The North American Free Trade Agreement (NAFTA) had a profound impact on maize trade between the United States and Mexico. Negotiated quota and tariff reductions and the Mexican government’s decision not to charge some tariffs to which it was entitled contributed to a tripling of U.S. exports to Mexico. U.S. corn now supplies about one-fifth of Mexican demand, primarily for feed grain, corn sweetener, and processed foods. Though US exports to Mexico account for only about 2 percent of total U.S. production, corn is such a large crop in the US that the marginal impacts of trade cannot be ignored.

The changes in U.S.-Mexico corn trade had significant environmental impacts on both sides of the border. Corn production in the U.S. has heavy negative impacts, while the production of maize in Mexico predominantly involves positive environmental externalities associated with the stewardship of genetic diversity in the world’s center of origin for maize. Neither the environmental costs of pollution-intensive U.S. production nor the benefits of Mexico’s biodiverse maize production are reflected in international prices. These externalities allow U.S. corn to be priced below its true costs of production, while traditional Mexican maize prices do not reflect their full value. The linking of these two dynamics through deregulated trade results in overall environmental impacts that are worse than the simple sum of its parts, as under-priced U.S. corn threatens to displace undervalued Mexican maize, a process referred to as the globalization of market failure.

U.S. Impacts
Looking first at the environmental impacts in the U.S., corn is one of the country’s largest and most chemical-intensive crops. Corn is planted on some 28 million hectares, 20 percent of all U.S. harvested land, and 3.7 percent of the entire land area of the contiguous 48 states. The environmental toll of intensive corn production is well documented. Chemical fertilizers are used on the vast majority of U.S. corn crops. The run-off is a major source of water pollution, affecting drinking water throughout the corn belt in the center of the country. Run-off also pollutes rivers and streams. Run-off into the Mississippi River contributes to a well-documented “dead zone” in the Gulf of Mexico, an area the size of a small U.S. state in which all life has been killed off.
U.S. corn is also intensive in its use of herbicides and insecticides. Due to important technological improvements, the intensity of herbicide use has declined in recent years, though atrazine and other chemical herbicides still pollute drinking water supplies. Pesticide intensity has remained roughly constant, which has been disappointing given the growing use of genetically modified corn. Nearly 30 percent of U.S. corn is now planted in varieties engineered with the Bt endotoxin to fight some common pests. While there are widespread concerns about the risks of such crops to human health and to the environment, their widespread adoption has not yet produced the environmental benefit they promised: reduced pesticide applications. In addition to Bt corn, another 11 percent of U.S. corn is now genetically engineered for herbicide tolerance. With 40 percent of U.S. corn land planted in GM crops, and the share still rising, there are serious concerns about the long-term health and environmental consequences.

Finally, though only about 15 percent of U.S. corn is irrigated, the vast majority of irrigated corn land is found in four states: Nebraska, Texas, Colorado, and Oklahoma. These states rely for their irrigation on water from the vast Ogallala Aquifer, an underground reservoir the size of Lake Huron. The Ogallala is being depleted at unsustainable rates, calling into question the wisdom of expanding corn production in areas lacking adequate rainfall. These warm, dry areas are also feeding the demand for Bt corn, since the variety is engineered to fight a pest that thrives in such climates.

While corn production has not expanded during this period, access to the Mexican market has allowed the U.S. to keep corn land in production when it would otherwise have been turned over to other crops. Increased exports to Mexico due to trade liberalization – the three-fold increase recorded since NAFTA – represent 1.3 percent of total U.S. production and should therefore be considered responsible for 1.3 percent of the environmental impacts of corn production. Given the scale of U.S. production, these are considerable, representing, for example, 100,000 additional tons of nitrogen, phosphorous, and potassium-based loadings to US water each year.

**Mexico Impacts**

For Mexico, the principal potential environmental impact of the loss of a significant share of its domestic maize market to the U.S. is the threat to agrobiodiversity. Mexico is the center of origin for maize and its wild relative, teosinte. Over 40 distinct native varieties – or landraces – can be found in Mexico, the product of several thousand years of selection by farmers in the region. Despite industrialization and urbanization, some 20 percent of Mexico’s economically active population grow maize, most on small to medium-sized plots in difficult environments and using low levels of modern technology, such as tractors, chemical inputs, or improved varieties. The agro-biodiversity they maintain is not only the source of their principal nutrition
and the center of Mexican culture, it is also a global resource, key to crop-breeding to meet evolving demands for corn varieties around the world.

Trade threatens Mexican maize diversity in two ways. First, and most important, the flood of imports from the U.S. has brought producer prices down nearly 50 percent, increasing economic pressure on marginal maize farmers. If they leave the land or leave maize, the traditional knowledge and practices that sustain this resource will go with them. While many – including some in the Mexican government – predicted NAFTA would lead to an exodus from maize, this has largely not occurred. Data suggest that production has remained relatively constant, and even increased in some of the states dominated by traditional production.

While this has caused some researchers to conclude that there is no threat to agro-biodiversity, our research suggests that such data mask long-term dangers. Though production is up in some agricultural areas of high diversity, so is migration to other parts of Mexico, as family members leave to find paying work elsewhere. This may suggest we are seeing only a delay in the threatened loss of maize diversity.

The second threat to maize diversity is the contamination of traditional fields by GM corn from the United States. Mexico has banned the cultivation of GM maize since 1998. Yet studies have verified the presence of Bt and herbicide tolerant transgenic traits in traditional landraces in several states, leading to widespread fears that such gene flow from GM varieties to landraces may be more rapid and widespread than previously thought. It is widely assumed the contamination came from US grain, which enters Mexico unsegregated and with no label and is distributed in rural areas as food by a government anti-poverty program. Unwitting farmers experimented with the grain as seed, and the pollen contaminated traditional varieties.

An exhaustive study by the North American Commission for Environmental Cooperation (NACEC), the agency set up by NAFTA’s side agreement, is underway. A preliminary draft of the report suggests that the threat to maize diversity is neither imminent nor negligible, and many are calling for precaution in the regulation of U.S. imports.

Conclusion
The case of Mexican maize clearly calls into the question the wisdom of across-the-board agricultural trade liberalization. Looking at Latin America, there are clearly other crops and countries that share Mexico’s status as a center of important genetic diversity for traded food crops. Potatoes in the Andean highlands would be a clear example. Positive environmental externalities are present in many traditional forms of agricultural production, from low chemical use to soil stabilizing farming techniques. Where traditional production continues to be a significant part of Latin American
agriculture, it is important to assess the environmental benefits of such activities before throwing such producers into unmediated competition with their more industrialized, pollution-intensive counterparts.

If agro-biodiversity is a common global good that is worth preserving, and if the market is unlikely to internalize these benefits any time soon, then non-market mechanisms will be needed to shelter such sectors in the economic integration process. In the end, tariffs may prove the best way to protect environmentally valuable farm sectors.

On the positive side, trade creates growing demand for some agricultural products, such as feed grain, corn sweetener, and corn flour in the case of Mexico. This demand has been largely filled by imports from the United States. But a different set of trade arrangements and government policies could allow rising demand to serve as the economic stimulus to improve the livelihoods and long-term economic prospects of traditional farmers.

The original Brasilia Discussion Paper is available at: