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A Public Policy for Plant Genetic Resources

BY TIMOTHY C. WEISKEL

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Tropical rain forests have long been recognized as a rich repository of plant species, but it is only relatively recently that scientists have understood their crucial role in maintenance of the world's biotic diversity. Ecologists now estimate that the tropical rain forests harbor fully a fourth of the world's species of plants—more than any other single ecosystem—and it is for this reason that concern is mounting over the recent devastation of tropical forests.

Since 1950 half of the world's forests have been destroyed, and most of this destruction has taken place in tropical areas. What is perhaps more ominous is the fact that this trend appears on the increase. The search for timber, the need for firewood, and the clearing for expanded cultivation have been contributing factors. In addition, according to a State Department study, "A wide range of well-intentioned development programs, including beef export promotion, veterinary medicine, population resettlement and the extensive upgrading of rural roads can place great pressure on the forest."

The scale of devastation is staggering by any criteria. If the present rate of destruction continues, it is estimated that more than two-thirds of the world's remaining rain forests will be gone by the turn of the century. This would entail not only soil erosion, timber and firewood shortages, and human displacement but, according to the estimate of biologists, the extinction of half a million species—one-fifth of the world's total—by the end of the century. The process by which this takes place is well known. As Venezuelan scientist Gerardo Budowski explains it: "When you cut down a wet, lowland tropical forest, what eventually grows back is something completely different. Instead of the rain forest's 300 tree species, a secondary forest might have only 10."

Added to the prospects of "genetic collapse" involved in the destruction of tropical rain forests are the serious problems concerning genetic diversity that are emerging in connection with improved cultivation practices on a global scale. Briefly put, the issue is this. Plant breeding techniques developed by scientists in Europe and America have been systematically applied to the food production systems in these regions, entirely transforming the agrotechnology in these areas over the last hundred and fifty years. Marked increases in productivity have been achieved with the coordinate development of selective breeding and improvements in soil fertility management. Since World War II some of this scientific understanding and applied technology has been focused upon improving crop yields in tropical regions to meet growing food requirements of expanding populations in the Third World. Once again, the productivity of individual crops under conditions of improved fertility and regulated water supply has increased dramatically, but the overall ecological implication of these improved agrotechnologies has been disconcerting for those concerned with the genetic varieties displaced in the process. As one study phrases it:

> In the belt of low latitudes where more than one half of mankind lives under conditions of serious under-nutrition and where the gene centres are to be found, a complex situation of grave consequence exists.... The highly successful wheats produced by the Rockefeller team in Mexico are transforming the agricultural picture over much of Asia and Latin America, as are the new rice varieties produced at the International Rice Research Institute in the Philippines. Yet their success represents a very real and immediate threat that the treasuries of variation in the centres of genetic diversity will disappear without a trace [O.H. Frankel and E. Bennett in *Genetic Resources in Plants: Their Exploration and Conservation*, 1979].

In short, it appears that for immediate local gains in productivity genetic variety may be lost. Some varieties may become extinct in the process, and scientists warn that crucial genetic material for possible future improvement in crop production benefitting mankind as a whole is being sacrificed. The global politico-economic implications become apparent at once. In instances in which the immediate survival of some populations seems to involve the extinction of material that may in the long run assure the survival of others, questions of scientific research and agrotechnology becomes matters of urgent public concern. There are major problems of national and global policy to be resolved in this sensitive realm.

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PRIVATE INVESTMENT AND PUBLIC POLICY

Funds for research in all aspects of the plant genetic resource work are woefully inadequate and major new financial commitments are needed to address the scientific and technical problems involved in "genetic collapse" and resource management. Perhaps more significant than the actual sum expended will be the source and control of these funds. In this realm further problems of public policy loom on the horizon, and once again the problems are of a global scale. Up to now research on plant breeding technology has come largely from government and from independent private sources like the Ford and Rockefeller foundations. In the future, however, it is doubtful that these sources will be sufficient. Major sources of private capital—principally the multinational food and grain companies—seem prepared to provide the necessary research funds *if* they are assured of privileged or exclusive control over the results obtained. This is a political issue of major magnitude.

If, over the course of the coming decades, the major source of funding for vital research on plant improvement passes from public to private hands, the results could be disturbing for populations worldwide. Already in the United States the genetic base of production is severely reduced. A mere six varieties account for 71 per cent of the acreage planted in corn; two varieties account for 42 per cent of sugar beets; and only three varieties account for all the acreage of millet. Since the agroecology of these crops is highly specialized, farmers are dependent upon continuous crop improvements to keep ahead of the coevolutionary development of pests and insects. To the extent that improved varieties of these and other plants come under the increasing control of private companies, the individual farmer may find himself in a very precarious position, forced to pay whatever price necessary for the improved seed varieties that he will need to keep himself in business. On a worldwide level the prospect could be equally troublesome. Already it is estimated that a single company—United Brands—holds two-thirds of the world's banana seeds.

Legislation that would extend "plant breeders rights," or patents, to private companies for the development of seed is now before the United States Congress, and such legislation has already been passed in several European countries. Major multinational corporations, including ITT and Union Carbide, are presently lobbying Congress to pass this patent protection bill. As yet, few citizens seem informed about the implications of such restrictive legislation, so there has been little public discussion of the problem. The issue is whether the seeds of the earth are a private or a public resource.

MORALITY AND PUBLIC POLICY

Scientists are now leading the effort to arrest the worldwide drift toward the decline of plant genetic resources. The issue could hardly have been put more clearly and forcefully than it has by Paul Ehrlich:

> *Aside from nuclear war, there is probably no more serious environmental threat than the continued decay of the genetic variability of crops.* Once the process has passed a certain point, humanity will have permanently lost the coevolutionary race with crop pests and diseases and will be no longer able to adapt crops to climatic change [emphasis in original].

In a period when meteorologists and geophysicists are observing increased climatic variability and some are predicting considerable climatic shifts, the urgency of the ecologists' observations is all the more apparent. Perhaps only increased scientific research can avert widespread disaster in the realm of agroecology.

At the same time, however, it should be remembered that scientific research leading to improved agrotechnologies is implicated in the overall process of genetic "decay" to the extent that improved varieties have displaced a wide range of existing species. Scientists cannot escape the ecological, politico-economic, and moral dimensions of their research in these realms. Furthermore, these responsibilities will become all the more pronounced as the politico-economic debate proceeds over the future funding and control of research on plant genetic resources. Because of the specialized nature of the knowledge involved in scientific research and agrotechnology, government officials and elected representatives will not always recognize the dimensions of the policy they are called upon to formulate. It becomes all the more important that scientists reflect seriously, debate openly, and communicate clearly about the issues at hand. To abdicate this responsibility now may mean that the chance for informed and responsible collective action will be lost forever.

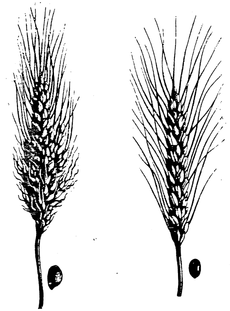
STRATEGIES FOR A GLOBAL PROBLEM

Given the full range of threats to plant genetic resources posed by contemporary conditions, the immediate need for scientific research is apparent. Environment and development specialist Norman Myers has indicated that plant species are becoming extinct at the average rate of one per day, and he predicts that as this trend accelerates the rate could well reach an average of one per hour by the turn of the century. What is needed are basic discovery expeditions to document the as yet imperfectly understood or entirely "undiscovered" plant species that remain.

Beyond this there are immediate problems of preservation. For crop species the Food and Agriculture Organization (FAO) in Rome has established an international seed bank and germ plasm program to stock all usable varieties of cultigens for future research and cultivation purposes. This is an encouraging start, but centralized storage of plant genetic resources poses new problems. Risks involved in the inadvertent deterioration or accidental destruction of centralized seed banks are colossal, and there are legitimate grounds for questioning the wisdom of such a pattern of preservation.

Furthermore, even if ideal storage conditions could be assured and an effective decentralized system of seed banks established, it is not clear that this would take care of the problem of plant genetic preservation. To insure the propagation of some species, most notably those found in tropical rain forests, a delicately balanced environment is required. It has proved difficult, if not impossible, to transplant or reproduce some of these tropical species away from their native environments, and in this sense tropical forest species are more habitat specific and ecologically vulnerable than forest species in temperate zones. As a recent study has pointed out, tropical forests may well be a "nonrenewable resource."

These ecological characteristics of tropical rain forests have led some scientists to advocate setting aside whole regions in the tropics as protected areas, or "ecological protectorates," to preserve genetic resources *in situ*. Similar proposals have been made with respect to primary production areas of basic cultigens as a means of protecting crop genetic material. The appeal of these protective measures is no longer limited to those who might be called "knee-jerk conservationists." The case is now being made for straightforward utilitarian motives, and the reason is clear.



In 1973, for example, Purdue University scientists attempting to develop high-protein sorghum to meet the food needs of a growing population in the semi-arid tropics examined more than nine thousand varieties of sorghum genetic strains stored in research facilities around the world. The eventual solution for their problem, however, came not from the materials stored in seed banks and laboratories but from two obscure strains discovered in some remote and as yet undisturbed fields of Ethiopian peasants. Examples like this one can be multiplied, and the message is clear: Preservation of plant genetic material *in situ* is vital for further scientific research and may prove crucial for the future survival of expanding populations.

MEETING THE CHALLENGE

It is one thing to recognize the need for immediate and effective policy formulations in these realms and quite another to implement them. Fortunately, the world scientific community shows signs of mobilizing itself. UNESCO has recently encouraged individual governments to establish or extend protective policies; by mid-1978, 144 areas in 35 countries had been set aside and officially recognized by UNESCO as part of a global network of Biosphere Reserves.

The major problem ahead, however, is to provide adequate international institutional and financial support as well as technical expertise to arrest deteriorating situations in the tropics. Faced with growing populations and expanding balance of trade deficits, it is extremely difficult for individual nation-states in the tropics to resist pressures from multinational corporations to exploit their forests for short-term return. Likewise, it is nearly impossible to convince governments burdened with major food problems to proceed cautiously in replacing existing cultivation systems with those based on new agrotechnology that promise palpable improvements in short-run yields.

The need for coordinated efforts across traditional boundaries of expertise is apparent. Writing legislation to set aside tropical forest reserves will have little or no impact if deteriorating agricultural conditions force peasants to encroach on forested regions to find arable land. Similarly, without intelligent forest management in watershed areas, topsoils for future agricultural production can disappear in devastating floods, and existing dams and irrigation systems can be crippled by rapid silting.

Beyond this it is becoming apparent that planning and technical management from "the top down" is not going to work. To move into tropical regions with externally generated improvement schemes that simply ignore local habits and aspirations is to invite disappointment, conflict, and ecological disaster. Recent programs of afforestation in drought-stricken regions of Africa foundered not because of inadequate technical expertise or lack of official will power but simply because the lands upon which new seedlings were planted were traditional grazing lands and local populations did not appreciate the central government's preemption of their livelihood. The carefully laid plans of foresters and agricultural ecologists were undone by the nibblings of sheep and goats.

Thus there is a pressing need for close coordination among foresters, agrotechnologists, cultural ecologists, and economic anthropologists. More can be done within existing programs, but these alone will not meet coming needs. New institutional mechanisms are required to facilitate the exchange of information, and new interdisciplinary programs of coordinated research must receive support to meet the threat to global plant genetic resources in the coming years. The stakes are high. To fail to meet this challenge is to gamble against future resources for human survival. As noted biologist George M. Woodwell has observed: "the ultimate resource is the biota—there is no other." WV