Part III
Biodiversity - A Must

Diversity within each crop is essential to agriculture, as is the diversity between crops and the genetic diversity among all species on earth. Diversity within crops refers to the multitude of ancestral and domesticated forms. This diversity has two components; First are the close relatives of cultivated crops and second are the different cultivated varieties of each crop, including the breeding lines that are the source of new varieties. Many of the varieties are landraces, which are locally used varieties of the crop developed by farmers for their own use. These landraces harbor most of the crop's genetic diversity. The world wheat collection, stored in dozens of national and international seed banks, includes 125,000 accessions (strains) that are held as an international service by the United States Department of Agriculture (USDA). Most of these strains are landraces. It is genetic diversity that has allowed wheat to be grown successfully around the world, allowing breeders to find varieties with genes that can overcome local problems such as novel diseases, insects, and climate. [16]

Genetic diversity has also been essential for maximizing and stabilizing the productivity of a crop in a given region. The genes that make crop varieties unique come from the existing genetic variability of crops, but genetic biotechnology now potentially allows genes to be transferred to crops from any other living species. Maintaining distinct strains of agricultural crops is important because these strains may contain genes useful in the continuing fight against pests and diseases, even those strains with overall characteristics that may not be attractive economically.[17]

Crop genetic diversity is not just a raw material for industrial agriculture; it is the key to food security and sustainable agriculture because it enables farmers to adapt crops suited to their own ecological needs and cultural traditions. Without this diversity, options for long-term sustainability and agricultural self-reliance are lost. The type of seed sown to a large extent determines the farmer's need for fertilizers, pesticides and irrigation. Communities that lose community-bred varieties and indigenous knowledge about them risk losing control of their farming systems and becoming dependent on outside sources of seeds and the inputs needed to grow and protect them.

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[16] Council for Agricultural Science and Technology (CAST). *Benefits of Biodiversity.* [Available at: *http://www.cast-science.org/biod/biod_ch.htm#2* - Posted on 02/26/99].

[17] University of California, Riverside. *Germplasm Collections.* [Available at: http://cnas.ucr.edu/`cnas/facilities/germplasm.html].

Figure 7: Genetic diversity and sustainable agriculture are compatible: Is biotechnology?

Without an agricultural system adapted to a community and its environment, self-reliance in agriculture is impossible. Diversity may help to decrease risk by decreasing the year-to-year variability of yields. For instance, landraces of wheat often have lower yield variances than many modern varieties. This lower variation in yields occurs because individual plants within a genetically variable population differ from each other. The ones favored by particular climatic and soil conditions in a given year can grow well and thus compensate for those that do poorly under those conditions. Similarly, farmers can grow mixtures of two or more varieties as a hedge against the risk of disease or environmental stress. [18]

These effects of diversity illustrate two points in general. First, greater diversity leads, on an average, to greater productivity. This effect of diversity on productivity should occur whether the diversity comes from growing many different plant species together in a pasture or forest; from growing a mixture of genotypes as a crop; from growing different crops in sequence, as in crop rotation; or from maximizing the genetic diversity within each individual plant, as it occurs in high-yielding crop varieties and commercial hybrids.

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[18] *Crop Genetic Resources*. [Available at: http://www.fao.org/sd/Epdirect/Epre0040.htm – Posted 02/09/98].

The level at which diversity occurs is most important, and the kind of diversity that is needed varies with the situation. For example, genetically diverse landraces are essential for farmers who must grow their crops in marginal, variable environments and who have no access to outside sources of diversity. These farmers must have plentiful diversity in their crops in the field. In contrast, commercial farmers are highly dependent on diversity in the foundation breeding pools of plant breeders who continually supply diverse new varieties to the commercial farmers, providing them with a kind of sequential diversity that has been called 'diversity in time.' The more heterogeneous the habitat and the more the environmental condition fluctuation during the growing season, the greater the beneficial effects of diversity. Conversely, in a spatially uniform, unchanging habitat in which a single factor always limits growth, a single strain is hypothesized to provide as great a yield as a mixture of several different strains grown together. [19]

Agricultural conditions, especially climate and disease and other pests, rarely are stable and predictable. Perhaps because of this, study of maize yields and years of practical experience has led to the recommendation that a farmer's best policy is to grow several unrelated single cross hybrids with good records for stability of performance as well as high yield. Second, greater diversity leads, on an average, to lower year-to-year variability in productivity; that is, to greater stability. The ability of diversity to decrease year-to-year variability in yield means that diversity can act as crop risk insurance. Farmers may plant several different crop varieties as an additional way to decrease risk. Planting several kinds of crops, several varieties of a given crop, or a mixture of varieties as one crop, increases the chance that some plants will be resistant to a disease or insect, or will perform well under existing climatic conditions. Greater crop diversity would thus decrease the odds of crop failure and may increase average yields. These features of biodiversity are greatly underutilized and merit further study and application.[20]

Evidence from the Green Revolution leaves no doubt that the spread of modern varieties has been an important cause of genetic erosion, as massive government campaigns encouraged farmers to adopt genetically engineered varieties and to abandon many local varieties. The uniformity caused by increasing areas sown to a smaller number of varieties is a source of increased risk for farmers, as the varieties may be more vulnerable to disease and pest attack and most of them perform poorly in marginal environments. Field performance of

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[19] Council for Agricultural Science and Technology (CAST). *Benefits of Biodiversity*. [Available at: http://www.cast-science.org/biod/biod_ch.htm#2 – Posted on 02/26/99].

[20] *Id.*

some recently released transgenic crops has shown that increased endeavors in this area may not necessarily lead to success.[21]

Figure 8: Greater crop diversity would decrease crop failures.

[21]Benbrook, Charles. *World Food System Challenges and Opportunities: GMO's, Biodiversity, and Lessons from America's Heartland.* Paper presented on January 27, 1999, as part of the University of Illinois World Food and Sustainable Agriculture Program.