



Antibiotics and Antibiotic Resistance in the Environment:

A One Health Perspective

One Health One Planet Symposium

One Health and the Future of Food

3/14/19

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Environment



Two main types of contaminant sources for Antibiotics reaching the Environment

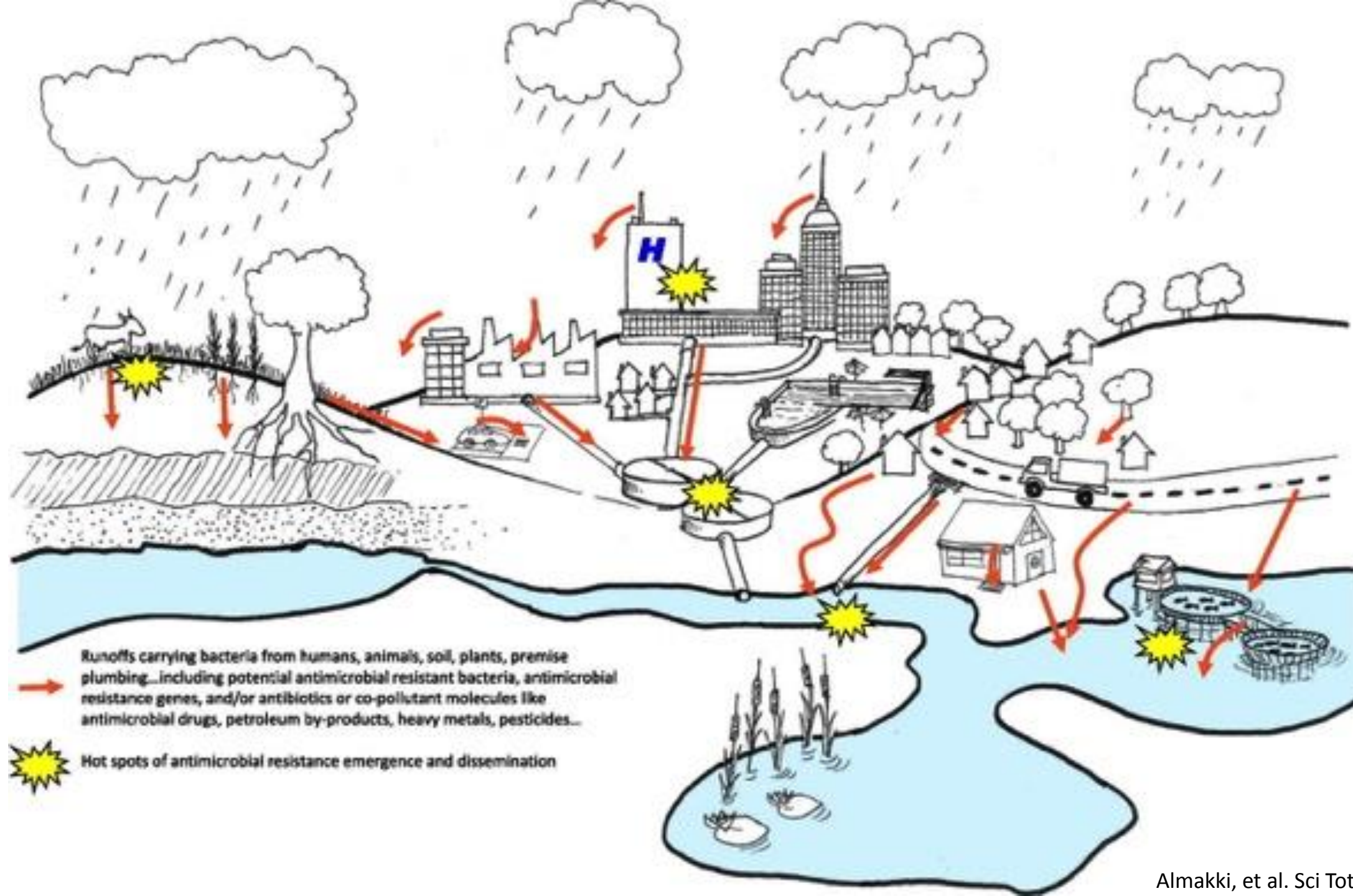


Point

vs.

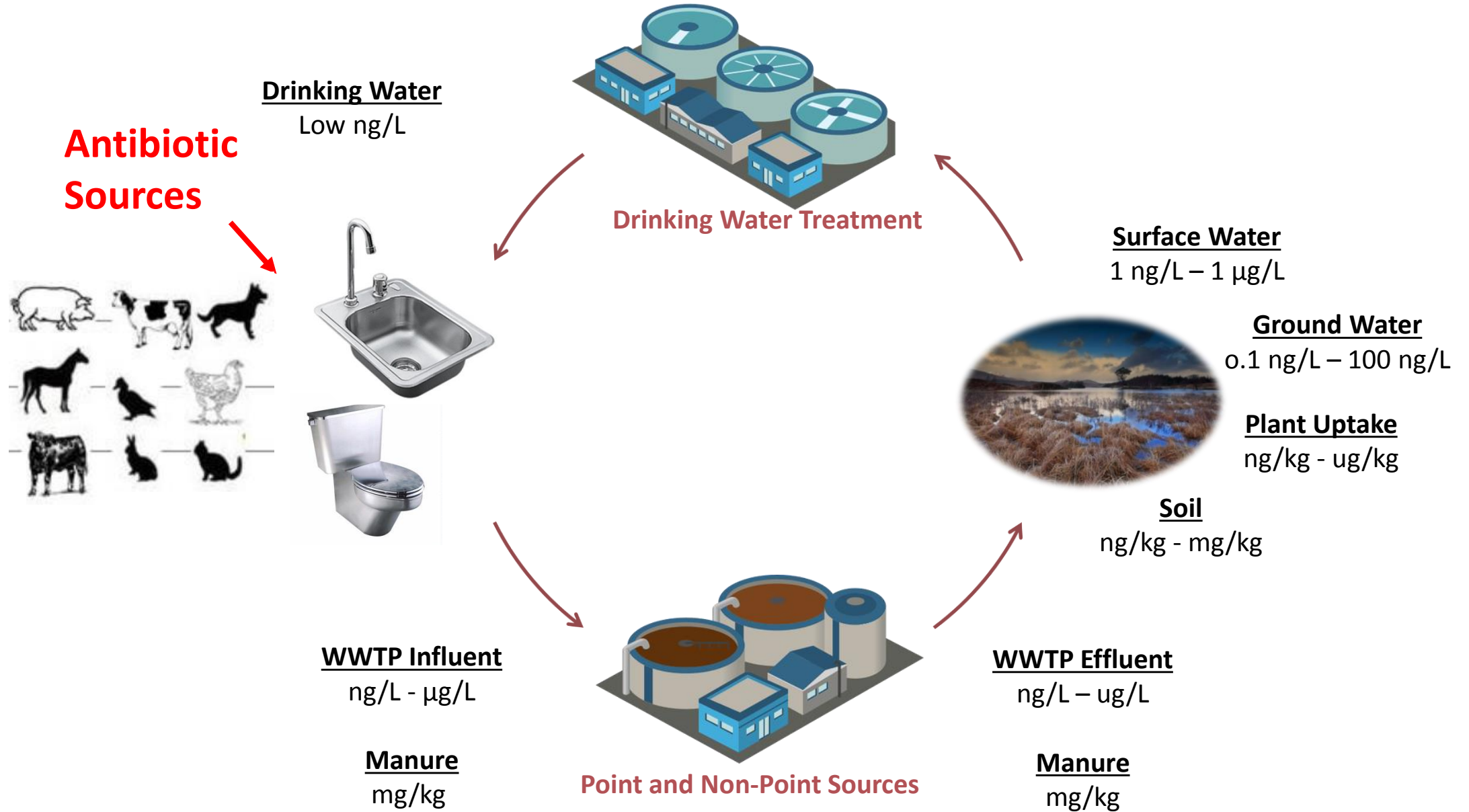


Non-point



Water is Cyclical:

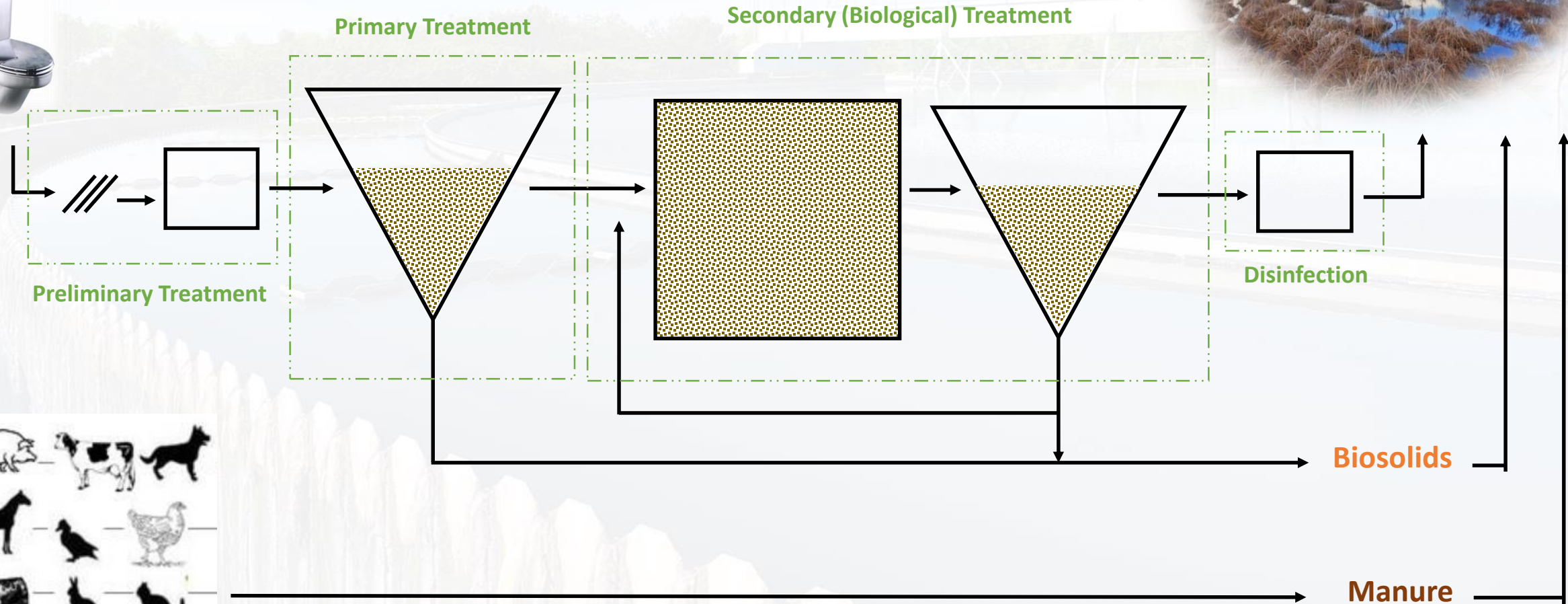
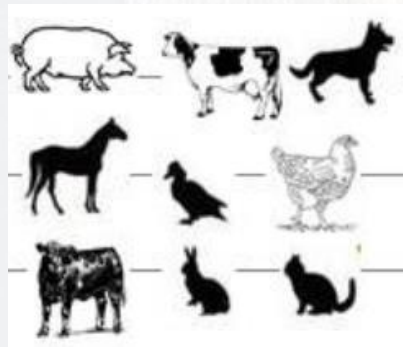
Concentrations of antibiotics in environment (ng/L- $\mu\text{g/L}$)



What happens once treated wastewater, biosolids, and untreated manure are released into the Environment?



Wastewater Treatment Plant



Movement and fate of pollutants in the aquatic environment



Antibiotics and Antibiotic Resistance in Aquatic Environments

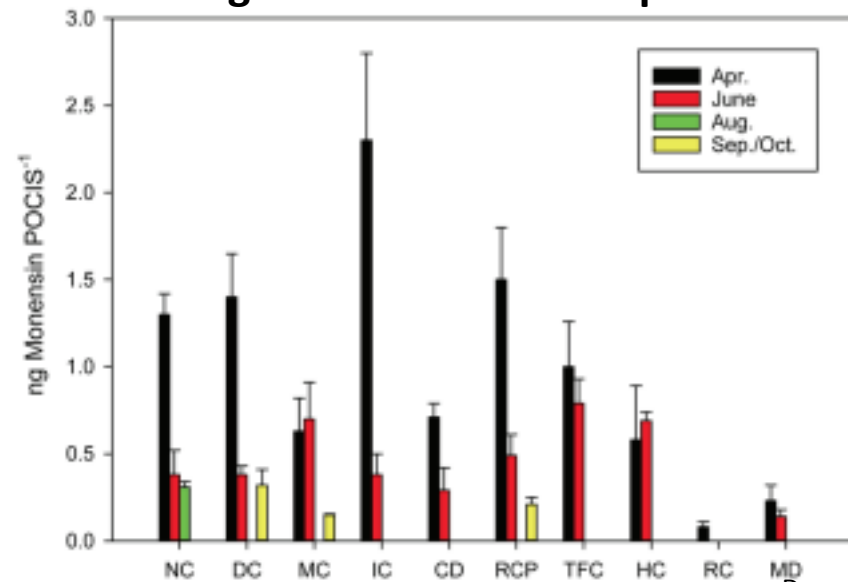
Antibiotic Contamination

WWTP Effluent

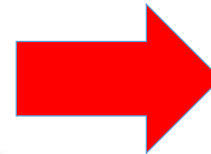
Site Location	Tetracyclines (ng L ⁻¹)	Sulfonamides (ng L ⁻¹)	Quinolones (ng L ⁻¹)
WWTP influent	1615.8	2263.0	3664.0
WWTP effluent	195.0	2001.0	3866.0
Upstream	265.2	648.1	728.8
Downstream	345.1	1111.0	2769.0
Removal efficiency	87.9%	11.6%	Increased ^a

Barancheshme & Munir, 2018

Agricultural Runoff Impacts

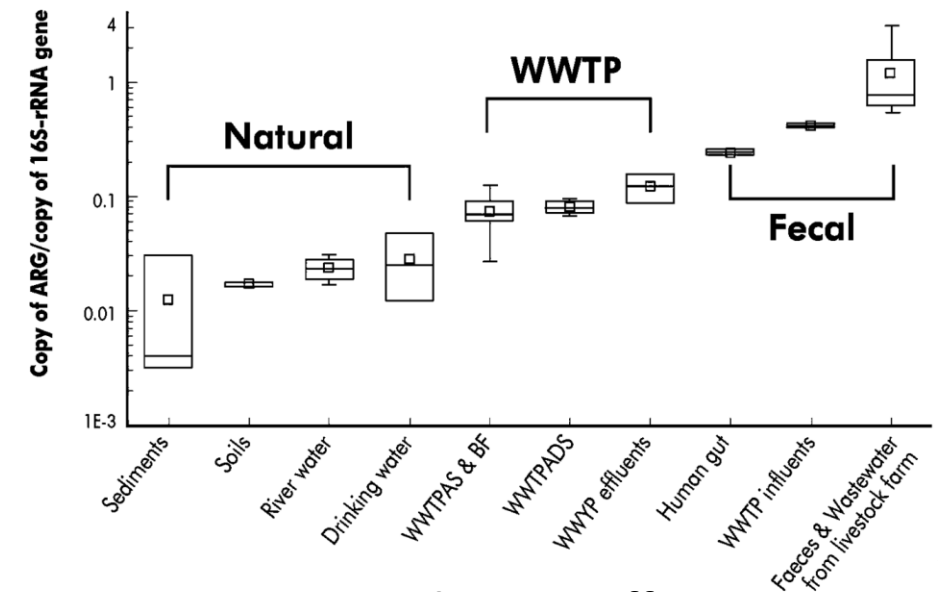


Dungan, et al., 2017



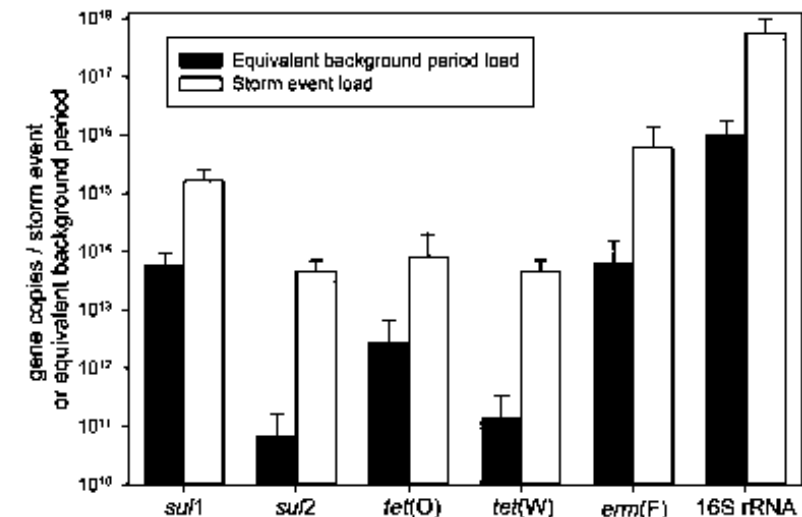
Presence of Antibiotic Resistance

WWTP & Fecal Contamination



Zhang, 2016

Urban Runoff



Garner et al., 2017

Antibiotics in the Soil

One Effluent Appl
Antibiotic Concent

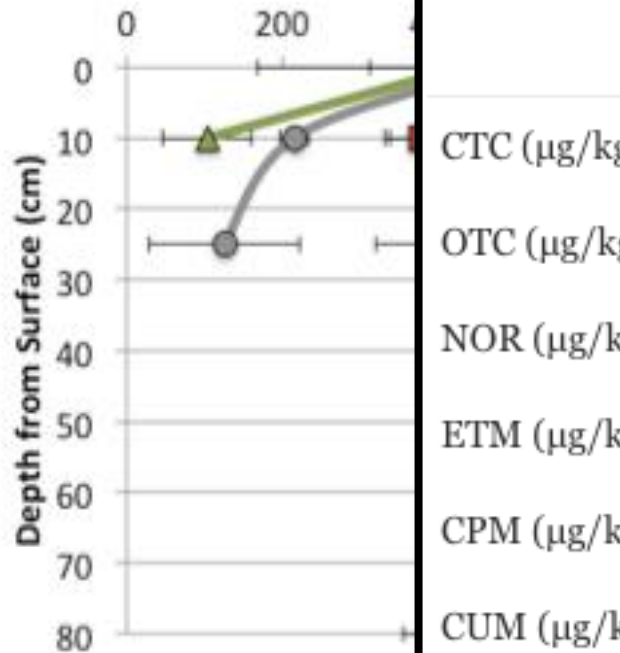
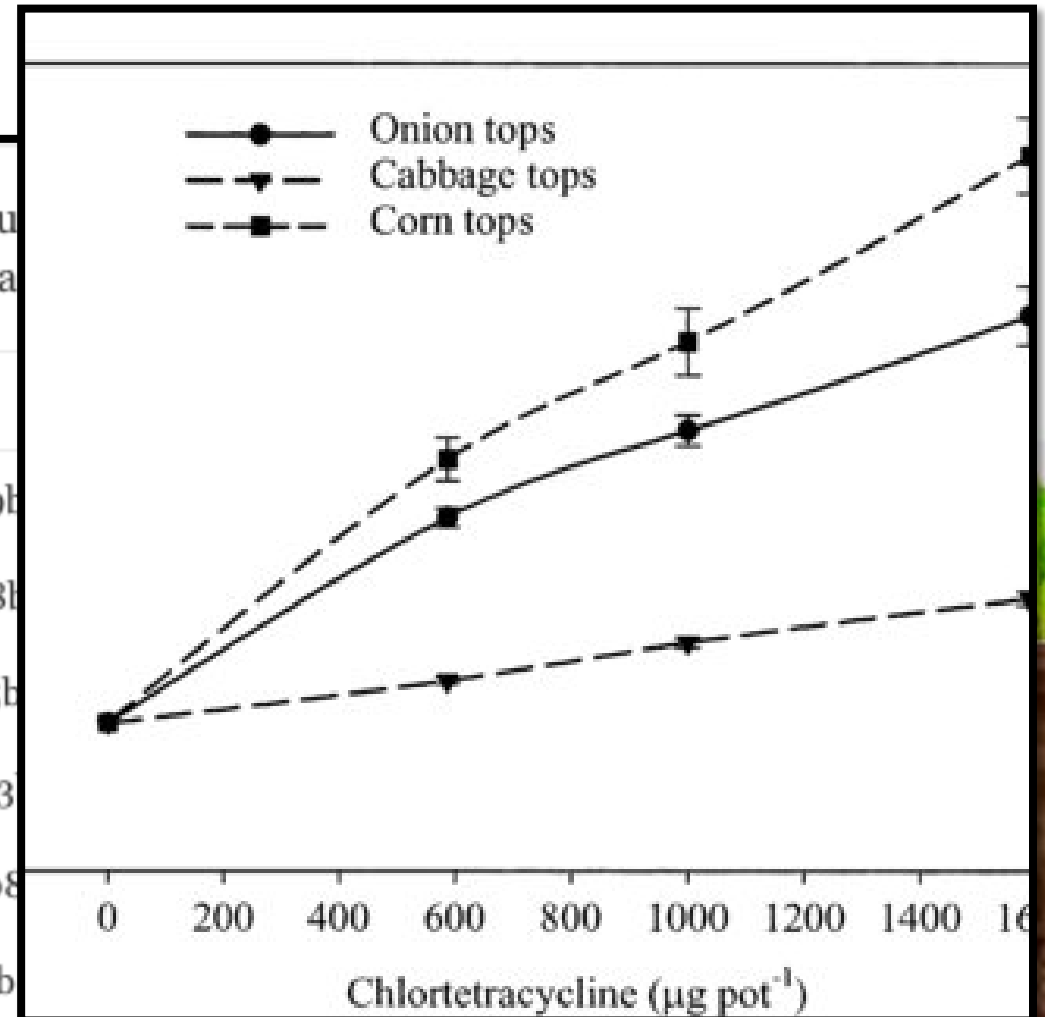
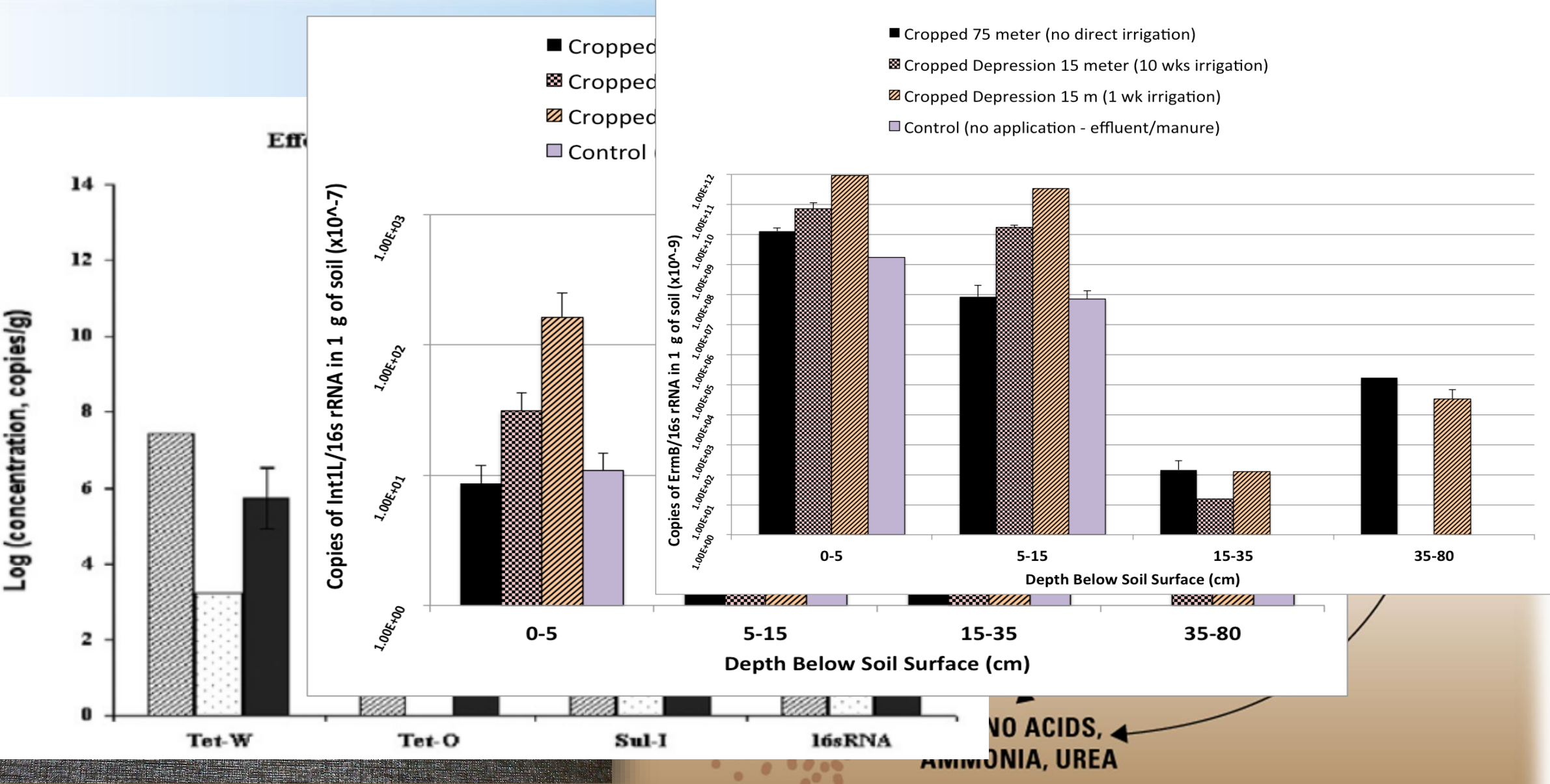


Table 2. The residual levels of **antibiotics** from u
dairy cattle- and chicken- manured soils (DM a

	CK	DM
CTC (µg/kg)	23.33 ± 4.03a	69.54 ± 8.59b
OTC (µg/kg)	23.56 ± 2.22a	64.62 ± 2.38b
NOR (µg/kg)	10.55 ± 1.43a	23.28 ± 1.85b
ETM (µg/kg)	56.38 ± 3.96a	112.27 ± 8.33b
CPM (µg/kg)	5.29 ± 0.08a	130.49 ± 5.08b
CUM (µg/kg)	8.49 ± 1.05a	59.36 ± 3.11b



Effects in Soil Organisms



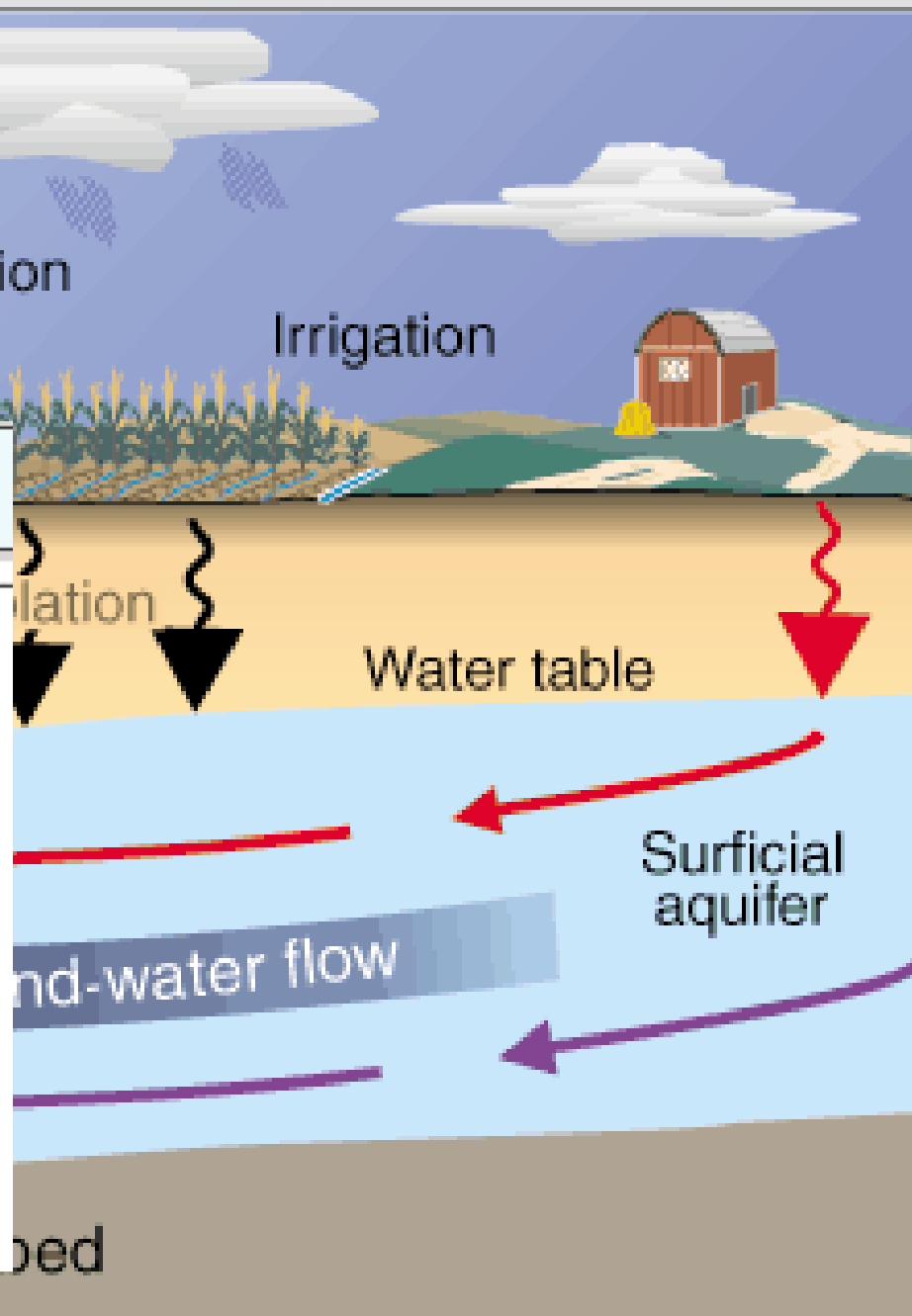
Drinking-water
well

Monitoring
well

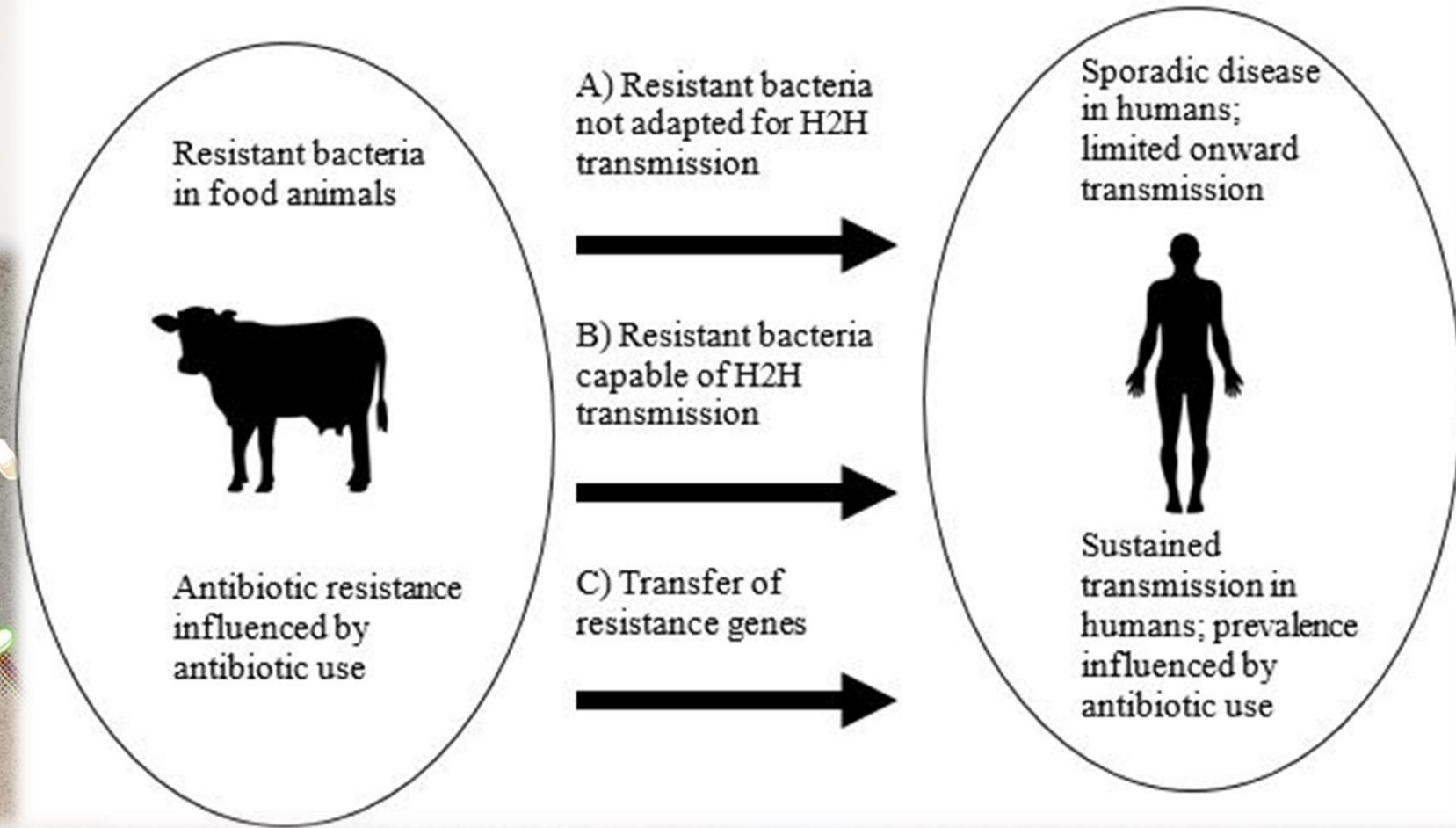
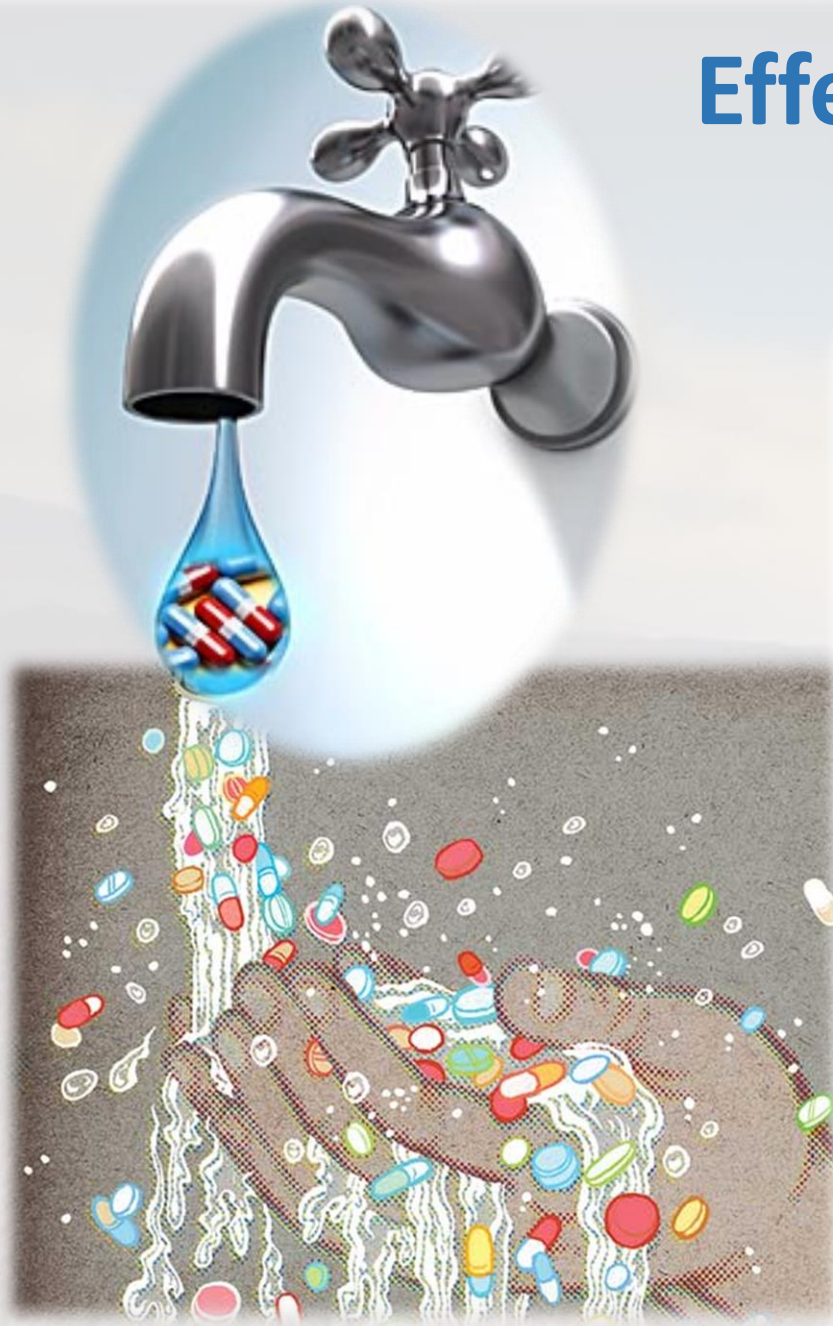
Precipitation

Irrigation

Compound	Groundwater at Living Filter		
	Min.	Mean	Max.
	ng L ⁻¹		
SMX	2.8 ± 2.4	92 ± 150	660 ± 20
TMP‡	<LOD§	3.4 ± 4.0	8 ± 3
OFL	0.14 ± 0.11	13 ± 20	67 ± 7



Effects in Humans and Mammals



A photograph of a cornfield with an irrigation system. Several nozzles are spraying water onto the rows of corn plants. The corn is green and appears to be in the middle of its growth cycle. The sky is clear and blue.

THANK YOU!

**And I'll answer questions
during the panel discussion.**

Watson Soil Water Quality Lab



Soil Water Quality Laboratory at Penn State

- Emerging contaminants in soil and water
 - Carbamazepine
 - Estrogens
 - **Antibiotics**
 - **Antibiotic Resistance Genes**
 - **Toxicological Impacts**
- People:
 - Jack Watson – PI
 - Professor of Soil Physics
 - Alison Franklin
 - PhD Student, Soil Science & Biogeochemistry
 - MS – Soil Science
 - BS - Toxicology
- Research Site: The Living Filter
 - Long term irrigation site

Most antibiotics (and pharmaceuticals) make their way into wastewater, biosolids, and manure via human and animal **ingestion**

