prevented from firing the MX promptly, "unless the Soviets want us to." The reason, he says, is that they can lob submarine- and land-based missiles high over the MX missile silos and detonate them in a rapid continuous sequence, thereby destroying any missiles launched in retaliation. Optimally, the Soviets would begin their attack with such a "pin-down" and then follow with a carefully orchestrated assault on, say, every third silo, repeating the attack in waves until all the silos were destroyed. Kent Johnson, a physicist at Lawrence Livermore National Laboratory who has studied the "pin-down" and other attack strategies, concedes that there is no means of stopping a pin-down short of finding and destroying the Soviet submarines and mounting a comparable attack over the Soviet Union, something that the United States may not be able to accomplish right away. The Air Force's only answer is to arrange the MX missile silos in a long column, so that a pin-down requires the highest possible number of Soviet weapons. It is the Pentagon's fervent hope that this will lessen the incentive for the Soviets to try it.

Garwin, along with some other scientists and arms control advocates, believes that the answer to this problem is not to deploy the MX in a different basing mode, but to rely instead on the invulnerable force of U.S. submarines for deterrence. "Technology has overtaken the land-based missile," Garwin says. This view is supported by the Union of Concerned Scientists, Common Cause, Friends of the Earth, and the Council for a Livable World, and representatives of these organizations will attempt to drive the argument home during the coming congressional debate.

Lobbying in favor of the closely spaced basing plan is expected from the White House, the Pentagon, the State Department, and the weapons manufacturers who stand to gain financially from its construction. According to a study by Common Cause in October, political action committees from these corporations donated $780,000 to incumbent members of Congress as of 1 August. The overall effort will probably be coordinated by Thomas Reed, a former Air Force secretary now on the National Security Council, and by General James McCarthy, who was recently appointed as the Air Force legislative liaison. McCarthy served as special assistant for MX matters in the Air Force research and development office for the past 2 years.

A forum for the debate will be provided by consideration of the defense appropriations bill for fiscal 1983, or alternatively, a resolution for continued defense spending at last year's levels, which would permit continued MX development. Senator Ernest Hollings (D–S.C.), a member of the defense appropriations subcommittee, has already announced that he will lead opposition to the basing mode on the Senate floor. In the House, opposition will be led by Joseph Addabbo (D–N.Y.), the defense subcommittee chairman. Additional efforts will be made by Senator Gary Hart (D–Colo.), and by 37 members of the House who signed a statement opposing closely spaced basing last month. "We are told that the initial array of 100 missiles will be survivable for only a brief period of time," the statement said. "Construction of this system will damage our economy and not provide additional security for our country."

Despite the breadth of this opposition, many vote-watchers give the Pentagon—and the basing mode—a good chance of success. Congress rarely cancels any major weapons program, particularly one on which billions of dollars have been expended. The President is expected to claim that a cancellation would send a signal to the Soviet Union that U.S. resolve is weak, and that the Soviets' incentive to negotiate an arms treaty with the United States will thereby be lessened. He may also argue that deployment of the MX in closely spaced basing is essential even if its invulnerability cannot be assured. Last June, Reed stated that "the President views the production of a new, larger, more accurate, and more easily maintained ICBM, with the earliest possible introduction into the operational force, as absolutely essential . . . . we must have a steady, ongoing ICBM program without turbulence." Turbulence, in Reed's view, is created by excessive concern about the ability of the MX to survive a Soviet assault.

—R. JEFFREY SMITH

Funds Squeezed for International Agriculture

Support for international agricultural research suffers from budgetary constraints, inflation, and a strong dollar

At a time when many experts are warning that the world faces a potential food crisis in the years ahead, support for agricultural research in the developing countries is being squeezed. That, at least, was the complaint that dominated the annual Centers Week of the Consultative Group on International Agricultural Research (CGIAR), held at the World Bank earlier this month. The principal item on the agenda was funding for 1983 and, as anticipated, a combination of unfavorable economic factors has produced a shortfall that will erode research and training in virtually all the 13 centers that constitute the group. "We are now at a point where we might have to contemplate closing a center," says Lloyd Evans, a member of the CGIAR's Technical Advisory Committee.

Established in 1972 and run with a degree of informality unusual in the arena of international organizations, the CGIAR is meant as a complement to national research programs in developing countries. Its most outstanding achievements so far include the development of high yielding varieties of wheat and rice (see page 877 of this issue) and new technology that has allowed extensive adoption of the potato as an important food crop. Warren Baum, the group's chairman, notes that increased production of wheat and rice through the use of high yielding varieties is sufficient to feed 300 million people annually.

Although food crops are a major focus of CGIAR efforts, problems of livestock production are addressed too. The International Livestock Center for Africa, based in Addis Ababa, Ethiopia, for example, concentrates directly on improvement of production, whereas the International Laboratory for Research in Animal Diseases, in Nairobi, Kenya, is doing high quality basic research that will take some years to come to fruition. Other long-term programs include the establishment of the International Board for Plant Genetic Resources, based in Rome, Italy, an effort that also recog-

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nizes the urgency of salvaging the rapidly shrinking range of genetic variability available to plant breeders.

Agricultural production in developing countries has increased steadily in the past decade, with some notable exceptions in areas of Africa. Although some of this increase has derived from improved practice and the use of new varieties of established crops, much is the result of expansion of land under the plow. "Use of new land for agriculture is coming to its limit," says Baum, "and future increase in crop production must therefore come from improved yields. This is precisely the target of CGIAR's research and training efforts."

Funding for the CGIAR's 13 centers for 1982 was $148 million, which is about 7 percent of that spent in national programs in developing countries and 0.03 percent of the value of commodities on which the centers concentrate. From its inception in 1972 through 1979 the consultative group experienced rapid growth, with annual funding climbing by 30 percent in some years. Expansion inevitably tailed off as centers became established and settled down to routine operational costs. The slowdown in funding was, however, exacerbated by a combination of three economic problems, and for 1983 growth in real terms has fallen into the negative.

Funds for the CGIAR centers come from 34 countries, foundations, and organizations, most of whom pledge support directly for centers of their choice. The U.S. agrees to donate one dollar for every three from other sources. And the World Bank acts as donor of last resort, with grants up to 10 percent of other funds. Most donors are experiencing tighter budgets for overseas aid, and this represents the first problem for CGIAR. In the past the consultative group has managed to attract new donors year by year, thus producing a flow of new funds that buffered losses elsewhere. Now, however, the list of donors includes all the world's major countries and potential donor organizations, with the exception of most of the oil-rich Arab nations and the Eastern Bloc. "We are trying to tap these potential sources," says Baum, "but if we are to have future growth much of it will have to come from existing donors."

Inflation presents a second problem for CGIAR funding, especially because most centers are based in countries where the level is much higher than in most donor countries. Unless donors can contribute an annual increase of more than 15 percent, the consultative group can do no more than stand still. Although final figures will take some time to be settled, the pledges made by donors at this year's Centers Week amount to around $162 million, or an increase of 9 percent over 1982. Funding, therefore, falls short of inflation by 6 percent.

The last of the three major economic problems is the rise in the strength of the American dollar, a problem that has been particularly acute in the last year. The CGIAR system works in dollars, but as half the donors pledge funds in their own currencies, their value declines as that of the dollar rises. In 1982 the robust dollar lost the system about $6 million.

Virtually all the centers will be cutting back on research programs and on training because of the shortfall in funding. Savings through trimming support for training can be made quickly, and it is therefore a ready target for budget cutters. But as a major goal of the centers is to disburse experience to national organizations, reduction in training cuts at the heart of the system. Directors general of centers have little choice, however, because an essential component of a successful research program must be some stability and continuity.

Another casualty of the current economic climate is an extremely popular proposal for a new center on water management and irrigation. "Advances in this area would have a major impact on crop yields in many countries," says Baum, "but when it became clear that support for the center would have to come out of existing funds we felt unable to recommend it." The idea might not perish, however, because a small group of donors hopes to pull together funds outside the CGIAR system.

According to a 1981 report to the World Bank, "There are probably few alternative investment opportunities to which national and international funds could be dedicated that so consistently yield returns as high as those from investments in carefully designed and managed agricultural research programs." Economic returns typically exceed 20 percent and are frequently greater than 40 percent, states the report. For the CGIAR the figures look even better. The annual value of the extra wheat and rice grown from varieties developed by two of CGIAR's centers is $5 billion, which is almost six times as much as the total funding for all the group's centers throughout its 11-year history.

The report by the CGIAR secretariat to donors at Centers Week recognizes the inclement economic climate and warns of the possible elimination of a center. "Yet the sums of money needed to sustain the system are trivial in comparison with what is being spent in bilateral programs of aid to stimulate agriculture and rural development," it states. "It would take only small changes in . . . aid allocations to ensure that the system is provided with the level of resources needed, and thereby sustain one of the most effective development instruments created by the international community."

One reason why it might be difficult to get the shift required is that the public and political perception is not tuned to the magnitude of the potential problem. "Who can believe there is a world food problem when it is so difficult to sell wheat on the international market," a representative of one donor told *Science*. "Even though this has nothing to do with the real needs of many countries, and particularly the needs of subsistence farmers, it makes a big impact on political perceptions. Funding for the CGIAR system probably won't improve until there have been a couple of years of catastrophic food shortages. That's a terrible thing to say, isn't it?"

—ROGER LEWIN

Rice paddies

Extra production of wheat and rice grown through the use of high yielding varieties developed at two CGIAR centers is sufficient to feed 300 million people annually.