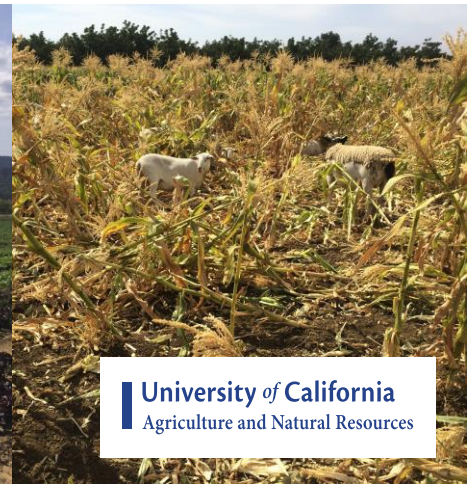


Livestock on Bio-diversified Farms: Food Safety Risks

**On Farm Food Safety:
A 4-part June Workshop Series for Produce Farmers
June 20, 2016 - Petaluma**

**Alda Pires, DVM, MPVM, PhD, Dipl. ACVPM
Urban Agriculture & Food Safety, ANR UC CE Specialist
School of Veterinary Medicine**



What is Cooperative Extension?



* Extension Specialists,
Researchers and Farm
Advisors

Mission Statement:

Statewide Network of researchers and educators focused on the creation and application of knowledge in agriculture

- 200 locally based CE advisors and specialists
- 57 local offices
- 130 campus based CE specialists
- 9 research and extension centers
- 700 academic researchers

- <http://ucanr.edu/>

University of California
Division of Agriculture and
Natural Resources

A Celebration of Science and Service

100
UC Cooperative
Extension



Food Animal Clinician (small - large - scale farms) and Lecturer, Portugal & UC Davis



Hopland REC



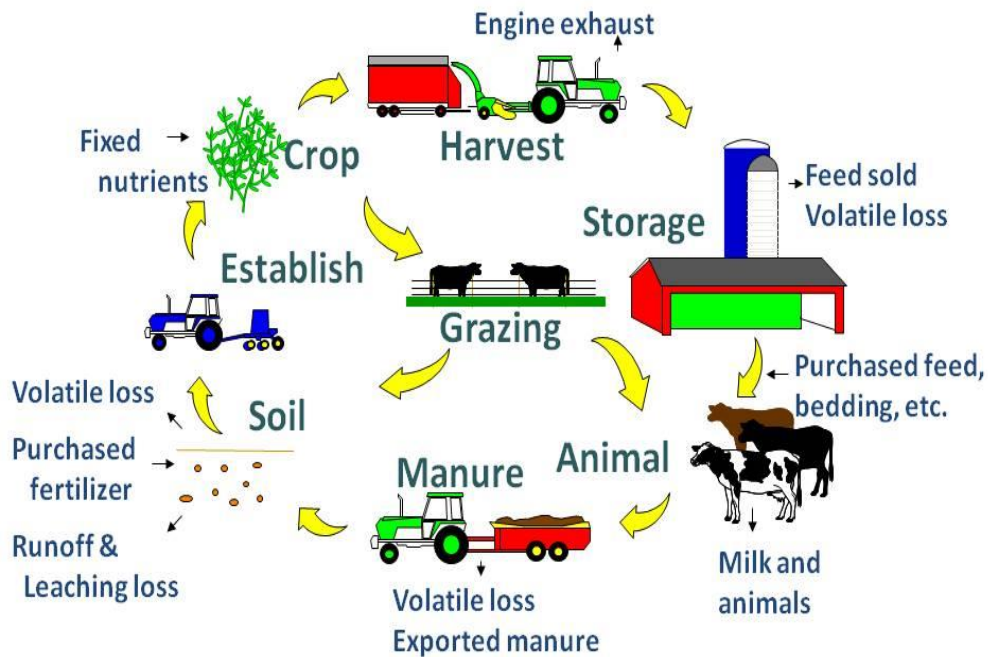
Sierra Foothill REC




Veterinary Epidemiologist (Food Safety & Epidemiology of Infectious Diseases), MSU & UC Davis

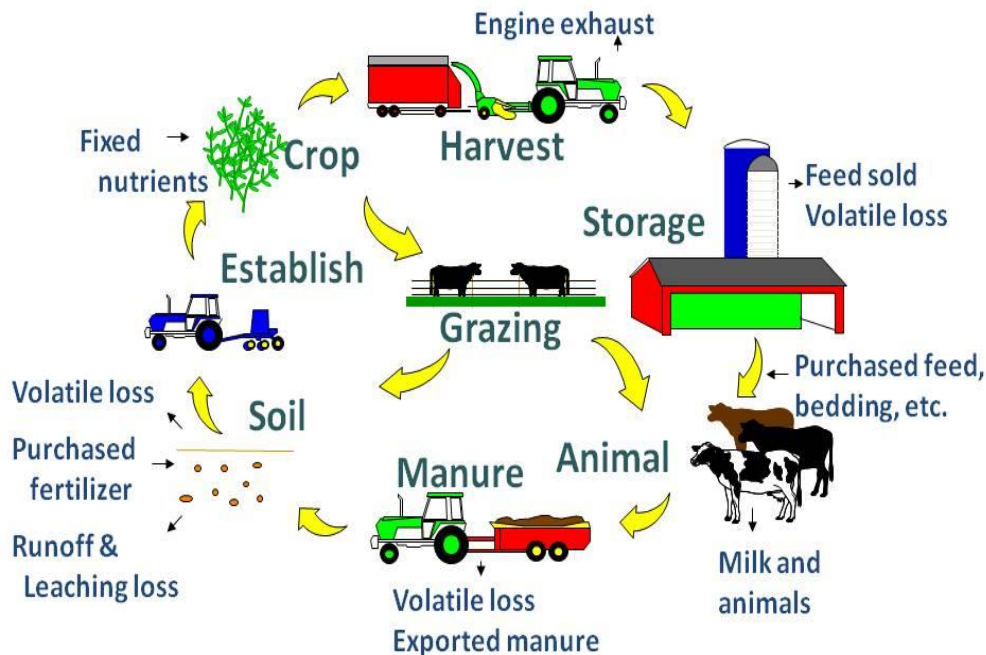
Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

- Mixed/integrated crop-livestock systems are farms where animals and crops are raised with the goal of utilizing the products of one for the growth of the other (*Hilimire, 2011*)



Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

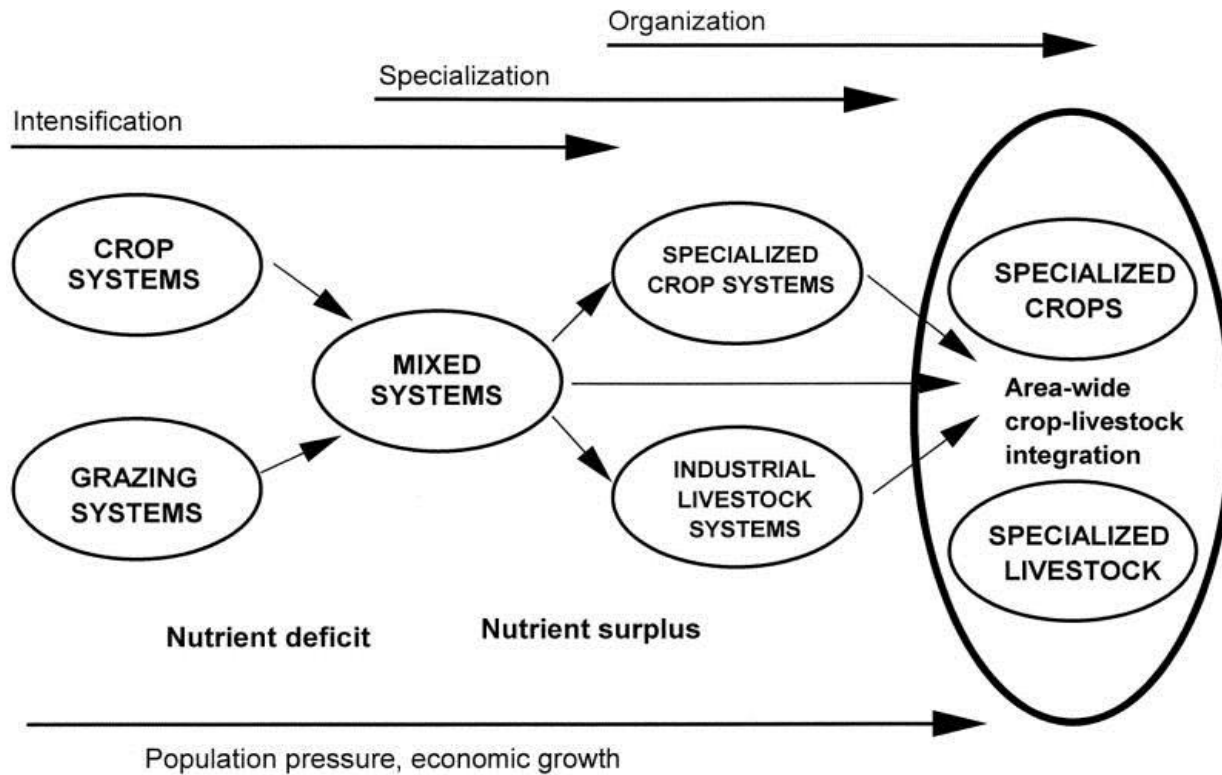
- Mixed/integrated crop-livestock systems are farms where animals and crops are raised with the goal of utilizing the products of one for the growth of the other (*Hilimire, 2011*)



Adapted from www.ars.usda.gov

- Other terms:**
 - Mixed crop-livestock systems
 - Integrated farms
 - Bio-diversified farms
 - Diversified farms

Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*



Pathways of crop-livestock integration

Adapted Steinfeld, 1998

Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

Specialized systems

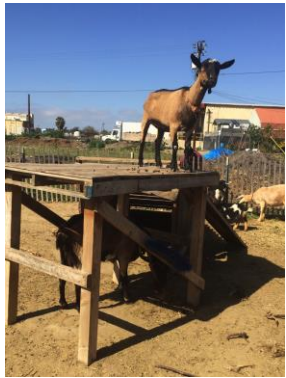


Integrated systems



Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

Spatially Separated



Rotational



Fully Combined



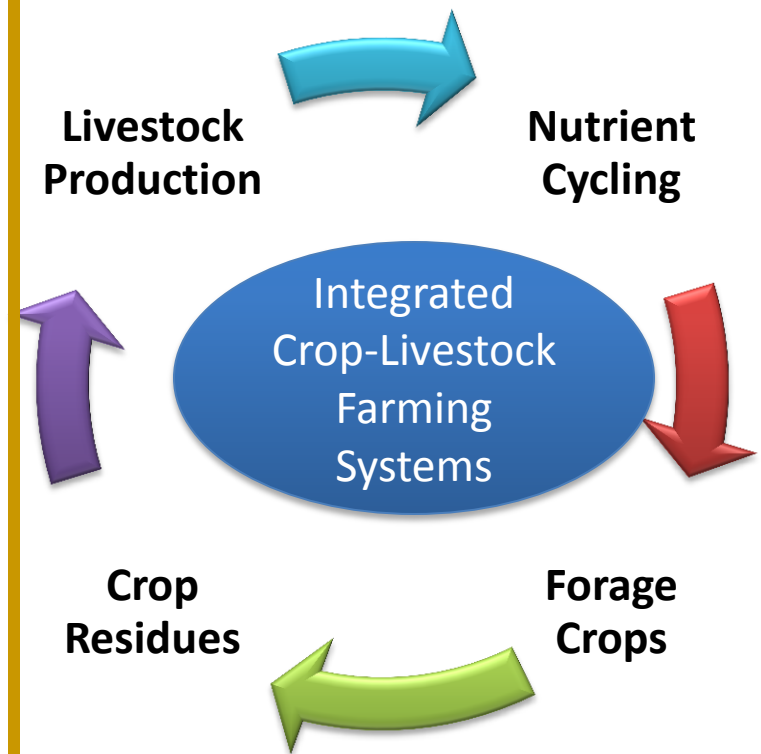
Adapted from reuters.com

Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

Benefits

- **Fertilize the soil** with on-farm input, livestock manure
- Encourage and allow growers to maintain **semi-permanent pasture fields**, which can **improve soil quality**
- Increase **crop yield**
- Enhance **on-farm bio-diversity** and related **ecosystem services**: pollination, weed/pest management
- Enhance **economic gain** to growers
- Confer **social benefits** to growers and communities
- **Sustainability**

(Hilimire, 2011)



Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

Challenges

- Confronting a loss of **animal husbandry knowledge***
 - **Animal Health**
 - **Cross-species Transmission & Cross-Contamination**
 - **Parasites**
 - **Enteric/Foodborne Pathogens**
- **Food Safety Concerns (new regulations)**
- Erosion of **Animal Genetic Diversity***
 - **Heirloom species**
- Limited **Meat Processing Infrastructure** for small-scale production*

(*Hilimire, 2011)

Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

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(*Hilimire, 2011)

Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

What are the risks?

- Predators
- Contact with wildlife
- Transmission of diseases
- Management/Husbandry practices to keep animals healthy



Grazing turnips in the fall provides sheep and goats with "clean" grazing and excellent nutrition during breeding season. Photo: Linda Coffey, NCAT

Adapted from, IP401, www.attra.ncat.org



Adapted from IP453, 2013 www.attra.ncat.org

Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

Animal and Herd/Flock Health

- Maintaining an herd/flock healthy
- Good Husbandry Practices
- Preventive Practices
- Biosecurity
- Minimize the contact with wildlife
 - pasture pigs & feral pigs (zoonotic diseases)
 - pasture poultry & waterfowl (ex: AI)
- Close Herd
- **Pasture Management**



Adapted from MA&VA CE



Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

Grazing behaviors:

Dietary Preferences for different livestock species



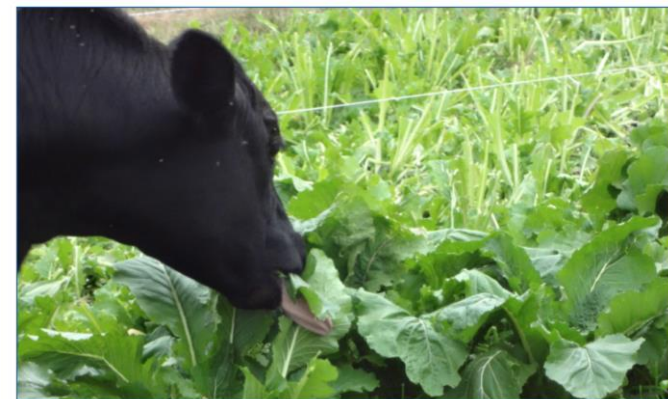
Cows prefer grass; sheep prefer forbs; goats prefer trees and shrubs. Nevertheless, there is regular crossover among the three types of feeders.

Species	Grass (%)	Weeds (%)	Browse (%)
Horse	90	4	6
Cattle	70	20	10
Sheep	60	30	10
Goats	20	20	60

Source: Multi-species Grazing can Improve Utilization of Pastures



Grazing buffer zones, lanes between tree rows, and riparian edges can help maintain the landscape while making these areas productive parts of the farm.
Photo: Joan Burke, USDA, ARS



Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

Parasites in Ruminants

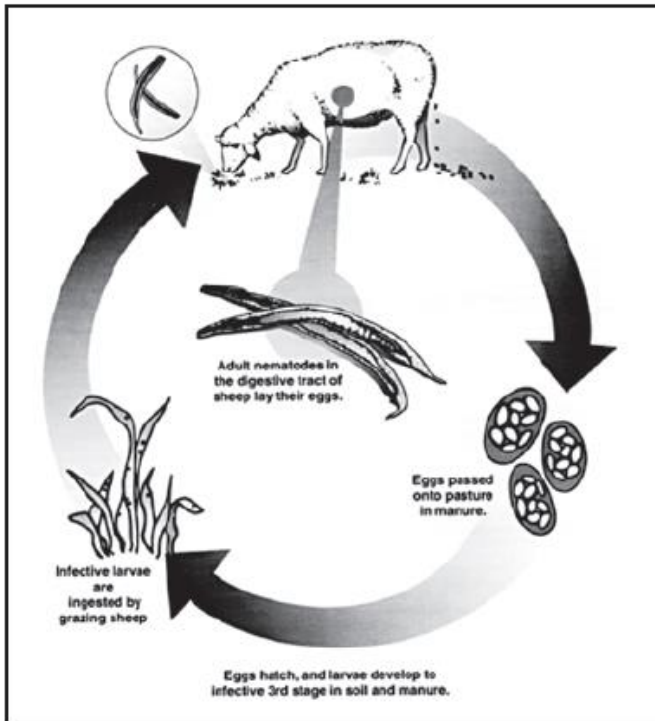


Figure 1: The lifecycle of a gastrointestinal parasite. This image is courtesy of Virginia Tech Cooperative Extension.

Adapted from MA&VA Cooperative
Extension Parasite Control Fact Sheet

Parasites

- *Nematodes (Roundworms):*
- Abomasum:
 - *Haemonchus* spp (sheep, goats, cattle)
 - *Ostertagia* spp (cattle)
 - *Trichostrongylus* (ruminants, horses)
- Small Intestine
 - *Trichostrongylus*
 - *Cooperia*
- Lungs
 - *Dictyocaulus* spp
- *Protozoa (coccidia)*
- *Trematodes (flukes)*
- *Cestodes (tapeworms)*

Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

Parasites in Ruminants

Prevention:

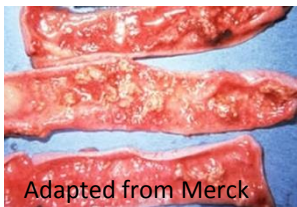
- Pasture Rotation
- Avoid overgrazing
- Animal Management
- Multi-species grazing
- Rotation between different anthelmintic
- Herd dogs (parasites)



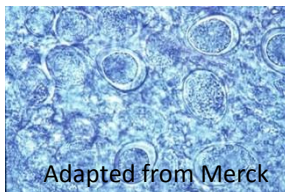
Figure 5: This picture shows a goat that is browsing, or grazing at shoulder-height.

Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

Parasites in Poultry



Adapted from Merck

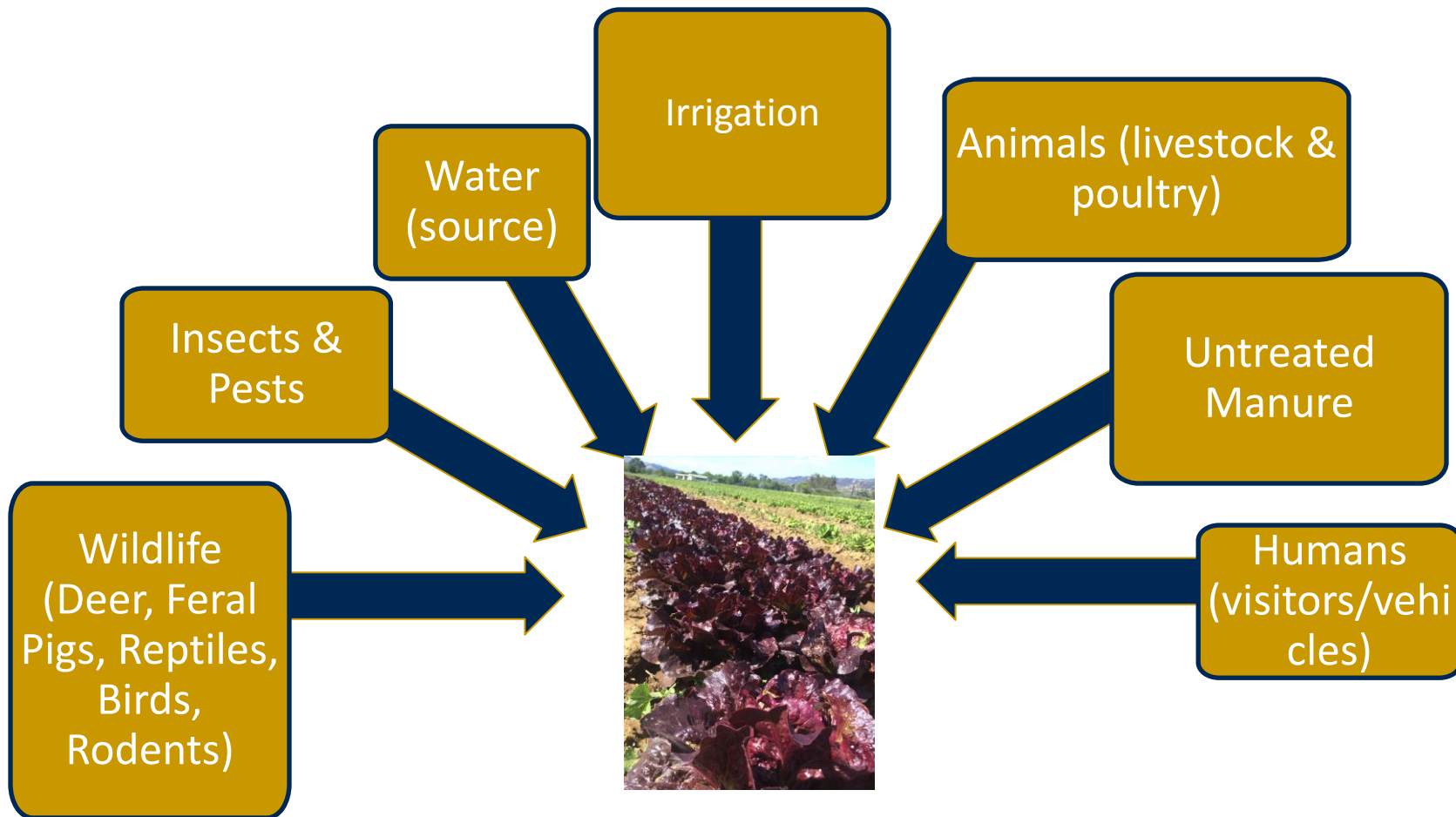


Adapted from Merck

Coccidia

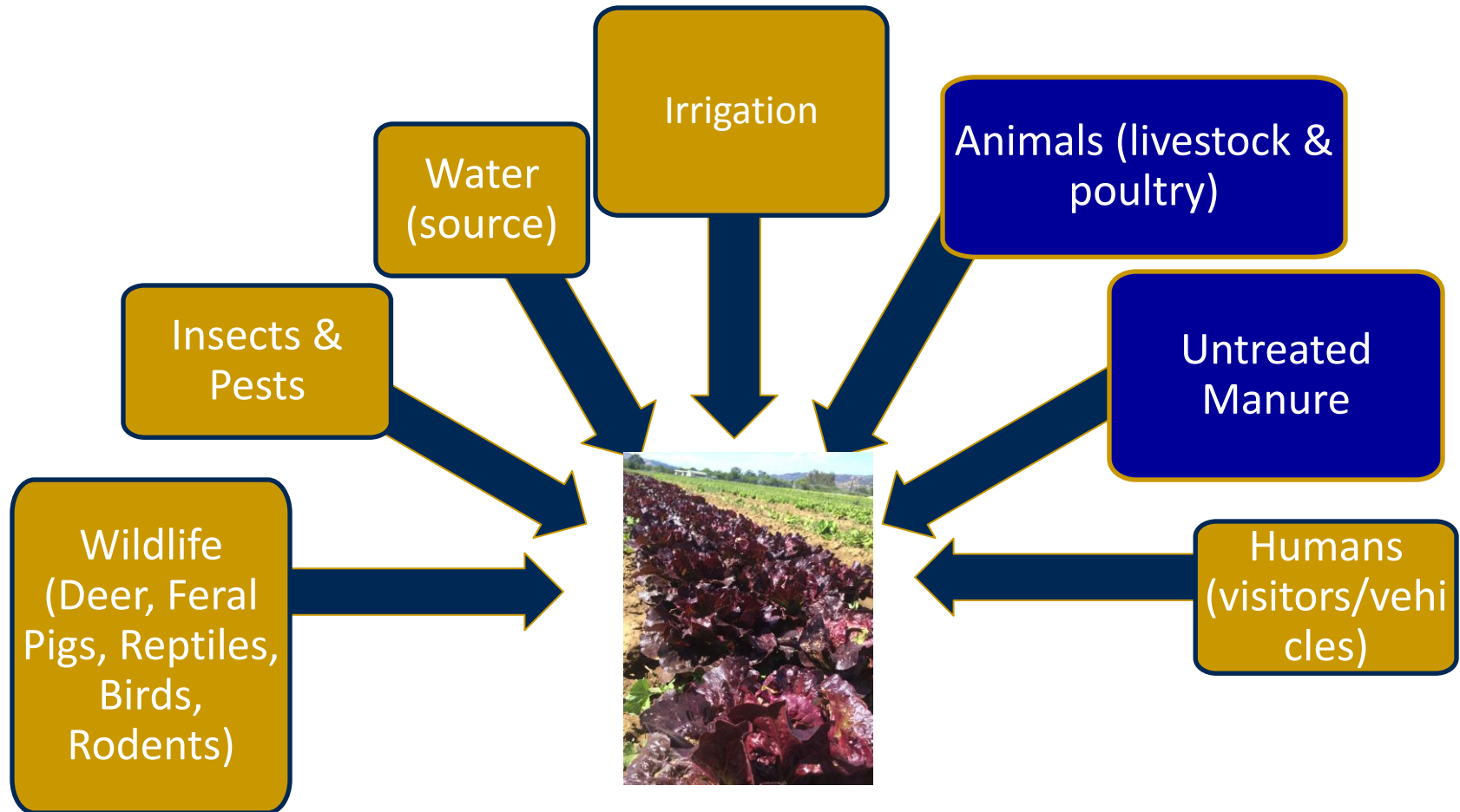
- Host and site specific (GI)
- Occurs under conditions of warmth and humidity (e.g., wet litter)
- One sporulated oocyst can produce 100,000 offspring!
- Oocyst very resistant (can survive 18 months in the environment)

Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*



Introduction of Foodborne Pathogens in produce crops

Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*



Introduction of Foodborne Pathogens in produce crops

Livestock on Bio-diversified Farms:

Some definitions

- **Foodborne Pathogens:** a biological infectious agent (bacteria, virus, parasites) that causes foodborne illness to host (food poisoning)
- **Food poisoning** is any illness resulting from consumption of contaminated food

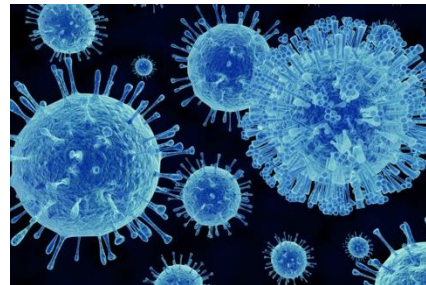
Bacteria:

- *Campylobacter*
- *Salmonella*
- *E. coli* O157:H7
- *E. coli* non –O157 STEC
- *Listeria monocytogens*
- *Shigella*
- Staphylococcus



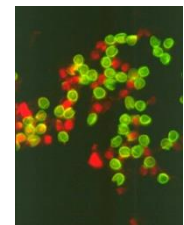
Virus:

- Noravirus
- Rotavirus
- Hepatitis virus



Parasites:

- Cryptosporidium
- Cyclospora
- Toxoplasma
- Trichinella



Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

- **Bacteria** can be found in the **gastro-intestinal tract** of a wide variety of **domestic** and **wild animals**

Bacteria:

- *E. coli* O157:H7
- *E. coli* non-O157 STEC

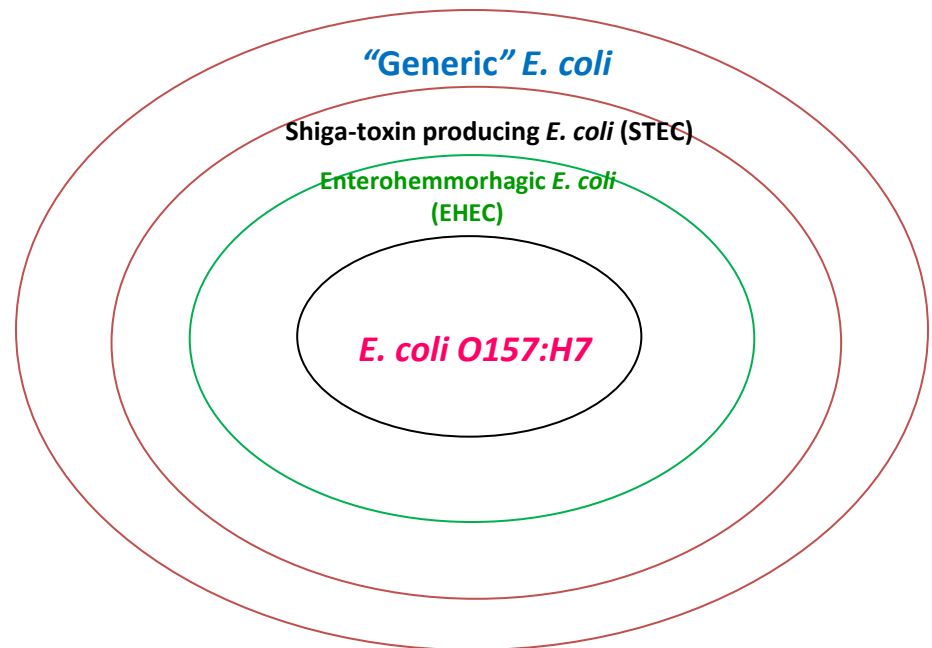


Diagram courtesy of Dr. Jay-Russell

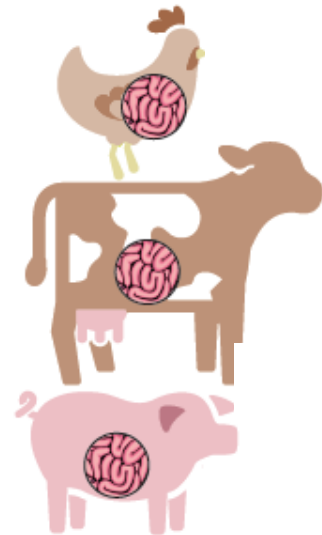
Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

- Certain **animals** are **reservoirs** for certain pathogens
- What can **affect animals shedding** in their manure
 - Age (e.g. young animals)
 - Husbandry practices (e.g. stocking density)
 - Diet (e.g. distillers grain)
 - Season (summer)
 - Environmental conditions

Salmonella
Campylobacter

E. coli O157:H57
Salmonella
Campylobacter

Salmonella
Campylobacter



Adapted from CDC, NARMS

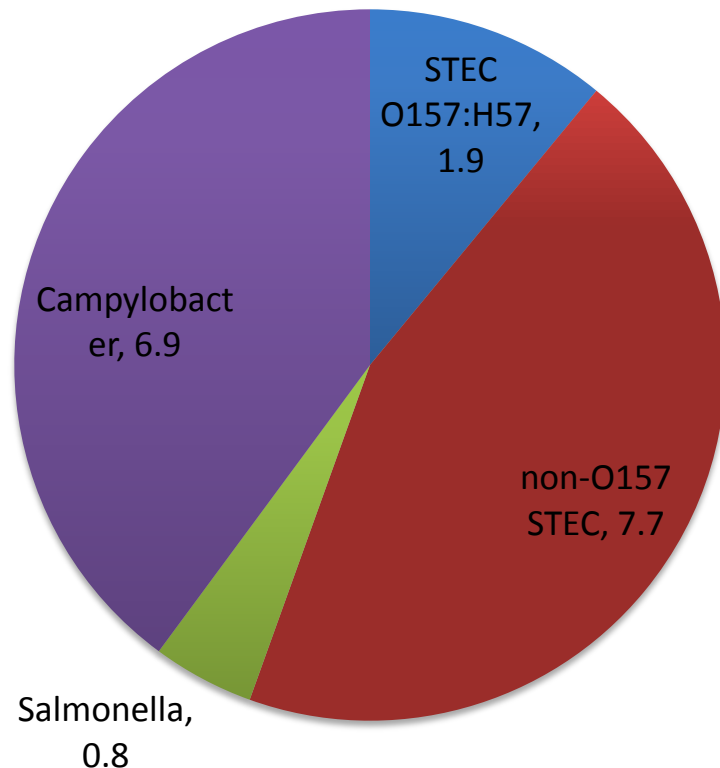
Livestock on Bio-diversified Farms: *Integrated Crop-Livestock Systems*

- All manures can carry pathogens (causing human illness)
- There is an increased **risk of pathogen spread** via food products (e.g., vegetables, fruits and nuts) when **manure is applied to crop fields**



Livestock on Bio-diversified Farms: *Manure & Food Safety Risks*

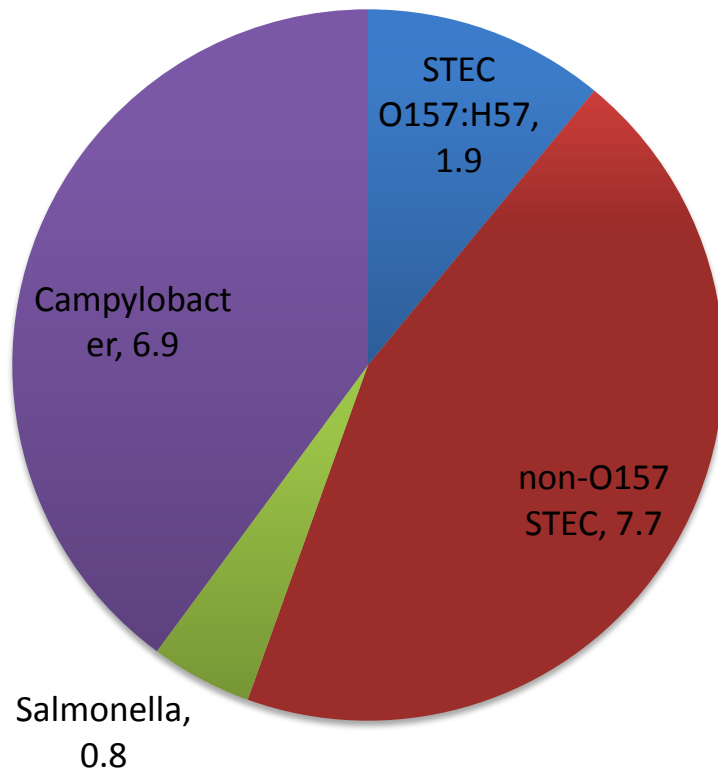
Small-Scale Farm Study



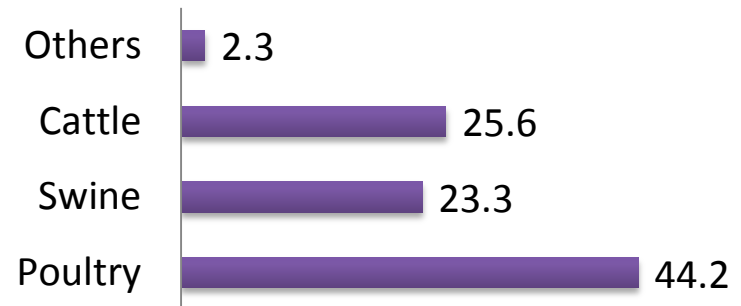
Patterson, L.; Navarro-Gonzalez, N.; Aminabadi, P.; Jay-Russell, M.; Pires, A.; 2016. **Prevalence of foodborne pathogens in livestock raised on small-scale farm**

Livestock on Bio-diversified Farms: *Manure & Food Safety Risks*

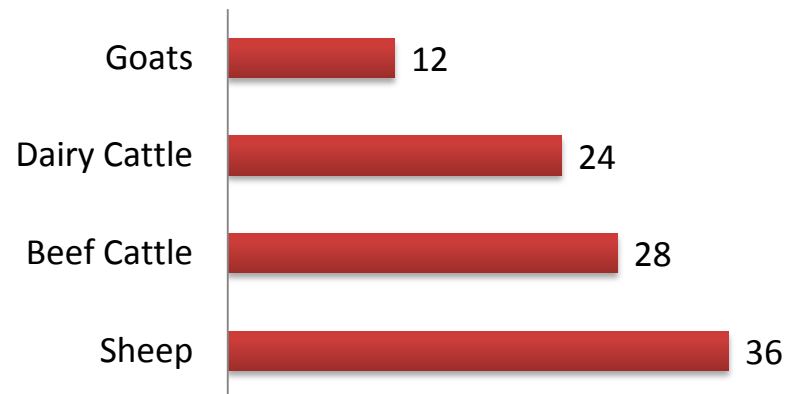
Small-Scale Farm Study



% Campylobacter by Livestock



% Non-O157 STEC by Livestock



Livestock on Bio-diversified Farms: *Manure & Food Safety Risks*

Soil

- Pathogens can persist for long periods in the soil:
 - *Salmonella* can persist in the litter applied to fields almost **4 months**, can survive up to **2 years**
 - *Campylobacter* can persist for about **25 days**
- Factors affecting the **survival in the soil**: livestock species, pathogen, manure type, composition (e.g., humidity, dry matter), soil type, environmental conditions (e.g. season, temperature, rainfall, sunlight)



Livestock on Bio-diversified Farms: *Manure & Food Safety Risks*

Good Agricultural Practices (GAPs)

- Selection
- Treatment (e.g., composting, Heat treatment)
- **Application timing**
- **Application methods**
- Handling and Storage
- Recordkeeping



Livestock on Bio-diversified Farms: *Manure & Food Safety Risks*

- The prevention of microbial contamination of crops has been **based on time-interval criteria** between the **application of raw manure** and crop harvesting



Livestock on Bio-diversified Farms: *Manure & Food Safety Risks*

- The Produce Safety Rule of the Food Safety Modernization Act (FSMA) that was released in 2015 **included treatment requirements for manure** that depend on how the manure is utilized, but has **‘reserved’ any minimum intervals between the application** and the harvest until FDA has conducted a robust risk assessment to better understand the health impacts of the use of manure for the production of produce.
- FDA will not take exception to **National Organic Program (NOP): requires that untreated animal manure be applied at least 120 days or 90 days prior** to the harvest of crops, depending on whether the edible portions come into direct or indirect contact with the treated soil



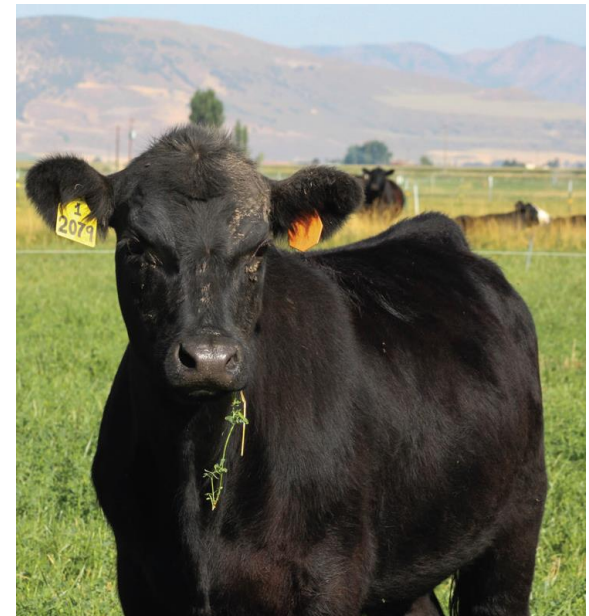
The screenshot shows the FDA website's 'Produce Safety Standards' page. The header includes the FDA logo and navigation links. The main content area features a list of links for 'Introduction', 'Guidance and Rules', 'Sections of the Law Relating to Produce Safety Standards', 'Alliances', 'Coordination with USDA on Produce Safety', 'FDA Outreach on Produce Safety', and 'Public Meetings'. A footer note states 'Prevention is Key for Produce Safety Standards'.



The screenshot shows the USDA website's 'National Organic Program' page. The header includes the USDA logo and navigation links. The main content area features a photograph of a farm and a list of 'Key Activities', including 'Maintain the list of certified organic operations and help new farmers and business learn how to get certified' and 'Develop regulations and guidance on organic standards'.

Livestock on Bio-diversified Farms: *Manure & Food Safety Risks*

- **Rotational Grazing or Pasture?**
- Integration of sustainable practices such as the use of grazing animals in fields destined for produce may introduce additional food safety risks ??



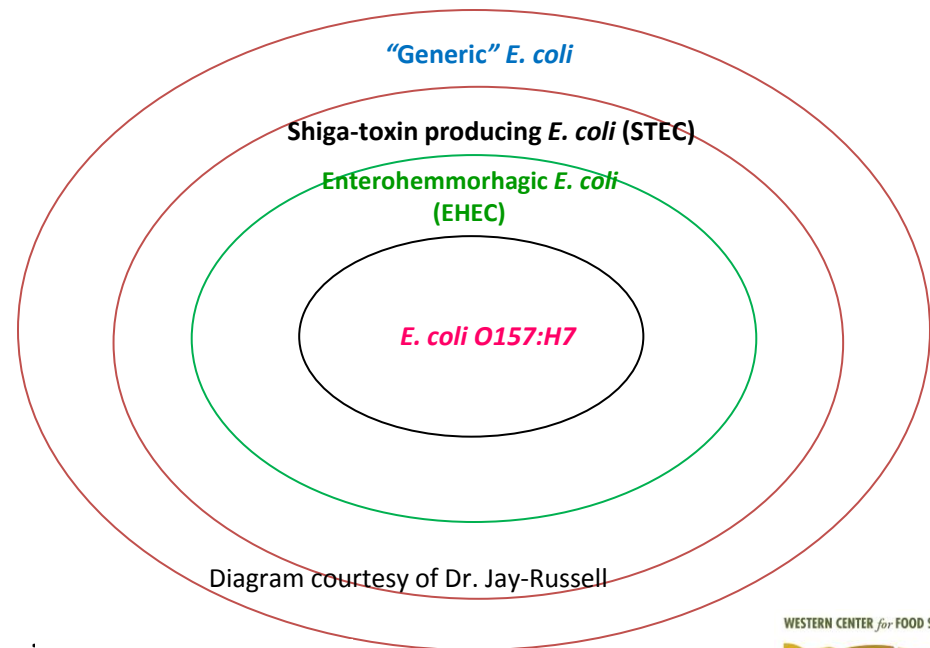
Livestock on Bio-diversified Farms: *Manure & Food Safety Risks*

- **Grazing animals, Working Animals and Animal Intrusion**
- Evidence of potential contamination of produce (during growing)?
- Yes (observation of animals, animal excreta or crop destruction)
 - Can be harvested or not based on measures taken during the growing and assessment of the risks/contamination at the harvesting (FSMA § 112.83)



Livestock on Bio-diversified Farms: *Rotational Grazing - Sheep*

Prevalence and Persistence of the the pathogen Shiga-toxin producing *E. coli* (STEC) in sheep and survival of generic *E. coli* & STEC in the soil in rotational grazing systems



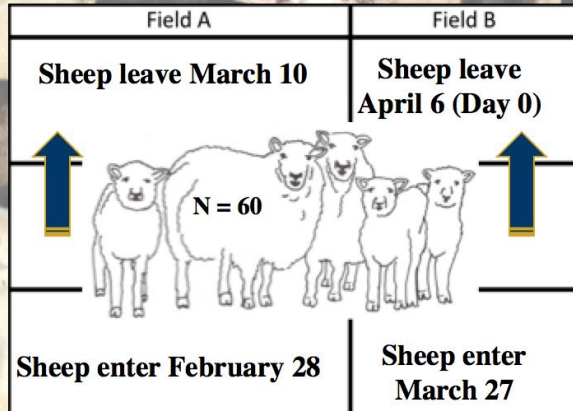
Patterson, L.; Navarro-Gonzalez, N.; Aminabadi, P.; Jay-Russell, M.; Pires, A.; 2016. Evaluating the persistence of *Escherichia coli* in the soil of an organic mixed crop-livestock farm that integrates sheep grazing within vegetable field

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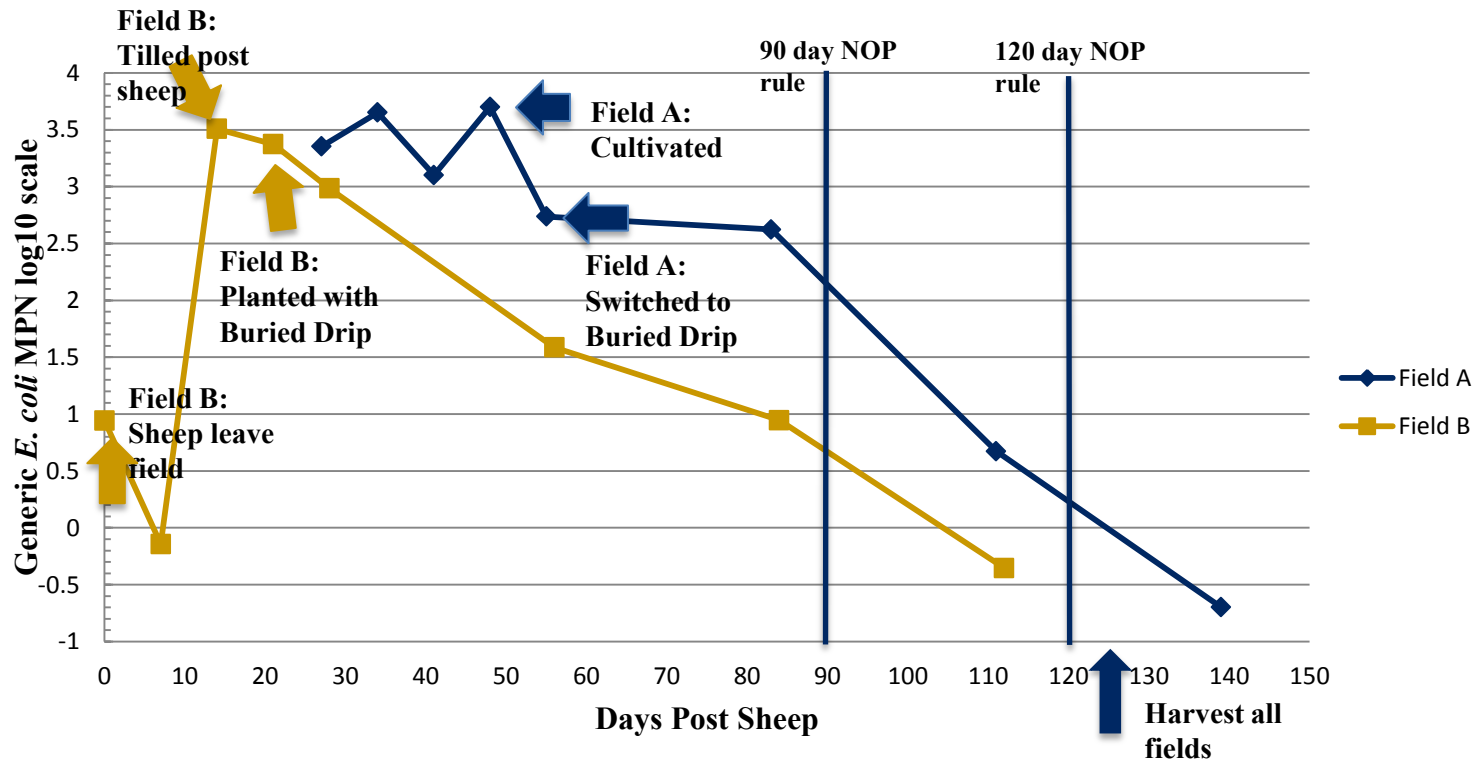
Research Field (5 acres)

- Planted with winter cover crops
- Each field divided into 3 grazing paddocks
- Sheep graze 3-5 days per paddock

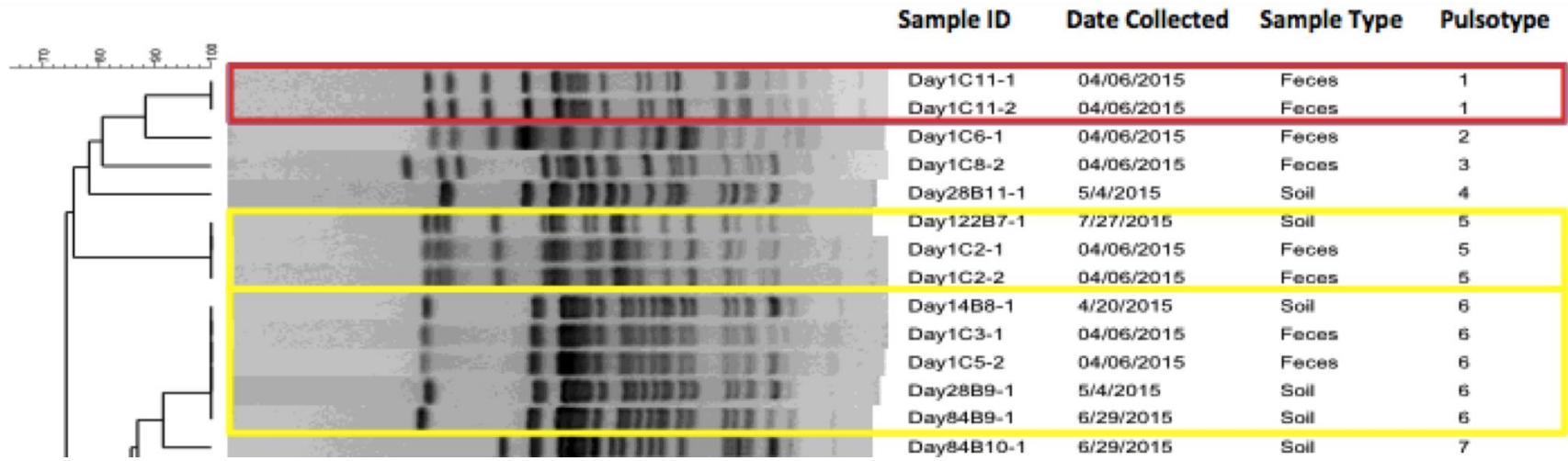


Livestock on Bio-diversified Farms: *Rotational Grazing - Sheep*

Mean generic *E. coli* MPN vs. Days Post Sheep (MPN per 1 gram soil, log₁₀ scale, ex: 10²=100)



Livestock on Bio-diversified Farms: *Rotational Grazing - Sheep*



Small-scale Farms & Urban Animal Ag SURVEY

- Please take a moment to fill out the online survey:

<http://ucanr.edu/survey/survey.cfm?surveynumber=15917>

- If you have any questions regarding the survey please contact:
 - Alda Pires (apires@ucdavis)



University of California
Survey

Needs Assessment in Small Scale Farms & Urban Ag - Livestock/Poultry Owner

Dear Livestock/Poultry Owner,

We need your assistance to better understand the scope and needs of urban, peri-urban and small-scale livestock and poultry owners in the West. The number of small-scale and urban or peri-urban farms appears to be increasing as the public desires more transparency in food production and locally-sourced product. A group of Western States Extension faculty would like to understand this sector of food production, in particular, livestock/poultry and their health needs. This study is led by Drs. Alda Pires (University of California), Dale Moore (Washington State University), Lauren Gwin (Oregon State University) and Ragan Adams (Colorado State University).

This survey will serve as a benchmark for designing effective educational programs to train farmers, backyard owners and veterinarians working within this sector.

All your answers will remain confidential and no personal information about you will be recorded. Your participation and responses will be kept confidential. The data we collect will be summarized before it is reported to other Extension personnel and veterinary faculty. You can choose not to participate and you can quit the survey at any time. There will be no penalty or loss of services or benefits if you decide to not take part in the survey.

Your participation is essential to helping us in this needs assessment. The survey will take about 15-20 minutes of your time. Thank you for time and consideration.

Husbandry Practices, Animal Health and Biosecurity

1. Do you know of a veterinarian in your area that treats livestock or poultry? Yes No

2. SCENARIO: Pretend for a moment that several of your poultry or livestock animals are sick or ill, beyond what you would feel comfortable taking care of yourself. What would influence your decision to call a vet? (For example: expense, distance/travel time, availability of vet, inexperience)

3. How often do you implement any of the following practices?



http://ucanr.edu/sites/Small_Farms/

Thank you



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530 -754-9855

Urban Agriculture & Food Safety, UC ANR CE Specialist

School of Veterinary Medicine

