The Technological Challenge in Africa

Why has the green revolution not worked in Africa? Experts meeting in Washington say the problems are more complex than those in Asia

Fifteen years ago, southern Asia was on the verge of famine and Africa was a net food exporter. Now Asia is largely self-sufficient in food production, while parts of Africa are in the grip of a terrible famine. What happened?

The simple answer is that the green revolution has dramatically raised crop yields in Asia but has barely touched sub-Saharan Africa. According to John Mellor, director of the Washington, D.C.–based International Food Policy Research Institute, the rate of growth of food production in Asia increased by 20 percent from the 1960's to the 1970's, while in Africa, crop yields have remained static and overall food production has not kept pace with population growth. During the 1970's, according to Mellor, Africa's population grew twice as fast as its food production.

Earthscan/IIED

Fragile soils

The trees alongside this field in Niger provide a windbreak to reduce soil losses.

The stimulus for the green revolution in Asia came largely from two international research centers, the International Rice Research Institute in the Philippines and the Maize and Wheat Improvement Center in Mexico. Those two institutions have since been joined by 11 others scattered around the globe in a network funded by governments, foundations, and international organizations. On 22 and 23 January, the directors of these 13 agricultural research centers were summoned to Washington for a private meeting at the World Bank to discuss what is needed to bring about technical change in African agriculture.

According to conversations with several of the participants after the meeting, the result was somewhat sobering. "The judgment of most of us is that it is going to be a long haul," said Shahid Hussein, the chairman of the consultative body that oversees the work of the centers.

The problems in bringing about agricultural change in Africa are far more complex than those faced in Asia in the late 1960's. For one thing, the green revolution in south Asia involved primarily two commodities, wheat and rice, which were almost entirely grown on irrigated land. In Africa, a large variety of crops is grown in a range of conditions, and the potential for irrigation is relatively limited. African soils also tend to be far more fragile than those in Asia. Thus new technologies have to be closely tailored to local conditions and soil management is more difficult.

Another problem is that there is only a limited amount of new technology on the shelf waiting to be applied in Africa. Notes Edmond Hartmans, director of the Nigeria-based International Institute for Tropical Agriculture, "research in food production in Africa started around 1970. We shouldn't be surprised that we are only now beginning to see results." In contrast, the key technological changes in the crops in Asia stemmed from developments extending back several decades.

Another key difference is that in many African countries, shortages of labor at key phases of the agricultural cycle can cause serious bottlenecks in production. Thus, argues Mellor in a paper prepared for a meeting of the center directors last November, improving labor productivity is likely to be more critical in Africa than it was in Asia, where labor was generally in surplus even at the periods of most intense work, such as planting and harvesting.

Aside from these largely technological factors, the Washington meeting noted two serious institutional obstacles to technical change in African agriculture. The first is the relatively low priority accorded agriculture by many African countries, and pricing policies that sometimes provide little incentive for increasing production.

The second is the generally underdeveloped state of national agricultural research and extension programs and the acute shortage of trained people. "Without adequate national programs, we are going to be hamstrung for development," says Trevor Williams, director of the International Board for Plant Genetic Resources, who chaired the meeting. This lack makes it difficult to transfer technologies developed by the centers to local farmers.

For example, according to Leslie Swindale, director of the International Crops Research Institute for the Semi-Arid Tropics, an improved variety of millet was recently transferred from a research center to a national program in Africa, but the program was unable to grow any seed for distribution to the farmers. "The infrastructure simply wasn't available," he said.

The poor state of national programs is not surprising, given the cost of maintaining research and training facilities. Moreover, because of the cost in terms of scarce foreign exchange of maintaining libraries adequately stocked with international journals, many national programs are somewhat isolated. Consequently, notes Peter Brumby, director of the Ethiopia-based International Livestock Center for Africa, national programs "are faced with the problem of reinventing the wheel on a continuing basis."

In spite of these difficulties, the international research centers have had some successes in Africa. For example, Hartmans, the ebullient director of the tropical agriculture institute, points to increases in yields of cassava, sweet potatoes, soybeans, tropical maize, and cow peas as evidence of "enormous potential" for increasing production in the humid regions.

The semiarid areas are a different story, however. Here, new technologies are generally not so well developed, and the networks for getting them to farmers are

generally poor. "A hell of a lot more work is needed to fill the shelf" with new technologies for the semiarid areas, says Hussein.

One bright spot in this region, however, is the recent introduction of a new variety of sorghum into the Sudan. Derived from a cross between a strain from Nigeria and one from Texas A&M University, the new variety produces three times the yields of standard varieties on irrigated soils and almost five times those grown on dry lands. According to Swindale, whose institute developed the strain with support from the United Nations Development Program, the government of Sudan has approved the variety for use, and a crash program is under way to grow seeds in Zimbabwe for planting in the Sudan next year.

All the research directors who spoke with *Science* emphasized that producing new technologies is only part of the solution to Africa's food production problem. Reforming policies to devote more resources to agriculture, making hard political choices on the allocation of scarce inputs such as fertilizer and seeds, and dealing with the problems of inequity that generally arise in any process of technological change will all be required in the years ahead.

All of this will be doubly difficult without a major increase in foreign assistance. The trend, however, is in the wrong direction. According to World Bank estimates, capital flowing into sub-Saharan Africa will drop from about $11 billion a year to $5 billion between 1985 and 1987.

To help turn this trend around, the Bank has proposed establishing a special international lending facility for the region, to which governments have been asked to contribute on a voluntary basis. The goal is to raise $1 billion for the facility to support national programs in Africa, including agricultural research. A meeting in Paris of potential donors will take place on 31 January to 1 February.—**COLIN NORMAN**

SPARX Fly Over U.S.–German Space Venture

A dispute over the application of U.S. laws to foreign companies could affect negotiations on Europe's participation in the space station

Paris. The apparent collapse of a joint U.S.–West German enterprise aimed at commercializing data from remote sensing equipment has left a legacy likely to affect future negotiations over European participation in the planned space station. The enterprise, known as SPARX, became embroiled in a dispute over the application of U.S. domestic law to foreign companies.

SPARX was to have been set up to finance regular flights on the space shuttle of the Modular Opto-electronic Multispectral Scanner, an instrument developed by the company Messerschmitt-Bolkow-Blohm (MBB) under contract from the German Aerospace Research Establishment. It has already been flown experimentally on two shuttle missions in June 1983 and February 1984.

Officials from the National Aeronautics and Space Administration (NASA) say that proposals received from SPARX were unacceptable, since the data were to have been made available solely on a proprietary basis to SPARX's commercial customers. This conflicted directly with NASA's "open skies" policy mandating nondiscriminatory access to all data obtained from U.S.–launched civilian missions.

Discussions are still continuing between NASA and MBB over whether or not a separate venture using the German equipment but respecting the open skies policy will be required to observe the licensing conditions applied to U.S. companies under the terms of last year's Land Remote Sensing Commercialization Act.

Even though SPARX itself seems to be dead, the apparent conflict between its planned commercial activities and current U.S. law is already being used by some members of Europe's space science community—in particular those with reservations about tying Europe's fortunes too closely to those of NASA's proposed space station—as evidence of the concrete nature of their concerns.

As originally conceived by its chairman, space consultant and entrepreneur Klaus Heiss, SPARX Corporation was to have been 60 percent U.S.–owned and 40 percent European-owned, with the major partners being Comsat in the United States and MBB in Europe.

It was to have flown what Heiss has described as the first commercial remote sensing demonstration mission on a shuttle flight originally scheduled for last August. Five more missions operated jointly with NASA were to have been flown in the following 2 to 3 years. SPARX would have eventually flown four missions a year on a purely commercial basis over the next decade, gathering data for customers who were never specified, but are thought to have included major oil and mineral companies interested in geological prospecting from space.

From an early stage, however, it became apparent that the enterprise, as conceived by Heiss, conflicted with NASA's interpretation of its legal responsibilities under the U.S. commitment to the open skies principle. This states that no country can forbid another country from taking photographs or obtaining other data about it from space, and in return, all such data will be made available on a nondiscriminatory basis to anyone interested.

The principle was established in a series of negotiations that took place under the auspices of the United Nations in the early 1970's, and was agreed to by the United States primarily to calm fears expressed by many Third World countries that remote sensing satellites could rapidly become a tool of commercial espionage. As such, in the words of Ray Williamson, project director for a report published last year by the Office of Technology Assessment, any alteration of the policy of nondiscriminatory data sale would be "harmful to U.S. foreign policy interests."

Heiss, however, has sharply contested the way in which the open skies policy has been interpreted by NASA. In evidence presented last year to a hearing on the commercialization of Landsat, held by the science, technology, and space subcommittee of the Senate Committee on Commerce, Science and Transportation, he challenged the U.S. position as being excessively protectionist. "The United States should not impose its interpretation of 'nondiscriminatory' on other nations and other users," he said.

According to reports, Heiss has said that he was quite prepared to go along