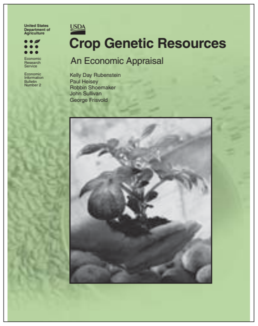
ERS Report Summary

Resources and Environment

Economic Research Service June 2005 U.S. Department of Agriculture


Crop Genetic Resources
An Economic Appraisal

This is a summary of an ERS report.

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Crop Genetic Resources

An Economic Appraisal

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Half the yield gains in major U.S. cereal crops since the 1930s are attributed to genetic improvements. Demand for crops continues to grow, and environmental conditions change, so continued productivity growth—and the genetic diversity that helps sustain it—remains important. Genetic diversity can be conserved in farmers' fields, in ecosystems that contain wild relatives of cultivated varieties, and in national or international germplasm collections. It is difficult to determine the best mix of conservation strategies. Regardless, the use of genetic resources by one farmer or plant breeder does not preclude their use by another, so private incentives to sustain diverse genetic resources are low. This motivates public measures (and underlying research) to conserve genetic resources.

What Is the Issue?

Crop genetic resources are the basis from which all crop production stems. But habitat loss, the dominance of scientifically bred over farmer-developed varieties, and genetic uniformity are all threats to continued diversity. Plant breeders need diverse germplasm to sustain productivity growth. The U.S. system for genetic resource conservation may lack sufficient diversity to reduce some crops' vulnerability to pests and diseases. The genetic uniformity of many modern crop varieties has also raised concerns that crop yields and production will become more vulnerable to evolving pests and diseases. At the same time, genetic resource conservation is expensive, and both private incentives and public funding are limited.

Many sources of diverse genetic resources lie outside the United States. To slow or prevent loss of crop genetic diversity worldwide, international agreements have been designed to encourage preservation of genetic diversity and promote the exchange of germplasm. For example, the new International Treaty on Plant Genetic Resources for Food and Agriculture will govern the exchange of germplasm for crops like wheat, maize, and cotton. But implementation has been hampered by a lack of consensus among the treaty's parties on the value of particular genetic resources. Thus, many of the treaty's provisions, such as procedures for transferring germplasm, are still vague. U.S. policymakers and genetic resource managers will face new exchange terms and rules governing the sharing of benefits from commercialized products among the treaty's parties, so the time is right to examine of the costs and benefits of conserving genetic resources.

What Did the Study Find?

Since crop genetic resources are largely public goods, private returns to the holders of crop genetic resources are lower than their values to the world. Thus, private incentives for conservation are likely not sufficient to achieve a level of crop genetic diversity that is socially optimal. Significant economic benefits derive from conserving and using genetic resources. For example, a one-time, permanent yield increase from genetic improvements for five major U.S. crops has generated an estimated $8.1-billion gain in economic welfare worldwide. The estimated stream of benefits from genetic enhancement activities exceeds the cost of investments in genetic resource preservation and use. Consumers in both the developed and developing world have benefited from higher yields and lower world prices for food. Without continued genetic enhancement using diverse germplasm from both wild and modified sources, the gains in crop yields obtained over the past seven decades are not sustainable, and yields might eventually grow more slowly (or even decline). Agricultural production increasingly relies on “temporal diversity,” changing varieties more frequently to maintain resistance to pests and diseases.

Three factors contribute to loss of genetic diversity—habitat loss, conversion from landraces (farmer-developed varieties) to scientifically bred varieties, and genetic uniformity in scientifically bred varieties. The loss of wild relatives occurs mainly through habitat conversion for agricultural use. Habitat loss is particularly problematic in developing countries, which often face greater pressures for wild land conversion than do developed countries. Crop genetic diversity also has diminished as landraces are displaced by scientifically developed varieties. Studies show that far less area is planted to landraces worldwide than a century ago. Finally, crop genetic diversity may decline with reductions in total numbers of varieties, concentration of area planted in a few favored varieties, or reductions in the “genetic distance” between these varieties. Thus far, yields for many major crops have been relatively stable as a result, at least in part, of frequent changes in modern varieties and breeders’ continued access to diverse genetic resources.

This economic assessment suggests that crop genetic resources are essential to maintaining and improving agricultural productivity. However, a General Accounting Office (1997) study found that current conservation efforts may fall short of what scientists believe are necessary levels for future crop breeding needs, suggesting a role for public policy. Policy initiatives include broad-based programs of multilateral and bilateral financial assistance, stronger intellectual property rights, and international agreements for germplasm exchange. But institutional constraints may prevent these initiatives from achieving their stated goals.

How Was the Study Conducted?

This report examines the role of genetic resources and genetic diversity in agricultural production, and efforts to value genetic resources. From a review of published literature, the report addresses the value of genetic improvements over time and among regions of the world. Given the role of genetic diversity in minimizing pest and disease epidemics, the report explores how incentives for land conservation, the breeding process, and access to modern varieties can affect diversity in the field.

The report also evaluates economic and institutional factors influencing the flow of genetic resources—including international agreements such as the Convention on Biological Diversity and the International Treaty on Plant Genetic Resources for Food and Agriculture—and their significance for agricultural research and development in the United States. The report synthesizes existing literature to review three proposed mechanisms to conserve plant genetic resources: (1) public investments in genetic resource preservation in their natural settings (*in situ* conservation) and of genetic resources saved in gene banks (*ex situ* conservation); (2) stronger intellectual property rights over genetic inventions, particularly in developing countries; and (3) agreements for transferring genetic materials among countries.