FARMING WITH FOOD SAFETY AND CONSERVATION IN MIND

Updated January 2013

Food-borne illness linked to pathogens in meat, processed food, and produce has led to increased attention to food safety issues at all points along the supply chain, including the farm. Farmers *can* produce safe food without sacrificing responsible on-farm conservation measures, such as maintaining riparian habitat or other non-crop vegetation. Some corporate buyers, attorneys, marketers, and food safety regulators have suggested that such practices may pose risks on the assumption that wildlife may carry pathogens. On the contrary, research so far demonstrates that wildlife usually have a low prevalence for carrying food-borne pathogens. Evidence indicates that conservation practices and natural areas can often reduce pathogen risk while providing many other benefits, such as soil and water conservation, and habitat for pollinators and beneficial insects. By using risk assessment strategies and explaining their rationale for management decisions that include conservation measures, farmers can more effectively advocate for their farming practices with buyers and food safety auditors.

How Did We Get Here?

Long before 2006, when *E. coli* O157:H7 made its way into packaged fresh-cut spinach—killing five people and sickening more than two hundred—food safety auditors were on Salinas Valley, California, farms. The *E. coli* outbreak was not a new phenomenon. Numerous such incidents had occurred since 1993. But the deaths and large numbers of people sickened by the produce in 2006 generated a strong response from the produce industry and the Food and Drug Administration (FDA). Response to a broad FDA Consumer Advisory effectively shut down spinach sales, causing large financial losses in spinach and other sectors of the produce industry. The handlers within the industry responded by creating the California (and later Arizona) Leafy Green Products Handler Marketing Agreements (LGMA), which require participating leafy greens handlers to ensure that their farm suppliers are practicing Good Agricultural Practices (GAPs) that the Agreements define.


What do hedgerows, cover crops, and grassed waterways have in common? Food safety!

Unknown Culprit - Misguided Reaction

A series of investigations following the 2006 outbreak examined both the field from which the spinach was harvested and the surrounding area. The outbreak strain was identified in cattle and feral pig fecal matter, surface water, sediment, and soil samples collected during this investigation. In general, cattle are a primary reservoir for *E. coli* pathogens. The pathway by which the pathogen may reach produce, however, remains unclear. In the 2006 outbreak, investigators could not definitively identify the pathway, but they theorized that irrigation water contaminated with manure may have been problematic. Because the outbreak strain of the pathogen was also found in non-native feral pig feces (known also as wild pigs, wild hogs, wild boars, European wild boars, Russian wild boars, or razorbacks), these animals were also discussed as potential sources of the pathogen in the produce growing area. The California LGMA listed cattle, sheep, goats, domestic and feral pigs, and deer as animals of significant risk, though the low prevalence of the pathogen in deer populations led many to challenge the appropriateness of including deer. It is important to take samples directly from an animal, not from feces on the ground that can be contaminated by other sources and/or deposited by an unknown number of animals. For example, the report of deer feces found with *E.coli* pathogens in Oregon strawberries was from feces on the ground. It is impossible to determine whether a high percentage of the deer were infected in that region, or if the sample came from a few deer.

The 2006 spinach *E. coli* outbreak and the inclusion of deer in the LGMA list of animals of significant risk increased concerns about wildlife habitat near production areas. The resulting proliferation of food safety metrics created a food safety arms race for marketing purposes. Growers found themselves required to meet increasingly stringent food safety requirements and to accommodate multiple food safety audits. In response to this pressure from food safety auditors, growers trapped, poisoned, shot, and fenced out wildlife. Natural habitat was denuded and conservation plantings—paid for by public and private funds—were removed. The prevailing sentiment was “Food safety trumps the environment,” and farms on the Central Coast of California were increasingly devoid of wildlife and any habitat that might support them. Unfortunately, quite often the vegetation removed was a critical component of sound soil and water quality conservation as well as wildlife habitat.

As understanding has increased regarding the prevalence of pathogens in wildlife and the pathways by which pathogens may move, it has become clear that the initial measures taken following the outbreak should be reconsidered. The concerns regarding wildlife created by some food safety metrics have been hard to dispel. At times they have led to the rigid application of conservation-threatening metrics in crops that present minimal to no food safety risk. Such a misguided focus on wildlife in food safety regulation has led to the removal of conservation measures that could actually benefit food safety, with little thought to the ecosystem services and public health benefits these features provide.

Bulldozing a twenty-acre lake (left) near Salinas, CA to keep food safety auditors happy cost the farmer plenty to carry out. Now it is costing more with water agencies requiring that the denuded lake (right) be restored.

Relative Food Safety Risk of Wildlife

Native wildlife species pose a low relative risk of carrying human pathogens such *E. coli* O157:H7 and *Salmonella (*prevalence in wildlife generally <3%). When wildlife share rangeland or water sources with higher risk beef cattle, feral pigs, hog or dairy operations, it is probable that contamination occurs, though this cross-contamination has not been well demonstrated. The risk of extensive contamination from wildlife is not zero—and will never be zero—but it is low. Despite this, if population density in the growing area is high for a wildlife species, steps should be taken to reduce wildlife activity, since the risk of contamination will increase.

Deer studies have found low prevalence of pathogens, even when they share rangeland with cattle (which may have much higher pathogen prevalence). Ongoing research has thus far found little evidence to support the intense focus on these animals as a food safety risk. Many growers already manage deer populations because the animals damage or consume crops. Of greater significance than the loss of deer themselves is the removal of their habitat. This habitat not only supports many other kinds of wildlife, but also acts as a 'natural filter' that provides us with clean air and water.

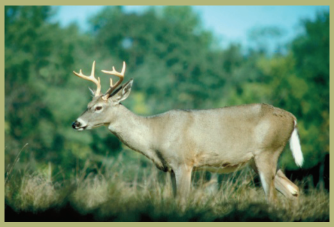
Feral pigs frequently share rangeland with cattle and consume cattle manure, which may increase the odds that they will carry pathogens. Prevalence data for these animals is scarce but indicates that they may carry food-borne pathogens at a higher rate than native wildlife. Populations may be quite high in some areas, and in this case control is warranted. Non-native feral pigs present a conservation challenge; therefore hunting and trapping are common population control measures.

Rodents living in the field show a low prevalence of *E. coli* pathogens, although some ground squirrels and deer mice have been detected with higher levels of *Salmonella* and other food-borne pathogens. Non-native rats and mice found around farm structures can carry many types of diseases. When rodents are in large numbers, or living near farm animal operations and polluted areas, steps to reduce them may be needed.

Birds pose a greater food safety risk when they inhabit areas with high levels of pathogens. Research has found increased levels of pathogens in birds that frequent landfills, feedlots, dairies, cattle ranches, or pig farms. Birds can transfer pathogens from these sites.

Flies can also carry pathogens from infected manure to crops, but they typically stay close to manure unless drawn by other food sources, such as honeydew secreted by an aphid infestation in a crop.

Reptiles and amphibians (such as lizards and frogs) can carry *Salmonella*, especially when kept as caged pets. Emerging research in the Central Coast of California is showing that there is a risk - albeit low - of frogs in the wild carrying *Salmonella.*



General Advice for Animal Management

Rather than striving to eliminate all wildlife, optimize features on the farm to encourage habitat-dependent species to stay in their preferred natural environment and out of the crop.

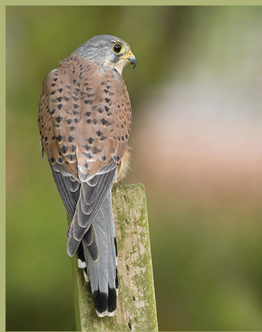
Livestock are easier to manage than wildlife. Exclude non-draft animals from fields during the growing season, especially close to harvest time. Catch manure of draft animals.

Monitor crop fields for animal intrusion and designate a no-harvest zone if fecal matter is present, depending on the crop spacing and other features of the farm.

When there is unusually heavy wildlife activity in the field, use loud noises, sprinklers activated by motion sensors, scare balloons, food attractants placed in other areas, and fencing to discourage wildlife from entering the crop area.

To deter wildlife, place fences around the growing fields only, not around the whole farm. Fencing individual fields rather than the entire property allows corridors for wildlife movement.

Avoid removing vegetation in and around growing areas, especially plants used in conservation practices, established riparian zones, or other natural areas. Removal may increase pathogen risk and have adverse impacts on public health.



Specific Wildlife Considerations

Deer: If deer are present in large numbers, steps may be needed to reduce entry, but removing habitat is counterproductive.

Feral Pigs: Hunt or trap feral pigs, or if they are continuously present in large numbers, install a short hog wire fence. Habitat removal will not effectively eliminate the animals.

Rodents: Control rodents near packing facilities, or when there is a high population in the field, particularly when they may have access to polluted areas or animal operations. Encourage predatory hawks and owls by providing birds with roosts and habitats, especially when rodent population density is high.

Birds: Birds could cause concern on farms situated near operations where copious manure or pathogen-rich wastes collect (e.g., landfill and feedlots). Birds should be discouraged from collecting at these sites, and should be dissuaded from moving into crop fields from these sites.

Flies: Farms located very near operations where significant amounts of manure accumulate should manage crop attractants (e.g., aphid populations that generate honeydew) so they do not draw flies.

Amphibians: Maintain vegetated buffers between water sources (where amphibians are likely to be more abundant) and crops to provide a preferred habitat.

Why Soil Microbial Diversity is Important to Public Health

Cover crops and compost support diverse microbial soil populations by increasing the organic matter content of the soil. As microorganisms decompose these materials, they create humus. This complex organic material provides numerous soil health benefits, such as improved soil structure and water holding capacity, increased nutrient holding capacity, improved nutrient cycling and long-term carbon storage in the soil.

Soil management practices can increase or decrease plant and human pathogens in the growing environment. For example, manure slurries may create conditions that favor pathogen survival in the soil. Composted manure provides nutrients and organic matter with less risk of pathogen contamination, since pathogens are killed when proper composting methods are followed. In general, *E. coli* O157:H7 survives best in anaerobic, carbon- and nutrient-rich conditions, such as those found in the guts of ruminant animals, its natural host. Management practices that influence carbon and nutrient supply may influence pathogen survival. Use of cover crops, compost, and other high-quality organic matter inputs encourage diverse soil microbial populations, which enhance suppression of soil-borne plant pathogens through competition and lower survival of *E. coli* pathogens in soil. Food safety and public health require careful consideration of soil management strategies that may impact pathogen sources and survival.

Vegetation's Filtering Capacity

E. coli and *Salmonella* pathogens may wash into surface waters and be carried with dust particles blowing in the wind. Grasses, vegetated buffers, and wetlands can effectively decrease water-borne pathogens by intercepting them as they move off the landscape toward surface waters. Hedgerows and windbreaks can help filter air-borne pathogens. They also support pollinators and other beneficial insects. Increased pollination enlarges fruit set, and a third of our food supply depends on pollinators. Predator and parasitic insects help to control pest insects. Biological control of pests provides public health benefits by reducing pesticide use and protecting pollinators, which are in decline worldwide.

A grass strip just one yard wide can remove up to 99 percent of *E. coli* organisms from overland flows across rangelands by trapping fecal matter and filtering surface flow water. Natural wetlands can filter up to 91 percent of *E. coli* organisms from water moving off rangelands. Vegetation connected to settling basins can also significantly reduce pathogen movement. The ability of vegetation in ditches and ponds to reduce pathogen movement to surface waters, as well as nutrient, pesticide, and other contaminants, depends on how much contact the water has with the vegetation and how quickly it flows past the vegetation. Longer residence times remove more pollutants. In crop production areas,

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Compost Considerations

When compost is made correctly, there is little chance of pathogens persisting in the finished product. To reduce pathogen risk from composted manure and to decrease the likelihood of pollution, keep the following considerations in mind:

- Bring compost to 131 degrees Fahrenheit for 15 days to kill pathogens with the heating process.
- All parts of the compost must be heated quickly. If it takes too long to heat up, pathogens may develop resistance to subsequent heat treatment thereby allowing their survival.
- Temperature should ideally arrive at the killing level within two days.
- Aerate compost by turning it regularly (a minimum of five times), so high and low temperatures alternate; varied temperatures are more harmful to pathogens than constant temperatures.
- Cover the pile with finished compost or a tarp to help ensure that all parts heat equally, so the edges reach killing temperatures.
- Control moisture and carbon to nitrogen ratio (C/N), as pathogen survival increases when these fall outside optimum ranges. Optimum moisture content is approximately 50 percent, and an appropriate carbon/nitrogen ratio is approximately 25:1 – 40:1. The C/N ratio is controlled by choice of materials added to the compost.
- Test finished compost for *E. coli* O157:H7 and *Salmonella*. Commercial composters that follow best practice management make results available to their customers.
- Take care not to re-inoculate finished compost with pathogens by using unsanitized equipment to move or spread the finished product.
- Locate the compost site a minimum of three hundred feet away from waterways.
- Divert clean surface water away from the composting site so it does not become contaminated.
- Change into clean clothes and footwear after touching manure or compost, particularly before harvesting and handling food crops.
- The National Organic Program offers additional guidance on recommended composting practices. See section 205.203: Soil fertility and crop nutrient management practice standard, found here: www.ams.usda.gov/AMSv1.0/nop.

Soil Management Considerations

Cover Crops and Compost: Use cover crops and compost to increase soil organic matter and to encourage diverse microbial soil populations.

Composting Process: Ensure that all composted materials have been produced following recommended practices.

Compost Recordkeeping: Whether making compost on the farm or purchasing it from others, maintain or request records of the process and the materials used to make it, the nutrient content and pathogen test results for finished product, and the finished product storage methods.

Fumigation: Don't fumigate the soil for food safety reasons. Rather than trying to kill all microbes in soils with fumigation, optimize microbial diversity. This will increase competition with pathogens, and may help reduce pathogen survival in the farm environment.

Raw Manure: Use caution in applying raw manure. Until more is known on best practices for safe use, avoid uncomposted manure or follow the National Organic Program regulations that require raw animal manure to be composted unless it is (a) incorporated into the soil not less than 120 days prior to the harvest of a product whose edible portion has direct contact with the soil, or (b) incorporated into the soil not less than 90 days prior to the harvest of a product whose edible portion does not have direct contact with the soil.

ditches are often planted in grasses, sedges, and rushes to help hold soil in place. The wider the ditches, the slower the water will move, which allows more grass surface area exposure and greater pollutant removal.

Hedgerows and windbreaks are also effective at reducing dust movement. When cattle congregate along fence lines or under shade trees, they grind manure underfoot into dust which may become airborne. Pathogen-contaminated dust can also blow in from nearby farm animal operations. For every foot of hedgerow/windbreak height, ten feet of modification occurs downwind; a 30-foot tall planting will provide a 300-foot long wind shadow. Such plantings also reduce pesticide drift and other types of particulate matter air pollution, thereby providing important public health benefits.

Good Food Safety Protocol

It is important to use risk assessment to optimize actions. Before planting crops, assess fields for any food safety problems that may have arisen since the last harvest. These could include new neighboring livestock or contaminated water that may have, or might, flow across the production ground. Other factors to consider include changes on the farm itself, such as a downed livestock fence or an altered wildlife corridor. Just as diligent farmers scout their fields routinely for insects and plant diseases in produce fields, they should scout for wildlife and livestock activity on a regular basis prior to harvest time.

Living systems always carry some risk. Minimize that risk by optimizing the natural services provided by well-managed vegetation, soil, and water—understanding that fostering healthy, balanced, agricultural systems offer the most robust strategy to support public health. Co-management of food safety and conservation on the farm can be attained. The information here will equip growers to evaluate food safety risk factors on their farm and thoughtfully manage to minimize them. A written food safety plan, which describes and explains the farm's management practices, is an excellent step toward avoiding food safety problems.

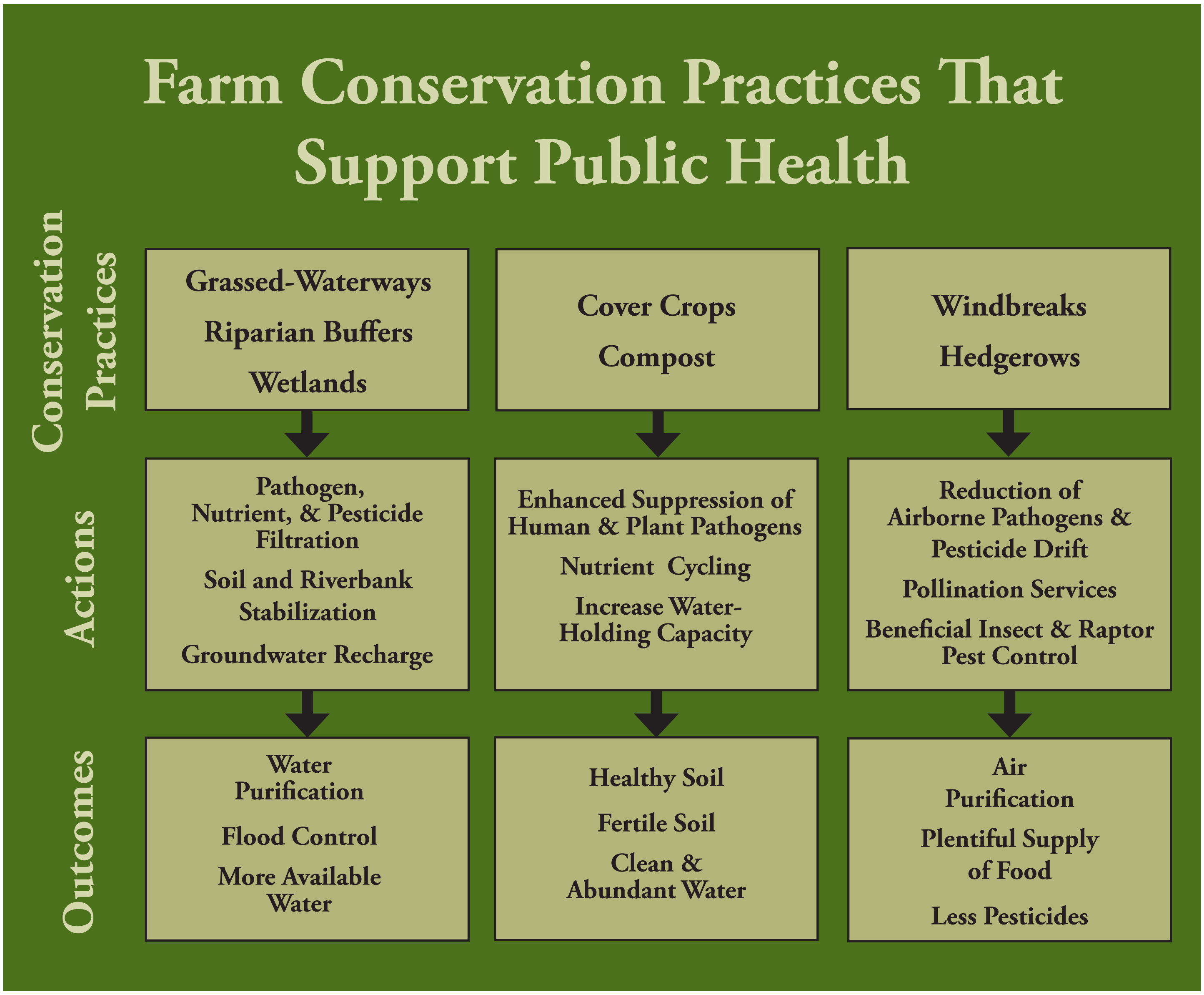
Vegetation Management Considerations

General: Removing vegetation—particularly when it is a part of conservation plantings or natural areas—is not advised. Instead, monitor the crop next to the vegetation for feces and feeding, and take steps to reduce wildlife entry, if warrented.

Grasses and Wetlands: Plant grass filter strips in ditches and between crops and pastureland to reduce pathogen movement in water. Avoid V-shaped ditches; choose U-shaped ditches instead. Conserve and restore natural wetlands. Create wetlands upstream of surface water sources used for irrigation.

Hedgerows and Windbreaks: Use plantings to reduce contamination from pathogen-laden dust, especially when growing crops near operations with significant amounts of manure or locations where animals congregate, such as loafing areas or water sources.

Native hedgerows and restored wetlands can create safe benefits, such as predator and pollinator habitat, dust and erosion control, and pathogen filtration.



For More Information

- To read the scientific articles that support the advice presented here, please see the following websites, or request a written copy using the following mailing addresses:
  - Wild Farm Alliance (WFA) – www.wildfarmalliance.org – PO Box 2570, Watsonville, CA 95077
  - Community Alliance with Family Farmers (CAFF) – www.caff.org – PO Box 363, Davis, CA 95617
- For further help in addressing food safety, see *Family Farm Good Agricultural Practices (GAPs) and Standard Operating Procedures (SOPs)* at www.caff.org.
- The most extensive report on balancing food safety and environmental considerations is *Safe and Sustainable: Co-managing for Food Safety and Ecological Health in California's Central Coast Region* found at– www.wildfarmalliance.org/resources/Safe_&_Sustainable.pdf.
- For some of the latest produce safety research, see UC Davis Center for Produce Safety http://cps.ucdavis.edu.

This brochure was written by Jo Ann Baumgartner of WFA and Dave Runsten of CAFF, July 2011, and updated January 2013.

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