ "The CGIAR Partnership, Working for Sustainable Food Security," [May 1999], <http://www.cgiar.org/>

⁶⁴ Ibid.

⁶⁵ For more on the Cold War relationship between the U.S. government and U.S. foundations see Berman, *The Influence of the Carnegie, Ford, Rockefeller Foundations on American Foreign Policy: The Ideology of Philanthropy* and Philip H. Coombs, *The Fourth Dimension Of Foreign Policy: Educational and Cultural Affairs*.

⁶⁶ Margaret Carroll, unpublished lecture notes, History 168, Latin American International Relations, University of California, Los Angeles, June 1999.

⁶⁷ Luis Fernando Chaparro, "Research Partnerships and the Role of the Global Forum on Agricultural Research," *30 Anniversary of the Foundation of CIAT 1967-1997* (Cali, Colombia: CIAT, 1998), 76.

⁶⁸ José Antonio Ocampo, "Widening Collaborative Partnerships," *30 Anniversary of the Foundation of CIAT 1967-1997* (Cali, Colombia: CIAT, 1998) 69. José Antonio Ocampo is currently head of the United Nation's Economic Commission for Latin America (ECLA). Previous to this, he served as Colombian Minister of Agriculture and later, Minister of Treasury and Public Credit. While he was Minister of Agriculture he was an ex officio member of the CIAT Board (1993-94). He is responsible for Colombia's decision to join CGIAR's membership and become one of CIAT's most important donors.

⁶⁹ For more on Future Harvest and its ambassador program see <http://www.futureharvest.org/ambassadors/index.shtml>.

⁷⁰ Richard Kamchen, "Gene-Altered Foods Face Uphill Battle In EU," *Journal of Commerce*, 5 Nov. 1998.

⁷¹ "Gene-Free Foods Yes, But It May Cost." *Reuters*, 16 December 1998.

⁷² "Environmental Groups Sue EPA Over Gene-Altered Crops," *AP*, 18 February 1999.

⁷³ "Genetically Modified Food Offers Benefits But Is It Safe For Human Consumption' Biotech Food Raises A Crop of Questions," *Washington Post*, 15 August 1999, A1.

⁷⁴ "U.S. Europe React Differently Over GM Foods," *ENN*, 25 June 1999.

⁷⁵ "U.N. Urges Caution With Biotechnology," *ENN*, 26 January 1999.

⁷⁶ According to Conway, "much of what is being said in Europe is driven by passion. Some of it is motivated by simple anti-corporate or anti-American sentiment. But underlying some of this rhetoric are genuine concerns about the ethical consequences of biotechnology, about fear for the environment and about the potential impact on human health."

⁷⁷ "Food Gains For The World's Poor Are Being Threatened By Furor Over Genetically Modified (GM) Foods; Terminator Seeds Should Be Dropped, and Labeling Added, Say Foundation Leader," *Rockefeller Foundation Press Release*, 24 June 1999.

⁷⁸ Ibid.

⁷⁹ "Toxic Pollen From Widely Planted, Genetically Modified Corn Can Kill Monarch Butterflies, Cornell Study Shows," *Cornell University News Press Release*, 19 May 1999.

⁸⁰ "Ecologists Urge Mexico About Corn," *AP*, 20 May 1999.

- ⁸¹ "Group Calls For Caution in Bt Corn Flap," *ENN*, 10 June 1999.
- ⁸² "Researchers Find Bio-Engineered Corn Harms Butterflies," *CNN*, 20 May 1999.
- ⁸³ "Bt May Be Unsafe For Organic Farming," *ENN*, 17 June 1999.
- ⁸⁴ "Field Research Planned," *ENN*, 17 June 1999.
- ⁸⁵ "Ecologists Urge Mexico About Corn," *AP*, 20 May 1999.
- ⁸⁶ Ibid; and "Is Your Breakfast Genetically Engineered?" *ENN*, 28 Sept. 1998; and Brian Halweil, "The Worldwatch Report: Unintended Effects of Bt Crops," *ENN* for Worldwatch Institute, 4 January 1999.
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- ⁸⁸ "Ecologists Urge Mexico About Corn," *AP*, 20 May 1999.
- ⁸⁹ "Group Calls For Caution in Bt Corn Flap," *ENN*, 10 June 1999.
- ⁹⁰ Norman Borlaug, "Un Reconocimiento A Maseca," May 1999.
- ⁹¹ Ivan Ortiz-Monasterio, "F4: Improving human nutrition by enhancing bio-available protein and micronutrient concentrations in maize, wheat, and triticale," CIMMYT, [1999] <http://www.cimmyt.cgiar.org/about/f4.htm>
- ⁹² *Research Briefs*, CIMMYT, June 1995, http://www.cimmyt.cgiar.org/publications/vol3_2.htm
- ⁹³ Ibid and "People and Partnerships: Medium-Term Plan of the International Maize and Wheat Improvement Center (CIMMYT) 2000-2002+," CIMMYT [1999] <http://www.cimmyt.cgiar.org/about/people-mtp2002.htm>.
- ⁹⁴ The CIMMYT Maize Program, 1997-98 Research Highlights, <http://www.cimmyt.cgiar.org/research/maize/98maizehighlights.htm>
- ⁹⁵ James Wilkie, "Revoluciones Verdes," *Uno Más Uno*, 13 June 1999 and Jean Roth, "Sharing Visions For Mexico's Future," *Intercom* (Los Angeles: UCLA International Studies and Overseas Program Newsletter, June 1999)
- ⁹⁶ Gruma's US subsidiary, Gruma Corporation, sells tortillas to Taco Bell and El Pollo Loco restaurants, among others. For more information see Hoover's company snapshots [1999] <http://www.hoovers.com>
- ⁹⁷ Wilkie, "Revoluciones Verdes."

⁹⁸ "Honduras and Nicaragua, Farming After the Hurricane," *The Economist*, 20 February 1999.

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¹⁰⁰ This includes both commercial and subsistence farmers. "Seeds of Hope for Mitch-Battered Central America," *World Bank Today*, 24 February 1999.

¹⁰¹ This project is based on experiences from a similiar project initiated after Rwanda's civil war in 1995. "International Effort Launched to Sustainably Restore Food Production in Honduras and Nicaragua Following Hurricane Mitch," *Future Harvest Press Release*, 18 January 1999.

¹⁰² "International Effort Launched to Sustainably Restore Food Production in Honduras and Nicaragua Following Hurricane Mitch," *Future Harvest Press Release*, 18 January 1999.

¹⁰³ It is estimated that these "foundation seeds" will supply 33% of Nicaragua's and all of Honduras' maize needs.

¹⁰⁴ Paul Constance, "Seeds of Hope for Central America," IDBAmerica, [1999] <http://www.iadb.org/exr/idb/stories/1999/eng/e499f4.htm>.

¹⁰⁵ "Seeds of Hope for Mitch-Battered Central America," *World Bank Today*.