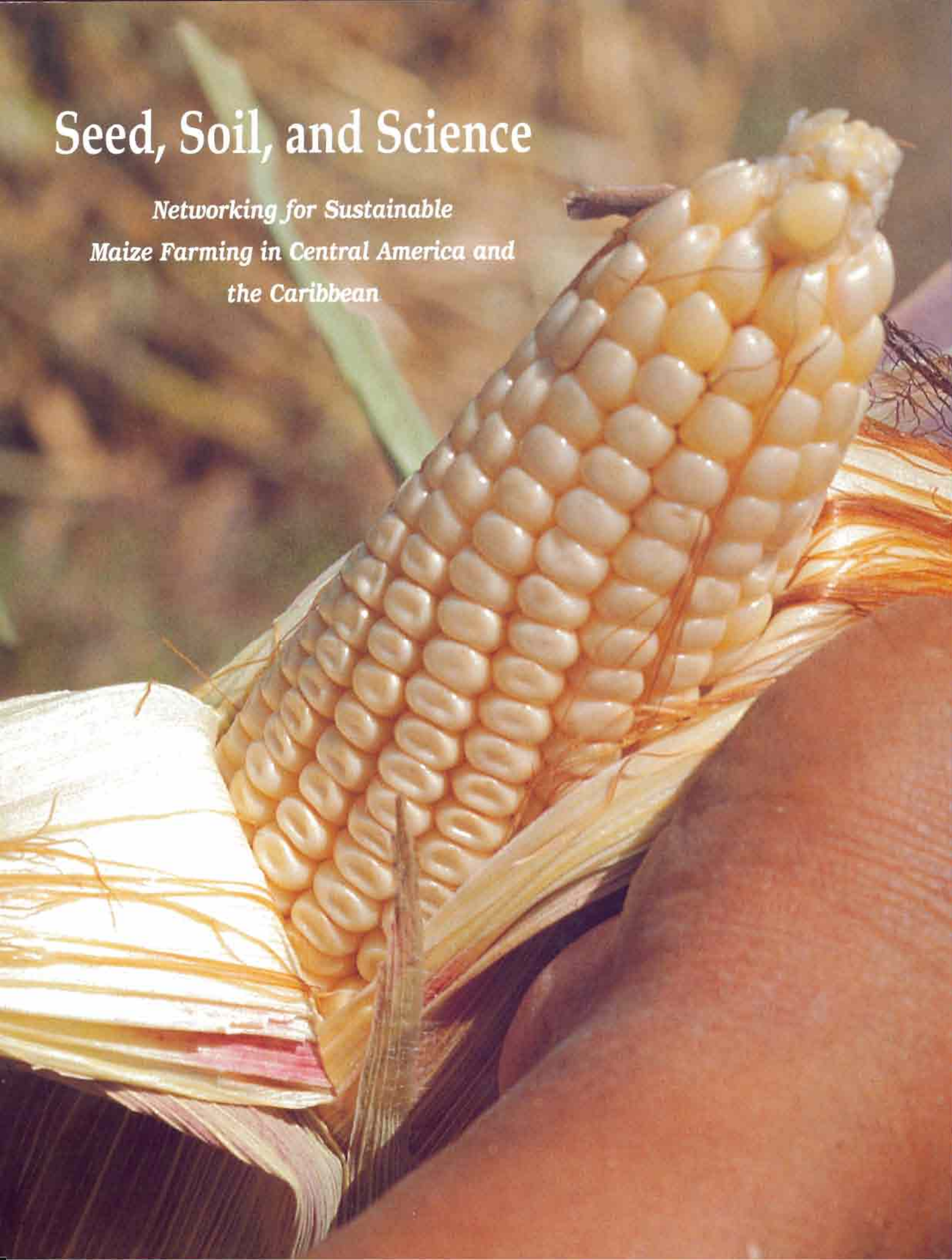
Seed, Soil, and Science

Networking for Sustainable Maize Farming in Central America and the Caribbean



Seed...

Maize, the cornerstone of culture in Central America and the Caribbean, a key source of food and livelihood for most farmers there.

Soil...

Fragile, sloping hillsides and tropical soils prone to erosion and degradation but vital to maize-based agriculture in the region.

Science...

International agricultural research that offers farmers environmentally compatible alternatives for increasing productivity. Networks—arrangements through which scientists share knowledge and products—make this research more effective and multiply its benefits to farmers and consumers.

The Regional Maize Program (Programa Regional de Maíz, or PRM)

A network of maize researchers from nine countries and the International Maize and Wheat Improvement Center (CIMMYT) in Mexico. With funding and guidance from Swiss Development Cooperation (SDC), the PRM develops maize varieties and crop management techniques for subsistence farmers who work the steep slopes and tropical lowlands in Central America and the Caribbean.

Networking for Sustainable Maize Farming in Central America and the Caribbean

Whenever you wake up feeling life is stressful, just consider the circumstances of Nicaraguan maize farmer, Juan Flores. He and his wife must support themselves and their seven children from a scant three hectares of land in the *Masaya* area south of Managua. They have no machinery, no subsidies, limited access to credit, and no welfare or crop insurance to help them through tough years. As do many farmers in Central America and the Caribbean, they subsist by growing maize and beans and raising pigs and chickens.

Improved seed for a land of tough choices

One thing that helps the family's peace of mind, though, is the maize variety[1] they use. "This seed resists *achaparramiento* (corn stunt)," says Flores, lifting a fistful of grain from a yellow plastic sack, "and the ear has a good husk, so it doesn't rot." The seed comes from his latest harvest of NB-6, one of many useful products from the Regional Maize Program (PRM), a research network for Central America and the Caribbean. Farmers in Masaya have used NB-6 since the late 1980s, when they first witnessed its performance in the face of corn stunt, a serious maize disease endemic in Central America.

"In 1985 the government brought foreign maize hybrids into this area, as part of plans for the intensive, high-tech production of basic grains," explains Róger Urbina, PRM administrative coordinator and former head of Nicaragua's maize research program. "Unfortunately, they were susceptible to corn stunt. During 1986-88 the disease reached critical levels, wiping out nearly all the maize in Masaya."

In the early-1980s, Urbina's team and PRM colleagues in El Salvador and Mexico had begun to develop NB-6, drawing on resistant seed from the International Maize and Wheat Improvement Center (CIMMYT), a nonprofit scientific research and training organization based in Mexico. In four short years after its release in 1984, the new variety already dominated the country's maize seed sales, capturing 80% of the market. It is easy to see why. Armed with NB-6, Masaya farmers normally harvest more than four tons of grain per hectare—over twice the average yield for maize in Central America and the Caribbean. "NB-6 is the 'maximum authority' here in yield," says Masaya farmer José Latino. The variety NB-6 and the newer, more resistant NB-12 cover a combined area of some 90,000 hectares (1 ha = 2.5 acres) in Nicaragua—approximately half the nation's maize lands. (See *Products of PRM Breeding Research*, p. 2, for information on PRM varieties used in other countries in the region.)

A study by Nicaraguan researchers on maize losses to stunt shows that farmers who use resistant varieties are receiving *annual* benefits on the order of US$5 million in Nicaragua alone. To put that figure in perspective, consider that the annual budget of the PRM has never gone beyond US$1 million (and is now much less), yet supports the development of new maize varieties and crop management techniques, as well as training, for the *entire* region. "Of course, the PRM works through national program infrastructure and personnel," observes Lucas Luisoni, assistant coordinator for Swiss Development Cooperation (SDC)[2] in Central America and the Caribbean. "Still,

[1] The term "variety" will be used to designate both hybrids and open pollinated varieties.

[2] SDC is part of the Federal Department of Foreign Affairs (DFAE) of the government of Switzerland.

investment in the network is like putting oil on the bearings of a tractor—it's only a few drops, but it helps the machine run smoothly."

Because of steady advances in yield, farmers who switch to the latest PRM maize varieties are obtaining 40% more grain—some 1.5 additional tons, under conditions such as those of Masaya—than they would have obtained from PRM maize cultivars a decade ago. The most advanced hybrids from the network yield at least 25% more than the best competitors and, in Guatemala and Honduras, give farmers nearly twice the yield of unimproved local varieties. Finally, as a result of PRM research on seed production technology, participating countries have vastly improved their capacity to offer farmers quality seed—a precondition to getting the best from improved varieties and practices.

M Listman

Full sacks spell food security for Nicaraguan maize farmer Juan Flores, shown here with agronomist Gloria Morales. Flores grows NB-6, a popular variety developed jointly by the PRM, national programs, and CIMMYT.

Products of PRM Collaborative Breeding Research

The varieties developed through cooperation involving the PRM, national programs, and CIMMYT are grown on more than 500,000 ha in Central America and the Caribbean—over three-quarters of the land sown to improved maize. The following partial list of such varieties released to farmers since the early 1980s suggests just how active—and effective—that collaboration has been:

- In Guatemala, farmers on some 120,000 hectares (nearly one-fifth of the national maize area) grow ICTA B-1, HB-83M, HB-85, HA-46, ICTA B-5, HA-28, HS-5GM, HB-83M, ICTA A-6, or T-101, to name a few. These varieties, together with improved crop management techniques, have allowed Guatemalan farmers nearly to double their yields—from one to almost two tons per hectare—since 1980.
- In Honduras, the varieties Guayape B-102, Honduras B-104, Honduras H-29 and 27, HS-3, HS-5G1, and Guaymas B-101 together account for one-fourth of the country's 400,000 ha of maize.
- In Panama, Guararé 8128 and the recently released P-8812, P-8814, and P-8916 account for over half the improved seed sold, greatly reducing seed imports.
- In El Salvador, the PRM's high yielding, early maturing H-53 has gained ground on the popular H-5 released during the 1960s; the two hybrids are sown on more than 140,000 ha, giving farmers yields of three-to-four tons per hectare—approximately twice the national average. In addition, H-17, H-9, and CENTA Pasaquina are grown on 14,000 ha.
- In Costa Rica, Tico V-1, Tico V-1M, Tico V-5, Tico V-7, EJN-2, and Los Diamantes 8043—which yield an average two tons per hectare (10% above the national average for maize)—are used on two-thirds of the country's maize area.
- In Dominican Republic, Cesda-28 and -88 are planted on about 20% of the nation's 25,000 ha of maize and yield more than four tons per hectare (the national average is 1.5 t/ha).

Sustainable methods for managing maize agriculture

Research on improved maize has long been its calling card, but the PRM also works on better crop management practices. These include the use of green manures—leafy legumes that are grown with maize or alternated between crops—and reduced tillage combined with residue covers. In both cases, the PRM tries to determine what makes the technology work, to develop improved recommendations for farmers who already use it, and to extend it to others who could benefit. This approach is evident in *Guaymango*, a hilly area in El Salvador where nearly all farmers practice conservation tillage.

"My father used to burn the residue, leaving everything black," says Martir Monroy, who started his own farm in Guaymango in 1981. According to Monroy, cultivation combined with slash-and-burn practices was resulting in low yields and serious erosion on Guaymango fields.

In the late 1970s, with support from Salvadorean researcher Fausto Calderón, leading farmers began letting crop residue lie and seeding directly into the mulch instead of plowing and burning. "We saw that other farmers did it and got good results," says Monroy. The practice is used on more than

Maize is among the most efficient plants at harnessing the sun's energy. Modern breeders have improved its productive qualities, reducing plant height and increasing the ratio of grain to stover.

G.Hettel

3,000 ha in Guaymango today. Farmers there, most of whom sow H-5 or H-53 and a local sorghum variety, normally obtain more than 3 t of maize, 2.5 t of sorghum, and 10 t of residue from each hectare.

M. Listman

J. Bolaños

It's an uphill climb for many maize farmers in Central America and the Caribbean. Techniques such as reduced tillage and residue management safeguard the fragile topsoil of Martir Monroy, Guaymango, El Salvador, and allow robust crop stands during the rainy season.

Spreading the word

With no cultivation to do, one could imagine that farmers' tasks are considerably lightened. In fact, reduced tillage requires a high level of management and specialized knowledge. So, in the mid-1980s the PRM began sponsoring on-farm studies to understand and refine the technique. Agronomists, extension specialists, and socioeconomists in the PRM and national maize programs have cooperated to develop relevant advice for farmers on such topics as the maize pests that hide in residue. "Researchers showed us that we should cut open 100 stalks after harvest, and put insecticide on our next crop only if 10 or more stalks have worms," says Monroy. He also uses a pesticide, dosage, and application methods recommended by extension specialists.

The network is testing conservation tillage at sites throughout Central America and the Caribbean where the practice has potential, and PRM socioeconomists are gathering data on *why* farmers adopt or reject the technique.

Guaymango itself has become a showcase for conservation tillage and residue management. Farmers are brought in from other areas of El Salvador and even other countries to see the practice firsthand and talk to Guaymango's producers. "Last year, there were six bus tours that came to my fields, sometimes with 50 to 60 people on each bus," says Alejandro Batres, a leading farmer in Guaymango.

As a result of joint research by the PRM, CIMMYT, and national programs, conservation tillage has been adopted by maize farmers on some 15,000 ha in Panama and is gaining ground regionwide.

Natural resource management

Over the years, CIMMYT and the PRM have developed a sizeable body of studies on interactions involving soil, soil nutrients, and maize yields. In the early 1970s, CIMMYT agronomist Roberto Soza conducted experiments on conservation tillage. The 1980s saw extensive work led by former CIMMYT

agronomists Fritz Kocher and William Raun on sulphur and phosphorus responses in volcanic soils. CIMMYT's Hector Barreto continued these efforts and added research on nitrogen availability and the use of legume cover crops in maize fields. Current PRM technical advisor, Jorge Bolaños, has introduced regionwide investigation to explain the effects of various crop and environmental factors on yields.

These efforts have produced new knowledge and research methods that national programs can apply. The work also reflects a gradual but significant shift of PRM focus from immediate production concerns to issues of long-term consequence.

Strengthening the capacity of national programs

The PRM also supports national programs in ways that improve the service farmers receive. Training is one example. The network has provided opportunities for advanced study at universities, in-service training in crop management and improvement at CIMMYT, and participation in regional and in-country courses and workshops on a range of topics. And researchers who attend PRM courses often go on to organize similar events for colleagues back home, using training materials provided in courses. As a result, maize researchers regionwide are using a common set of tools, including PRM software to analyze their data, statistical methods and modelling techniques spread through the network, and seed production techniques acquired through PRM training.

Although it is difficult to measure the profit to farmers of such activities, the report by a panel of outside experts who reviewed the PRM in 1991 says "...the overall effect of the training is reflected in the professionalism of most national researchers associated with the PRM, as well as the technical quality of...activities that benefit the region's smallholders."

On-farm research: An essential step

Around the outset of the 1970s, agricultural researchers began to realize that developing and testing new technology in farmers' fields could provide a valuable complement to work on experiment stations. As of 1974, the PRM and CIMMYT began collaborative work with maize specialists in Central America and the Caribbean to refine and spread a practicable methodology for on-farm research (OFR). A landmark study in western Panama in the early 1980s, for example, obtained a more-than-50% return to investments on research aimed at improving farmers' practices and helped set the credibility of OFR regionwide. Based on results

A sample of PRM training over the years: workshops and courses offered during 1989-92.

Title	Target country/area	Number of sessions/courses	Number of participants
Research planning/priority setting	Nicaragua	1	27
Economic analysis of research results	Region	5	122
Socio-economic diagnostic studies	El Salvador	1	37
Continuous economic analysis of fertilizer response	Region	1	12
Interphase OFR course	Region	2	48
Agronomic probes and diagnostics	Nicaragua	1	17
Maize seed production by smallholders	Guatemala and region	2	85
Stability and selection criteria	Region	1	12
Production of breeder's and basic seed	Region	2	70
Breeding for ear rot resistance	Region	1	15
Breeding for drought tolerance	Region	1	12
Seed production	Region	6	150
Agronomy and seed production	Region	2	70
Breeding for stress tolerance	Region	4	62
Conservation tillage for hillside maize farming	Region	2	40
Totals		**32**	**779**

of OFR in Les Cayes, Haiti, in the late 1980s, policy makers made more fertilizer available to farmers there. These efforts added significantly to the worldwide development of a "farming systems" perspective for agricultural research.

Throughout the 1980s, CIMMYT socioeconomists in the PRM led training in OFR and economic analysis. "Our efforts on the latter topic have enhanced the skills of more than 700 technicians from the region," says Gustavo Sain, CIMMYT socioeconomist and technical advisor to the PRM. Toward the end of the decade, CIMMYT, the International Center of Tropical Agriculture (CIAT), and the Inter-American Institute for Agricultural Cooperation (IICA) established a specialized OFR network for the region. This and related work has been taken up by the Regional Program in Support of Basic Grains (PRIAG), a network recently established by the European Union.

Networking in socioeconomics

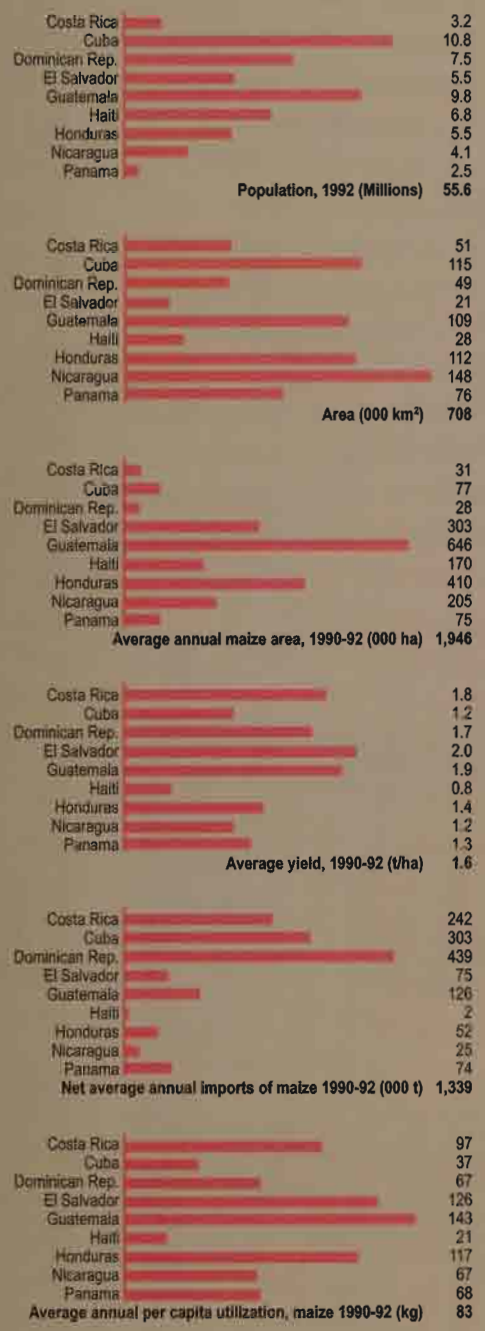
To strengthen socioeconomics research in Central America and the Caribbean and foster its integration with breeding and crop management research, the PRM, CIMMYT, CIAT, SDC, and the Ford Foundation established a network for social scientists in Central America and the Caribbean. Among other things, this specialized network sponsors joint studies across countries on common themes and offers training in economic analysis.

Implicit in these socioeconomics activities is a cycle whereby the PRM, CIMMYT, and national programs work together to develop relevant, practical methodologies. The PRM brings together researchers and experiences within the region; CIMMYT staff work jointly with regional specialists at many locations, adding knowledge gained in other parts of the world and from the scientific literature. Once research methods are well defined, they can be established in national programs through training and collaborative work. The programs can apply the methods in their own research and train others. At that point methodology development moves on to other areas, and the cycle begins anew.

H.Barreto

The poorest farmers in Central America and the Caribbean clear precious tropical forests in their desperation for a livelihood. "Poverty has pushed slash-and-burn agriculture into forest margins," explains Jorge Bolaños, CIMMYT agronomist and PRM technical advisor. "Farmers grow maize there at subsistence levels until soil fertility fails—usually after three-to-five years—then the land is converted mostly to pasture.

Maize and Agriculture in Central America and the Caribbean



Source: FAO Agrostat PC production statistics.

The nine PRM countries have a combined population equivalent to that of France. At current growth rates, the number of inhabitants will double by the year 2020. Urbanization has been dramatic over recent decades, but more than half the populace still lives in rural areas. Nearly all these people farm to survive, growing maize, beans, sorghum, and rice. Approximately 2 million hectares of maize are sown each year in Central America and the Caribbean, more than three times the area sown to any of the region's other leading crops.

Central America and the Caribbean is dominated by rolling mountains and valleys. Over 60% of the region's maize is grown on hillside plots. On steep hills, erosion can remove as much as 200 tons of topsoil *per hectare per year*—20 times tolerable levels. Soils are thin and often lacking in nutrients needed for high maize yields. Production may be further constrained by such factors as corn stunt disease; ear rot (especially in wet environments), drought (largely in Guatemala, El Salvador, Honduras, and Nicaragua); and insect pests.

High impact cropping

Maize farmers in the region usually harvest two or more crops per year from a single plot—either maize and beans, or maize and sorghum in drier areas. Farmers sow the crops simultaneously or delay planting of the second to lessen competition between the two. Such intensity of land use improves food security—the primary concern of a subsistence farmer—but also puts a heavy strain on the soil. Burning of crop residues is still widespread. Many farmers do not use fertilizer, and farm animals sometimes eat residues, adding to net losses in organic matter.

Limited use of improved technology

Maize yields regionwide average only 1.6 tons per hectare, well below the crop's potential. Output falls far short of demand in the region, and imports account for nearly one-third of all maize utilized. Farmers on some 40% of the maize area have adopted the core technologies of modern agriculture: improved seed, fertilizer, land preparation, and chemical control of pests.

The *Programa Regional de Maíz:* Ingredients of a Successful Network

The PRM has built on and multiplied the impacts of maize research institutions in Central America and the Caribbean (see *The Origin and History of the PRM,* p. 12). Hugo Córdova, CIMMYT maize breeder and former technical advisor to the PRM, says "The PRM has all that you could ask for in a network: research results, collaboration in problem solving, and free exchange of products among participants." What is it about the PRM that makes it so effective?

M.Listman

PRM coordinator Róger Urbina, a native of Nicaragua, brings to his work ample experience as a breeder and an intimate knowledge of the region.

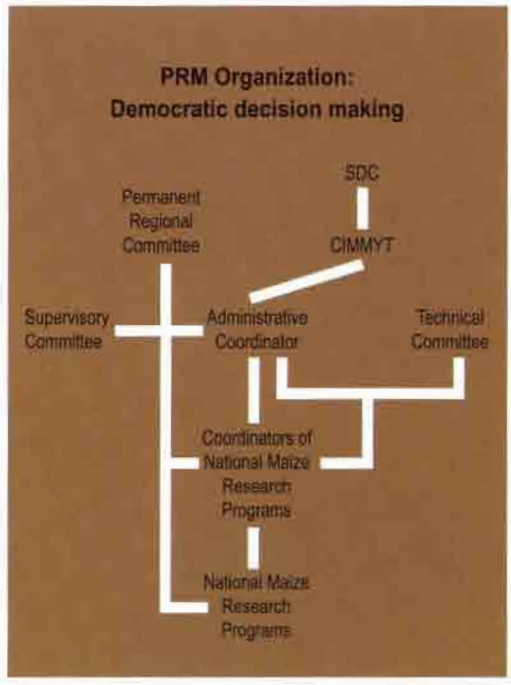
Structure without obstruction

Of the three PRM committees, only the permanent regional committee (*comisión regional permanente*, or CRP) is directly involved in decision making. The other two committees are strictly advisory. The CRP is made up of the maize program coordinators of participating countries and a CIMMYT technical advisor. It approves the annual plan and the allocation of resources to projects and countries.

The administrative coordinator of the network reports to the CRP, handles administrative and financial management, monitors progress with the help of the technical committee and national program leaders, and prepares financial and technical reports to the CRP, CIMMYT and SDC. In daily activities, the coordinator receives valuable support from the CIMMYT office in Guatemala. Network operations are decidedly non-bureaucratic. For example, requests for funds for approved activities are met within two weeks or less.

The key is planning

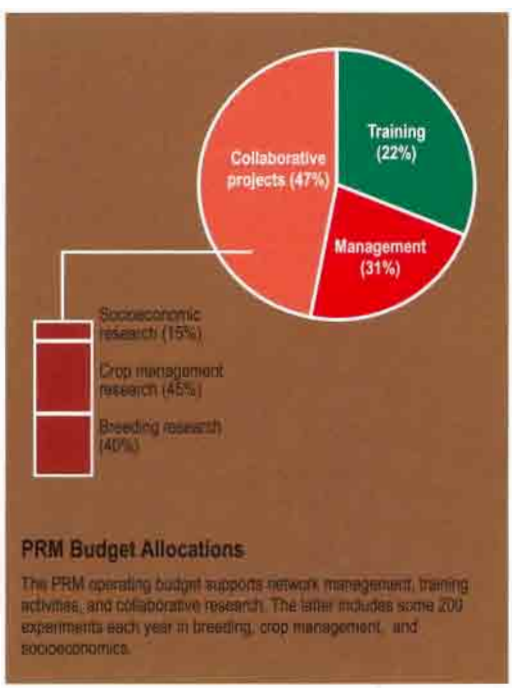
The heart of the PRM is its annual planning meeting. Here 20 or more PRM breeders, agronomists, and socioeconomists check progress, map out activities, and allocate funds for the coming year. The process entails several exhausting days of technical presentations and sometimes heated discussions. When participants finally emerge from the sessions, the objectives, activities, and allocations agreed upon are recorded in a book known as the "annual operating plan." A copy goes to the research teams of each country: this is the blueprint that will guide their PRM activities throughout the year. "Without this," says network coordinator Róger Urbina, "things



would be chaos." In addition to developing a plan, researchers come away from the sessions with a strong sense of involvement in the network itself.

Sharing work

Rather than spreading responsibilities over the entire region, the PRM assigns certain national programs the lead on issues where, for reasons of environment, skills, or interest, they have a special advantage. For example, studies on green manures are led by Honduras, one of the places where legume cover crops were first used. Costa Rica spearheads breeding for resistance to ear rot, an important disease in wet areas of that country. Honduras, Guatemala, and El Salvador, countries where lack of moisture often limits maize yields, head up research to develop drought tolerant varieties. Project leaders are directly accountable for results in their assigned area.



PRM Budget Allocations

The PRM operating budget supports network management, training activities, and collaborative research. The latter includes some 200 experiments each year in breeding, crop management, and socioeconomics.

National agricultural research programs in the PRM (as of 1994).

Country	Institute*	CRP representative
Costa Rica	Agriculture and Livestock Ministry (MAG)	Leopoldo Pixley
Cuba	Liliana Dimitrova Horticulture Research Institute (IIHLD)	Marcos Torres
Dominican Republic	Secretary of Agriculture (SEA)	Rodolfo Pierre
El Salvador	National Center of Agricultural Technology (CENTA)	Fidencio Guerra
Guatemala	Institute of Science and Agricultural Technology (ICTA)	Salvador Castellanos
Haiti	Center for Agricultural Research and Documentation (CRDA)	Jean Rene Bossa
Honduras	Secretary of Natural Resources (SRN)	Luis Brizuela
Nicaragua	Nicaraguan Institute of Agriculture and Livestock Technology (INTA)	Rafael Obando
Panama	Institute of Agriculture and Livestock Research (IDIAP)	Román Gordón

* The Spanish or French acronym is given in parentheses

And while PRM funds pay for the actual activities, national program staff time and infrastructure are important "hidden" resources upon which the network draws.

Sharing outputs

Maize research directors and, in some cases, agriculture ministers of PRM countries have signed contracts committing their programs to share all network products. Such agreements would be mere piles of paper, though, if the routine exchange of maize seed and research data were not an integral part of PRM activities. Seed is normally circulated through annual trials and specific breeding experiments. Breeders also exchange samples directly.

Information flows in several ways, the annual planning session being one of the foremost. Professional meetings provide another forum for research results. Finally, as a permanent record of its research, the PRM produces a

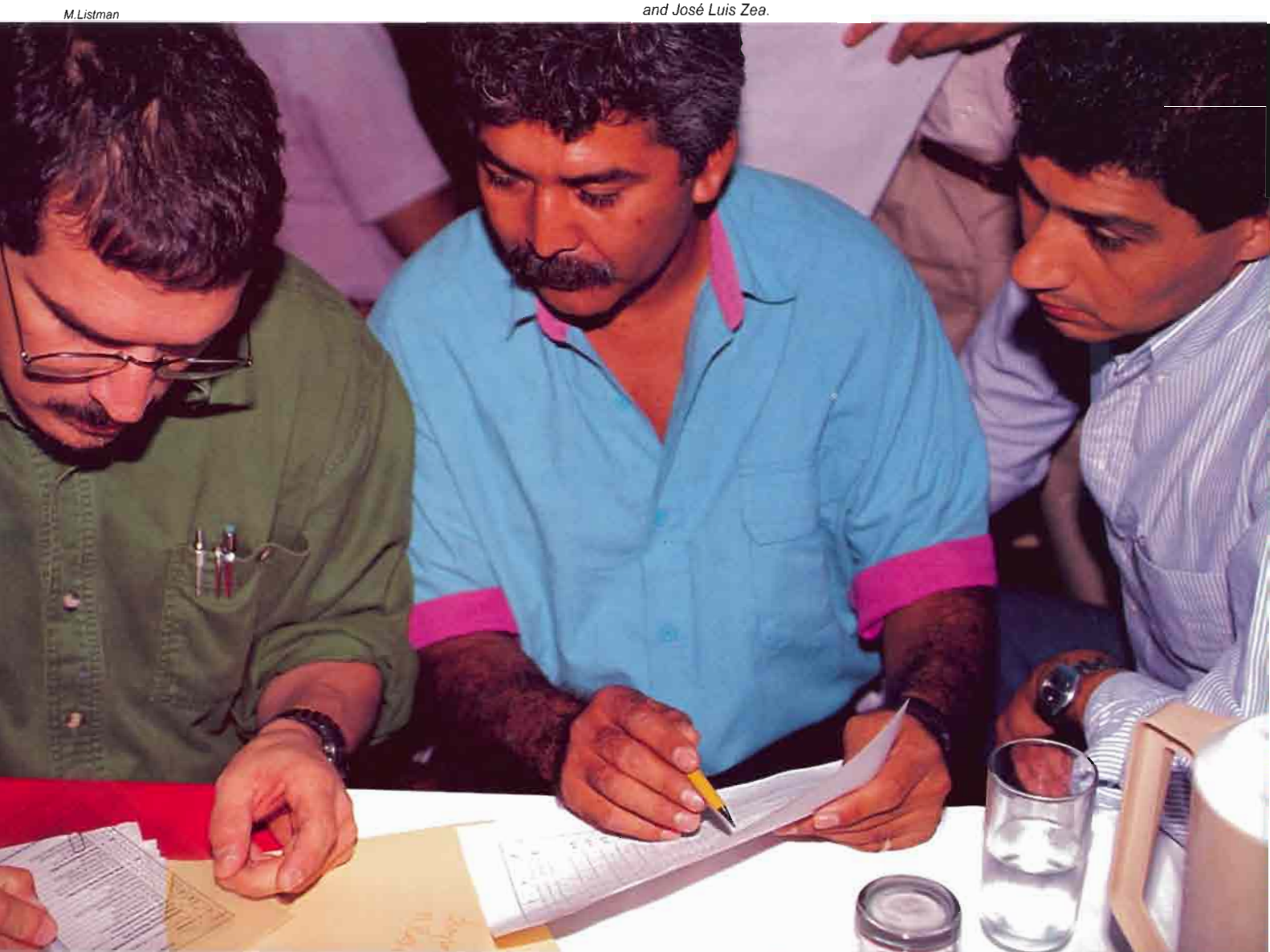
yearly collection of scientific-journal-style articles entitled *Synthesis of Experimental Results*. "Statistically significant evidence, based on clear objectives and working hypotheses, is presented on a regional level," says Ernst Schaltegger, international consultant and agronomist who headed a 1991 review of the PRM, regarding the 1992 edition of *Synthesis.* As much as one-fifth of the *Synthesis* articles are published in leading international journals each year.

Results of regionwide relevance

In the late 1980s William Raun introduced regionwide, uniform experiments on crop management techniques, similar to the approach in breeding of circulating uniform sets of maize seed for testing at many sites. The trials furnish a basic 'recipe' of several

PRM planning follows the "goal-oriented project planning" method introduced by the German development agency Gesellschaft für Technische Zusammenarbeit (GTZ) in 1981 for its technical assistance projects. Objectives are laid out in a grid that includes associated activities and progress indicators. Here CIMMYT technical advisor Jorge Bolaños (left) is shown in planning with Guatemalan researchers Luis Larios (center) and José Luis Zea.

M.Listman



experimental treatments—such as varied fertilizer levels or planting densities—to which researchers in particular locations can add their own. The result is standardized data that local researchers can use to frame guidelines for farmers. The report by the 1991 review panel notes this strategy throughout PRM work: "...conservation tillage and the legume studies are typical strategic research projects where the PRM has a comparative advantage." Resounding words for a simple idea: the PRM identifies, refines, and spreads technology useful to farmers *throughout* the region, thereby helping national programs to avoid duplicating each other's work.

Adding innovation

The PRM stands out among networks of the region for its technical quality. This crucial ingredient ensures useful products, as well as a clear *esprit de corps* among network participants. CIMMYT contributes significantly to the quality of network research. As a primary source of technical innovation over the years, the center has provided improved seed, new research methodologies, training opportunities, supplies, consulting, and a range of technical support.

Valuable innovations, especially in organization and operations, have also come from SDC. Goal-oriented project planning is a good example, according to Jürg Benz, Scientific Advisor, Agricultural Service, SDC. "It has proven to be an effective mechanism for consensus building and national program participation in priority setting, assigning responsibilities, and allocating resources."

Integrating research across disciplines

"One of the greatest achievements of the network is integrating breeding, agronomy, and socioeconomic research *within* national programs," says Adys Pereira de Herrera, agricultural economist in Panama since 1983. PRM social scientists work closely with agronomists and breeders to study the factors

G. Hettel

For the ancient Maya, the life blood of the cosmos flowed through a leafy maize plant. Mayan descendents today form the base of Central America's rural populace. They have superimposed the Christian cross on the Mayan world tree, but maize still permeates their existence, and the crop cycle re-enacts birth, death, and the renewal of life.

Origins and History of the PRM

The story of the PRM begins with the Office of Special Studies (*Oficina de Estudios Especiales*, or OEE), a collaborative project begun in 1943 by the Rockefeller Foundation and the Mexican Ministry of Agriculture. The OEE helped Mexico attain near self-sufficiency in maize and wheat production during the mid-1950s. Its success also gave rise to modern agricultural research in Latin America.

First PCCMM coordinator, Alfredo Carballo Quiroz, ca. 1954.

CIMMYT Files

The birth of agricultural research in the region

Based on OEE accomplishments, the Rockefeller Foundation commissioned OEE specialists Edwin J. Wellhausen and L. Sterling Wortman to develop an assistance plan for other nations in Central America. The result was the Central American Cooperative Program for Maize Improvement (*Programa Cooperativo Centroamericano para el Mejoramiento de Maíz*, or PCCMM—now known as the PCCMCA), established in 1954. "This was an informal organization that would link national research institutions of Central America with larger programs established by the Rockefeller Foundation in Mexico and Colombia," says Alfredo Carballo Quiroz, a Costa Rican researcher who served as the first coordinator and gave form to the PCCMM.

Soon, through the PCCMM, Central American maize researchers received in-service and advanced degree training, equipment, supplies, and assistance in maize breeding and production research. The organization also began distributing uniform trials—identical sets of seed of varieties, hybrids, and seed bank collections—for testing. By the early 1960s, the PCCMM was developing improved varieties of maize, with assistance from the newly founded International Maize and Wheat Improvement Center (CIMMYT).

CIMMYT establishes a regional maize program

Soon after its creation in 1963, CIMMYT took a leading role in maize research for Central America and the Caribbean. Staff began sending out experimental maize varieties, visiting research fields, and helping to analyze results. Thus assisted, during 1963-74 national programs developed a steady stream of improved varieties and hybrids for farmers. Over the same period, CIMMYT helped national programs improve their organization and operations, and some 50 researchers from the region attended training courses at the center.

Development agency support: the PRM emerges

In 1974, the joint work by CIMMYT and national programs in Central America and the Caribbean was formalized under a two-year grant from the Inter-American Development Bank (IDB). This was part of the Bank's first-ever investment in international agricultural research, intended to spread advances in food production.

1943
The Rockefeller Foundation-Mexican Office of Special Studies is established.

1954
The Central American Cooperative Program for Maize Improvement (PCCMM) begins operations.

1954 - 61
Large-scale collection and evaluation of maize genetic resources in the Americas.

1960
National maize research programs in Central America begin developing improved varieties of maize; the Rockefeller Foundation initiates a training and advanced studies program for maize researchers in the region.

1962
The PCCMM begins distributing uniform maize trials regionwide.

1963
The International Maize and Wheat Improvement Center (CIMMYT) is established and begins to assist the national programs of Latin America, offering improved, experimental maize varieties and in-service training.

1974
The "birth" of the PRM: the Inter-American Development Bank (IDB) provides a two-year grant to support CIMMYT collaboration with maize researchers in Central America and the Caribbean.

The project marks the inception of the PRM. During the early years, CIMMYT determined priorities and activities. With time, the PRM moved toward self-determination.

The special role of Swiss Development Cooperation

Swiss Development Cooperation (SDC) began financing the PRM in 1977, when the BID grant ended. In addition to providing money, in the mid-1980s SDC representatives began offering guidance on network organization and planning, suggesting among other things that priority setting be shared among participants. The Swiss agency also promoted a shift toward crop and natural resource management research. During this decade SDC began to support PRM-type networks for beans (PROFRIJOL) and potatoes (PRECODEPA).

Empowering national programs

To make PRM planning and operations more representative, during 1986-89 the network established its own governing bodies, assumed responsibility for breeding, implemented participatory planning, and set network goals and activities in writing.

In 1991, a panel of outside experts who reviewed the PRM complimented its achievements and operation, and recommended that the network continue with SDC support through 1996. The PRM developed a five-year plan based on panel suggestions and established the position of administrative coordinator to free CIMMYT advisors for more technical support.

1977	1986 - 89	1991	1992
Swiss Development Cooperation (SDC) signs on as the major financer of the PRM. As part of the network, CIMMYT leads efforts to improve seed production and foster on-farm research in the region.	The PRM establishes directive bodies and participative planning. Crop management and socio-economic research are integrated and a socio-economics network established.	The PRM is reviewed by a panel of experts. A strategic plan is developed for 1992-96.	An administrative coordinator for the PRM is appointed.

G Hettel

Before the 1950s there was only limited access to improved technology in Central America and the Caribbean. Then efforts by the Rockefeller Foundation and PCCMM helped forge competent national agricultural research programs, opening new options for farmers.

that determine the adoption and impact of PRM maize varieties and natural resource management techniques. They also try to predict the possible economic benefits to farmers of new such varieties and techniques. One important additional use for the resulting information is to enlighten policy decisions that can affect farmer acceptance of environmentally friendly practices. Adoption of green manures or reduced tillage, for example, is strongly influenced by national research and extension priorities, the availability of credit, and price controls or subsidies, to name a few factors. PRM socioeconomists will soon bring together national and regional policy makers, farmers and ranchers, NGOs, and other

interested groups from areas where improved natural resource management holds promise. The idea will be to identify problems and solutions and develop a specific 'action plan' for each of these stakeholders.

When research is training

The PRM often adapts research to training needs and, conversely, uses training to generate useful scientific results. For example, as part of a methodology course, PRM socioeconomists are gathering regionwide data on why farmers adopt or reject conservation tillage. The results will also guide further research and extension.

The network as a lifenet for national programs

Involvement in PRM activities has often provided stability for local researchers in times of ebbing national program budgets. In addition to money for research and training, the network offers a way for national program staff to reach out to one another personally and professionally.

Social scientists such as El Salvador's Cristina Choto de Cerna (left) help PRM colleagues understand farmers' reactions to technology, thus making it easier for agronomists and breeders to shape relevant options.

M.Listman

PRM Directions: Helping Maize Farmers in the Future

The challenge for maize research in Central America and the Caribbean will be to reconcile two vital yet seemingly incompatible goals: increasing productivity and protecting the environment. And, important as these goals may be, resources to accomplish them will be scarce. To continue playing a relevant role under these changing and difficult circumstances, the PRM must continue to evolve, modifying its research focus, its organization, and its financing.

Funding is crucial

There is broad agreement that the network's ability to extend its financial base is the key to its future. SDC has always encouraged the network to move toward full administrative and financial autonomy—not an easy goal in times of limited resources. The issue gains special relevance in light of PRM research on natural resource management: such work must be long-term to be useful. Possible sources of funding, aside from SDC, include other development agencies and the governments of Central American and Caribbean nations. Network members and observers have also suggested that the PRM market its germplasm, training capacity, or databases. Though the idea draws interest, there is concern about how selling products would affect the free exchange of these commodities within the network.

The other side of autonomy involves having PRM decision-making bodies take full charge of operations. CIMMYT technical advisors, for example, gladly devote as much as half their time to PRM administration, but that leaves less for actual field work. This will change as the network coordinator extends his reach and the CRP becomes more active.

Striking a higher profile

Network plans to boost funding could depend on its ability to "sound its own horn," at least more than it done has in the past. "The network needs to publicize itself more in Central America," says Roberto Munguía, socioeconomist from Nicaragua who joined the PRM in August, 1993. "Before I became a member, I knew the PRM existed, but had no idea of what it was about." He suggests for starters that the PRM distribute *Synthesis* to more libraries, universities, and agricultural cooperatives throughout the region. Likewise, the PRM will begin reaching out to development assistance agencies, policy makers, and broader audiences with general information about its work.

Maize farming and culture are passed from generation to generation in Central America and the Caribbean. Economic restructuring notwithstanding, it is hard to imagine that either will disappear from the region any time soon.

G.Hettel

Networking with other institutions

Guatemalan agronomist José Luis Zea expresses a common sentiment when he says that the PRM needs to strengthen ties with other networks and non-government organizations (NGOs). "Maize is generally only part of a system here that includes multiple crops and animals—it cannot be handled in isolation," says Zea. In a recent example of such collaboration, in 1992 the PRM worked with several regional networks[3] in a study on combined maize-bean cropping. Plans are now afoot for the PRM, CIMMYT, CIAT, and PROFRIJOL to establish closer ties in research on natural resource management under hillside maize-bean farming. The mix of expertise in such an arrangement could bring relevant technology to farmers more efficiently.

Finally, experts say the PRM should "extend its nets" to organizations that represent farmers directly. "The PRM is not an extension organization—it specializes in research," says Lucas Luisoni. "It needs to work with a spectrum of clients—national programs, NGOs, private companies, and even cooperatives—to get its products out onto farmers' fields."

Applying the PRM model elsewhere

Given the PRM's achievements in Central America and the Caribbean, could similar networks serve the needs of other maize producing regions? There are certainly precedents for PRM-type networking in other maize growing areas of the world. For many years, for example, staff of CIMMYT's regional offices in Asia and Africa have worked with local maize specialists in breeding and crop management research, organizing regionwide experiments and training activities. Based on that groundwork, CIMMYT is contacting development assistance agencies with plans to launch full-fledged maize research networks for those regions.

There will be many challenges. PRM participants share a common culture and language, circumstances hard to replicate in Africa or Asia. Production environments in Central America and the Caribbean also share more similarities than those of, say, Southeast Asia and the Pacific. Finally, the PRM was founded on an uncommonly rich tradition of research cooperation, beginning with the PCCMM.

Unquestionably, though, the PRM experience can help point the way. Key qualities, for example, would include democracy in decision making, stability in national program staffing, a strong technical presence, reliable funding, and—last but not least—a corps of dedicated researchers.

[3] The Regional Bean Program for Mexico, Central America, and the Caribbean (PROFRIJOL), the Research Network on Tropical Grasses (RIEPT), and CIAT.

In the largely rural nations of Central America and the Caribbean, improved, sustainable agriculture can foster economic growth and enhance the livelihood of farmers and consumers.

Swiss Development Cooperation and Humanitarian Aid (SDC) coordinates development cooperation and humanitarian aid within the Swiss government. SDC supports efforts of developing countries to improve the living conditions of their people. Development cooperation programs focus on selected countries and address priority areas such as the environment, health, small industry, human resource development, and agriculture. Within agriculture, priorities are sustainable soil management, integrated pest management, commodity programs (cereals, potatoes, beans), livestock, biodiversity, and biotechnology. Special emphasis is given to building national capacity and regional cooperation. Partners include multilateral or international organizations, governments, and private agencies. SDC also contributes to the development perspective of Swiss foreign policy. (Contact information: SDC, Eigerstrasse 73, CH-3003 Berne, Switzerland, Fax: [41-31] 371-57-21.)

Contact information:
Róger Urbina, *Programa Regional de Maíz*, PRM, Bello Horizonte D-II-22, Apdo. Postal 6135, Managua, Nicaragua, Tel: (505) (2) 490583, Fax: (505) (2) 49058;
Jorge Bolaños, CIMMYT, 12 calle 1-25 zona 10, Edif. Geminis 10, Torre Norte, Of. 1606, Guatemala, 01010, Tel: (502) (2) 353418, Fax: (502) (2) 353407;
Gustavo Sain, CIMMYT, Apartado 55, 2200 Coronado, San José, Costa Rica, Tel: (506) 2292457, Fax: (506) 229474.

Contact information:
International Maize and Wheat Improvement Center, Lisboa 27, Apdo. Postal 6-641, 06600 Mexico D.F., Mexico, Tel: (5) 726-9091, Fax: (595) 41069.

Correct citation: Listman, G.M. 1994. Seed, soil, and science: Networking for sustainable maize farming in Central America and the Caribbean. Mexico, D.F.: CIMMYT.

Design and layout: Miguel Mellado E. and Eliot Sánchez P.

ISBN: 968-6923-20-6
AGROVOC descriptors: Zea mays; Cropping systems; Sustainability; Diffusion of research; Innovation adoption; Research institutions; Research projects; Central America; Caribbean
AGRIS category codes: F08 A50
Dewey decimal classification: 631.58

Printed in Mexico.