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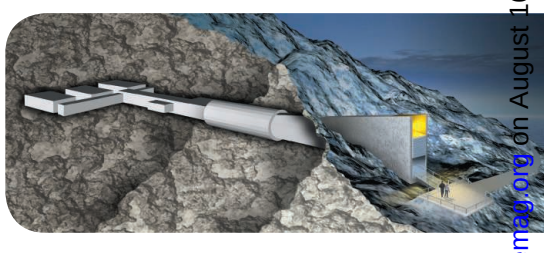
Gene Banks for a Warming Planet

THE BICENTENARY OF CHARLES DARWIN'S LIFE AND WORK REMINDS US THAT THE GREAT biodiversity on Earth underlies natural selection, selective breeding, and the biotechnologies required to provide humanity with food, fiber, fodder, and fuels. In particular, biodiversity affords the development of plant varieties with novel genetic combinations, which will be required to meet the challenges arising from adverse alterations in temperature, precipitation, sea level, and the frequency of drought and floods—all of which are anticipated from human-induced climate change. The loss of each gene and species therefore limits our options for the future.

At the International Congress of Genetics in New Delhi in 1983, I stressed the need for a conservation continuum, beginning with revitalizing conservation of domesticated plants by farm families in all countries, and extending to the establishment of an international genetic resource repository maintained under permafrost conditions. Since then, thanks to the spread of participatory breeding and knowledge-management systems involving scientists and local communities, on-farm conservation and gene banks have become integral parts of national biodiversity conservation strategies. For example, there are now over 125,000 genetic strains of rice, of which over 100,000 are in a cryogenic gene bank maintained by the International Rice Research Institute (IRRI) in the Philippines. This gene pool is invaluable for adapting one of the world's most important cereal grains to the consequences of global climate change.



We now largely depend on a few crops such as rice, wheat, corn, soybeans, and potatoes for sustaining global food systems. However, their genetic homogeneity increases their vulnerability to abiotic and biotic stresses. If their production is affected by a natural calamity, their prices will increase and food-deficient countries are likely to face riots and worse. Important publications such as *Lost Crops of the Incas** and *Lost Crops of Africa*† document the historic role of agrobiodiversity in ensuring food and health security. Saving vanishing "orphan crops" has therefore become an urgent task. We also know that millets, tubers, and grain legumes are rich in micronutrients but require less irrigation than the major crops. These plants and others are also sources of genes that confer tolerance to drought, floods, and the increased salinity of soils.

Although plant conservation on farms and in the wild is the ideal approach to preserving genetic diversity in crop plants, these methods are constantly jeopardized by invasive species, human destruction of habitat, and market factors. Therefore, other preservation strategies become essential. There are many cryogenic gene banks around the world resembling that at IRRI, but each is very expensive to maintain. Now, thanks to an initiative of the government of Norway and the Global Biodiversity Trust that began in 2007, the Svalbard Gene Vault located near the North Pole will conserve over 4 million accessions without the need for expensive cryogenics. The remote isolation and capacity of this facility should be sufficient to preserve a sample of the existing genetic variability in all economically important plants, a vast resource generated over the past 10,000 years of agricultural evolution.

But what about species that lie outside the agrobiodiversity realm? We need specialized genetic resource centers to preserve them as well if science is to ameliorate the future consequences of a warming planet. For example, the M. S. Swaminathan Research Foundation in India is conserving genes from plants such as mangroves, which are unusually tolerant of saltwater, and from *Prosopis juliflora*, an excellent source of genes for drought tolerance.

The Global Biodiversity Convention (CBD) that was adopted at Rio de Janeiro in 1992 calls for the conservation and sustainable and equitable use of biodiversity. However, the extinction of species and erosion of genes continue to occur at an alarming rate. The agrobiodiversity conservation model of mobilizing the power of partnership may be useful for achieving the goals of the CBD, and initiating such international projects should be one of many important outcomes of the United Nations Climate Change Conference in Copenhagen this December.

– M. S. Swaminathan

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*http://books.nap.edu/openbook.php?isbn=030904264X. †www7.nationalacademies.org/dsc/Lost_Crops_of_Africa.html.

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