CULTIVATOR PRESENTATIONS

JENNA WICKS

MODERATOR | FARM FOUNDATION

CULTIVATOR PRESENTATIONS

June 2022 Farm Foundation Cultivators

- **Rio Bonham**
  Oklahoma State University
  Mentor: Dr. Jack Payne
- **Nipuna Chamara**
  University of Nebraska–Lincoln
  Mentor: Jeremy Zwinger
- **Chloe Eggert**
  Auburn University
  Mentor: Sheldon Jones
- **Payton Flower**
  University of Nebraska–Lincoln
  Mentor: Karen Carr
- **Elizabeth Haymaker**
  Oklahoma State University
  Mentor: Christine Hamilton
- **Hope Miller**
  University of Florida
  Mentor: Dr. Keith Coble

Thank you to BNSF and the Round Table Fellows for your support of the Cultivators Program!

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RIO BONHAM

OKLAHOMA STATE UNIVERSITY

Effectiveness of Soil Moisture Sensors to Improve Irrigation Management

Rio Bonham, Mukesh Mehata, Sumon Datta, Saleh Taghvaeian, Ali Mirchi
Department of Biosystems and Agricultural Engineering
Oklahoma State University, Stillwater, OK

DIVISION OF
AGRICULTURAL SCIENCES
AND NATURAL RESOURCES

DEPARTMENT OF
BIOSYSTEMS AND
AGRICULTURAL ENGINEERING
Ferguson College of Agriculture

Background

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DEPARTMENT OF BIOSYSTEMS AND AGRICULTURAL ENGINEERING
Ferguson College of Agriculture

Figure 1. Oklahoma drought map, July 2011.

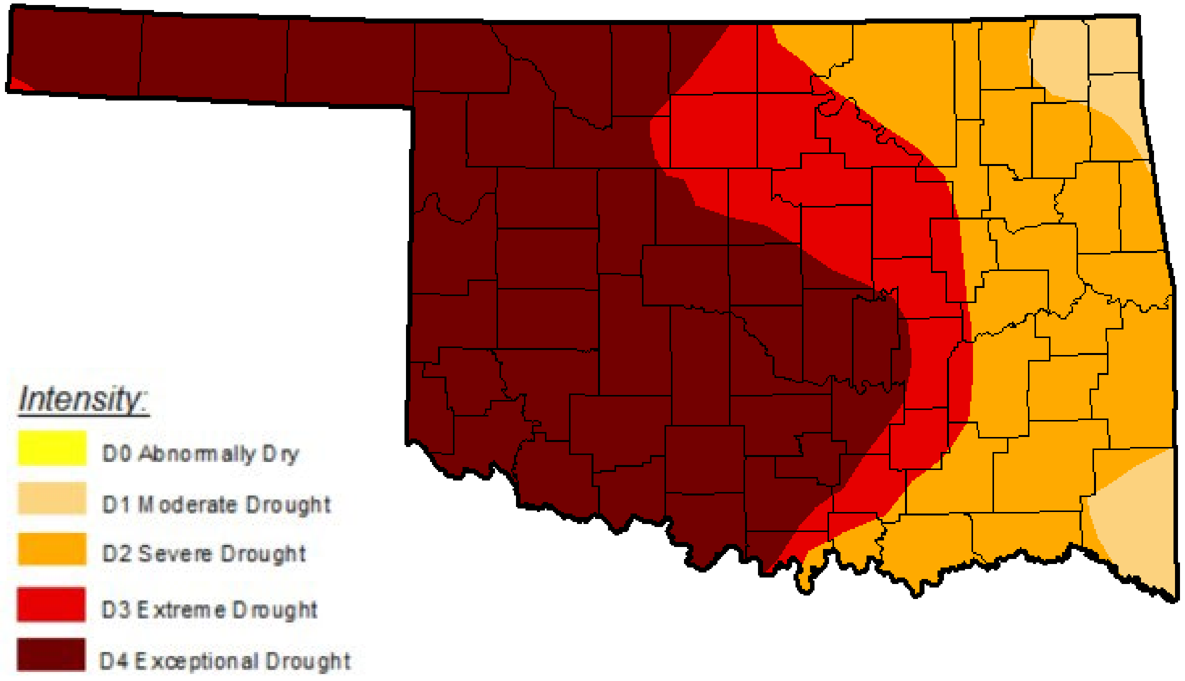
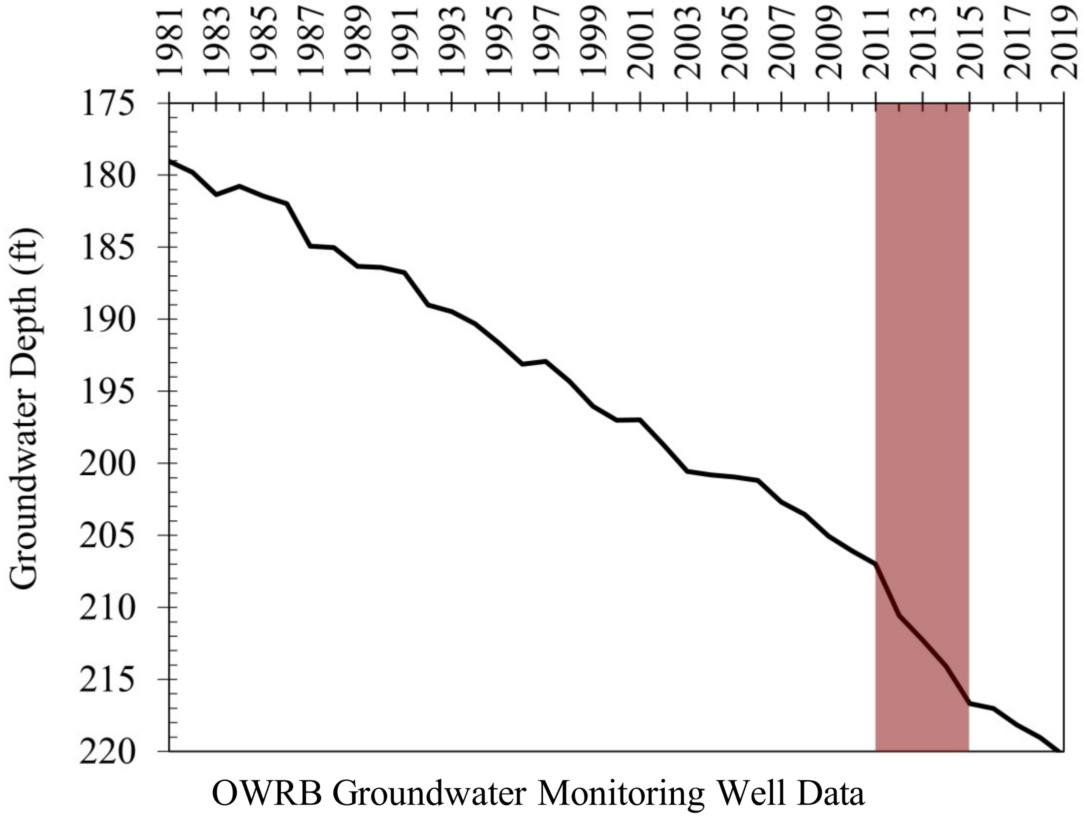


Figure 2. Average depth to water table in Oklahoma portion of Ogallala aquifer.



Need for Study

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Figure 3. Oklahoma Water Resource Board 2060 Projected State-Wide Water Demands.

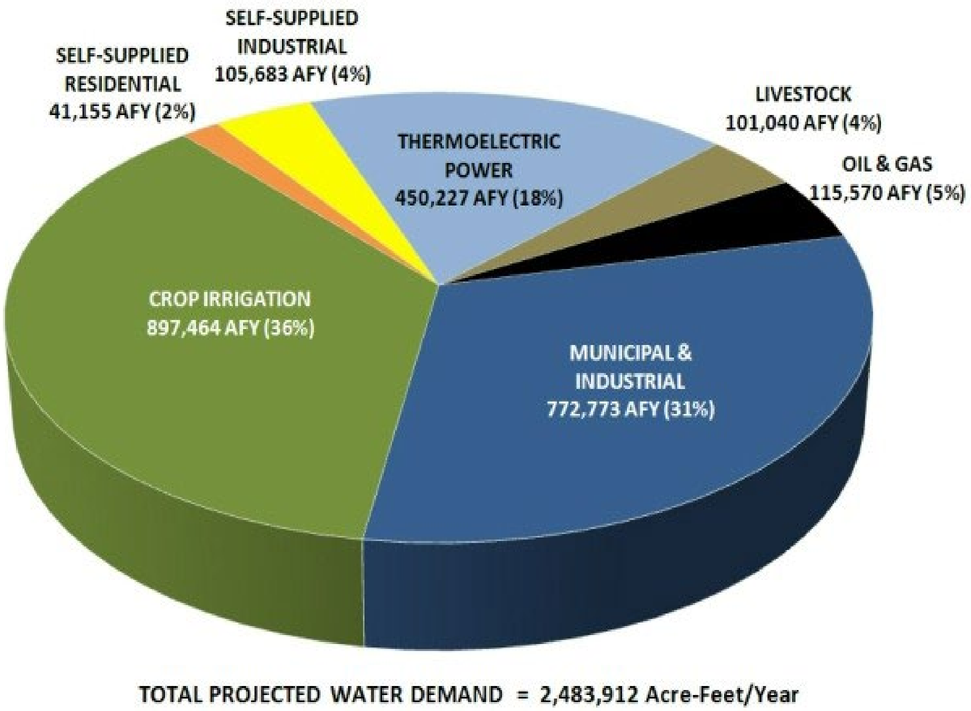


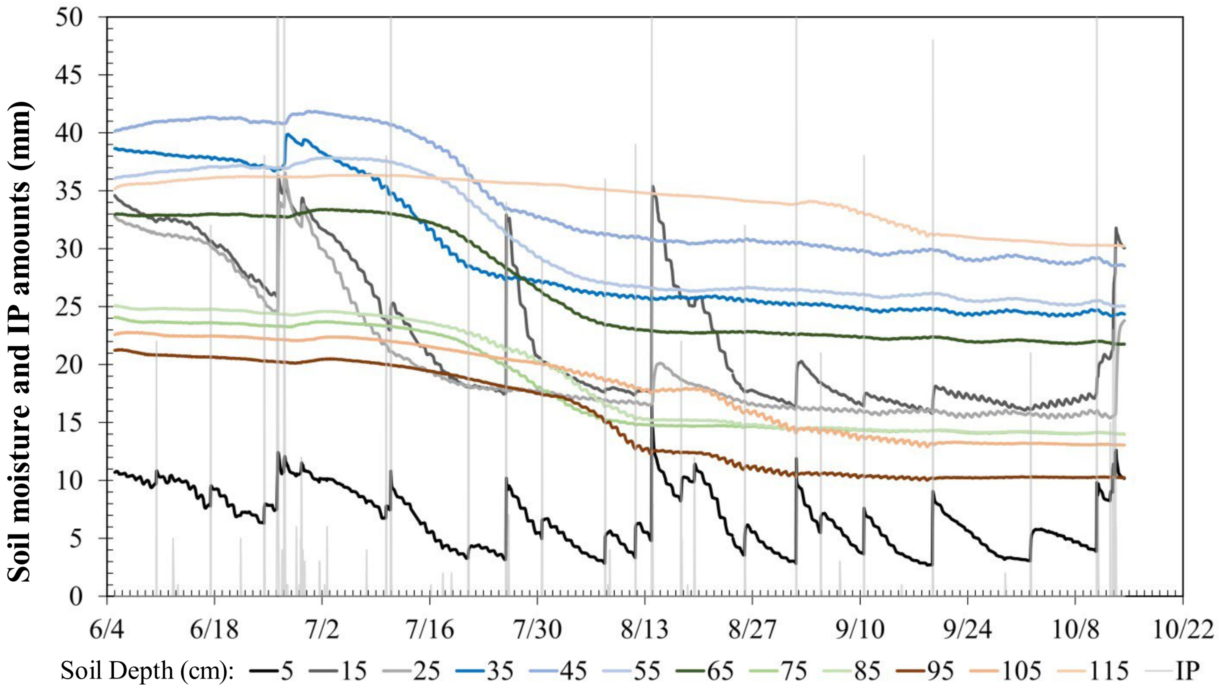
Table 1. State adoption rate of 'smart' irrigation technologies.

State	Adoption Rate (%)
Oklahoma	5%
Texas	10%
Arkansas	11%
Kansas	19%
Nebraska	33%
Nationwide	**12%**

Methodology

Figure 4. Example experimental setup under irrigated cotton at Caddo Research Station (Ft. Cobb, OK).

Figure 5. Example of collected sensor data.



Results & Conclusions

Figure 6. Sensor errors for different calibrations at various ranges of clay content.

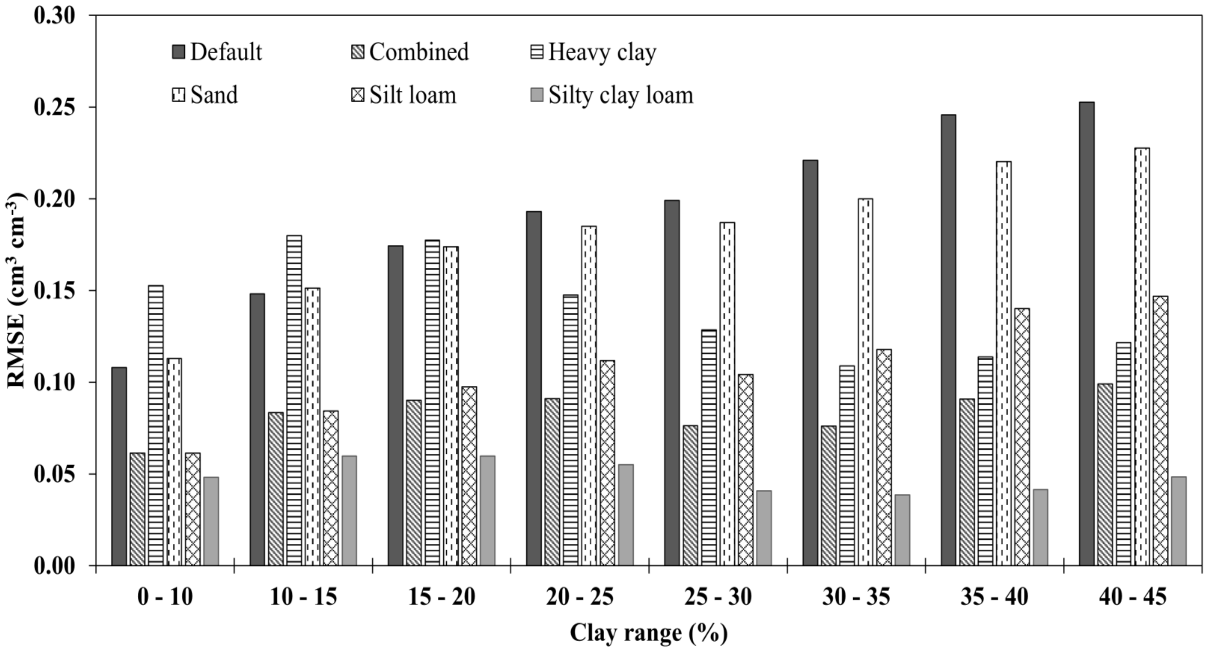
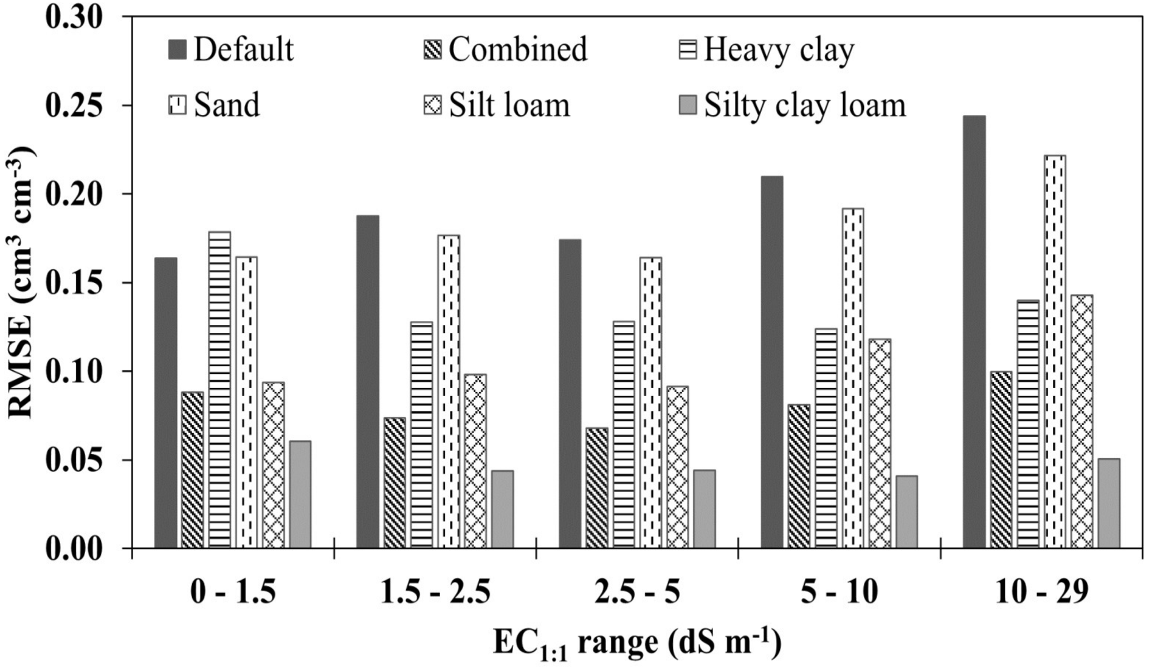


Figure 7. Sensor errors for different calibrations at various ranges of soil electrical conductivity (EC).



The main finding is that these sensors are effective when clay content and salinity are low, but site-specific calibration is required as these two parameters increase.

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NIPUNA CHAMARA

UNIVERSITY OF NEBRASKA—LINCOLN

METER, MEASURE, AND MANAGE IRRIGATION WITH INTERNET OF THINGS

Nipuna Chamara (PhD Student)
Department of Biological Systems Engineering
University of Nebraska, Lincoln

IRRIGATION MANAGEMENT INTRODUCTION

Irrigation management is process of applying water that satisfying the crop water need at the right time while minimizing the water waste, nutrient, and energy. Crop water requirement estimation, soil water content measurement, monitoring, and water application monitoring are essential for efficient irrigation management.

NEBRASKA, USA

Agriculture benefited with Ogallala Aquifer

Issues

Excess ground water extraction reduces the water table

More energy required to pumping water

Nutrient leaching and polluting the aquifer water

Increase the cost of irrigation and fertigation

Irrigation Systems

Center and linear pivot irrigation systems

KALPITIYA PENINSULA, SRI LANKA

Agriculture benefited with Coastal Sandy Aquifer

Issues

Excess ground water extraction

Potential brackish and sea water intrusion

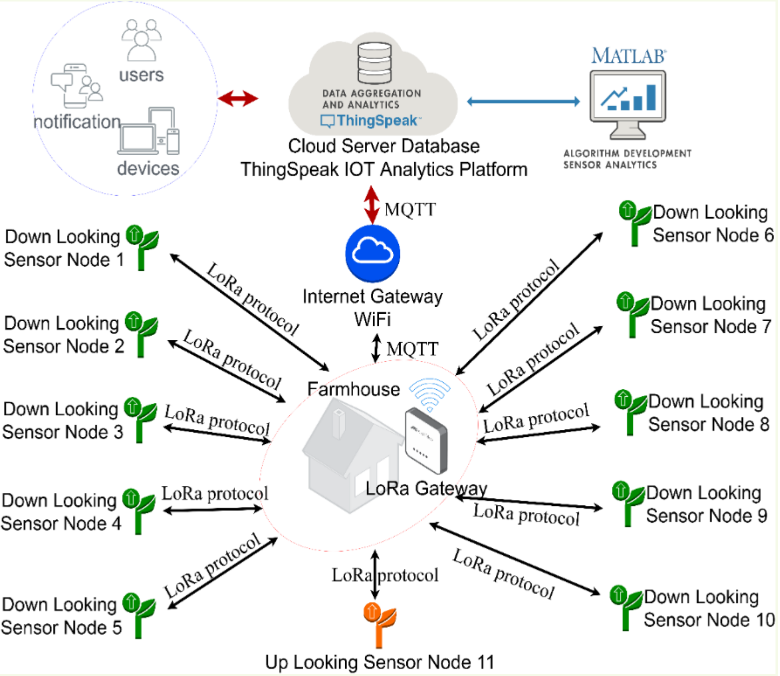
Nutrient leaching and polluting the aquifer water

Increase the cost of irrigation and fertigation

Irrigation Systems

Solid set sprinkler irrigation

INTRODUCTION TO INTERNET OF THINGS



Our system overview

WHAT IS IOT

Internet-connected devices are considered **IoT**. It include sensors (ex:- soil water content sensor) and actuators(ex:- irrigation controller).

FUNCTIONALITY

Collect telemetry data, **transmit** for **analysis** and storage and act

ADVANTAGES

Automation of data collection, analysis, and acting

Connectivity between multiple networks improves real-time decision making

DISADVANTAGES

Associated **costs**

Security flaws

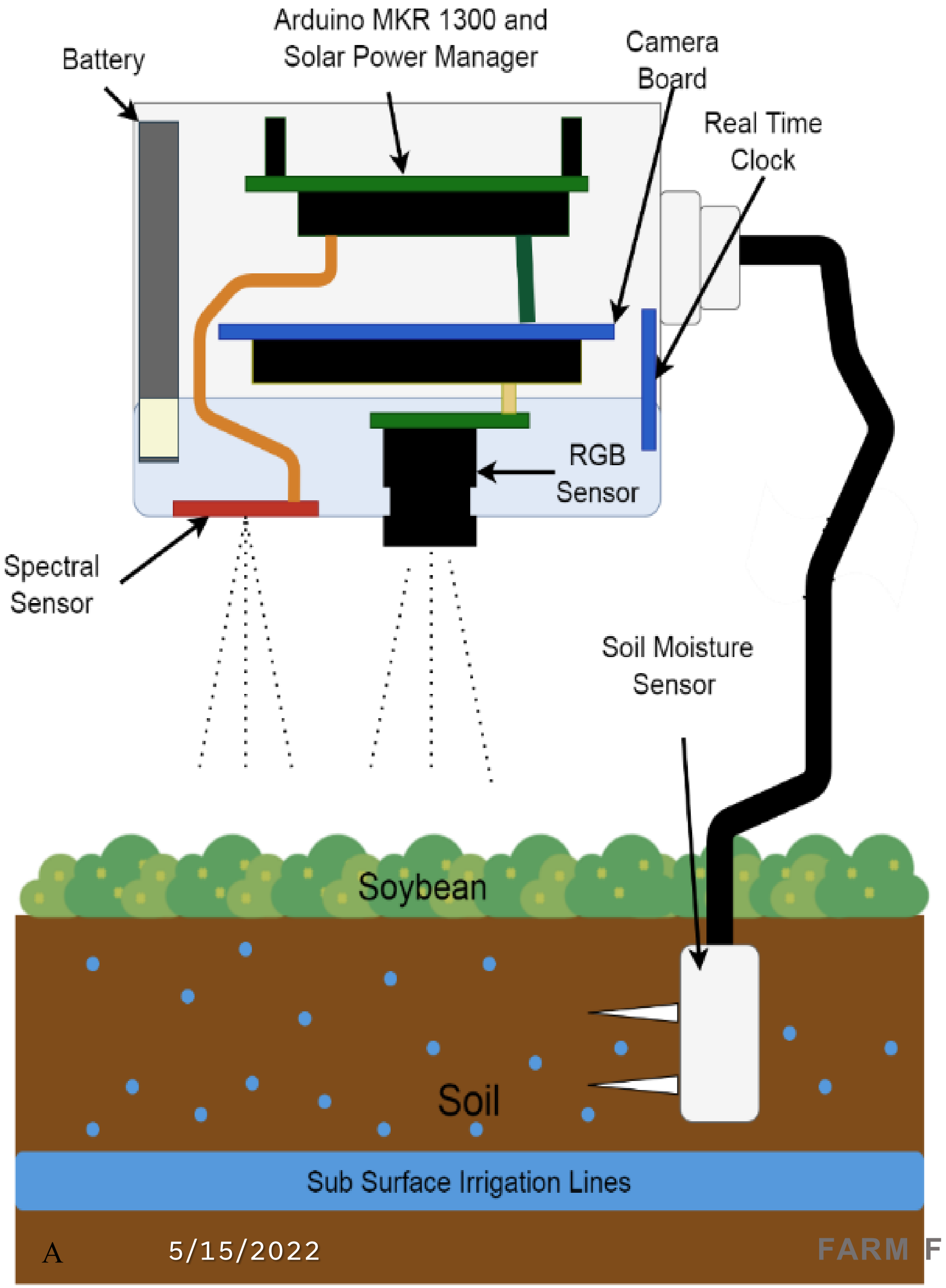
Power supply dependence

Network dependence

High **skill** requirements

FUTURE

IoT devices in the agriculture industry reached **75 million** in 2020, **growing 20%** annually. At the same time, the global smart agriculture market size is expected to triple by **2025**, reaching **$15.3 billion** (www.statista.com)



METHODOLOGY
WHAT WE HAVE DEVELOPED

SOIL WATER CONTENT MEASUREMENT

Time Domain Reflectometry (TDR)based soil water content measurement and transmission

IMAGING SENSOR

Captures and transmit RGB (color images)to cloud data storage

MULTISPECTRAL SENSOR

Able to generate multiple vegetation indices including (Normalized Difference vegetation index)NDVI and (Photochemical Reflectometry Index)PRI

WI-FI AND LORA

Enable data transmission via Wi-Fi and LoRa (Long range low power transmission)

CASE STUDIES OUTCOMES

WATER AND ENERGY SAVING

By introducing sensor-based irrigation Kalpitiya Sri Lankan farmers can reduce water usage by 50-75% while reducing the energy cost

YIELD ESTIMATION

Continuous soil water monitoring and vegetation indices allows to estimate the soybean yield.

ACCURATE EVAPOTRANSPIRATION ESTIMATION

Accurate canopy coverage estimation via image processing allows to accurate evapotranspiration estimation

PLANT GROWTH ESTIMATION

Vegetation indices and image processing allows to estimate the crop growth rate and pest density estimation

CONCLUSIONS

SYSTEM BENEFITS

- Continuous target monitoring, high temporal resolution
- Accurate soil water content measurement
- Realtime decision making ability
- Long range low throughput and short-range high throughput data transmission
- Has the potential to estimate evapotranspiration

CONCLUSIONS

REQUIRED IMPROVEMENTS

- More nodes required to increase the spatial resolution
- Mechanism to avoid disturbance to mechanized agriculture activities

IoT should be in future agricultural water policies

1. Water saved through efficiency is water gained.

2.Timely important and forward-thinking policies are required to save the water for future

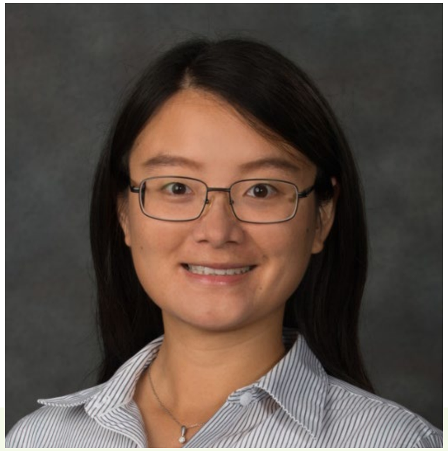
3.IoT is a very powerful tool when it comes to measuring and monitor water use, demand, and waste

4. Policies are required to encourage farmers to use IoT enabled sensors

MEET THE TEAM

YUFENG GE
Associate Professor

GENG BAI
Research Assistant Professor



YEYIN SHI
Assistant Professor and Agricultural Information System Engineer

NIPUINA CHAMARA
Graduate student

“A Picture Is Worth A Thousand Words”

THANK YOU

Nipuna Chamara

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CHLOE EGGERT

AUBURN UNIVERSITY

NUTRIENT HISTORY AND STORAGE IN THE SEDIMENTS OF GEOGRAPHICALLY ISOLATED WETLANDS

CHLOE EGGERT

AUBURN UNIVERSITY & THE JONES CENTER AT ICHAUWAY

AUBURN UNIVERSITY

THE JONES CENTER AT ICHAUWAY
Natural Resource Research & Management

GEOGRAPHICALLY ISOLATED WETLANDS

- Lack hydrologic connection to surface waters
- Excluded from Clean Water Act (WOTUS)
- Ecosystem services
  - Habitat
  - Flood mitigation
  - Biogeochemical processing
- 11,620 GIWS in Dougherty Plain Mostly small < 1 hectare[1]

[1]Martin et al., 2012

GIWS: GEOGRAPHIC CONTEXT

- Agriculture
  - Georgia agriculture industry $69.4 billion[2]
  - Peanuts, cotton, sweet corn, soybeans
- Water
  - Ground water center pivot irrigation systems
  - Southeastern Water Wars
- Fire
  - Prescribed burning: pine

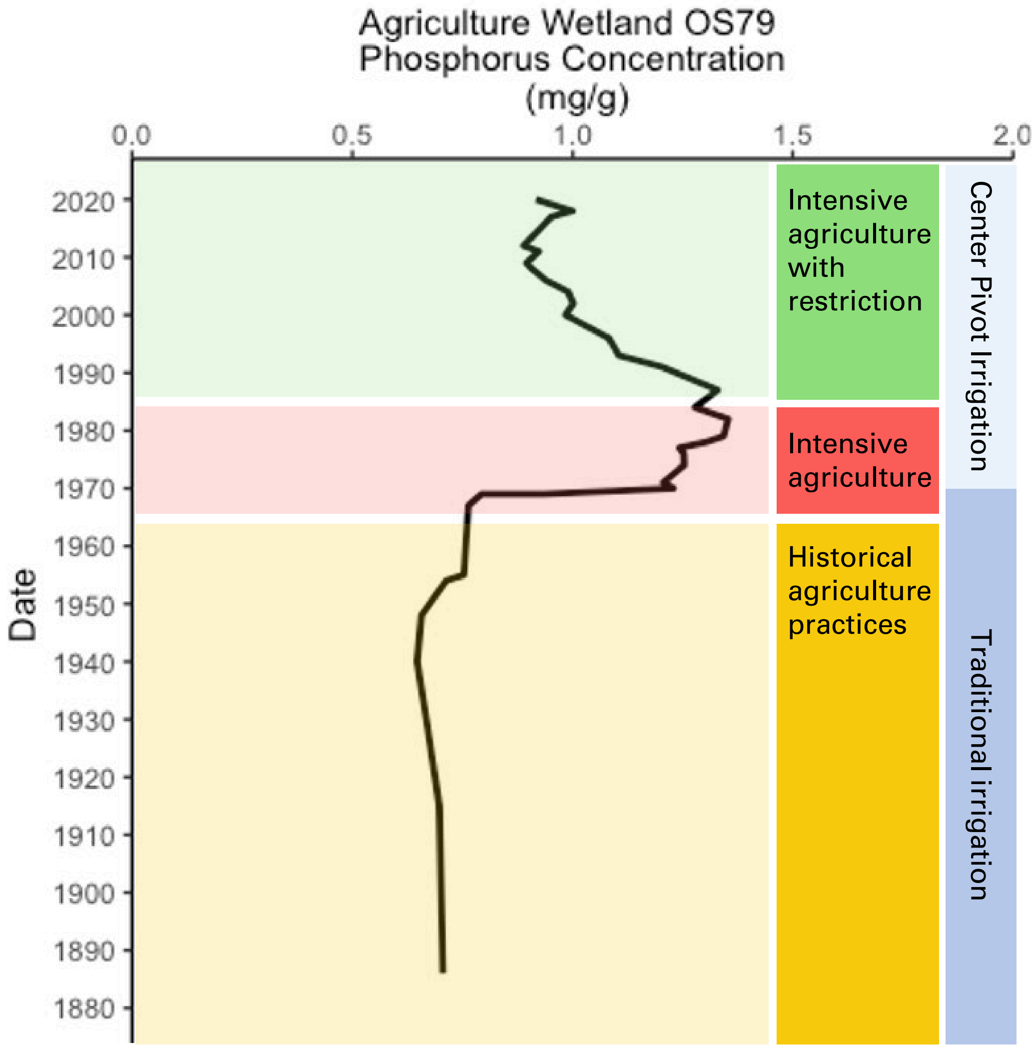
[2]UGA Center for Agribusiness & Economic Development

PALEOLIMNOLOGY

(The history of Lakes)

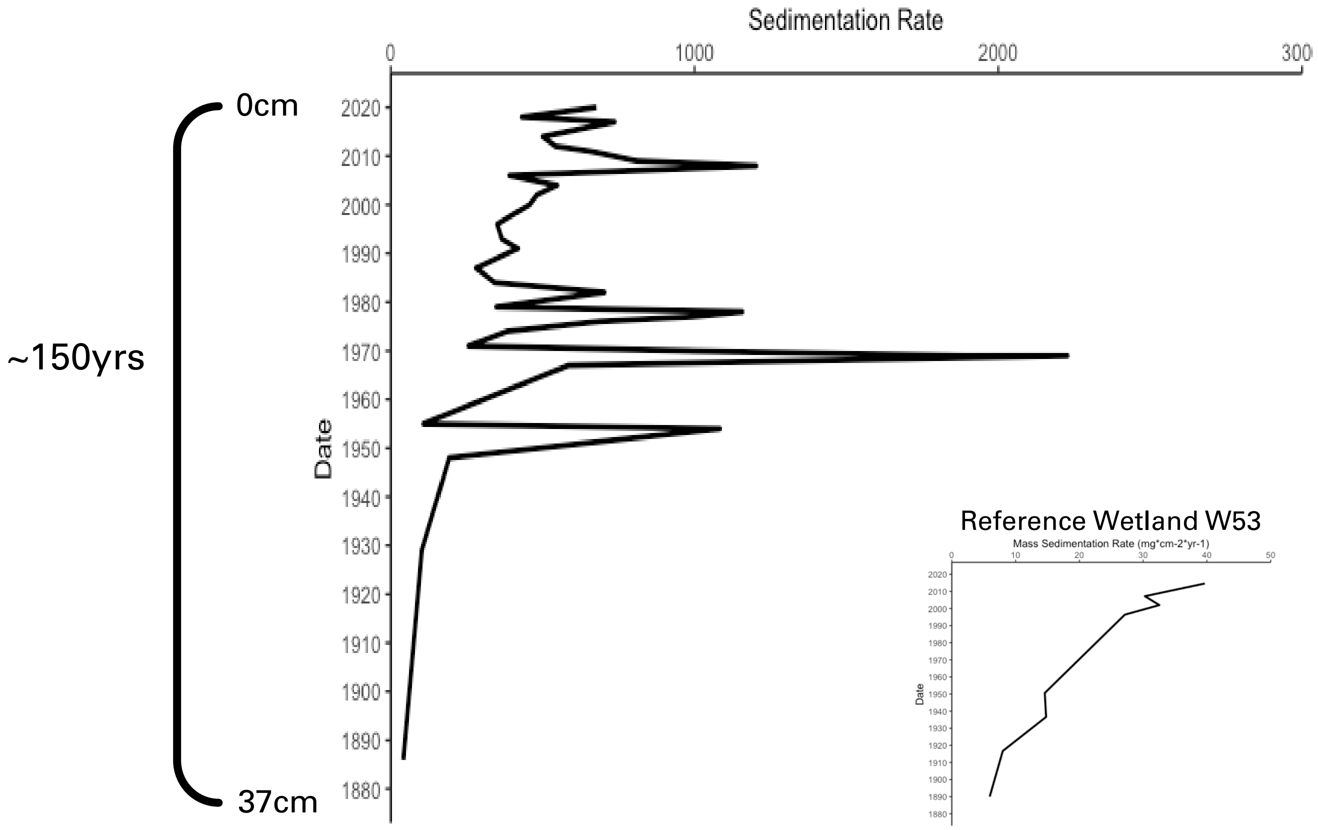
- History and storage
- Carbon, Nitrogen, Phosphorus
- ^{210}Pb dating – Mass Sedimentation Rate
- Water Quality
- Charcoal

RESULTS: HISTORY



RESULTS: STORAGE

Agriculture Wetland OS79



Agriculture Wetland OS79 Cumulative Storage 1886-2020

Nutrient	Kilograms	Tons	Pounds
Carbon	24719	25	54447
Nitrogen	1406	1	3097
Phosphorus	13319	13	29337

Table 1: Agriculture Wetland OS79 Cumulative Storage in the last 150 yrs. of nutrients P, C, and N in kilograms, tons and pounds.

THANK YOU

Acknowledgements

Thank you to funders:
USDA
AAES

Collaborators:
The Jones Center at Ichauway

Mentors:
Matthew N. Waters
Stephen W. Golladay

The Farm Foundation Cultivator Program

Contact:
Chloe Eggert
Cme0036@auburn.edu
Twitter: Eggert_Chloe

QUESTIONS?

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PAYTON FLOWER

UNIVERSITY OF NEBRASKA—LINCOLN

The Broadband Mapping Challenge: An Overview of Rural Broadband Status and Policy Solutions

Motivation:

- Many modern activities rely on the availability of high-speed broadband internet
- Large disparity between the country's urban and rural areas

•*Broadband Mapping* – How can flaws in this process create negative outcomes for the future of rural areas?

Scope:

- Analyzation of the Federal Communications Commission's (FCC) data collections in relation to actual availability in the U.S.
- Possible Policy Solution: State-Led Initiatives through Public-Private partnerships
- 5 Public Policy Criteria – Effectiveness, Efficiency, Equity, Feasibility, Social Acceptability

Payton Flower

Objectives

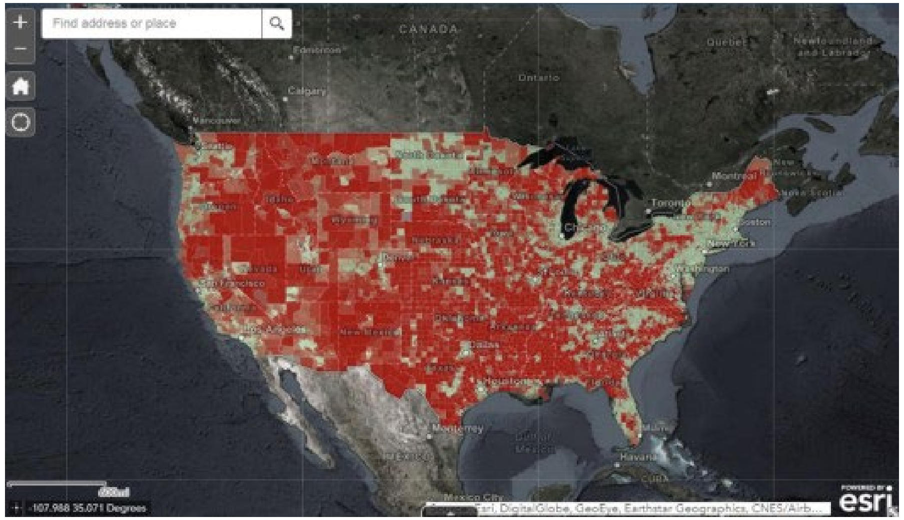
- Identify shortcomings of FCC data collection methods
- Identify and evaluate state-led mapping initiatives to make a policy recommendation

FCC Data Collection Flaws

- Large Geographical scales create a lack of granularity. (Mack et al., 2019)
- Actual speeds largely unavailable, as advertised and contractual speeds are reported. (Mack et al., 2019)
- Verbiage of Form 477 misconstrues data and has resulted in overstating access. (Ali, 2020)

State-Level Initiatives

- **Georgia** - Utilized location-specific data through collaboration with providers and state broadband office, resulting in infrastructure investments
- **USTelecom** – Virginia and Missouri; Broadband Serviceable Location Fabric – address, building, and parcel data.
- **Nebraska** –Economic Development Districts with private companies.



Recommendations

- State-led maps can improve federal maps and funding allocations.
- Existing state mapping efforts may encourage other state efforts while waiting for FCC mapping improvements

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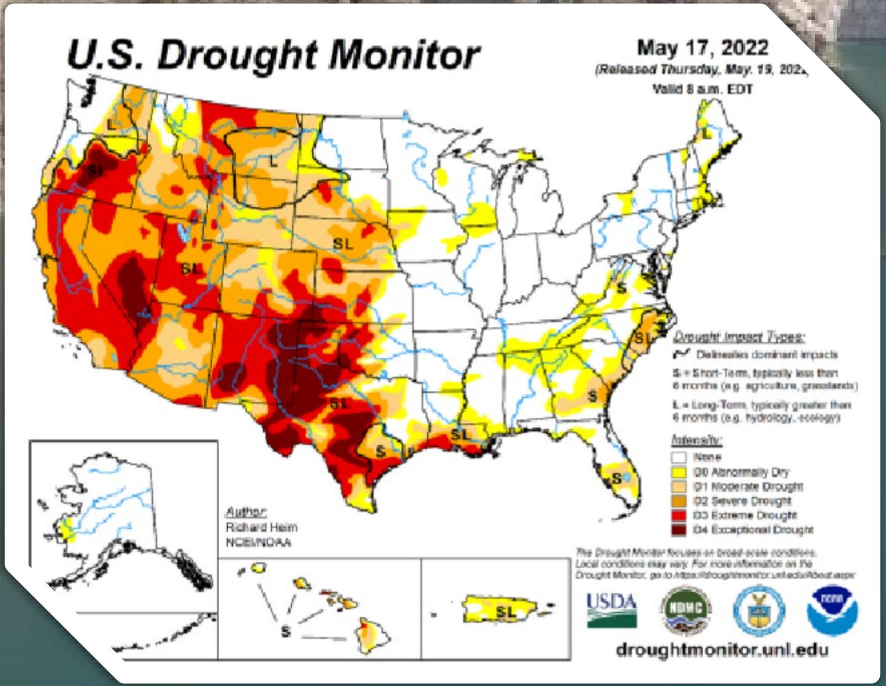
ELIZABETH HAYMAKER

OKLAHOMA STATE UNIVERSITY

Digging Deep into Dryland Agriculture Drought Risks: Assessing Roots for the Solution

Elizabeth Haymaker
PhD. Student
Oklahoma State University

Water Risk



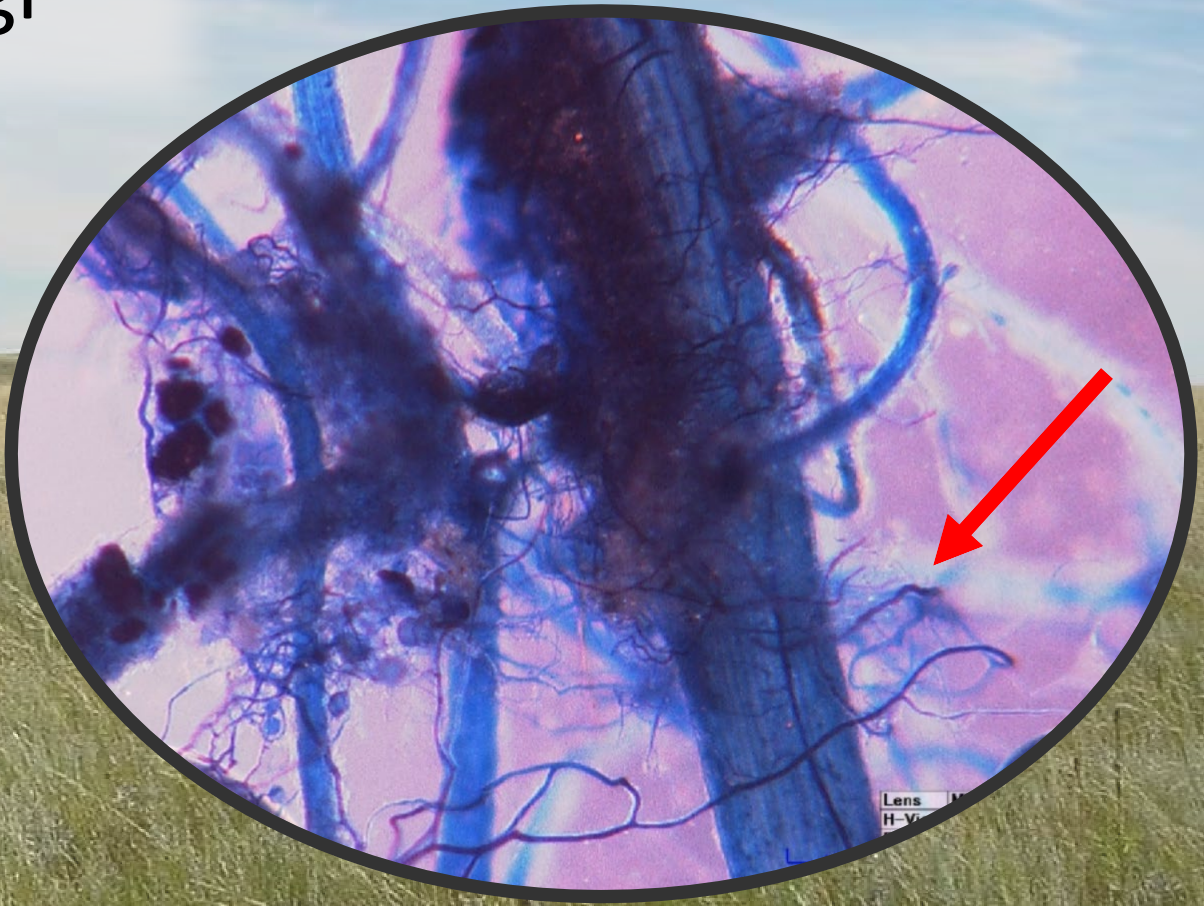
- **Climate change models**
  - **– increased frequent droughts in Southern Plains and Western U.S.**

- **Increasing water demands in urban areas.**

- **Agricultural irrigation ~70% of global water consumption**

Belowground Interactions
Arbuscular Mycorrhizal Fungi

- **Associate with ~80% of plant species**
- **Aides in nutrient & water uptake**
- **Boosts host-plant health/disease resistance**
- **Indicator for host-plant energy allocations**



Drought Adaptation Trait: Rhizosheaths

- **Soil adhering to root**
  - **Root & bacteria exudates**

- **Potential root trait for drought resilience**
  - **Protects roots from drought stress**

- **Most plants evolved under severe (drought) conditions exhibit this trait**

My Research

- **Timescale of rhizosheath development**
- **Drought influences on mycorrhizal colonization**
- **Plant adaptation traits**
  - **Plant species adapted to drier regions will be more likely to develop rhizosheaths**

Impacts

- **Water conservation traits for crop species**
- **Increase sustainability of dryland agriculture**
- **Possible indicator for future shifts in prevalence of highly desirable grassland species**

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OSU | DEPARTMENT OF NATURAL RESOURCE ECOLOGY AND MANAGEMENT

Visit my poster questions welcome!

Elizabeth Haymaker
PhD Student, Oklahoma State University

Advisor
Dr. Gail Wilson
Regents Professor, Oklahoma State University

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HOPE MILLER

UNIVERSITY OF FLORIDA

Fire Science Needs of Southeastern Extension Professionals

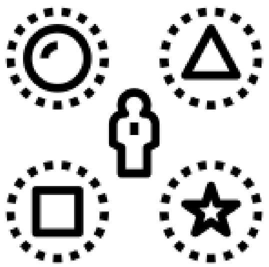
Hope Miller
(she/her)
June 2022

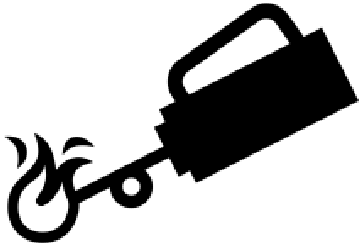
SOUTHERN Fire Exchange

Interviews with 23 Extension agents

Agents came from several states in the southeastern US.

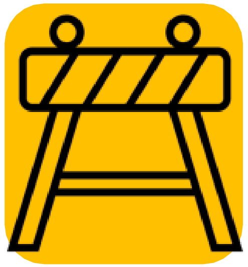
Agents had a wide range of job titles and audiences they served.



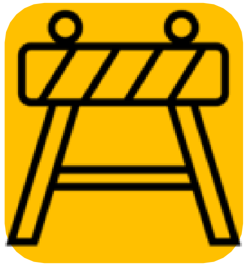


21 out of 23 agents had previous fire experience.

Agents identified multiple barriers:



- Reporting quotas
- Politics
- Job description
- Audience fear of fire
- Distrust of the government
- Lack of time
- Not enough technical skill



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QUESTION AND ANSWER

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