

FARMING FOR PUBLIC HEALTH



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Center for Energy & Environmental Education



Public health is a preventative field

- We are systems thinkers
- We prioritize upstream solutions
 - *Turning off the Faucet > Mopping up the floor*
- Objectives:
 - *Describe the connections between farming, land use, and human health*
 - *Explore how agriculture in the Midwest and public health relate*
 - *Share land-based solutions that address environmental and human health*



IA Farming landscape

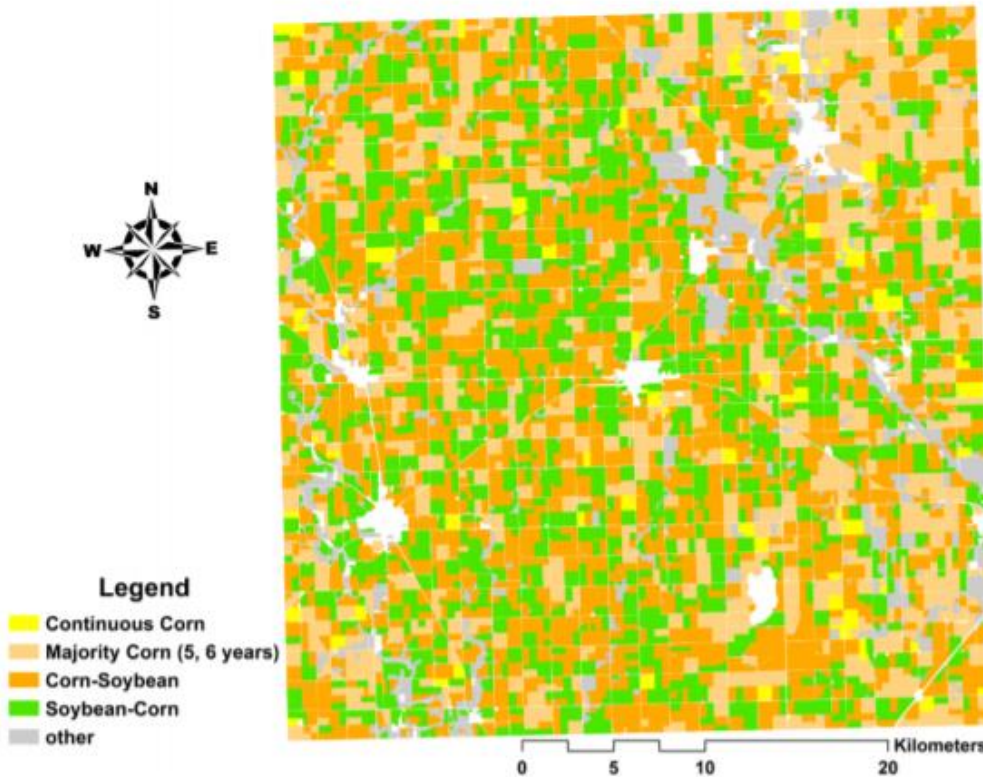
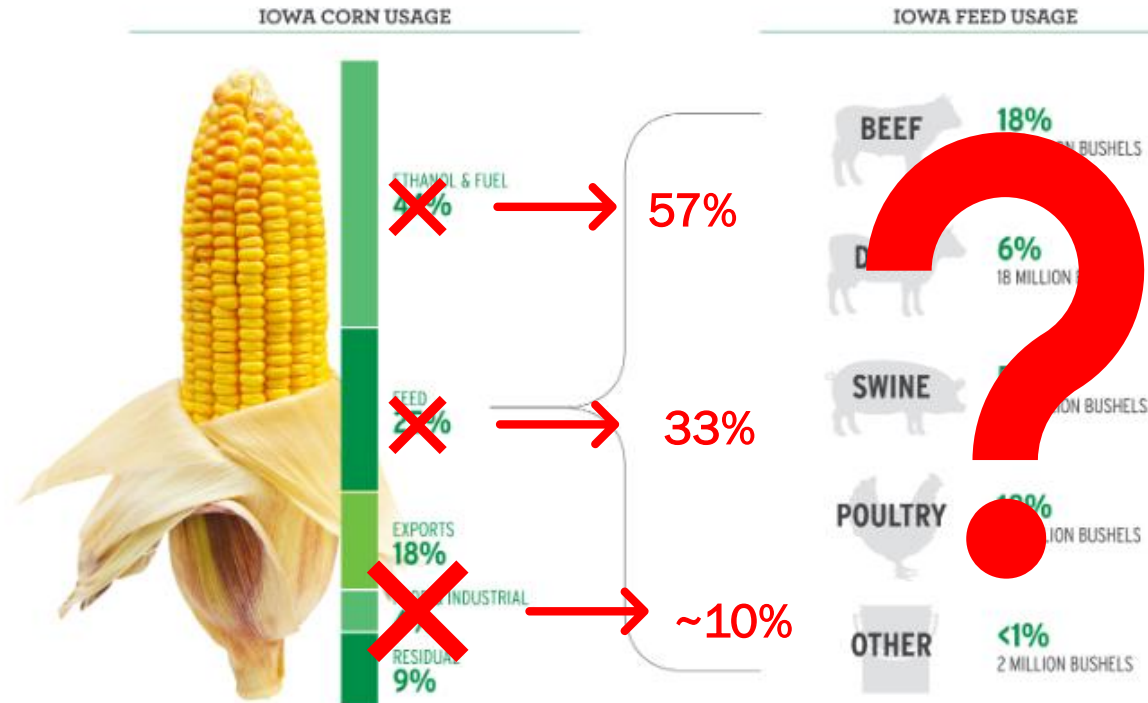


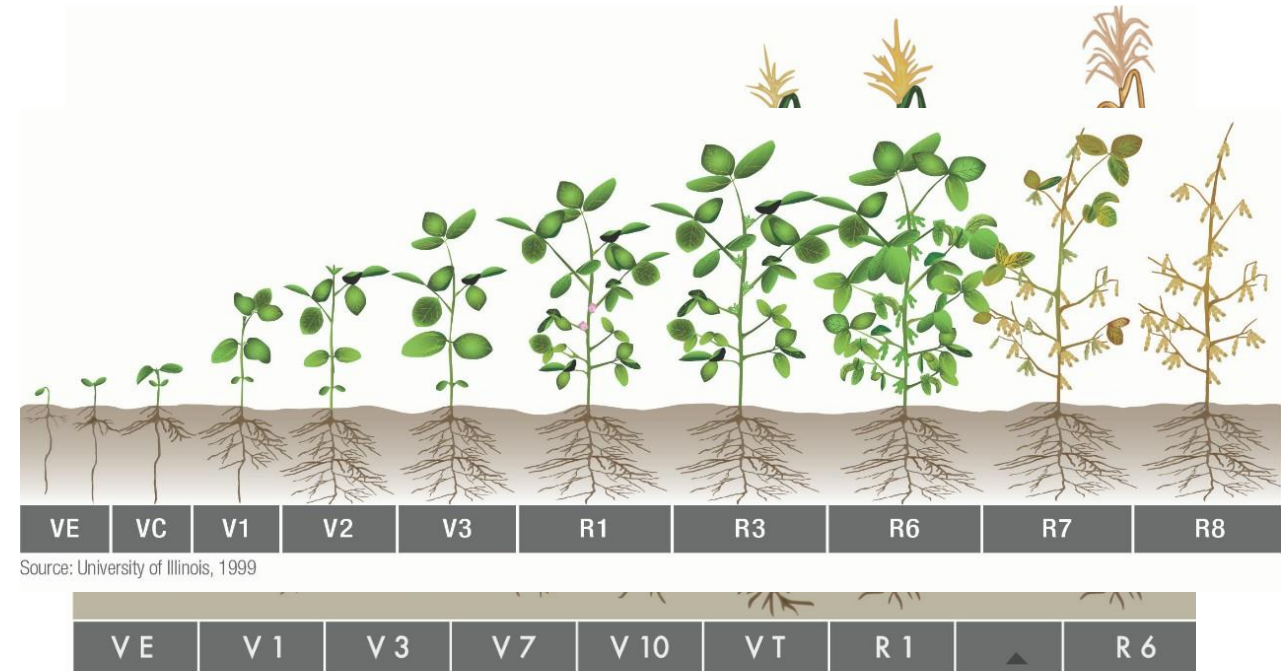
Fig. S1. A map of fields in Wright County, IA shows alternating corn-soybean rotations, more intensive corn, and “other” crop rotations without corn. Corn-soybean and soybean-corn rotations have corn in even or odd years, respectively, for the years 2010-2016. Areas with no color (white) were excluded as urban areas, road corridors, or water bodies. The total number of fields/polygons is 5882.

- Notice where continuous/majority corn dominate the map.
- Maps like these change based on market prices of different crops.
- Very little emphasis is placed on soil/ecosystem health, other externalities.
- Corn and soy make up ~63% total land area, ~82% cropland

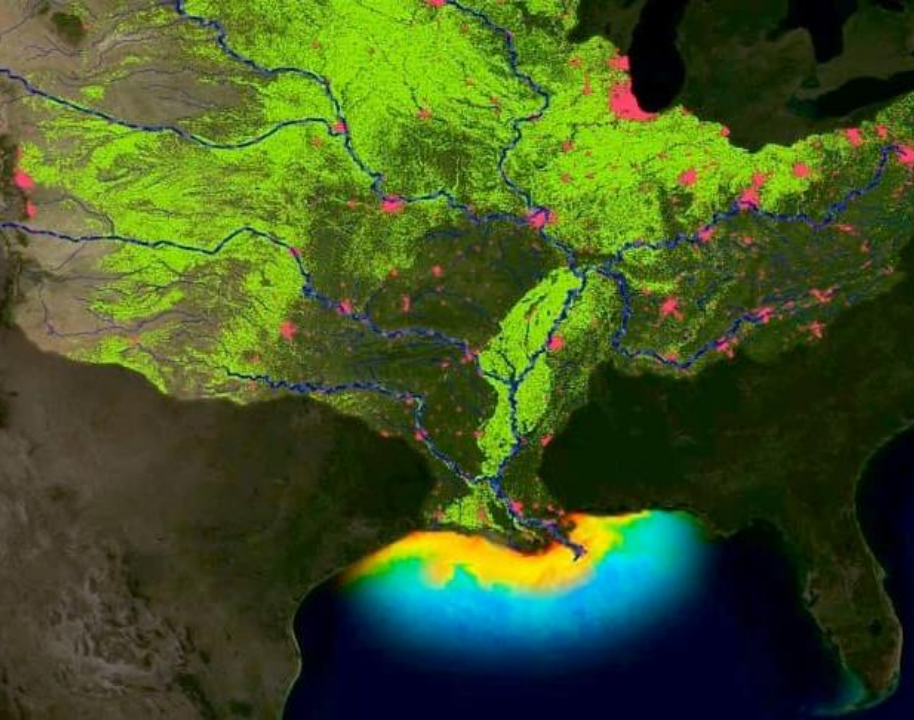


What is a “leaky” crop?

- Corn is inherently leaky—it doesn’t hold soil or nutrients very well.
- Annual root system/nitrogen hungry

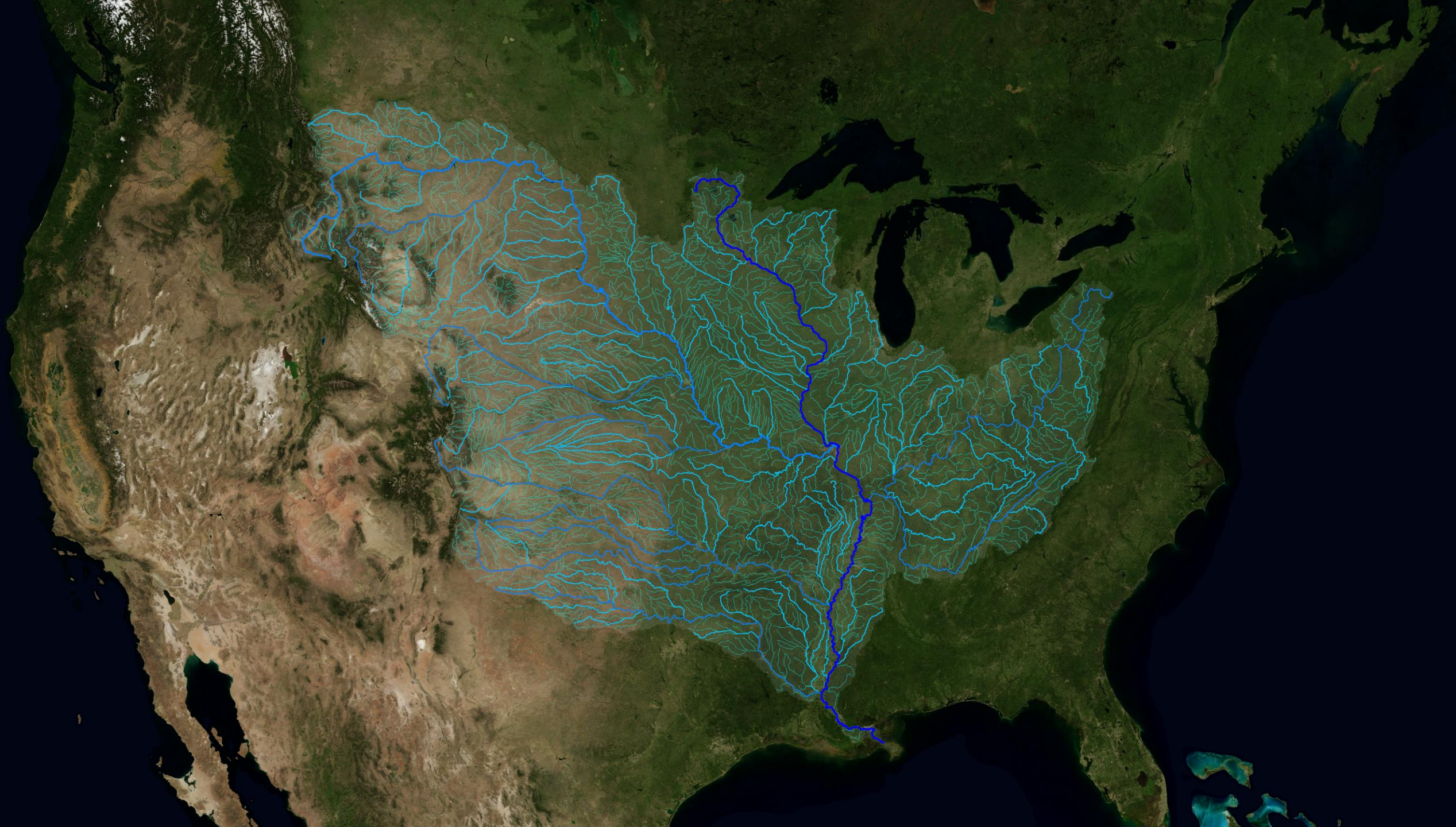






Issues of water quality

- Remember: Fertilizers make things grow
- Gulf of Mexico Hypoxia
 - *“The state averaged 45 percent of the nitrogen levels going into the Upper Mississippi River basin, and 55 percent of the nitrogen going into to the Missouri River basin.”*
 - *~29% contribution to Mississippi delta*
- Fish kills, downstream economic impacts
 - *Quality of life, recreation, livelihoods*



JULY 4, 2015
REGISTER: "HIGH
PLAGUE 60 IOW
SHO

Nitrates in the water may be more harmful than we thought

Donnelle Eller deller@dmreg.com

Published 1:28 p.m. CT Sept. 29, 2016 | Updated 10:42 a.m. CT Sept. 30, 2016

NEWS

More than 60 Iowa cities and towns have battled high nitrate levels in their drinking water over the past five years, evidence of a contamination problem that

Water Works plans \$15 million for expanded nitrate facility



MacKenzie Elmer

The Des Moines Register

Published 7:34 p.m. CT May 24, 2017 | Updated 9:41 p.m. CT May 24, 2017

NEWS

Des Moines Water Works calls for lawn watering cutbacks as nitrate levels continues to pose hazard

Des Moines Register

Published 7:46 p.m. CT June 22, 2022 | Updated 6:46 a.m. CT June 23, 2022

Water: Quality? Quantity?

How we farm impacts both.

- Blue baby syndrome
 - *MCL 10ppm*
- Safe Drinking Water Act
 - *To whom does it apply?*
 - *Private wells?*
 - *Bacteria, Atrazine, etc....*
- Implications for high nitrates?
 - *Cost? Who pays for it?*
 - *Rural vs Urban resources. Water treatment plants are EXPENSIVE.*



A photograph of a flooded field. The water is a murky, brownish-grey color, indicating it is muddy. Small clumps of green grass or weeds are scattered throughout the field, some partially submerged. The background is hazy, suggesting a distant shoreline or trees. The overall scene depicts a waterlogged area with poor water retention.

Slow water infiltration,
low water-holding
capacity, and high
runoff

Amy Carolan photo,
May 20, 2005



May 2004, Marshall County, Iowa Photo: Kamyar Enshayan

Quantity: Floods



DISASTER RECOVERY

Public health implications?

Mental health?

Disease?

Access to care?

Indoor air quality?



Which communities are hit hardest?



Pesticides

Umbrella term – Can include: Insecticides
Organochlorine > Organophosphates

Int. J. Environ. Res. Public Health 2014, 11, 3743–3764; doi:10.3390/ijerph110403743

OPEN ACCESS

International Journal of
Environmental Research and
Public Health
ISSN 1660-4601
www.mdpi.com/journal/ijerph

Article

Exposures of 129 Preschool Children to Organochlorines, Organophosphates, Pyrethroids, and Acid Herbicides at Their Homes and

Marsha K. Morgan ^{1,*}, Nancy

¹ National Exposure Research
109 T.W. Alexander Drive,

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REVIEW
ENVIRONMENTAL EXPOSURE

Environmental exposure to pesticides and respiratory health

Wagner-Schuman et al. *Environmental Health* (2015) 14:44
DOI 10.1186/s12940-015-0030-y



ENVIRONMENTAL HEALTH

RESEARCH

Association with attention deficit hyperactivity disorder in a national cohort of children

Melissa Wagner-Schuman^{1,11},
Jeffery N. Epstein^{1,11}, K

American Academy
of Pediatrics
DEDICATED TO THE HEALTH OF

TECHNICAL REPORT
Pesticide

James R. Roberts, MD, M
and GOVERNMENT ON ENVIRON
KEY WORDS
pesticides, toxicity, children,
management

ABBREVIATIONS
CDC—Centers for Disease C
C—confidence interval
2,4-D—2,4-dichlorophenoxya
DDE—p,p'-dichlorodiphenylid
EPA—Environmental Protecti
ES—lung sarcoma
GI—gastrointestinal
IIR—international normaliz
IPM—integrated pest managem
NPD—National Poison Data S
OP—organophosphate

www.nature.com/pr

REVIEW ARTICLE

Children's low-level pesticide exposure and associations with autism and ADHD: a review

James R. Roberts¹, Erin H. Dawley¹ and J. Routt Reigart¹

DEVELOPMENT OF EPIDEMIOLOGY

JOANNA JUREWICZ¹ and WOJCIECH

¹ Nofer Institute of Occupational Me
Department of Environmental Epid

² Medical University, Łódź, Poland
Department of Informatics and Med



NIH Public Access Author Manuscript

Workplace Health Saf. Author manuscript; available in PMC 2014 November 28.

Published in final edited form as:

Workplace Health Saf. 2012 May ; 60(5): 235–243. doi:10.3928/21650799-20120426-73.

Pesticide Exposure and Child Neurodevelopment:

Summary and Implications

Jianghong Liu, PhD [Associate Professor] and
School of Nursing and School of Medicine

Erin Schelar, BSN [nursing student]
University of Pennsylvania, Philadelphia, PA

Pediatric RESEARCH



Research

Citation: Transl Psychiatry (2014) 4, e360; doi:10.1038/tp.2014.4
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www.nature.com/tp

Environmental toxicants and autism spectrum disorders: a review
David RE Frye¹



POLICY FORUM

Organophosphate exposures during pregnancy and child neurodevelopment: Recommendations for essential policy reforms

Irva Hertz-Picciotto^{1*}, Jennifer B. Sass², Stephanie Engel², Deborah H. Bennett¹



United States Department of Agriculture
National Agricultural Statistics Service

Iowa Ag News – Chemical Use

Corn and Soybeans: Fall 2018



Upper Midwest Regional Field Office · 210 Walnut Street Ste 833 · Des Moines IA 50309 · (515) 776-3400 · (800) 772-0825
fax (855) 281-9802 · www.nass.usda.gov

Cooperating with the Iowa Department of Agriculture and Land Stewardship

May 10, 2019

Media Contact: Greg Thessen



IA corn herbicide use in 2018 (USDA NASS):

Acetochlor 8.8 million pounds

Atrazine 6.8 million pounds

Total 32.3 million pounds



IA soybean herbicides use in 2018 (USDA)

Glyphosate 1.2 million pounds (probable carcinogen, WHO)

Dicamba 625 thousand pounds

Total 21.5 million pounds

Insecticide: 202,000 pounds of Chlorpyrifos

Children

- *Children are vulnerable*
 - Physically
 - Physiologically
 - Behaviorally
- *Dose is important, but so is time of exposure.*
- *Pesticides have been linked to:*
 - Neurobehavioral issues (strongly)
 - Childhood cancers (multiple)
 - Birth defects
 - Endocrine and reproductive harms
 - Asthma



Drift incidence is high, but likely under-reported

How many pesticide misuse complaints does the Department investigate each year?

Total Pesticide Incidents (Ag Use and Non Ag Use) involving misuse investigated by the Department.

Crop Year runs from October 1st to September 30th of the following year.

Crop Year	Misuse	Ag	Non-Ag
2012	121	89	32
2013	125	105	20
2014	88	66	22
2015	118	97	21
2016	110	91	19
2017	248	211	37
2018	245	214	31
2019	252	231	21
2020	320	295	25
2021	315	289	26

Date of counts is current as of 11/10/2021.

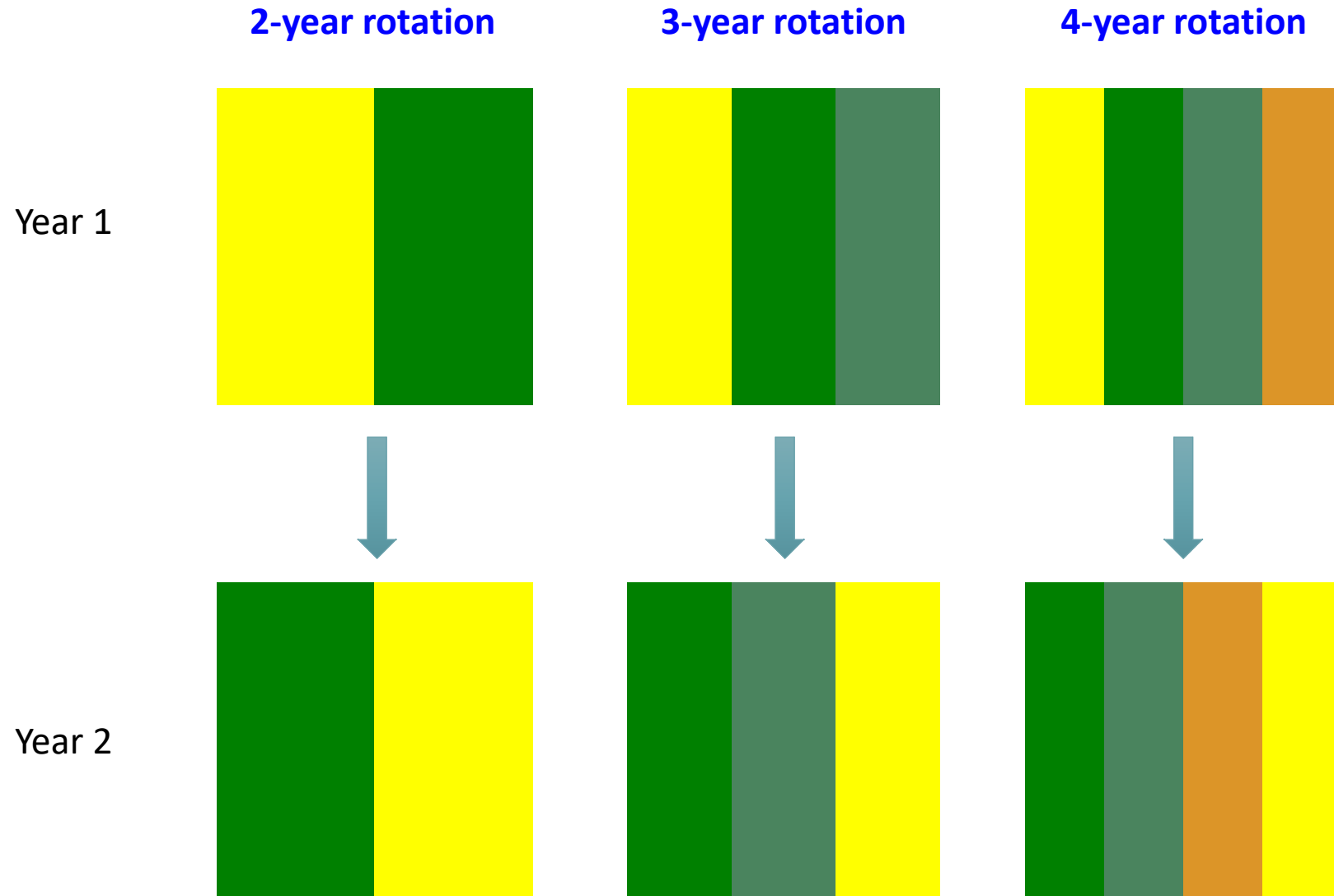


Can **diversifying** corn and soybean systems with small grain and forage crops:

- reduce requirements for purchased inputs?
- maintain or improve productivity and profitability?
- suppress weeds effectively?
- reduce susceptibility to diseases?
- improve environmental performance characteristics?

Prof. Matt Liebman, Iowa State University

Changes in crop location in different rotation systems over time



Mean Yields, 2006-2014



Crop	2-year rotation	3-year rotation	4-year rotation
Corn (bu/acre)	188	194	197
Soybean (bu/acre)	47	52	55
Oat (bu/acre)	---	93	97
Alfalfa, 2 nd year (tons/acre)	---	---	4.1

Sources: Liebman et al., 2008; Gómez et al., 2012; Davis et al., 2012.

	N fertilizer				Herbicides		
Rotation	2-year	3-year	4-year		2-year	3-year	4-year
	lb N/acre				lb a.i./acre		
Corn	147	23	20		1.41	0.06	0.06
Soybean	2	2	2		1.49	0.12	0.12
Oat	--	2	2		--	0	0
Alfalfa	--	--	2		--	--	0
Rotation av.	74	9	6		1.45	0.06	0.05
Reduction		-88%	-92%			-96%	-97%

Mean annual mineral N fertilizer
and herbicide use, 2006-2014

	Rotation		
	2-year	3-year	4-year
	—— \$/acre ——		
Corn	496	666	652
Soybean	311	381	387
Oat		214	218
Alfalfa			477
Rotation average	404	420	433

Net returns to land and management, by crop and rotation, 2008-2013

Important to broaden the scope of “return” from *year*, to *system*.



Prof. Matt Liebman, ISU

Diverse crop rotations feature:

- higher yields
- 96% less herbicides- 200 times less freshwater toxicity
- 88% less synthetic nitrogen
- 49% less fossil energy
- Improved soil quality



The New York Times

Medical Journals Call Climate Change the ‘Greatest Threat to Global Public Health’

An editorial published by more than 200 journals worldwide warned of ‘catastrophic harm to health that will be impossible to reverse.’

By Winston Choi-Schagrin

Published Sept. 7, 2021 Updated Nov. 4, 2021

Fossil Energy Use, Climate Change Impacts, and Air Quality-Related Human Health Damages of Conventional and Diversified Cropping Systems in Iowa, USA

Natalie D. Hunt,* Matt Liebman, Sumil K. Thakrar, and Jason D. Hill



Cite This: *Environ. Sci. Technol.* 2020, 54, 11002–11014



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Metrics & More



Article Recommendations



Supporting Information

ABSTRACT: Cropping system diversification can reduce the negative environmental impacts of agricultural production, including soil erosion and nutrient discharge. Less is known about how diversification affects energy use, climate change, and air quality, when considering farm operations and supply chain activities. We conducted a life cycle study using measurements from a nine-year Iowa field experiment to estimate fossil energy (FE) use, greenhouse gas (GHG) emissions, PM_{2.5}-related emissions, human health impacts, and other agronomic and economic metrics of contrasting crop rotation systems and herbicide regimes. Rotation systems consisted of 2-year corn-soybean, 3-year corn-soybean-oat/clover, and 4-year corn-soybean-oat/alfalfa-alfalfa systems. Each was managed with conventional and low-herbicide treatments. FE consumption was 56% and 64% lower in the 3-year and 4-year rotations than in the 2-year rotation, and GHG emissions were 54% and 64% lower. Diversification reduced combined monetized damages from GHG and PM_{2.5}-related emissions by 42% and 57%. Herbicide treatment had no significant impact on environmental outcomes, while corn and soybean yields and whole-rotation economic returns improved significantly under diversification. Results suggest that diversification via shifting from conventional corn-soybean rotations to longer rotations with small grain and forage crops substantially reduced FE use, GHG emissions, and air quality damages, without compromising economic or agronomic performance.



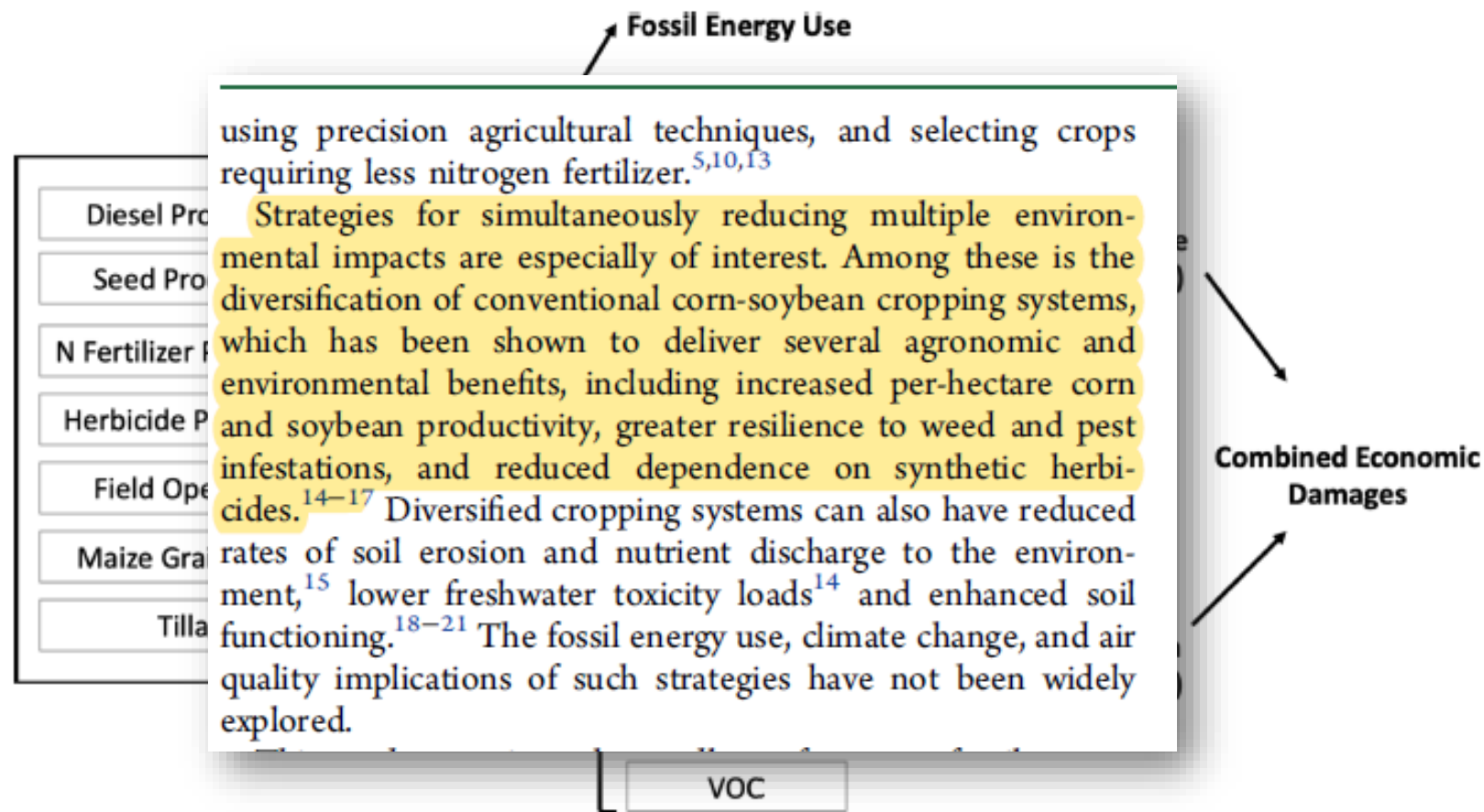


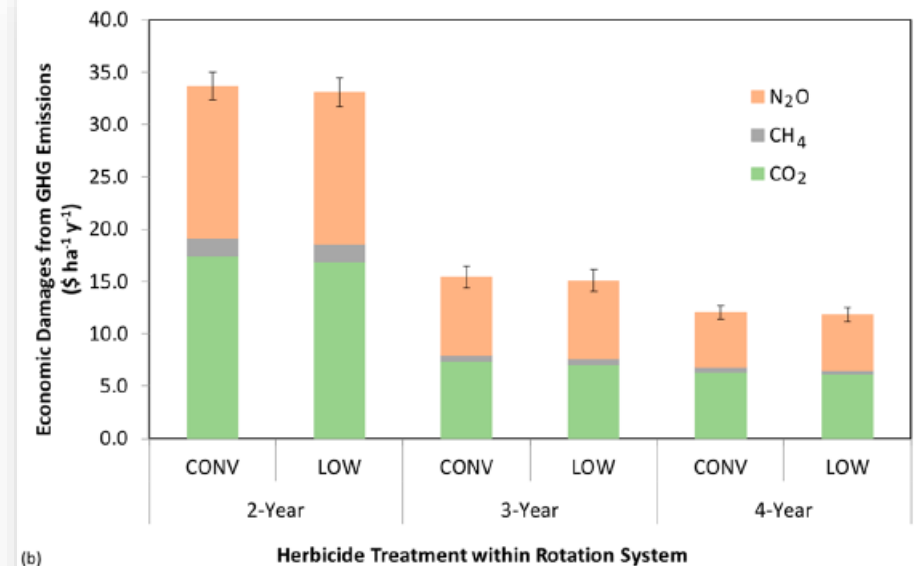
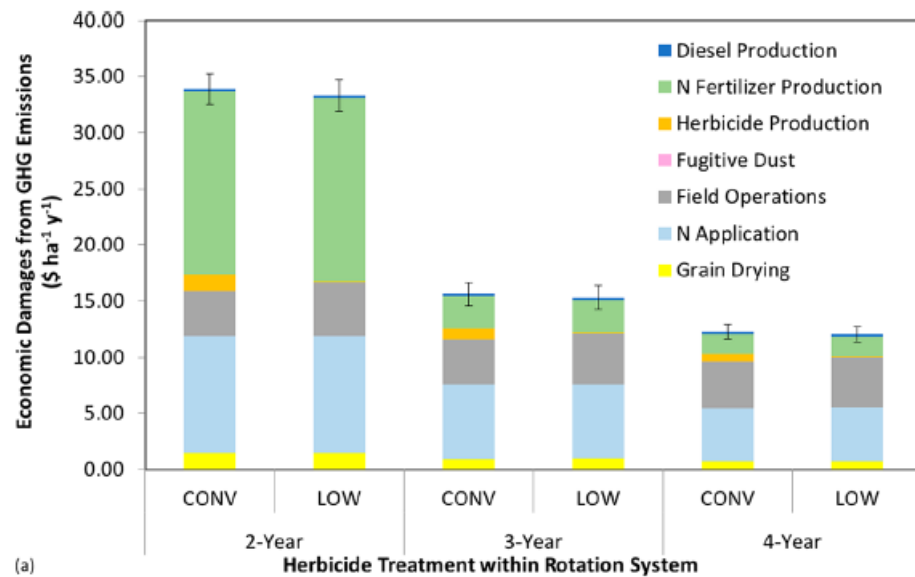
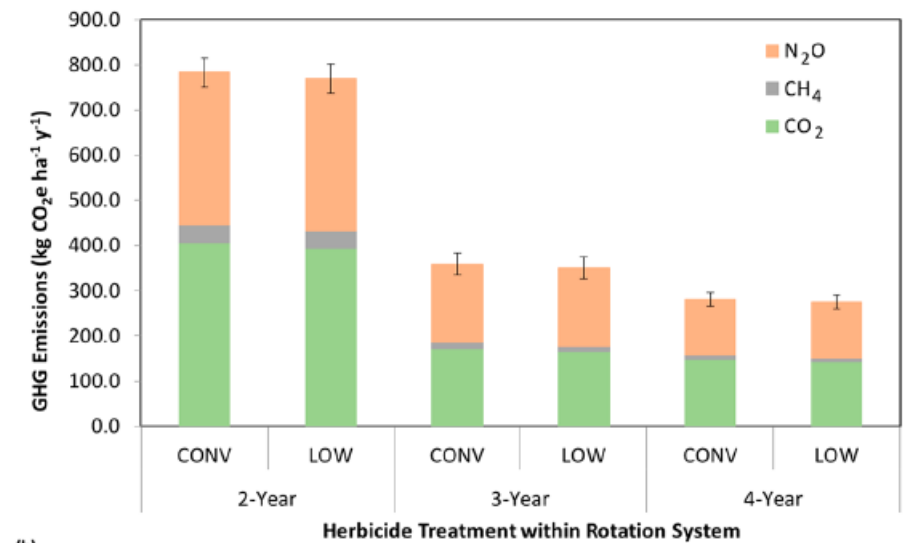
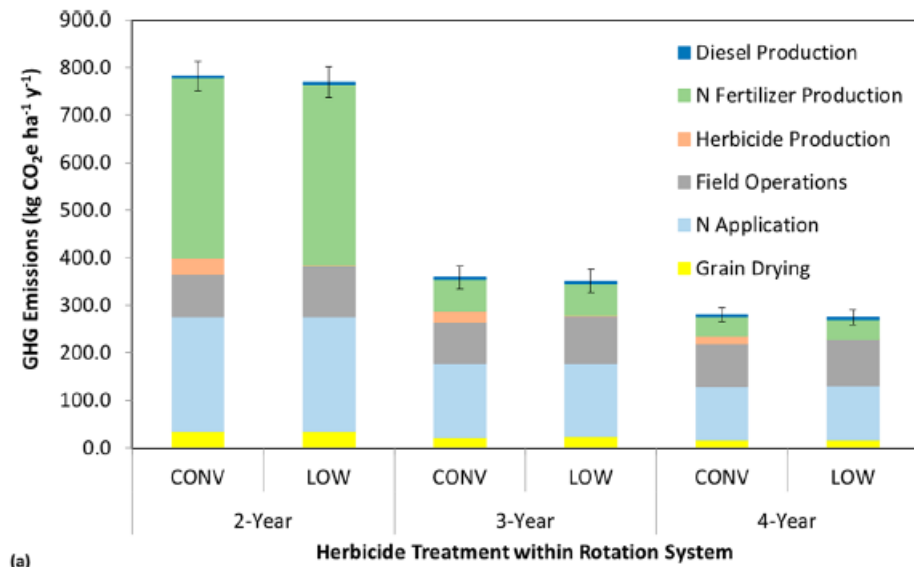
Figure 1. Flowchart of system boundaries, system outputs, and impacts.

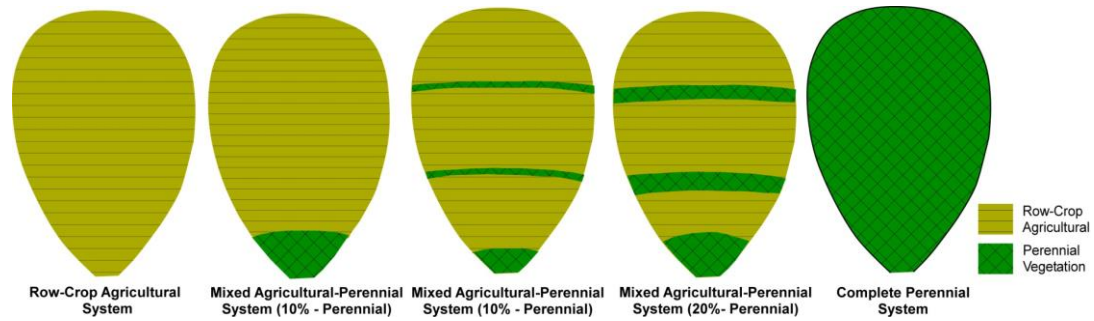
■ RESULTS

Fossil Energy Consumption. The greatest consumer of fossil fuels was the corn-soybean rotation, for both absolute and normalized values, at $9,441 \text{ MJ ha}^{-1} \text{ y}^{-1}$ and $761 \text{ MJ Mg}^{-1} \text{ y}^{-1}$, respectively. Means for fossil energy consumption by the 3- and 4-year rotations decreased by more than half to 4110 and $3366 \text{ MJ ha}^{-1} \text{ y}^{-1}$, respectively. Energy consumption was dominated by N fertilizer production for the 2-year system

;

<https://dx.doi.org/10.1021/acs.est.9b06929>
Environ. Sci. Technol. 2020, 54, 11002–11014





Dr. Matt Helmers, ISU

Visual Examples (4 inch rain in June 2008)

100% Crop

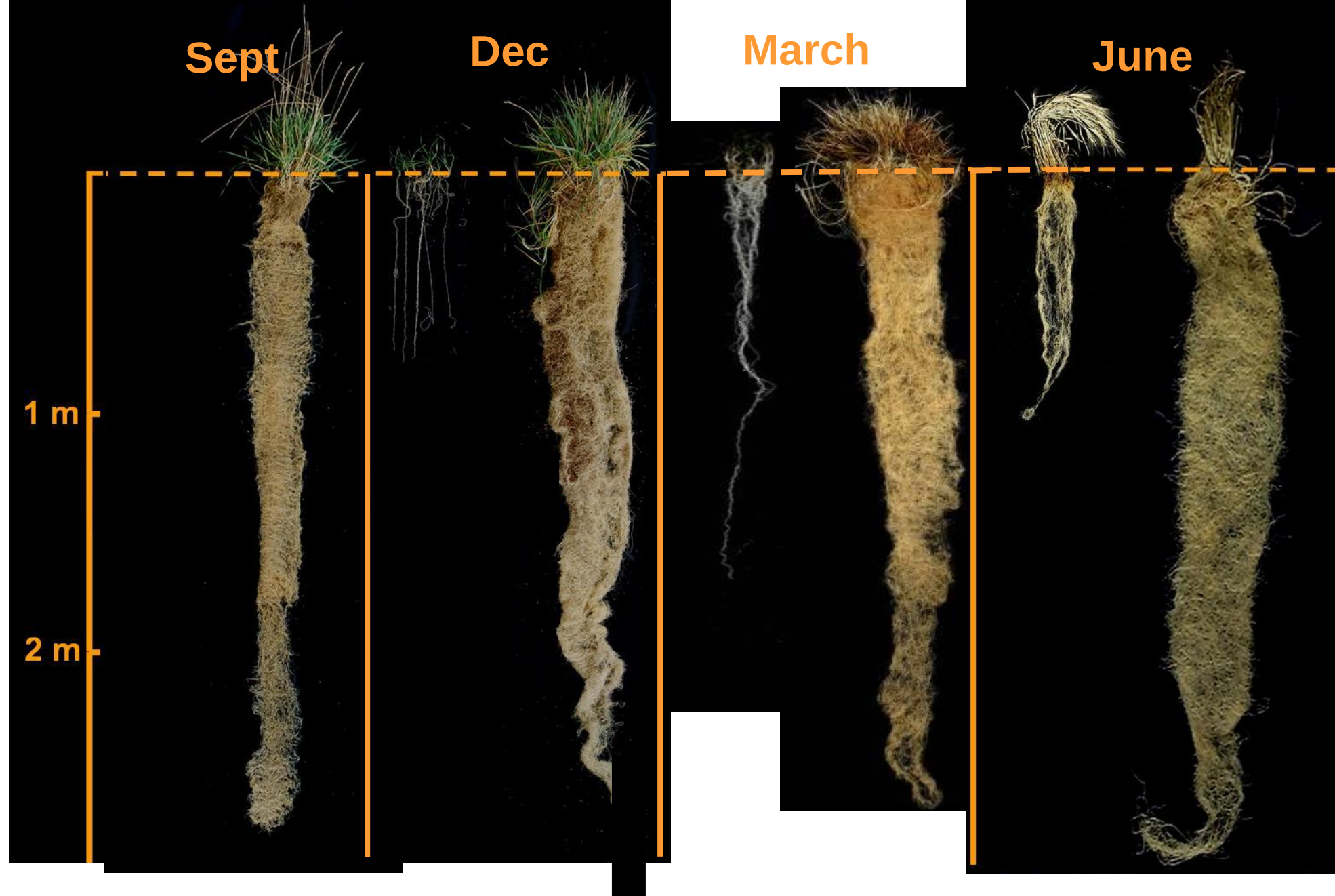


10% Perennial
90% Crop



100% Perennial





Annual wheat (on left in each panel) and Perennial wheatgrass



Improving Ecosystem Services

*10% planted into native prairie strips
Compared to fields without prairie strips*

- Insect richness—**2.6 fold**
- Pollinator abundance—**3.5 fold**
- Native bird species—**2.1 fold**
- Total water runoff—**37% reduction**
- Soil retention—**20 fold**
- Phosphorus retention—**4.3 fold**



Farming for Public Health aims to **highlight the role of sustainable agriculture practices as an upstream solution to many environmental health issues in the state**, particularly to a public health audience.



The Conference is the public health professional version of the Field Day loool

What's a field day?



- Facilitated by Practical Farmers of Iowa
- Peer-to-peer learning opportunities
- Place to share successes, lessons learned, techniques, equipment

Tie to FFPH? Accessible venue for Public Health Professionals to learn & show support



QUESTIONS

Thank you!
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