Buyer Conflicts with Conservation Goals

• In 2006, spinach contaminated with *E. coli* O157:H7 caused the death of five people.

• In 2007, 89% percent of growers managing 140,000 acres on California’s Central Coast reported that they had actively discouraged or eliminated wildlife from crop areas.

• Over a 5 year period after the contamination, about 13% of the remaining riparian habitat in CA’s Central Coast region had been eliminated or degraded.
Buyer Conflicts with Conservation Goals

• A recent 2015 study found that reducing wildlife habitat and conservation practices does not reduce pathogen risk.
Is this the Future of our farms?

Help promote biodiversity in agriculture by supporting the Wild Farm Alliance.

www.wildfarmalliance.org
Food Safety Modernization Act

- Take into consideration, consistent with ensuring enforceable public health protection, conservation and environmental practice standards and policies established by Federal natural resource conservation, wildlife conservation, and environmental agencies; and in the case of production that is certified organic, not include any requirements that conflict with or duplicate the requirements of the national organic program established under the Organic Foods Production Act of 1990 (7 U.S.C. 6501 et seq.), while providing for public health protection consistent with the requirements of this Act.
Factors that Influence Pathogen Reduction

- Biotic
- Abiotic

(NOAA)
Biotic Factors - Microbial Interactions

- Kill and consume pathogens
- Outcompete pathogens for food, water, space
- Make conditions unfavorable by exuding toxins
Biotic Factors - Harborage

- Biofilms
- Amoebas
- Algae
Abiotic Factors –
Sunlight/UV Exposure

NRCS
More Abiotic Factors

- Salinity
- pH
- Nutrient Sources
- Temperature
- Moisture and
- Microscopic Niches
Multi-Barrier Approach to Minimizing Food Safety Concerns on the Farm and in the Watershed

• Barriers that Prevent Pathogens from:
  ‒ Entering the Farm
  ‒ Contaminating Produce Crops
  ‒ Spreading from Livestock to the Crops
  ‒ Moving to the Wider Landscape
1st Barrier—Be Aware of Pathogens That May Enter the Farm Through Water and Wind

• Pathogens from neighboring areas
Animals in Nearby Farm

Animals on hillside above crops may increase risk when rain carries pathogens into crop fields.
Animals overly impacting streams can result in polluted water downstream on the farm.
Waterborne Pathways

Processes Affecting Microbial Quality of Irrigation Water

Adapted from: Pachepsky et al. 2011
Prevalence of Pathogens in Domestic Animals

**E. coli 0157:H7**
- Widespread in cattle; higher in CAFOs than on pasture
- Also in pigs, dogs, poultry
- Higher in young than in adults

**Salmonella**
- Poultry
- Pigs
- Cattle
- Other livestock
Prevalence of Pathogens in Livestock

**Campylobacter**
- Most common in poultry
- Cattle
- Other livestock

**Cryptosporidium**
- Cattle
- Sheep
- Goats
- Pigs
- Horses
- Geese
- Poultry

**Listeria**
- Sheep
- Goats
- Cattle
- Other livestock

For a thorough discussion, see *Introduction to Waterborne Pathogens in Agricultural Watersheds*, USDA NRSC Nutrient Management Technical Note No. 9.
1st Barrier — Practices that Prevent Pathogens From Entering the Farm

Intercepting waterborne pathogens

– Diversion (NRCS 362)
– Riparian Forest Buffer (NRCS 391)
1st Barrier — Practices that Prevent Pathogens From Entering the Farm

• Intercepting waterborne pathogens
  – Grassed Waterways (NRCS 412)
  – Filter Strips (NRCS 393)
1st Barrier — Practices that Prevent Pathogens From Entering the Farm

Intercepting waterborne pathogens

- Wetlands
  - Constructed (NRCS 656)
  - Natural Wetlands (NRCS 657, 658, 659)
1st — Barriers that Prevent Pathogens From Entering the Farm

Intercepting windborne pathogens

- Windbreaks (NRCS 380)
- Hedgerows (NRCS 422)
## Land Use Action Plan

State clearly what you plan to do and create accountability.

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### 1st Barrier — Assess Risk of Pathogens Entering the Farm

- **Waterborne Pathogens**
  - Install a Diversion Ditch
- **Neighboring Livestock are Uphill from Produce Fields**
  - Farm’s Designated Food Safety Person
  - Before Field is Planted
  - May Want to Request Assistance from USDA NRCS
  - Check that Diversion is Working During Rainstorms and Record

- **Check In**
  - 3
1st Barrier— Be Aware of Domestic Animals That May Enter the Farm

- Wandering Livestock or Neighbor’s Dogs
1st Barrier — Be Aware of Wildlife That May Enter the Farm

• The risk depends on the type and number of wildlife.
Native wildlife species pose a low relative risk of carrying human pathogens such as E. coli O157:H7 and Salmonella (prevalence in wildlife generally <3%), but in localized areas it may be higher.

[http://www.wildfarmalliance.org/Press Room/WFA_Relative_Risk_Animals.pdf](http://www.wildfarmalliance.org/Press Room/WFA_Relative_Risk_Animals.pdf)
Type of Animals

But it Depends on the Species and Location

Photo Credit for American crows on irrigation pipe: Western Center for Food Safety, UCD; Produce Safety Microbiology Research Unit, WRRC ARS, USDA; Wildlife Services, APHIS, USDA
Animals Associated with Contamination

Animals that frequent contaminated areas can be sources of pathogens.
Recorded Outbreaks Associated with Wildlife

<table>
<thead>
<tr>
<th>Crop</th>
<th>Pathogen</th>
<th>Wildlife</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinach (a)</td>
<td><em>E. coli</em> O157:H7</td>
<td>non-native feral pigs*</td>
<td>California</td>
</tr>
<tr>
<td>Strawberries (b)</td>
<td><em>E. coli</em> O157:H7</td>
<td>deer</td>
<td>Oregon</td>
</tr>
<tr>
<td>Peas (c)</td>
<td><em>Campylobacter jejuni</em></td>
<td>sandhill cranes</td>
<td>Alaska</td>
</tr>
<tr>
<td>Carrots (d)</td>
<td><em>Yersinia pseudotuberculosis</em></td>
<td>shrews</td>
<td>Finland</td>
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* While feral pigs were found with the same DNA pattern of *E. coli* O157:H7 as the spinach, so were nearby cattle and pasture soil, and water/sediments from a creek that may have contaminated the irrigation well.

From (a) Jay 2007; (b) Laidler and Keene 2012; (c) McLaughlin 2008; (d) Kangas 2008.
E. coli 0157:H7 Prevalence in US Native and Non-Native Mammal and Avian Species
Salmonella Prevalence in US Native and Non-Native Mammal and Avian Species
Campylobacter and Cryptosporidium*
Pathogen Prevalence in US Native and Non-Native Mammal and Avian Species

* *
Biodiversity Loss May Increase Pathogen Prevalence

• A study conducted in California suggests that a reduction in rodent species diversity may cause increased pathogen prevalence in the individuals that remain.

• Other research shows that biodiversity loss frequently increases disease transmission.
FDA Proposed Produce Rule

Wild Animals

FDA recognizes that it is impossible to keep all wild animals away from produce fields.

Monitor for Animal Damage and Feces

• During Growth of Crop
• Prior to Harvest

http://www.wildfarmalliance.org/resources/FSMA_1.htm
If damage, or feces is found determine how much of the crop can be harvested.

Determination depends on what can be seen and if part of a field has to be excluded so that harvesting equipment isn’t contaminated.
FDA Proposed Produce Rule

Wild Animals

FDA does not require farms to take measures to exclude animals from outdoor growing areas, or to destroy animal habitat or otherwise clear farm borders around outdoor growing areas or drainages.

FDA does not authorize the “taking” of threatened or endangered species as that term is defined by the Endangered Species Act.
FDA states in the Preamble that the presence of wild animals in a production field of produce, in and of itself, is not a significant food safety risk.

We recommended that the FDA move this language to the main body of the rule.
1st Barrier — Deter Problem Wildlife From Entering the Farm

It will scare the wits out of guys like these.
2\textsuperscript{nd} Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Choosing the Appropriate Sites:

- Avoid frequently flooded land or institute a waiting period after flooding
# Land Use Action Plan

## Area of Food Safety Action

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## 2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

### Choosing Appropriate Sites

| Avoid flooded land or institute a waiting period after flooding        | Destroy Crop; Establish a Waiting Period Before Planting/ Harvesting Depending on Crop | Farm’s Designated Food Safety Person | Crop is Destroyed When Field Dries Out; Waiting Period Begins When Floodwaters Dissipate | Yes. It will Explain Waiting Period Based on Crop Choices | All Farm Staff Must Be Trained Not to Harvest from Flooded Fields | Dates of flood, Dried Field, Planting and Harvesting | 1        |          |
Write a Standard Operating Procedure (SOP)

• Title and Date: Flooded Field; 1/1/15
• Policy: Destroy Crop; Implement Waiting Period
• Purpose: Adulterated Food
• Responsibility: John Doe, Farm Manager
• Materials: Records
• Procedure:
  • 1. Remind Staff of Policy for Not Harvesting Flooded Field
  • 2. Once field is dry, mow first and let dry more.
  • 3. Replant based on waiting period for crop.
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Choosing the Appropriate Sites:
• Avoid nearby or overhead contamination
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Preventing Pathogens from Coming in Contact with the Crop:

- Monitor for animal signs in the crop
2\textsuperscript{nd} Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Preventing Pathogens from Coming in Contact with the Crop:

• Establishing a no-harvest buffer around contamination
2\textsuperscript{nd} Barrier — Reduce Likelihood of Wildlife on the Farm Contaminating Crops

- Double electric deer fencing
- Inexpensive electric pig fencing
- Ground squirrel / rabbit fencing
- Expense pig fencing
2\textsuperscript{nd} Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

Discourage unwanted wildlife in the crop fields by leaving them corridors to get where they need to go.
2nd Barrier — Encourage Raptors to Deter Pests on the Farm Contaminating Crops
2nd Barrier — Other Ways to Deter Rodents on the Farm Contaminating Crops

- Removing brush and cull piles near crops
- Stacking irrigation pipe off ground
2\textsuperscript{nd} Barrier — Reduce Likelihood of Pathogens Contaminating Crops

- Mitigate water quality concerns caused by food safety requirements
2\textsuperscript{nd} Barrier — Reduce Likelihood of Pathogens Contaminating Crops

- Monitoring Water Quality
Proposed FSMA Produce Rule

Farmer must inspect his/her agricultural water system at the beginning of a growing season, taking into consideration:

• Ground water vs. surface water source;
• Farmer’s control over each source;
• Protection of each source; and
• Use of adjacent or nearby land.

http://sustainableagriculture.net/fsma/
Proposed FSMA Produce Rule

Test water when:

• Directly contacts the harvestable portion of a crop prior to, during, or after harvest;
• Directly contacts food-contact surfaces;
• Is used for hand washing during and after harvest;
• Is used to make agricultural teas; or
• Is used to irrigate sprouts.
Proposed FSMA Produce Rule

Doesn’t need to test water when:

• Uses water from public water systems and has public water system results or certificates of compliance;
• Uses an irrigation method that does not directly contact the harvestable portion covered produce (e.g. drip or furrow irrigation); or
• Treats the water according to the water treatment requirements
Sediments and algae blooms can be a key site for pathogen persistence in water bodies.

Biofilms can provide protection from environmental stress and predation by other microbes
Prevent Backflow

- Drain / overflow pipe
- Fill pipe from well
- Potential cross-connection
2\textsuperscript{nd} Barrier — Reduce Likelihood of Pathogens Contaminating Crops

- Nutrient Management
- Irrigation Management
2nd Barrier — Reduce Likelihood of Pathogens Contaminating Crops

- Intercept waterborne and windborne pathogens before they reach the crop

- Diversion (NRCS 362)
- Grassed Waterway (NRCS 412)
- Sediment Basin (NRCS 350)
- Filter Strips (NRCS 393)
- Windbreaks (NRCS 380)
What Action Should Be Taken?

A row crop operation is sourcing water from an open pond on-site for overhead spray irrigation.

• The operation has no testing data but claims there are no risks because their children swim in it.
What Action Should Be Taken?

Compost being spread on a field adjacent to a strawberry operation just prior to harvest.

•The operation’s pre-harvest assessment was performed prior to the compost being spread and did not comment on it. The strawberry operation has no protection against wind drift and compost drift is visibly coming onto the field. The food safety plan has no provision for the event.
Persistence of Soil Pathogens

• Examples of Pathogen Persistence
  – *E. coli* O157:H7 (25 - 226 days)
  – *Salmonella* (7 - 332 days)
  – *Campylobacter* (31 – 64 days)
  – *Listeria* (43 - 128 days)
  – *Cryptosporidium* (<1 year)
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

- Soil management practices that reduce pathogens
  - Using manure and waiting between applications and the next harvest
FDA Re-Proposed Produce Rule

Soil Amendments of Animal Origin

If soil touches crop, the interval between application and harvest:

• Untreated Manure – must wait 9 months between application and harvest
• FDA retracted this until more research is done.
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

- **Soil management practices that reduce pathogens**
  - Cover cropping and crop rotations
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

- *Soil management practices that reduce pathogens*
  - Using compost as an alternative to raw manure
FDA Re-Proposed Produce Rule

Soil Amendments of Animal Origin

• Compost — must wait 45 days
• FDA retracted this for good.
2nd Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

- Soil management practices that reduce pathogens
  - Using green waste
Keep Records of Soil Amendment Use

- Source and methods used to produce compost or the manure storage time.
- Application rates, timing, and fields receiving manure or compost.

<table>
<thead>
<tr>
<th>Date</th>
<th>Field Applied</th>
<th>Rate</th>
<th>Incorporated (Yes or No)</th>
<th>Supplier</th>
<th>Crop Planted (Type and Date)</th>
<th>Crop Harvested (Date)</th>
<th>Initials</th>
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Reviewed By: ___________________________  Title: ___________________________  Date: ___________________________
2\textsuperscript{nd} Barrier — Reduce Likelihood of Pathogens on the Farm Contaminating Crops

- \textit{Soil management practices that reduce pathogens}
  - Contaminated site management
3rd Barrier — Reduce Spreading Pathogens to Crops When Livestock are on the Farm

- Avoiding contamination
- Decreasing pathogens through air and water management
- Restricting wild and feral animals that move between livestock areas and crop fields
3\textsuperscript{rd} Barrier — Reduce Spreading Pathogens to Crops When Livestock are on the Farm

- Using waiting period between fecal deposits and harvest
3rd Barrier — Reduce Spreading Pathogens to Crops When Livestock are on the Farm

- Managing animals used for weeding, or guarding crops or livestock
# Land Use Action Plan

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## 3rd Barrier — Reduce Spreading Pathogens to Crops When Livestock are on the Farm

| Avoiding contamination (place food and water sources away from crops) | Establish Waiting Period Between Chicken Presence and Apple Harvest | Farm’s Designated Food Safety Person | Before Chickens are Brought into Apple Orchard | No | All Farm Staff Needs to Know That Chickens Can Not Be Present For a Time Before Harvest | Note Date Chickens are Brought into the Orchard and When They are Removed | | | | |
3rd Barrier — Reduce Spreading Pathogens to Crops When Livestock are on the Farm

- Managing animals used for traction
FDA Re-Proposed Produce Rule

Domestic Animals

FDA still requires waiting period between grazing and time of harvest for produce in any growing area that was grazed.

We recommended they retract this until further research is completed.
4th Barrier — Prevent Pathogens From Leaving the Farm

• Placing manure and compost stockpiles away from water sources
• Intercepting waterborne pathogens
Farm Conservation Practices That Support Public Health – Specifically Food Safety

- Grassed Waterways
- Riparian Buffers
- Wetlands

- Cover crops
- Compost

- Windbreaks
- Hedgerows

Soil Microbes Outcompete and Kill Human Pathogens

Water Quality

Air Quality

Cover crops
Compost

Grassed Waterways
Riparian Buffers
Wetlands

Windbreaks
Hedgerows

Nutrient Cycling
Increase Water Holding Capacity

Nutrient and Pesticide Filtration
Soil and Riverbank Stabilization
Groundwater Recharge

Reduction of Airborne Pesticide Drift
Pollination Services
Beneficial Insect and Raptor Pest Control
Map Your Farm

What potential contamination risks do you have?

What beneficial conservation practices can you use?
Food Safety Without Compromising Natural Resources

www.wildfarmalliance.org