

U.S. and Missouri Agriculture

Perceptions, Megatrends, and Grand Challenges



What is agriculture to you?




Public Perceptions

- Farmers are using more pesticides, energy, water
- Farmers don't care about their animals
- Big farms = corporate farms = Bad
- We don't need farmers anymore, because we can get what we need at the grocery store
- Organic farming is safer and will supply all the food we need
- Farmers shouldn't be allowed to use modern technology



Relative Toxicity

Toxicity	Hazard	Product	Acute Oral LD50
High	Extreme	Nicotine	10
High	Very high	Strychnine (rodenticide)	30
High	Moderate	Diazinon (insecticide)	87
Moderate	Low	DDT (insecticide)	113
Moderate	Low	Dursban (insecticide)	163
Moderate	Low	Caffeine	200
Moderate	Low	Sevin (insecticide)	500
Slight	Very low	2,4-D (herbicide)	720
Slight	Very low	Aspirin	750
Slight	Very low	Cyfluthrin (insecticide)	1070
Slight	Very low	Malathion (insecticide)	1375
Slight	Very low	Table salt	3320
Slight	Very low	Glyphosate (herbicide)	5600

LD50 is the number of mg of substance per kg of body weight of test animal that is required to kill 50% of the test animals.



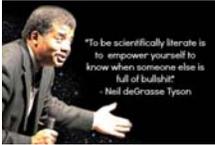
Farming looks mighty easy when your plow is a pencil and you're a thousand miles from a corn field.

— Dwight Eisenhower




Be Skeptical - Question Everything

- Natural Resources Defense Council (NRDC) www.nrdc.org
- Environmental Working Group (EWG) www.ewg.org
- Union of Concerned Scientists (UCS) www.ucsusa.org
- Environmental Defense Fund (EDF) www.edf.org
- Humane Society of the United States (HSUS) www.humanesociety.org
- People for Ethical Treatment of Animals (PETA) www.peta.org




Megatrends

- FAO predicts need to feed 9.6 billion people on this planet by 2050
- Increasing bi-modal distribution of farm size and scale
- Aging and changing workforce
- Consumers are 3-4 generations removed from farm
- Labor shortages/migrant labor



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Megatrends -- continued

- Energy – conservation and domestic production; food vs. fuel
- Increasing industrialization/vertical integration
- Increased use of consultants (eg. CCA's)
- Water – quality & quantity
- Climate change




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Megatrends -- continued

- Increased need for entrepreneurship skills for small/mid-size farm managers
- Locally-grown is expanding, but what is its share of market?
- Increased growth/economic importance of horticulture "Green Industries"
- Increased need for compliance programs – environmental, workforce, food safety

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Grand Challenges

- More food from less energy, less water, less land
- Food production must increase by 70% by 2050, in spite of:
 - Limited availability of arable lands
 - Increasing need for fresh water
 - Agriculture consumes 70% of the world's fresh water supply
 - Impact of climate change affecting seasonal events in the life cycle of plant and animals
- Regulations impeding agriculture growth
- How to grow new farmers to replace aging ones

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Three Areas of Controversy

- Genetically-Modified Organisms (GMOs)
- Unmanned Aerial Systems (UAS or drones)
- Waters of the United States (WOTUS)

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Genetically-Modified Organisms (GMOs)

- Traditional plant cross-breeding
 - Offspring of parents contains a gene mix from each
 - Mistakes (mutations) possible in copying genetic code
 - Often produces undesirable traits; some useful traits
- Genetic engineering is a logical extension of traditional plant cross-breeding
 - No mixing of genes
 - Changes genes in the DNA, so no need for sexual cross-compatibility; quicker to see results
 - Three general categories
 - Bt, herbicide resistant and virus resistant

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GMOs – Three Categories

- Bt crops
 - Include corn, cotton, sweet corn
 - Are toxic to certain insects when they ingest plants
- Herbicide resistant crops
 - Include soybeans, corn, cotton, canola, sugar beets, alfalfa
 - Allows herbicides to selectively kill weeds in crops
 - Herbicides used are less toxic; allows reduced tillage to save soil
- Virus resistant crops
 - Include papaya in Hawaii and some summer squash

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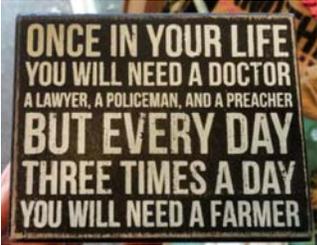
Genetically-Modified Organisms (GMOs)

- GMOs have been proven safe for 30 years
 - A 2014 summary of 1,700 studies found no credible evidence of food, feed or environmental safety concerns
 - Not one case of ill health attributed to GMOs
- Products:
 - Virtually all beer (the brewing yeast)
 - Virtually all cheese (chymosin or rennin)
 - Virtually all soy products
 - One-quarter of the medicines we use (such as insulin)
 - Most maize (corn)
 - Virtually all papayas
 - Some summer squash

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Genetically-Modified Organisms (GMOs)

- Products that are not man-made GMOs:
 - Potatoes
 - Milk
 - Eggs
 - Wheat
 - Tree nuts
 - Peanuts
 - Shellfish
 - Fish



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Genetically-Modified Organisms (GMOs)



Reference: <https://gmoanswers.com/>

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Unmanned Aerial Systems (UAS)



Photo credit: <http://modernfarmer.com/2014/01/precision-hawk/>

Photo credit: <http://mimban.ut.edu/projects/crop-surveying-using-aerial-robots/>

Photo credit: <http://hoosieragbusiness.wordpress.com/2014/09/22/are-drones-the-next-big-thing/>

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Economic Impact of UAS (drones)

- **Precision agriculture** and **public safety** are the most promising commercial and civil markets
 - = 90% of the known potential markets for UAS
- Agriculture in U.S. anticipated to provide:
 - \$65 billion of \$82 billion UAS business from 2015-2025
 - 103,700+ new jobs (at least 34,000 jobs over \$40K/year)
 - \$13.6 billion in first 3 years
 - \$1.56 billion in Missouri with 1,970+ jobs over 10 years
- **Every year that integration is delayed, the U.S. loses over \$10 billion in potential economic benefit = \$27 million loss per day**

Source: Association for Unmanned Vehicle Systems International (AUAVSI)

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Possible Jobs for UAS (drones)

- Agricultural monitoring (crops , animals, people)
- Weather monitoring
- Disaster assessment & management (tornadoes, floods, wildfires, earthquakes)
- Tower, bridge, rail and power line surveys
- Hazardous site evaluation (chemical, nuclear, etc.)
- Law enforcement (locate threats, document site for evidence)
- Environmental monitoring & research
- Aerial imaging/mapping (real estate)
- Oil and gas exploration
- Telecommunications (news coverage, sporting events, moviemaking)
- Freight transport/package delivery
- Agri-tourism
- Entertainment (unique photography, remote dog walking ©)



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Most Common UAS Uses by Farmers

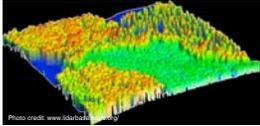
- “Directed scouting” of animals, crops and people, which involves “ground-truthing” what you observe from air
 - Crop condition (growth, insects, diseases)
 - Cattle counts, rustler monitoring
 - Worker safety



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Possibilities with Other UAS Sensors

- Thermal (infrared)
 - Livestock detection, sick animals
 - Water temperature, source identification
- Hyperspectral
 - Crop growth, plant identification
- LiDAR (Light Detection And Ranging)
 - Measuring plant height, 3-D terrain mapping



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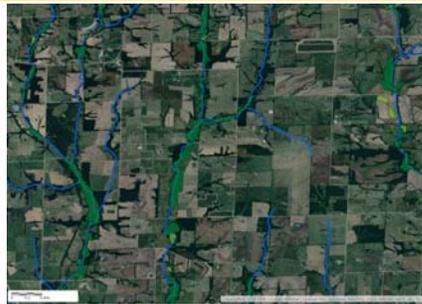
Waters of the United States (WOTUS)

- Clean Water Act of 1972 established regulated waters (“blue line” streams) by EPA and U.S. Army COE
- WOTUS rule blocked by federal court from starting 8/28/2015
 - Greatly differs from the proposed rule provided for public comment
 - COE believes EPA used flawed technical and scientific analysis in crafting the regulation
 - EPA failed to consult with state and local governments, confer with business stakeholders, comply with the requirements of the Regulatory Flexibility Act, or produce an accurate cost-benefit analysis.
 - Puts millions of additional acres of private land under federal control
 - Major parts of the rule remain largely incomprehensible to experts and laypeople
 - Landowners have no reliable way to know which of the water and land within that area will be regulated, yet they must still conform their activities to the new law.

Reference: <https://www.washingtonpost.com/news/voilant-conspiracy/wp/2015/08/28/north-dakota-district-court-blocks-controversial-waters-of-the-united-states-rule/>

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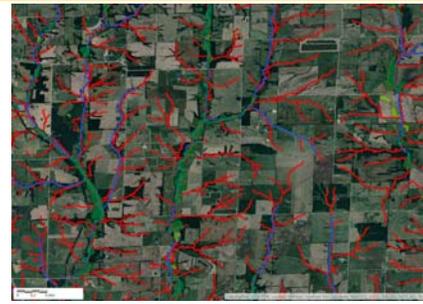
WOTUS example from Missouri



Previous rules/guidance – Tributaries and Adjacent Wetlands
Absent case-specific “significant nexus” finding, only perennial and intermittent tributaries (blue lines) and adjacent wetlands (green shapes) deemed jurisdictional.
(Note: light blue shapes designate freshwater ponds.)

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WOTUS example from Missouri



New WOTUS Rule – More Automatically Regulated “Tributaries”
Ephemeral tributaries (red lines) deemed jurisdictional without further analysis.
Ditches also regulated if “excavated in” or “relocated” a tributary.
Note: This map does not show jurisdictional ditches and may not include all ephemeral tributaries

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WOTUS example from Missouri



New WOTUS Rule – Automatically Regulated Adjacent Waters
Includes all “waters”—including wetlands—that lie even partially within a 100-foot buffer (pink shading) around all perennial, intermittent and ephemeral streams.

WOTUS example from Missouri



New WOTUS Rule – More Automatically Regulated Adjacent Waters
Includes all “waters”—including wetlands—where any part is within the 100-year floodplain and not more than 1,500 feet from a tributary. Light green shading shows the 1,500-foot zone and hash marks show the known FEMA Flood Zone maps (which may be out-of-date or may not be relied upon by the Corps). Absent definitive flood zone information from the Corps, any water partially within the light green shading is a possible “adjacent water.”

WOTUS example from Missouri



New WOTUS Rule – Maybe Regulated “Significant Nexus” Waters
Water/wetlands even partially within 4,000 feet (about ¾ mile) of a tributary can be regulated on a “significant nexus” finding. Orange shading shows land outside the possible adjacency zone but within the 4,000 feet zone.
Even without mapping around jurisdictional ditches, the area of possible regulation covers the entire map.

Missouri WOTUS Zones

Missouri	Acres	Share of Total Acres
Total Acres in State	44,692,943	
Acres within 100-ft buffer (adjacent)	3,869,667	7%
Acres within 1,500-ft buffer (possibly adjacent)	4,1172,874	92%
Acres within 4,000-ft buffer (subject to “significant nexus” finding)	44,549,122	99.7%

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In Balance with Nature

In the beginning, there was Earth, beautiful and wild,
And then man came to dwell.
At first, he lived in caves like other animals,
Feeding himself on creatures and plants around him.
And the man called it BALANCE WITH NATURE.
Soon man multiplied.
He grew tired of scavenging hunting for food.
He built homes and villages. Wild plants and animals were domesticated.
Some men became Farmers so that others might become Industralists, Artists, or Doctors.
And this was called Society.

Man and Society progressed.
With his God-given ingenuity, man learned to feed, clothe, protect, and transport himself more efficiently as he might enjoy Life.
He built cities, houses on top of each other, and nylon.
And life became more enjoyable.

The man called Farmers became efficient.
A single Farmer grew food for 28 (155) Industralists, Artists and Doctors.
And Writers, Engineers, and Teachers as well.
To protect his crops and animals,
The Farmer produced substances to repel or destroy insects, Diseases, and Weeds.
These were called Pesticides.

Similar human substances were made by Doctors to protect humans.
These were called Medicines.
The Age of Science had arrived and with it came better diet and longer, happier lives for most members of Society.

Soon it came to pass, that certain well-fed members of Society
Chickpeaked of the Farmer using Science.
They spoke hardly of his techniques for feeding, protecting,
and preserving plants and animals.
They dreamed his speaking the “Balance of Nature.”
They longed for the simple life referred to by some as the “Good Old Days.”
And the food emotional appeal to the rest of Society.

By this time Farmers had become so efficient,
Society gave them a new title: Unimportant Minority.
Because the well-fed Society could now imagine a shortage of food,
Laws were passed abolishing Pesticides, Fertilizers, and Food Preservatives.
Insects, Diseases, and Weeds flourished.
Crops and animals died.
Food became scarce.

To survive, Industralists, Artists, and Doctors were forced to grow their own food.
But they were hardly self-sufficient growers.
Parks, golf courses and wilderness had to be converted to growing food.
Starving people and governments fought wars to gain more agricultural land.
Billions of people were exterminated.
Those who survived, faced plagues and famine.

In the end, only a few remained.
They lived in caves like animals,
Feeding themselves on creatures and plants around them.
And the man called it BALANCE WITH NATURE.

“In Balance With Nature” is a thought-provoking verse written by the late Dr. John Carew, former head of the Horticulture Department at Michigan State University. His original version was first published in 1970. (Updated with 2015 statistics)

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Resources

- eExtension – the Google search of unbiased information
<http://www.extension.org/>
- National Agriculture in the Classroom
<http://www.agclassroom.org/>
- GMO Answers
<https://gmoanswers.com>
- Know Before You Fly — Unmanned Aircraft Systems
<http://knowbeforeyoufly.org/>
- Waters of the United States
<http://www.fb.org/issues/wotus/resources/>

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MU Extension – Serving The State



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Questions??

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Program Complaint Information

To file a program complaint you may contact any of the following:

University of Missouri

- MU Extension AA/EEO Office
109 F. Whitten Hall, Columbia, MO 65211
- MU Human Resources Office
130 Heinkel Bldg, Columbia, MO 65211

USDA

- Office of Civil Rights, Director
Room 326-W, Whitten Building
14th and Independence Ave., SW
Washington, DC 20250-9410

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