Iowa State University
Dept. Agricultural and Biosystems Engineering

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Antimicrobial Resistance in Agriculture

Introduction

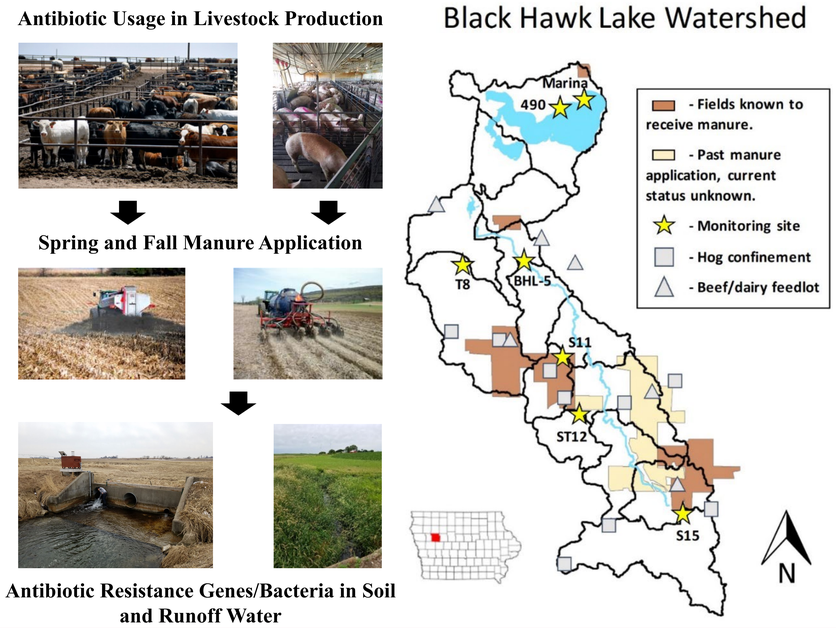
United States Livestock Production total gross income in 2018:
- Swine: $25.414 billion [1]
- Beef Cattle: $8.332 billion [2]

11 million kilograms of antibiotics sold to livestock production in the US in 2019 [3].
- 53% medically important

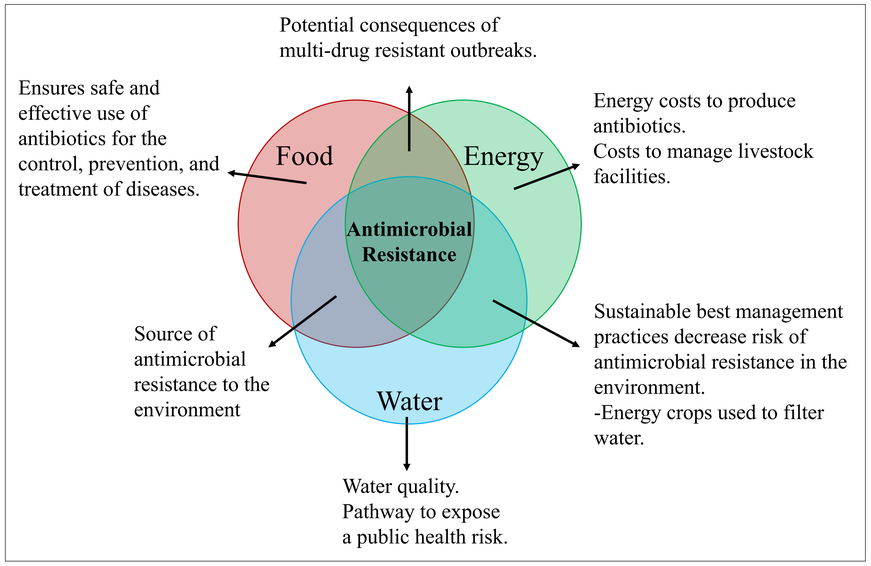
Bacteria in the presence of antibiotics select for resistant bacteria that develop antimicrobial resistance.

"Antibiotic resistance is one of the biggest threats to global health, **food security**, and development today."
–World Health Organization

Graphical Abstract



FEW Nexus



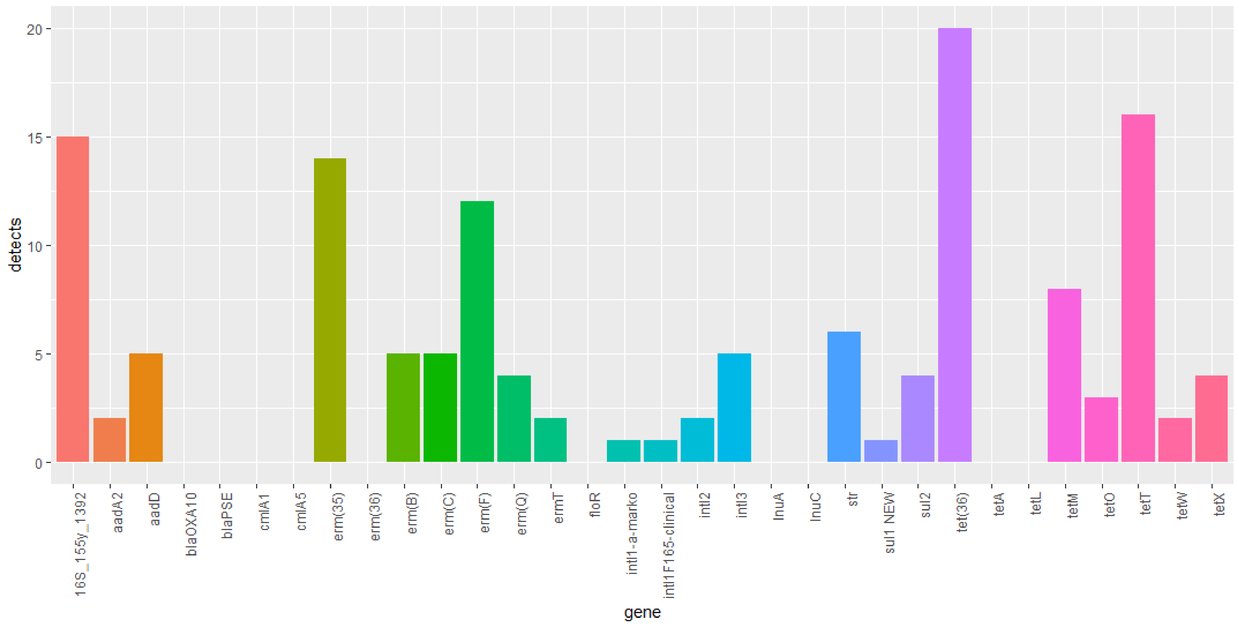
Research Projects

Antibiotic Resistance Genes in Swine Manure

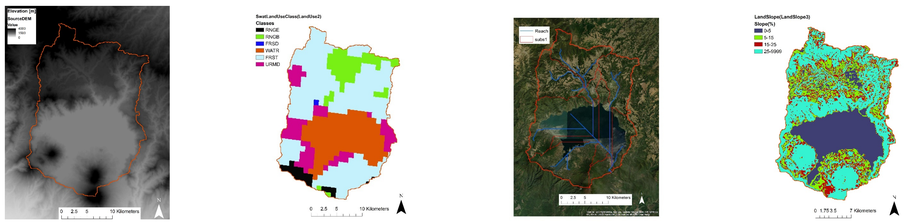
Swine manure collected from 50 swine confinements in Iowa

Goals:
1. Identify common antibiotic resistance genes present among all farms.

2. Evaluate the effects of farm management on select genes of interest.
   - Growth stage
     - Gilt development
     - Wean finish
     - Grow finish
   - Diet
   - Antibiotic management
     - Dosed in feed/water
     - Spot treated only



SWAT Modeling of bacteria and Antibiotic Resistance Genes



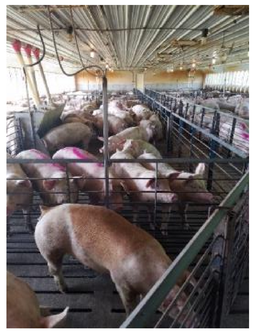
Soil and Water Assessment Tool (SWAT)
- Models nutrients, sediment, and bacteria in runoff water.
- Used to create TMDLs (total maximum daily loads) for impaired waterbodies.
- Helpful in predicting impacts of land use and land management change.

- Goal 1: Improve the fecal indicator bacteria algorithm in the source code for better predictive modeling.

- Goal 2: Model antibiotic resistance genes in the Black Hawk Lake watershed and the South Fork Watershed.
  - Identify public health risk factors for hotspots of antibiotic resistance to begin minimizing risk.

For questions, please contact Timothy Neher:
Email: tpneher@iastate.edu

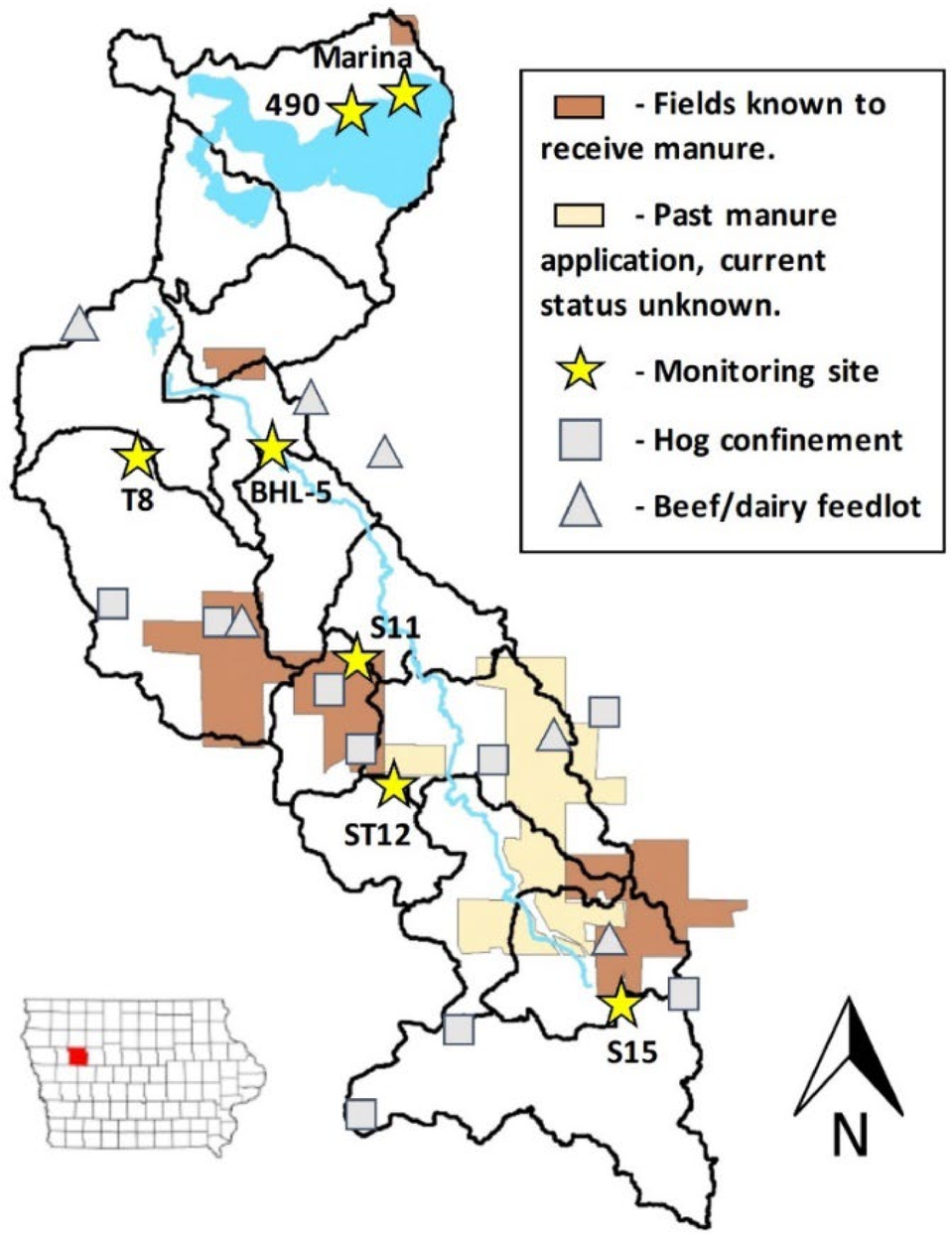
Antibiotic Usage in Livestock Production



Spring and Fall Manure Application

Antibiotic Resistance Genes/Bacteria in Soil and Runoff Water

Black Hawk Lake Watershed



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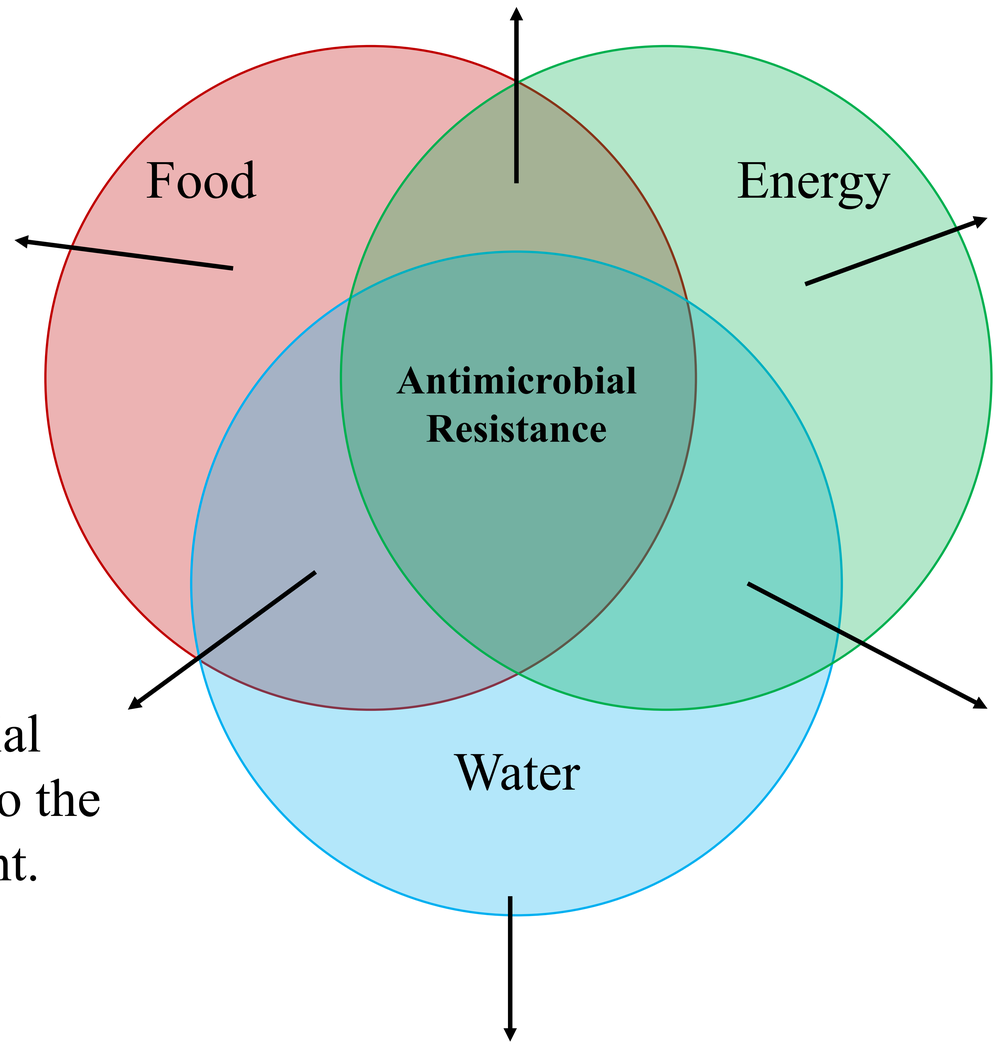
FEW Nexus

Potential consequences of multi-drug resistant outbreaks.

Ensures safe and effective use of antibiotics for the control, prevention, and treatment of diseases.

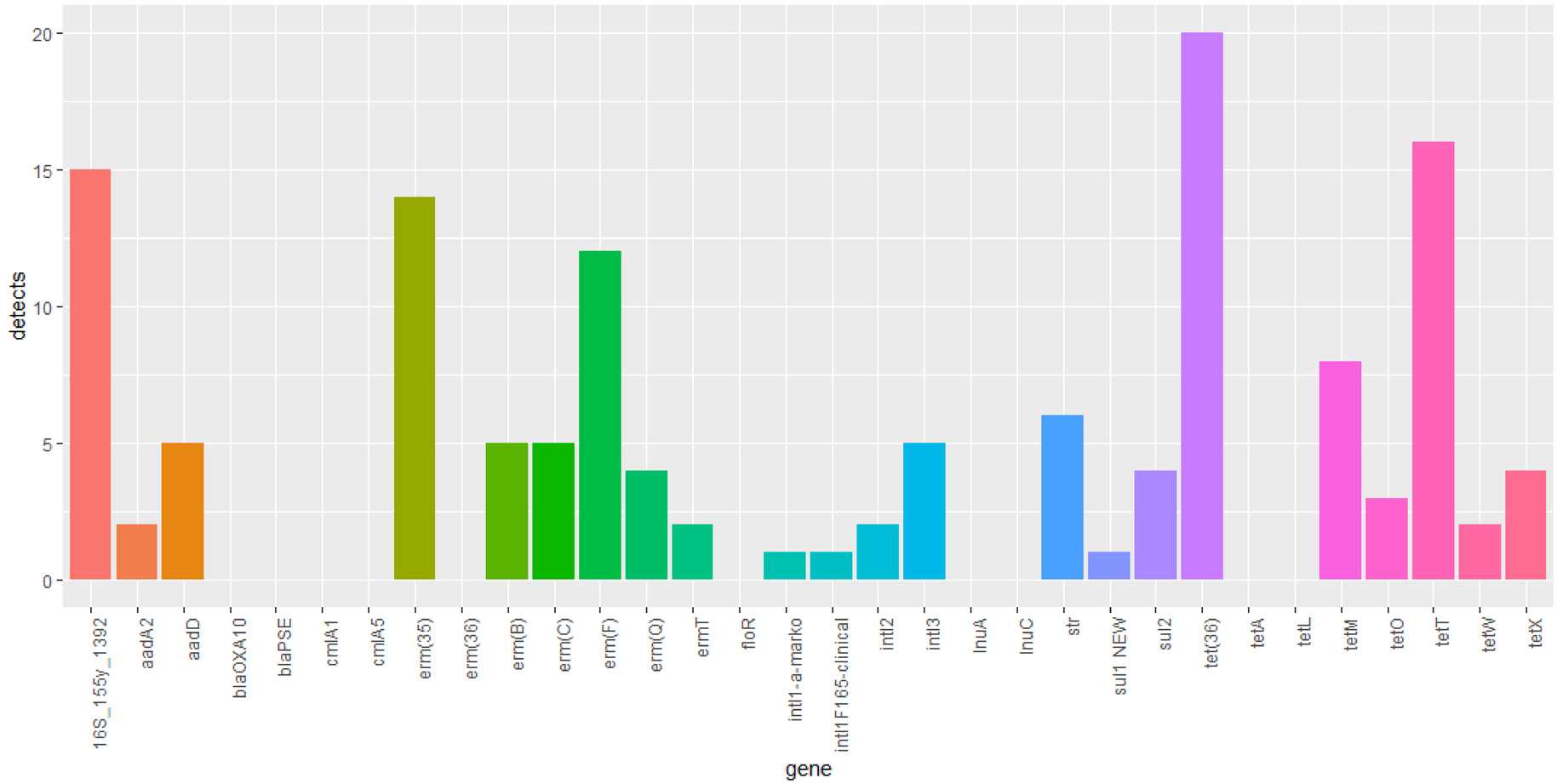


Energy costs to produce antibiotics.
Costs to manage livestock facilities.

Source of antimicrobial resistance to the environment.

Sustainable best management practices decrease risk of antimicrobial resistance in the environment.
-Energy crops used to filter water.

Water quality.
Pathway to expose a public health risk.



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     - 1
     - 2
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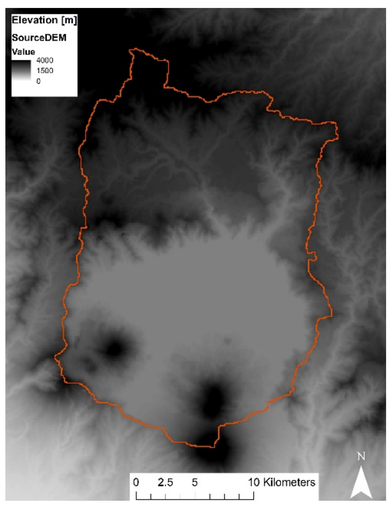
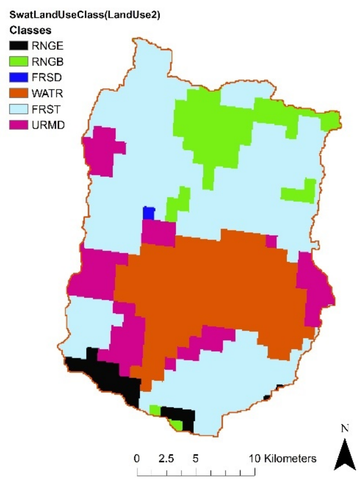
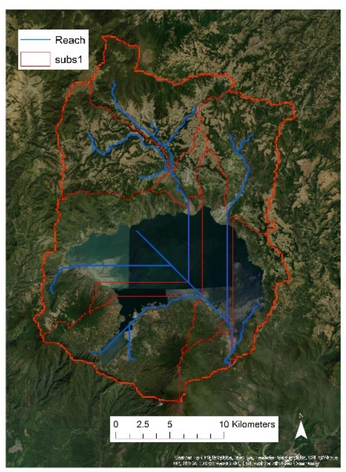
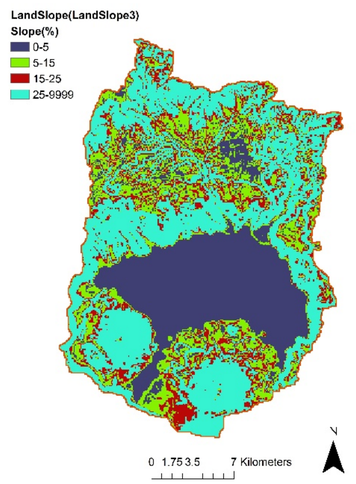
SWAT Modeling









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