Organic Land Management and the Protection of Water Quality

Organic land management, including agriculture and the production of organic food, utilizes a system that seeks to maintain and improve the environment. Organic standards, codified in the *Organic Food Productions Act* (OFPA), are subject to independent public review and oversight of practices and allowed inputs, assuring that toxic, synthetic pesticides used in conventional, chemical-intensive agriculture are replaced by methods focused on soil biology, biodiversity, and plant health. This ensures that pesticides that contaminate our water and air, hurt biodiversity, harm farmworkers, and kill bees, birds, fish and other wildlife are reduced or eliminated completely.

Current laws to protect water quality under the *Clean Water Act* (CWA) are limited by risk calculations that offer limited public health and environmental protection. Meanwhile, the nation as a whole still relies on toxic inputs to grow food and manage landscapes. These chemicals, like atrazine, 2,4-D, and glyphosate, are linked to a myriad of human and environmental health concerns, including cancer, birth defects, reproductive and sexual dysfunction, and neurological/learning problems. The high rates of cancer, learning and behavioral effects, and infertility call for a serious reevaluation of the way food is grown and waterways protected. Organic farming and landscape management provide the model for transitioning from chemical-dependent to sustainable practices.

Conventional Farming Threatens Waterways

Conventional, chemical-intensive agriculture in the U.S. and its reliance of toxic, synthetic inputs, such as insecticides, herbicides, and synthetic nitrogen and phosphorus fertilizers, have affected the quality of surface and groundwater for decades. According to data from the U.S. Geological Survey (USGS) and the Environmental Protection Agency (EPA), of the over 300 food production pesticides with tolerances registered –allowable levels of pesticide residue on food– 52 are known surface or groundwater contaminants. (See Beyond Pesticides' *Eating with a Conscience* (EWAC) at www.eatingwithaconscience.org.) The overwhelming majority of the most popular pesticides used in the U.S. have been detected in surface and groundwaters, including the popular herbicides atrazine, glyphosate, and 2,4-D.[1] (See Table 1.)

Ten Most Toxic Crops to Produce

Corn and soybeans are the most widely grown crops in the U.S. and as such contribute overwhelmingly to pesticide contamination, especially in the Midwest where these crops are predominantly grown, and pollution of the Mississippi River watershed and the Gulf of Mexico. Ninety percent of corn and soybeans are genetically engineered, which also correlates to an increase in herbicide use. The EWAC database indicates that of the 84 pesticides with established tolerances for corn, 22 are known to contaminate streams or groundwater. Of the 83 pesticides registered for use on soybeans, 26 contaminate streams or groundwater.

Conventional, chemical-intensive farming of bell peppers, potatoes, tomatoes, and wheat are the biggest contributors to water contamination after corn and soybeans. Asparagus, peaches, pears,

Table 1.
Most Used Pesticides in the United States by Poundage

Chemical	Millions of Pounds Used Annually	Identified as a Surface/ Groundwater Contaminant
Glyphosate	180-185	✓
Atrazine	73-78	✓
Meta Sodium	50-55	✓
Metolachlor	30-35	✓
Acetochlor	28-33	✓
Dichlopropene	27-32	✓
2,4-D	25-29	✓
Methyl Bromide	11-15	No
Chloropicrin	9-11	✓
Chlorphyrifos	7-9	✓
Chlorothalonil	7-9	✓
Ethephon	7-9	No
Metam Potassium	7-9	✓
Pendimenthalin	7-9	✓
Copper Hydroxide	6-8	✓
Simazine	5-7	✓
Trifluralin	5-7	✓
Mancozeb	4-6	No
Propanil	4-6	No
Aldicarb	3-4	✓
Acepahte	2-4	✓
Dimethenamid	2-4	No
Diuron	2-4	No
MCPA	2-4	✓
Paraquat	2-4	✓

and hot peppers round off the top 10 dirty crops that are grown with the most water contaminating pesticides. (See Tables 2 and 3 for foods with most toxic production practices.)

Pesticides Most Frequently Detected

Urban vs. Agricultural

According to USGS' *Pesticides in the Nation's Streams and Ground Water,*[2] the herbicide atrazine is the most frequently detected pesticide in surface and groundwater. The others most frequently detected nationwide are the herbicides metolachlor, simazine, prometon, and the insecticide diazinon. For insecticides, the most frequently detected are chlorpyrifos, carbaryl, malathion, diazinon, and carbofuran. For herbicides, atrazine, metolachlor, acetochlor, trifluralin and cyanazine are the five most frequently detected. These pesticides are registered for use mostly on agricultural sites, but trifluralin, simazine, and prometon also have residential uses, while cyanazine's uses have been cancelled since 1999. 2,4-D is overwhelmingly detected in urban areas, due to its prevalence in lawn care products. Simazine and diuron are also detected in urban areas.

While the vast volume of pesticide runoff comes from agricultural areas, urban uses of pesticide products contribute to water contamination. Lawn applications, uses on rights-of-way, and mosquito control applications lead to pesticide runoff into streams and rivers. One California monitoring study of urban creeks (2009) found pyrethroid insecticides in every sample collected. Bifenthrin is identified as the pyrethroid of greatest toxicological concern, followed by cypermethrin and cyfluthrin. Pyrethroids are commonly formulated in over-the-counter pesticide products for consumers or professional pest control operators. However, seasonal patterns of discharge of these chemicals into waterways are more consistent with professional use as the dominant source of bifenthrin.[3]

Water Monitoring Continually Detects Pesticides

According to USGS, 56 percent of streams sampled have one or more pesticides in water that exceed at least one aquatic-life benchmark set by EPA. Benchmarks, developed by EPA through baseline risk assessments, are estimates of the chemical concentrations that establish "acceptable" risks associated with harm to aquatic life. Urban streams have concentrations that exceed one or more benchmarks at 83 percent of sampled sites –mostly by the insecticides diazinon, chlorpyrifos, and malathion. Agricultural streams have concentrations that exceed one or more benchmarks at 57 percent of sites –most frequently by chlorpyrifos, azinphos-

Table 2.
Ten Most Toxic Crops to Produce

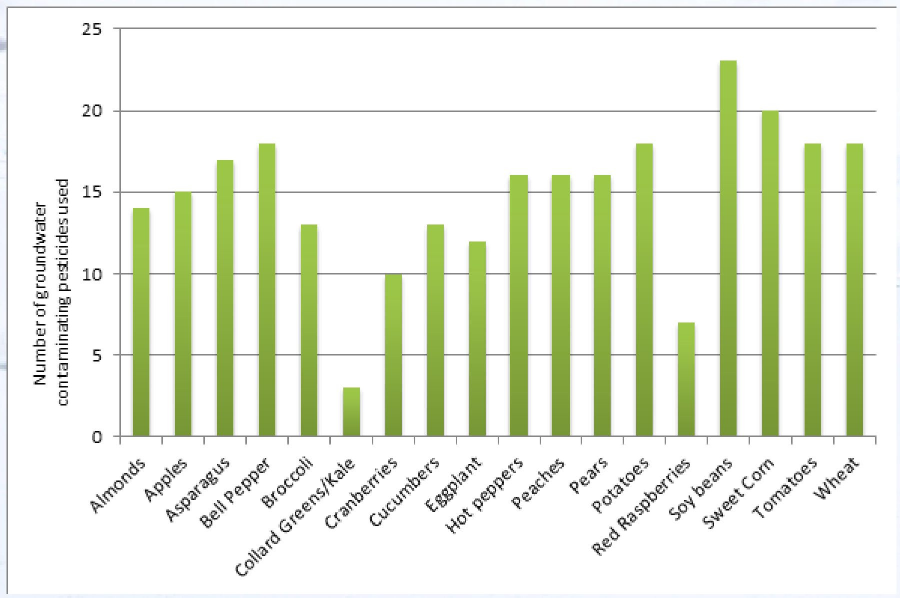
Crops	2,4-D	Atrazine	Carbaryl	Chlorothalonil	Glyphosate	Malathion	Metolachlor	Paraquat	Pendimethalin	Permethrin
Soybeans	✓		✓	✓	✓	✓	✓	✓	✓	✓
Sweet Corn	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bell Peppers			✓	✓	✓	✓	✓	✓	✓	✓
Potatoes	✓		✓	✓	✓	✓	✓	✓	✓	✓
Tomatoes			✓	✓	✓	✓	✓	✓	✓	✓
Wheat	✓				✓	✓	✓	✓	✓	
Asparagus	✓		✓	✓	✓	✓	✓	✓	✓	✓
Peaches	✓		✓	✓	✓	✓		✓	✓	✓
Pears	✓		✓		✓	✓		✓	✓	✓
Hot Peppers			✓		✓	✓		✓	✓	

Top ten most toxic crops to produce based on number of allowed pesticides. Source: Eating with a Conscience Database, Beyond Pesticides.

methyl, atrazine, p,p'-DDE, and alachlor.[4] Pesticide compounds analyzed in most water by USGS include many of the most heavily used herbicides and insecticides, and one or more pesticides or their degradates are detected in water more than 90 percent of the time during the year in agricultural streams, urban streams, and mixed-land-use streams.[5]

Atrazine shows consistent patterns of high levels in U.S. waterways,

Table 3.
Crops Associated with Surface and Groundwater Contamination



Source: Eating with a Conscience Database, Beyond Pesticides.

especially in the Northeast (2000–2008), South (1996–2004 and 2000–2008), and Midwest (1996–2004 and 2000–2008) regions of the U.S.,[6] demonstrating the prevalence of the herbicide in surface waters. Agricultural streams located in the Corn Belt (Illinois, Indiana, Iowa, Nebraska, Ohio, and parts of adjoining states) and the Mississippi River Valley account for most concentrations that exceed benchmarks for atrazine.[7] The likelihood of pesticide concentrations exceeding a human-health benchmark is greatest for those streams draining agricultural or urban watersheds.

Glyphosate has also been detected at significant levels in rain and rivers in agricultural areas across the Mississippi River watershed. 60-100 percent of air and rain samples are contaminated with glyphosate.[8,9]

Downstream Impacts on Human and Environmental Health

Pesticides and nutrients from fertilizers can find their way into finished drinking water and well water. This is especially true for rural and agricultural communities. One USGS survey (2008) analyzed water from nine selected rivers, which are used as a source for public water systems, and found that low levels of certain synthetic chemicals remain in the finished drinking after being subject to treatment by community water facilities.[10] Nearly 10 percent of the 2.6 million people living in California's Tulare Lake Basin and Salinas Valley are drinking nitrate-contaminated water, as a result of nitrate contamination in groundwater from fertilizer (weed and feed products) and animal manure, according to a study by researchers at University of California Davis (2012).[11] Additionally, a study (2010) in Iowa shows a nearly three-fold increase in thyroid cancer risk for women with more than five year's use of public water supplies contaminated with nitrates at levels of five milligrams per liter (mg/L) or above.[12]

The emerging presence of synthetic pyrethroid pesticides (permethrin, bifenthrin, and resmethrin) in waterways can now be attributed to the home use of these popular products. Pyrethroid insecticides have been found in street runoff and in the outflow from sewage treatment plants in urban creeks at low levels –exposure around 10-20 parts per trillion, but high enough to kill standard test organisms.[13] A report released in 2012 by the California Surface Water Ambient Monitoring Program (SWAP) found a 55 percent increase in statewide pyrethroid detections in sediment from samples in 2008 to 2010.[14] Pyrethroids are highly toxic to aquatic organisms and can damage the gills of fish.

Newer pesticide technologies, like systemic neonicotinoid pesticides, are now showing that they can contaminate surface waters at concentrations that harm aquatic organisms. Work by the California Department of Pesticide Regulation finds that imidacloprid, a neonicotinoid, is detected in water samples at a frequency of 89 percent at concentrations that exceed EPA's chronic aquatic benchmarks. Concentrations are also frequently greater than similar toxicity guidelines developed for use in Europe and Canada.[15]

Studies link increased seasonal concentrations of pesticides in surface water with a peak in birth defects in infants conceived during the spring and summer months, when pesticide use increases and high concentrations of pesticides are found in surface waters.[16] Prenatal exposure to atrazine is linked to small head circumference and fetal growth restriction.[17] Similarly, studies by Paul Winchester, M.D., et al., (2009) report a strong correlation between the month of conception and likelihood of premature birth, certain birth defects, and lower IQs.[18]

Non-Point Pesticide Sources Trouble the Nation's Largest Estuary

When we purchase over-the-counter pesticide products, we may be contributing to water contamination and the degradation of unique aquatic ecosystems. One prime example is the Chesapeake Bay, where toxic contamination remains widespread, with severe impacts in some places, despite federal mandates for cleanup. A 2013 report, *Technical Report on Toxic Contaminants in the Chesapeake Bay and its Watershed: Extent and Severity of Occurrence and Potential Biological Effects,* finds that nearly three-fourths of the Bay's tidal waters are "fully or partially impaired" by toxic chemicals, with people warned to limit fish consumption from certain areas. Contamination is severe in a handful of "hot spots" around the Bay, including Baltimore's harbor, also related to a legacy of past industrial and shipping activity.

Atrazine has been found to act as an endocrine disruptor that can cause complete sex reversal in male frogs. In fact, research led by Tyrone Hayes, PhD at the University of California, Berkeley finds that male frogs exposed to atrazine can become so completely female that they can mate and lay viable eggs.[19] In 2008, atrazine, along with chlorpyrifos, endosulfan, and metolachlor, were identified by USGS, with other contaminants, as possible suspects in the alarming discovery of "intersex" fish –male fish producing eggs– in the Potomac River,[20] which flows through downtown Washington, DC. These pesticides are noted endocrine disruptors capable of affecting hormones in wildlife. Alarmingly, research (2011) shows that women who drink water containing low levels of atrazine, which has been detected in drinking water, may be more likely to have irregular menstrual cycles and low estrogen levels, even at concentrations far below federal drinking water standards considered safe by the EPA.[21]

In Connecticut, a state-sponsored study (2012) detected residues of mosquito control pesticides in lobsters pulled from Long Island Sound. Three common mosquito control chemicals –malathion, methoprene, and resmethrin– were found in the lobsters tested. These chemicals, and their chemical classes, organophosphates, insect growth regulators, and synthetic pyrethroids, respectively, are frequently used for mosquito control, and are known to be toxic to many aquatic species, including crustaceans.

Conclusion

Growing food with a reliance on toxic pesticides has resulted in the nation's waterways being heavily contaminated with toxic chemicals. Organic farming demonstrates clearly that relying on toxic chemical inputs for crop yields is not only unnecessary, but serves to protect waterways and public health from chemical pollution. Creating healthy soils, which is the foundation of organic systems, conserves water, nurtures fertility, leads to less surface runoff, and reduces the need for nutrient input. With less toxic pesticide use, organic farming helps to protect the quality of the nation's waterways.

How Does Organic Farming Protect Water Quality?

- ***Reduces/Eliminates Pesticide Runoff–*** Organic farming and land management reduces or eliminates water pollution and helps conserve water and soil. According to the Food and Agriculture Organization (FAO), several countries in Europe compel or subsidize organic farmers to use organic techniques specifically to combat water pollution problems.[22]
- ***Reduces Nutrient Runoff–*** Organic standards stipulate that soil fertility and crop nutrients can be managed through tillage and other cultivation practices, such as crop rotation, which preserve and maintain the fertility of the soil so that synthetic inputs become unnecessary. Organic therefore eliminates the need and use of synthetic nitrogen/phosphorus-based fertilizers, thereby significantly reducing the threats that nitrogen and phosphorus runoff have on aquatic ecosystems and the prevalence of algal blooms and eutrophication.
- ***Prohibits the Use of Sewage Sludge/Biosolids–*** Organic does not allow the use of sewage sludge, which is often contaminated with a host of chemicals, including heavy metals, pharmaceuticals, and pesticides. These can all re-enter the aquatic environment once the sludge is recycled on land.
- ***Prohibits Genetic Engineering–*** Genetic engineering that incorporates the popular herbicide-tolerant, Roundup Ready corn and soybeans, or insecticidal genes into plants, is prohibited in organic. Genetically engineered (GE) crops have led to an increase in herbicide use, as farmers are able to apply these chemicals without killing their crop, and weed and insect resistance.

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