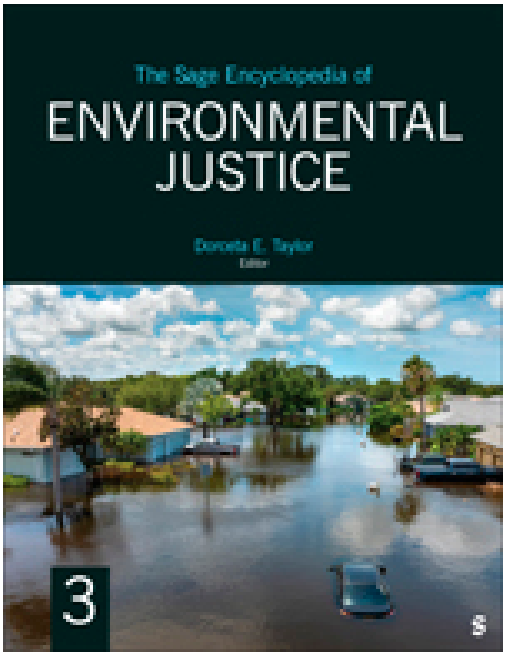
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Genetically Modified Crops

Genetically modified (GM) crops result from a plant-breeding technology known as recombinant DNA. With the aid of a gene gun, scientists insert a gene from another living organism, bacteria, or virus into the DNA of plant cells to express a desired trait. Proponents of GM crops have argued that they offer solutions to global food insecurity, rural poverty, and climate change. But critics have argued that the widespread adoption of GM crops has exacerbated existing inequalities by concentrating control of agricultural practices, land, and seeds in the hands of corporations. In addition, critics raise concerns about the health and environmental impacts of increased pesticide spraying for large-scale GM monocropping. This entry explains the biotechnology of GM crops, describes the main issues arising from the widespread adoption of GM crops from an environmental justice perspective, and gives examples of social mobilization against GM crops.

Types

GM biotechnology in agriculture has been used mainly to develop two traits: herbicide tolerance and insect resistance. Herbicide-tolerant crops (primarily soybeans) have been modified to resist spraying with glyphosate-based herbicides, a technological development branded by the company Monsanto (later Bayer) as Roundup-Ready. As a result, farmers can apply the herbicide to the entire field to control weeds, effectively killing weeds while leaving the herbicide-tolerant crops unharmed. Insect-resistant crops (primarily corn and cotton) have been modified to produce the pesticide *Bacillus thuringiensis* (Bt) toxins, so insects die through poisoning when they feed on the crop. This technological development reduces farmers' need to spray chemical insecticides to control insect pests, particularly corn borers, cotton bollworms, and certain types of caterpillars. Monsanto/Bayer, DowDuPont (later Corteva), and Syngenta (later Sinochem) developed GM plants that "stack" desired traits. Commercially available stacked-trait crops mainly express insect resistance and herbicide tolerance.

GM crops were first grown commercially on a significant scale in 1996. The United States, Argentina, Canada, China, and Mexico were the first countries to adopt GM biotechnology. Since then, GM crop acreage has rapidly expanded to cover almost 200 million hectares (494, 000,000+ acres) by 2019, primarily across five countries: the United States, Brazil, Argentina, Canada, and India. Four commercial crops—soybeans, corn, cotton, and canola—represent the vast majority of GM crops planted worldwide.

Newer varieties of genetically modified crops are being developed using tools such as CRISPR-Cas9.

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Genome-editing technology allows scientists to make targeted changes to the plant's DNA to achieve desired traits. Proponents contend genome editing offers advantages to conventional genetic modification, including greater precision, lower costs, and faster completion of the breeding process and the marketing of crops. More precise and predictable genetic changes promise fewer unintended effects, which, proponents claim, should lead to less burdensome regulations that slow down commercialization. Critics contend that the promising narratives surrounding genome editing mirror those of conventional genetic modification. At the same time, they warn that the agricultural revolution of GM crops has failed to live up to its promise. Critics thus recommend scientists, donors, and policymakers integrate the lessons learned from GM crops into future breeding programs based on genome editing to avoid repeating previous mistakes.

Environmental Justice Perspectives

The widespread adoption of GM crops has radically transformed socioenvironmental dynamics, raising significant environmental justice issues. Among them is the increasing industrialization and corporate concentration of farming practices and inputs, particularly seeds. The adoption of GM biotechnology to grow commodity crops (i.e., soybeans, corn, cotton, and canola) and the expansion of large-scale industrialized farming go hand in hand. Large-scale industrialized farming has significant socioecological impacts, including environmental degradation from monocropping, deforestation to expand agrarian frontiers, and water and soil pollution due to intensive agrochemical use. Adding to this is the loss of rural livelihoods due to labor replacement and land consolidation, the health risks from pesticide exposure, and the challenges to food security and sovereignty by favoring export crops over local food production. Furthermore, a central issue surrounding GM crops concerns restrictive patents that grant a handful of multinational companies exclusive rights to GM technologies, seeds, and traits. This leads to the high cost of seeds and agricultural inputs for small farmers, dependency on agribusinesses, and less autonomy and decision-making power over seed saving and farming practices.

Social Mobilization

Farmers, consumers, environmental activists, and scientists have mobilized worldwide to protest the development, use, and impacts of GM crops. Several European countries, including France, Germany, and Italy, have

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seen significant public opposition against GM crops. The European Union has implemented strict regulations on GM crops, requiring labeling and thorough risk assessment before their approval for cultivation. In Brazil, India, and Mexico, coalitions of scientists, peasants, and Indigenous Communities have organized to contest the expansion of GM industrial agriculture, citing concerns about land rights, environmental degradation, and the loss of traditional farming practices. In Latin America, peasant and Indigenous families who contest the expansion of the agricultural frontiers of GM crops over their territories face escalating violence. Movements have also emerged to challenge the health hazards of pesticide exposure in the United States and Argentina.

See also Agricultural Production; Biofuels, Food Production, and Land Use; Food Insecurity and Food Access; Food Movements; Green Revolution; Pesticide and Fertilizer Use; Seed Saving; Seed Sovereignty

Further Readings

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