



“Summary of article by James Boyce: Ecological Distribution, Agricultural Trade Liberalization, and In Situ Genetic Diversity” in Frontier Issues in Economic Thought, Volume 6: A Survey of Sustainable Development. Island Press: Washington DC, 2001. pp. 235-238

Social Science Library: Frontier Thinking in Sustainable Development and Human Well-being

“Summary of article by James Boyce: Ecological Distribution, Agricultural Trade Liberalization, and In Situ Genetic Diversity”

Most of the discussion surrounding the environmental effects of trade liberalization between developed and developing countries assumes that liberalization may threaten strong environmental standards in developed countries. Conversely, this paper focuses on how liberalization can undercut more sustainable practices in developing countries by inducing developing countries to import goods from developed countries that have not internalized the negative externalities associated with those goods.

This notion is illustrated in the context of genetic diversity. Genetic diversity in crop plants is essential for long term world food security. Such diversity is sustained “in the field” by poor farmers in developing countries. Agricultural imports from developed countries that do not include the internalization of externalities in their prices, can displace local production in centers of genetic diversity. Such a displacement can threaten both rural livelihoods and the continued provision of crop genetic diversity. The paper shows how the North American Free Trade Agreement (NAFTA) has impacted Mexican maize farming in this manner.

Ecological Distribution and the Power Weighted Social Decision Rule

There are distributional issues associated with environmental externalities. Those who impose external costs on others benefit from negative externalities by avoiding internalization of the environmental costs of production. In effect, they are subsidized by those who bear those costs. Those who produce positive externalities cannot internalize those benefits as well. They in effect, pay a tax. To identify the most economically efficient environmental policies, conventional economic theory holds that analysts should be guided by use of cost-benefit analyses. This rule requires that, constrained by available resources, net benefits summed over all individual members of society should be maximized. This formula treats all individuals the same, in that costs or benefits to one person count as much as the costs or benefits to another.

In practice, social decisions may give greater weight to the costs or benefits to some people than to others. Such outcomes can be described as following a “power weighted social decision rule.” That is, social decisions maximize net benefits “weighted by the power of those who receive them.” (267) Put another way, the extent to which government intervenes to correct market failures in the economy is governed by the balance of power between winners and losers. The effects of trade liberalization between Mexico and the United States with respect to genetic diversity and maize production can be evaluated with respect to these principles.

***In Situ* Genetic Diversity**

By providing the raw material necessary for future crop adaptations to changing pests, pathogens, and environmental conditions, genetic diversity in the world's major food crops is a key to maintaining long-term food security around the globe. Modern agriculture is associated with less genetic diversity than traditional agriculture. While such uniformity can bring high land productivity, it can also increase vulnerability to large-scale crop failures due to plant disease and pest epidemics.

The centers of origin and diversity of the world's major food crops are located in the developing world. To respond to the long-term threats posed by genetic erosion, national and international agencies now collect and store seed samples in what are called *ex situ* (off-site) germplasm banks. These banks give plant breeders access to genetic diversity while providing insurance against losses of *in situ* (on-site or "in the field") genetic diversity.

Ex situ banks are not substitutes for but are rather complements to, *in situ* genetic diversity for three reasons. First, gene banks are not completely secure due to financial constraints, human and mechanical failures, and the delicate nature of the seeds themselves. Second, many genetic attributes can only be ascertained by growing plants in habitats very similar to those from which they originated, which are costly and difficult to reproduce in the laboratory. Finally, gene banks can only store the existing *stock* of genetic diversity at a point in time, not the evolutionary *flow* of new varieties that can only occur by the processes of mutation and natural selection of genes in the field.

NAFTA and Mexican Maize

Maize originated in what is now southern and central Mexico and Guatemala. Today, central and southern Mexico remain the global center of genetic diversity in maize. Scientists refer to the Mexican campesino farmers' maize plots as "evolutionary gardens" because they not only maintain and produce vast stock of maize varieties, but they also manage an ongoing evolutionary flow of new varieties.

While maize is the leading crop in both Mexico and the United States, use and production techniques differ greatly in the two countries. The U.S. has average yields of 7.4 metric tons per hectare and produces roughly 200 million metric tons of maize each year on 300,000 farms. Mexico has average yields of 2 metric tons per hectare and produces roughly 14 million metric tons on 2.7 million farms each year. U.S. maize is used mainly as animal feed. Mexican maize is consumed by people in the form of tortillas.

Where the contrast is most stark, however, is in production techniques. Only six varieties of maize account for almost half of total U.S. acreage, leaving U.S. maize genetically vulnerable to insect and disease epidemics. In addition, 96 percent of U.S. maize acreage is treated with herbicides, and one-third with insecticides. These inputs have contaminated groundwater supplies in a number of U.S. states.

By standard market prices, U.S. maize is more “efficient” than its Mexican counterpart. When NAFTA was negotiated, U.S. maize was priced at roughly \$110 per ton, where Mexican farmers received \$240 per ton. The price advantage of U.S. maize has four sources: natural factors such as better soil and rainfall conditions; farm subsidies; the exclusion of environmental costs such as groundwater contamination from market prices; and the failure of market prices to capture the value of the maintenance of genetic diversity by Mexican maize farmers.

Estimates of the number of Mexican farmers who will eventually be displaced by U.S. imports vary widely. NAFTA will not totally eliminate Mexican maize production, but it is likely to hurt the most genetically diverse areas cultivated disproportionately by poor campesinos. Much of the abandoned maize land is likely to be converted into cattle pastures, which require less labor. Relatively conservative estimates of the amount of campesinos who will migrate to Mexican cities number in the hundreds of thousands; upper-end estimates reach as high as 15 million.

The impact of NAFTA on ecological sustainability arises from both positive and negative externalities; the erosion of positive externalities in the form of conservation of the evolution of *in situ* genetic diversity in Mexico, and the proliferation of negative externalities associated with intensive agrochemical use in the U.S.. Referring to the power-weighted social decision rule discussed earlier, the clear winners from NAFTA in this case are U.S. maize producers and to some extent Mexican consumers. The clear losers are Mexican maize producers and the environment. The Mexican producers will lose their livelihoods. There are two environmental “losers”: future generations whose food security will be diminished by the reduction of *in situ* genetic diversity, and those adversely affected by the agrochemical pollution resulting from the U.S. corn production.

Conclusions and Policy Recommendations

Industrialized nations have long protected their farm sectors to safeguard employment, political stability, cultural values, and food security. In the case of Mexican maize, there is an even more compelling case for trade protection: the need to sustain genetic diversity in one of humankind’s most important food crops. In principle, the first-best policy in Mexico would be ecological subsidies in the form of payments to Mexican maize farmers to reward their contribution to the public good via *in situ* conservation of genetic diversity. Since a good part of the benefits accrue to the planet as a whole, there is also a case for international assistance in such subsidization. However, tariff policy -which brings in revenue for the government rather than requiring expenditures- may be more politically feasible.

Given the power-weighted social decision rule, it will take international political backing, as well as financial support, to protect genetic diversity in maize. Recent history has shown that the Mexican campesinos hold little leverage over Mexican government policy. But international cooperation to sustain *in situ* diversity may alter the political balance, and help to devise ways to compensate farmers who perform this valuable service.