Cultivator Presentations

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Remember: Round Table is off the record.

Jenna Wicks

MODERATOR | FARM FOUNDATION

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January 2022 Farm Foundation Cultivators

- **Adam Knoblock**
  Iowa State University
  Mentor: Dan Kerkhoff
- **Justin Leslie**
  North Carolina A&T State University
  Mentor: Gale Buchanan
- **Kirsten Nickles**
  The Ohio State University
  Mentor: John Foltz
- **Roberto Ortez**
  University of Florida
  Mentor: Jack Payne
- **Kantilata Thapa**
  University of Nebraska Lincoln
  Mentor: Jenny Maloney
- **Alyssa Vander Woude**
  California Polytechnic State University, San Luis Obispo
  Mentor: Ryan Schohr

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

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Alyssa Vander Woude

CALIFORNIA POLYTECHNIC STATE UNIVERSITY, SAN LUIS OBISPO

STRATEGIES FOR RESILIENCE AMONG CALIFORNIA DAIRY FARMS

Alyssa Vander Woude -- Cal Poly, San Luis Obispo

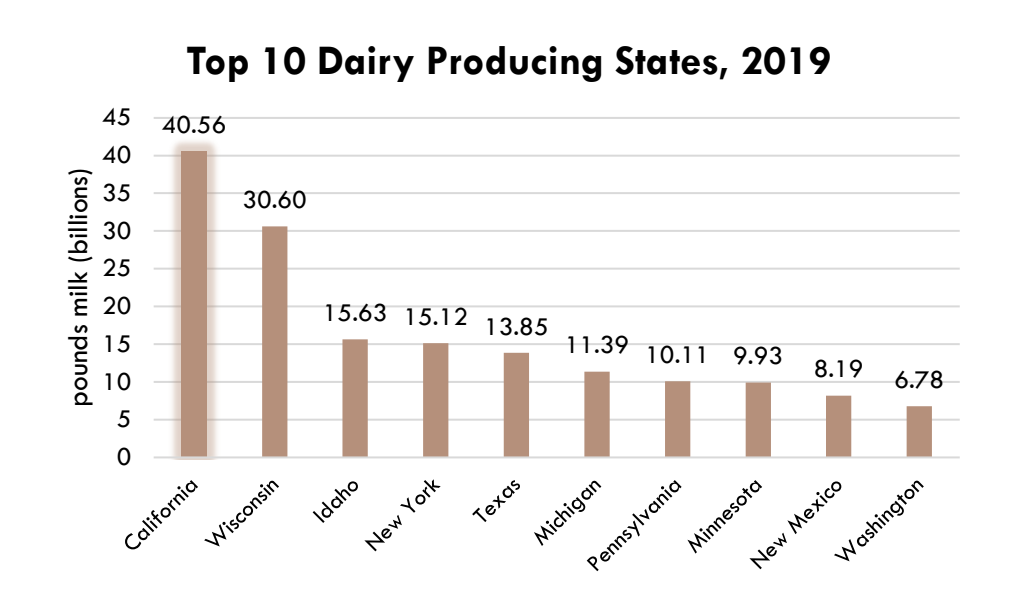
Overview of the California Dairy Industry

California leads the nation in milk production

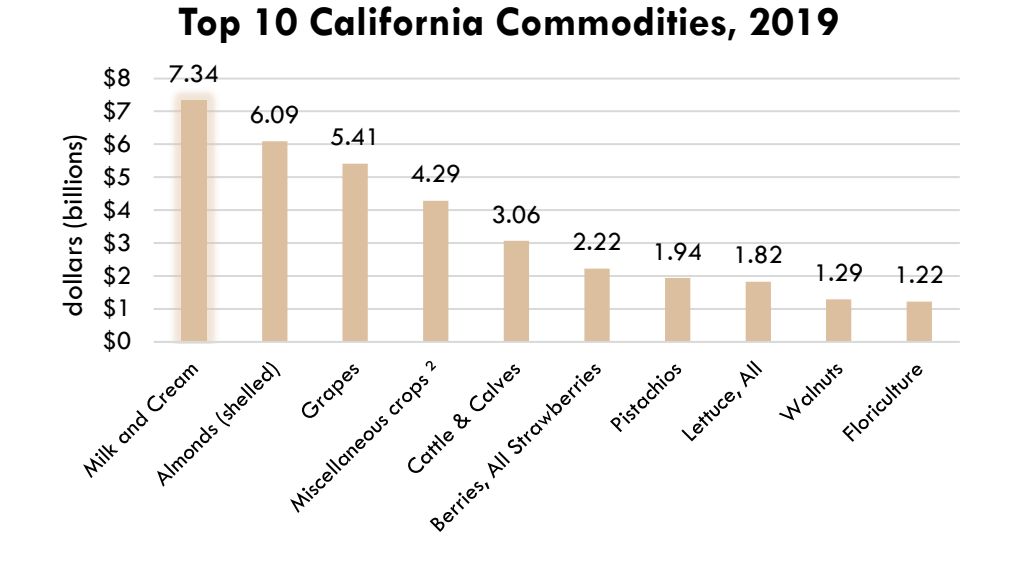
Dairy is the leading commodity in the state

The industry has faced market fluctuations, policy changes, and other challenges in recent years

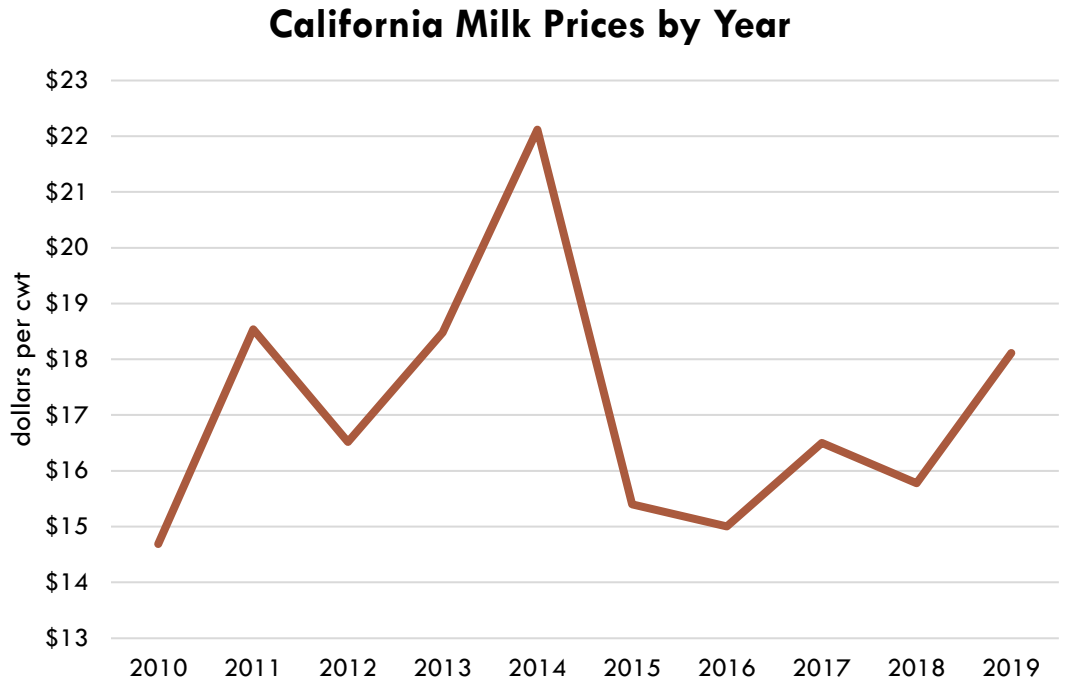
Dairies are taking different strategies to manage risk and improve profitability



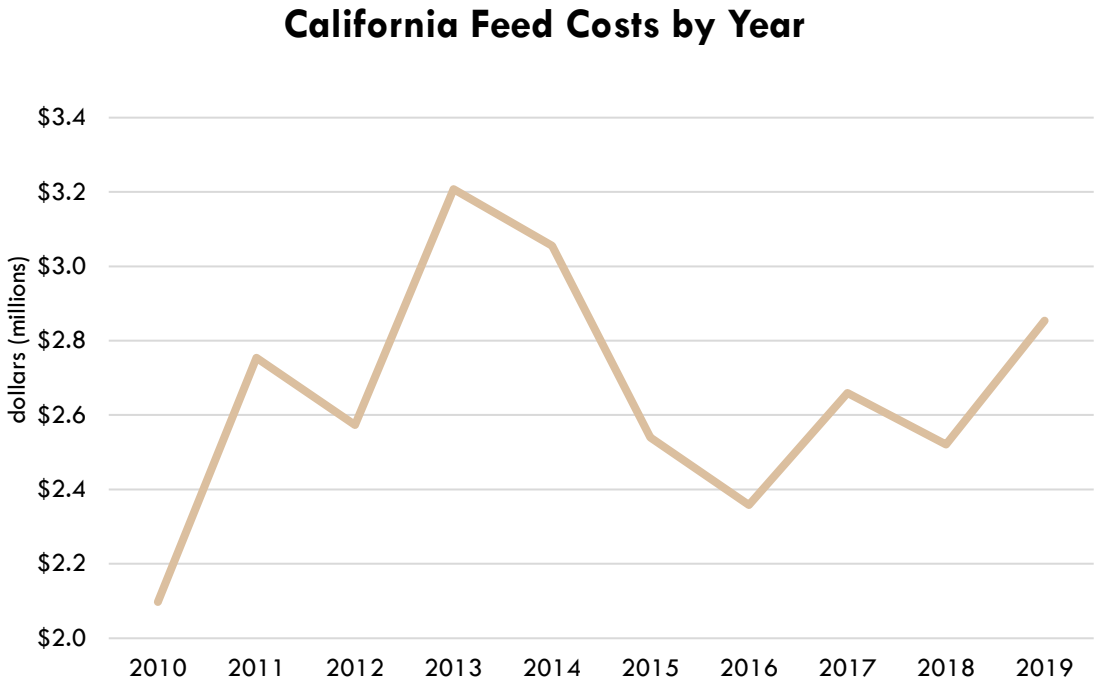
Source: USDA, National Agricultural Statistics Service (NASS), 2019-2020



Source: California Agricultural Statistics Review, 2019-2020



Source: California Agricultural Statistics Review, 2019-2020



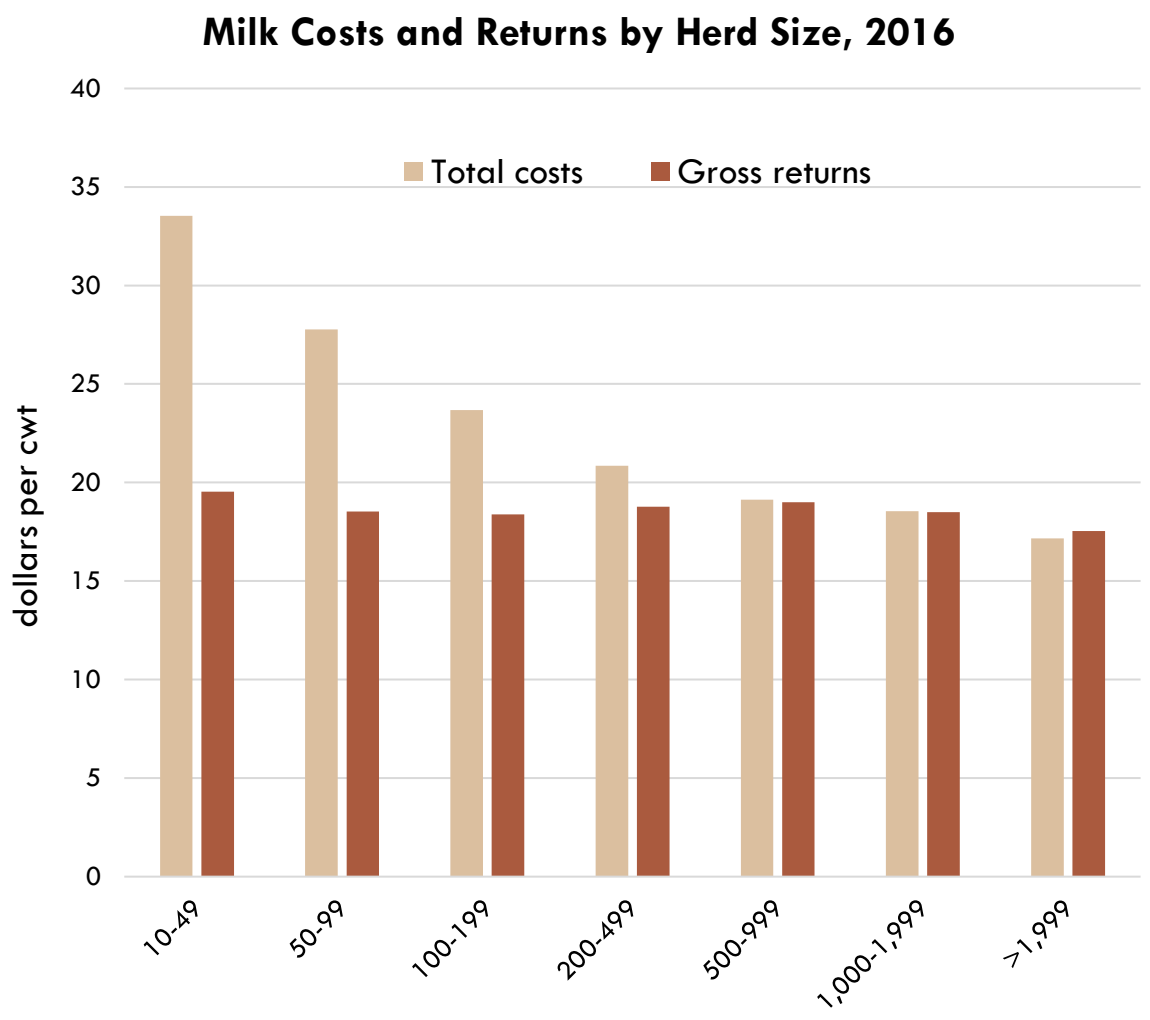
Source: USDA, Economic Research Service and National Agricultural Statistics Service, Agricultural Resource Management Survey

Cost and Return Fluctuations

- **Milk price and feed cost fluctuations have caused considerable income risks for California dairies since 2004**
- **Feed costs account for over half of total farm expenses**
- **In 2014, California dairies were earning an average net income greater than $2.7 million and just two years later, in 2016, that number dropped below $500,000**

Consolidation Across the United States

- **Production in all states is shifting towards larger, more efficient operations**
- **Bigger scale dairies realize substantially lower costs than smaller operations**
- **These differences provide powerful economic incentives behind dairy consolidation**



Source: USDA, Economic Research Service and National Agricultural Statistics Service, Agricultural Resource Management Survey, 2016 Dairy Version.

Beef x Dairy

- Many dairies are breeding a portion of the herd to beef semen for crossbred beef calves
- This helps manage herd size and creates an additional, sometimes significant, revenue source
- Most farms are already overproducing replacement heifers and have no need for excess heifers or low-priced dairy bulls.

"For GENEX, our beef sales numbers are continually increasing due to farms improving management, genetics, and reproduction; this means they are getting more efficient with their sexed semen use (higher conception rates) and can subsequently increase their use of beef semen."

–Gwen Powers, GENEX

"It's a way to make the state happy and, at the same time, dairymen are happy because it's a way to keep them in business."

–Eileen Martinho, Maas Energy Works

Carbon Credits

- **In 2006, statewide programs and standards were created to reduce greenhouse gas (GHG) emissions**
- **Dairies are not currently subject to any compliance obligation but there are incentives in place for voluntary participation**
- **Under the Compliance Offsets Program, dairies can earn tradeable Offset Credits from qualifying projects that reduce or offset GHG emissions**
- **These credits can then be sold to other regulated entities trying to meet their obligations**

Tree Nuts

- **A spike in demand for almonds led a number of dairy farmers to pivot from milk to nuts in the early 2010s.**
- **Many farms began sourcing feed from out of state and replaced previously used farmland with acres of tree nuts.**
- **At the time, planting trees was a growing financial opportunity for struggling dairy farmers, but recent drought issues have proven farming's ever-evolving challenges.**

"We looked at the return on trees over the last 10 years and felt it was too good to pass up."

–Jack Hoekstra, Hoekstra Dairy

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Justin Leslie

NORTH CAROLINA A&T STATE UNIVERSITY

Optimizing The Use Of Rural Land In Georgia

Organic Vegetable Production In High Tunnels

By: Justin Leslie

North Carolina A&T S.U.

Senior Agribusiness Major/ Minor: Supply Chain Management

Introduction

- I will be using the S.W.O.T Analysis to determine the optimal use of the land

S: Strengths

W: Weaknesses

O: Opportunities

T: Threats

Strengths

- Conserves land
- Provides fresh high quality produce
- Sustains Soil and Water
- Enhances biodiversity
- Profitable
- Less disease and weather interference

Weaknesses

- Converting from conventional agricultural practices to organic can be challenging with your soil. Allowed 3 growing seasons to completely convert.
- Challenges in finding organic input suppliers
- Growing practices are more labor and time intensive
- Start up cost

Opportunities

- Increasing demand for organic products
- Provide employment opportunities to the community
- Unique products different from other farms

Threats

- Marketing
- Demand within the community
- Location can limit your markets and profitability
- Labor barriers

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Kantilata Thapa

UNIVERSITY OF NEBRASKA LINCOLN

High Throughput Phenotyping of Crops for Building Resilience in Agriculture and Environment

Presented by:
Kantilata Thapa
Master's in Mechanized System Management(MSYM)
Department of Biological Systems Engineering
University of Nebraska -Lincoln

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Statement of the Problem

Population increase

Decreasing Agriculture Production

Climate change impacts- prolonged and severe drought, flood, heat/cold spells, unpredicted precipitation, biotic and abiotic stress.

Degradation of natural resources

Building Resilient and sustainable agricultural production and management of resources is the need of an hour.

High throughput Plant Phenotyping (HTPP) for Resilient Agriculture and Environment

High throughput plant phenotyping (HTPP) is in frontier

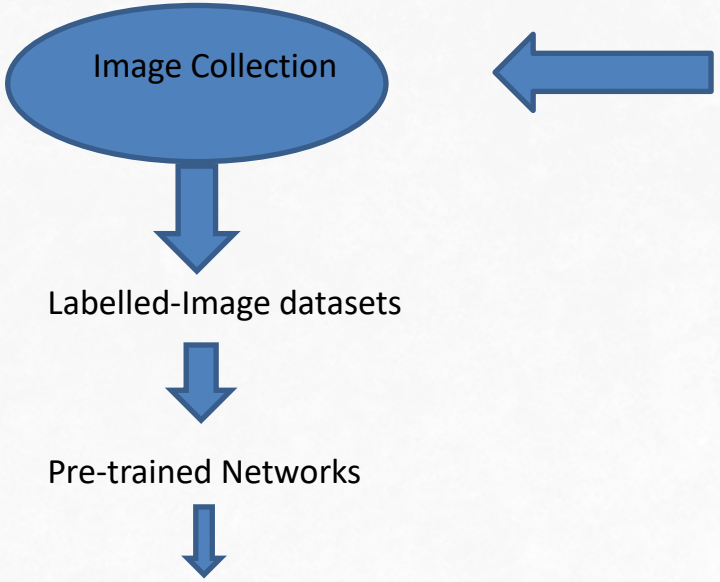
- to measure the physical, chemical, and developmental characteristics.
- Selection of genotypes with great adaptability to future climates.
- HTPP uses automated sensing, robotics, and big data analytics to measure crop phenotypes.

- Imaging is one of the most popular and emerging methods to collect HTPP data.

Imaging Techniques

- Visible Imaging
- Fluorescence Imaging
- Thermal Imaging
- Spectral Imaging

Representation of Computer Vision Plant Phenotyping



Sensors

RGB Camera
Multispectral and hyperspectral sensors
RADAR, Lidar sensors

Pre-processing
- Noise reduction
- Image correction
- Normalization
- Scaling
- Augmentation

Segmentation
- Object detection
- Instance segmentation
- Semantic Segmentation

Feature Extraction
- Key point detection
- Representation Learning

Classification
- Disease-Resistance/Sensitive
- Taxonomic classification
- Growth Stages

Applications
Agriculture-stress detection, productivity forecasting
Genetics/Breeding- Mutant discovery, genomic prediction, desirable trait selection

Fig : Schematic Representation of Image-based High-throughput Plant phenotyping
Source : ZHANG, Y., & ZHANG, N. (2018b). Imaging technologies for plant high-throughput phenotyping: a review. Frontiers of Agricultural Science and Engineering, 0(0), 0. https://doi.org/10.15302/j-fase-2018242

Acknowledgements

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Farm Foundation

Thank you !

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Adam Knoblock

IOWA STATE UNIVERSITY

Perennial Ground Cover for Biofuel Production and Environmental Sustainability

ADAM KNOBLOCK

AGRICULTURAL BUSINESS

IOWA STATE UNIVERSITY

Presentation Outline

- What is perennial groundcover?
- Incorporating groundcover in crop production
- Biofuel production
- Environment, soil conservation and sustainability
- Conclusion and Implications

Perennial Ground Cover

- Grown between regular cash crop growing seasons to reduce soil erosion, improve soil organic matter, and conserve soil moisture by increasing the amount of residue on the soil surface
- Grasses
  - Rye
  - Wheat
  - Oats
- Legumes
  - Red Clover
  - White Clover
  - Field Peas

Groundcover in Crop Production

Planted typically after harvest has been completed

Needs at least 1 month to grow before first frost

Will either die off naturally, need to be harvested, tilled, or sprayed with herbicides

Benefits:

- Reduces soil erosion
- Improves soil health
  - Adds organic matter
  - Biological activity
- Reduces weed competition
- Allows for better air and water movement in the soil
- Reduce carbon in the air
- Add nitrogen into the soil so you do not have to spend a lot of money on fertilizer
- Place to graze livestock on

Biofuel Production through Cover Crops

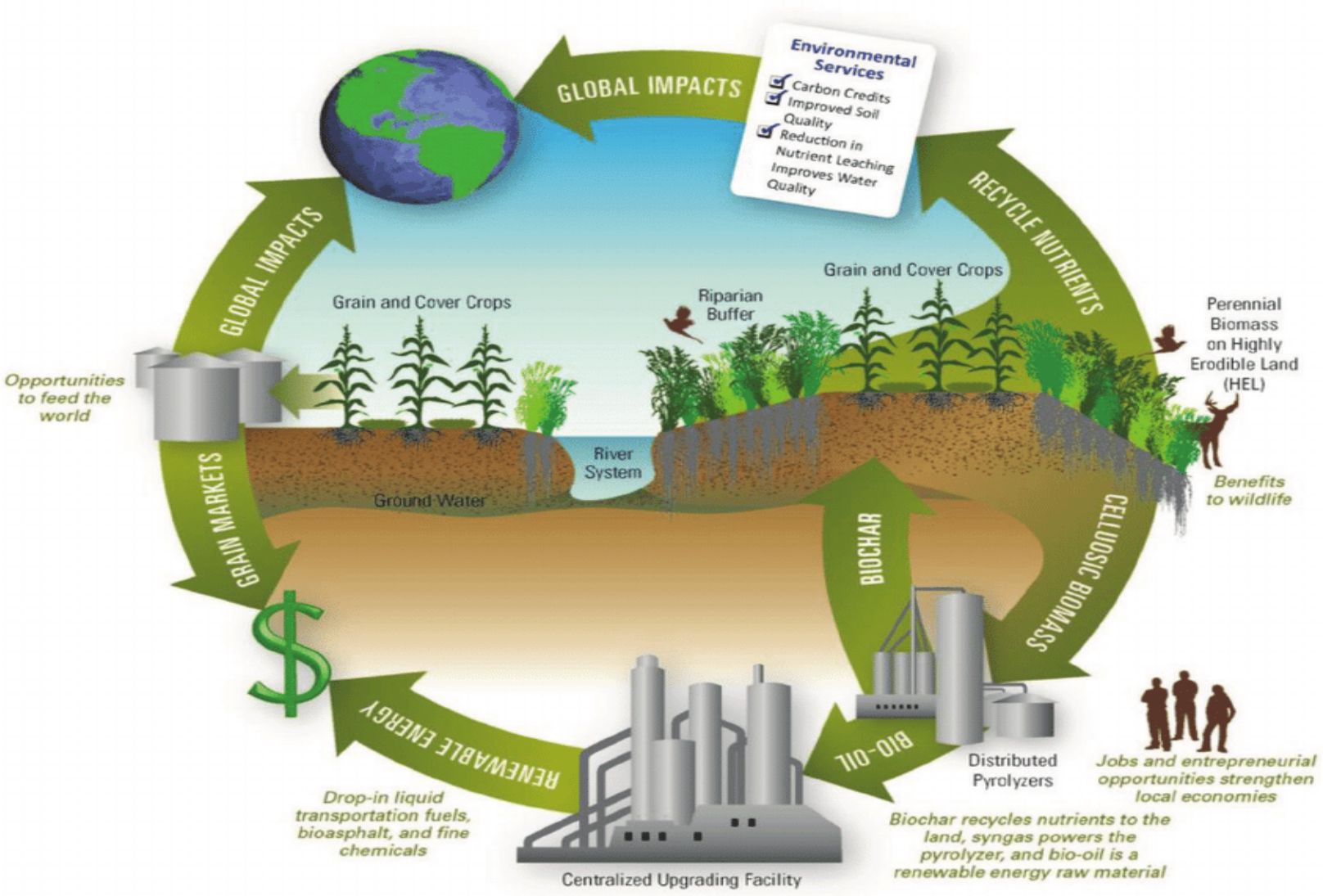
- Research being headed by Iowa State University on this topic, since it is a newer concept
- Switchgrass in the main cover crop that would be used
- Derived from the plant's cellulose and lignin to produce biofuels
  - More plentiful than starch and sugars

Benefit:

- Increase in revenue

Costs/Negatives:

- Lower yields of cash crop if managed poorly
- Increase in management cost
- Could lead to more erosion and less organic material returned to the soil if harvested too soon
- Reduce the effects that cover crops are supposed to have


GLOBAL IMPACTS
Environmental Services
Carbon Credits
Improved Soil Quality
Reduction in Nutrient Leaching Improves Water Quality
RECYCLE NUTRIENTS
GLOBAL IMPACTS
Grain and Cover Crops
Riparian Buffer
Grain and Cover Crops
Perennial Biomass on Highly Erodible Land (HEL)
Opportunities to feed the world
River System
Ground Water
Benefits to wildlife
GRAIN MARKETS
BIOCHAR
CELLULOSIC BIOMASS
RENEWABLE ENERGY
BIO-OIL
Distributed Pyrolyzers
Jobs and entrepreneurial opportunities strengthen local economies
Drop-in liquid transportation fuels, bioasphalt, and fine chemicals
Biochar recycles nutrients to the land, syngas powers the pyrolyzer, and bio-oil is a renewable energy raw material
Centralized Upgrading Facility

Environment, Soil Conservation and Sustainability

Environment:

- Reduces carbon emissions up to 83% compared to no cover crops and tillage

Soil Conservation:

- Up to a 77% reduction in soil erosion compared to a single crop
- Adds organic material and encourages biological activity
- Allows for better water and air movement in the soil

Sustainability:

- Helps reduce carbon in the air, which leads to a cleaner Earth
- Aid in cleaner biofuels so less harmful emissions are given off
- Could be a more productive source for biofuels in the future

Conclusion

- Lead to a cleaner Earth through the reduction of carbon in the air
- Improve soil conditions through prevention of erosion, adding soil organic matter, and conserving soil moisture
- Could create the next generation of biofuels that will be much more efficient and sustainable in the future
- Another avenue for revenue within the agricultural world

Work Cited

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"Natural Resources Conservation Service." *Conservation Choices: Cover Crops*, https://www.nrcs.usda.gov/wps/portal/nrcs/detail/null/?cid=nrcseprd414410.

Schlautman, Brandon, et al. "Perennial Groundcovers: An Emerging Technology for Soil Conservation and the Sustainable Intensification of Agriculture." *Emerging Topics in Life Sciences*, Portland Press Ltd., 21 May 2021, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8166338/.

A Systems View of CENUSA's Vision of a Potential Biofuels ... https://researchgate.net/figure/A-systems-view-of-CenUSAs-vision-of-a-potential-biofuels-system-where-perennial-biomass_fig1_274634080.

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Kirsten Nickles

THE OHIO STATE UNIVERSITY

Muddy environmental conditions increase the cow herd's net energy requirements during late gestation

Kirsten R. Nickles

THE OHIO STATE UNIVERSITY

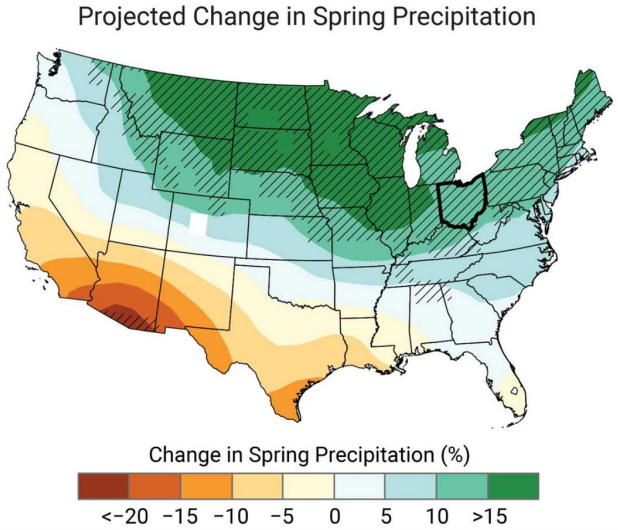
COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES

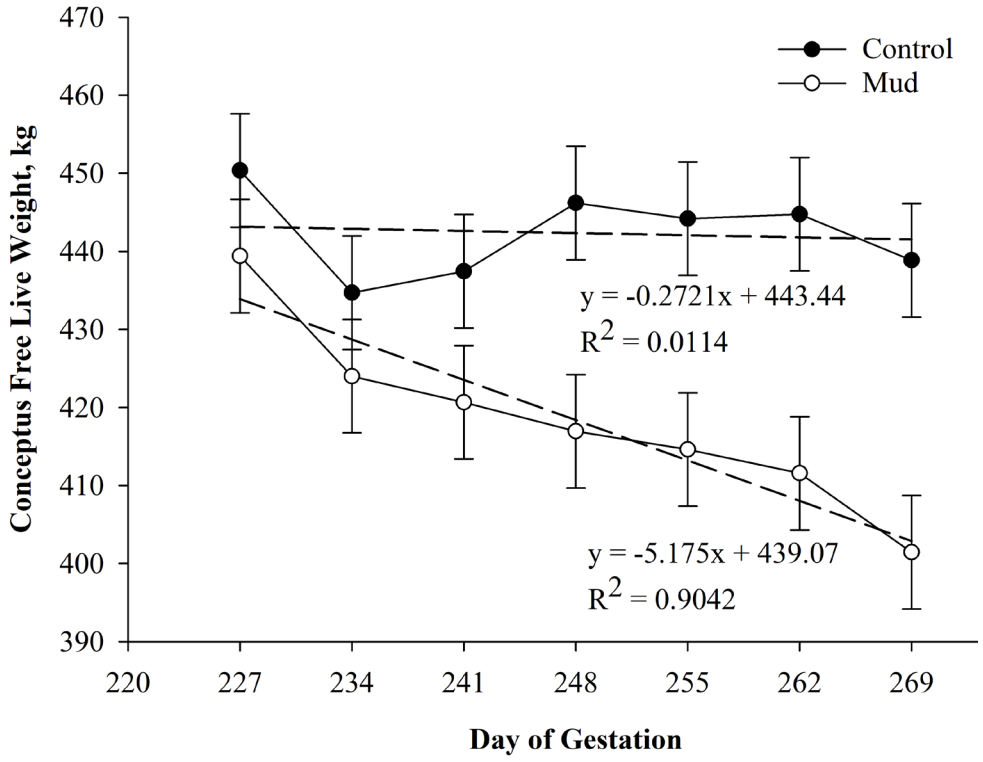
Historically…

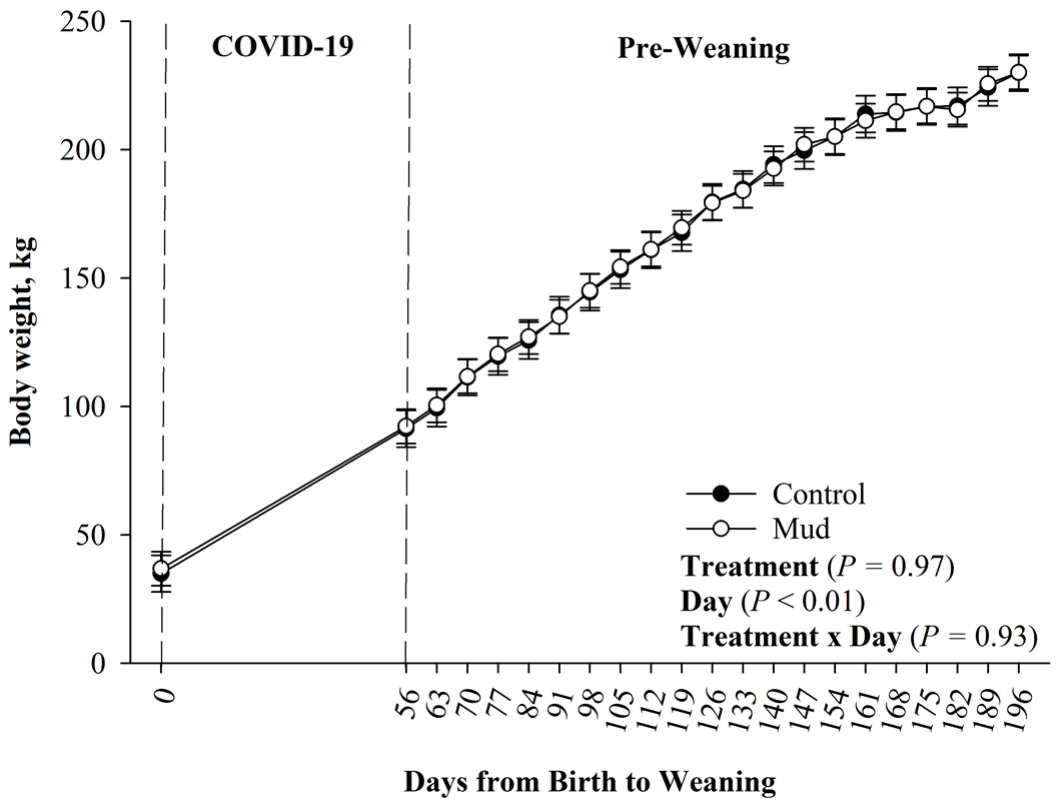
More recently…

CFAES

Research goals: To evaluate the effects of a muddy environment on cow body weight, body condition score, and calf birth weight and to determine late gestation energy requirements of cows housed in mud.







1. **After 56 days, cows in the mud weighed 83 lbs lighter than the cows in bedding**
2. **This equated to an extra 3.9 Mcal/day of net energy to compensate for the muddy environment**
3. **This is approximately 40% more energy/day**
4. **No differences in calf birth weight or growth up to weaning**

Conclusions

- Muddy conditions during late gestation increase the amount of energy needed per day by 40% for cows to maintain their body weight

- Cows decreased their body weight during late gestation, but we did not observe any negative effects on calf growth or metabolism

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Roberto Ortez

UNIVERSITY OF FLORIDA

“Her Soil Is Her Fortune”

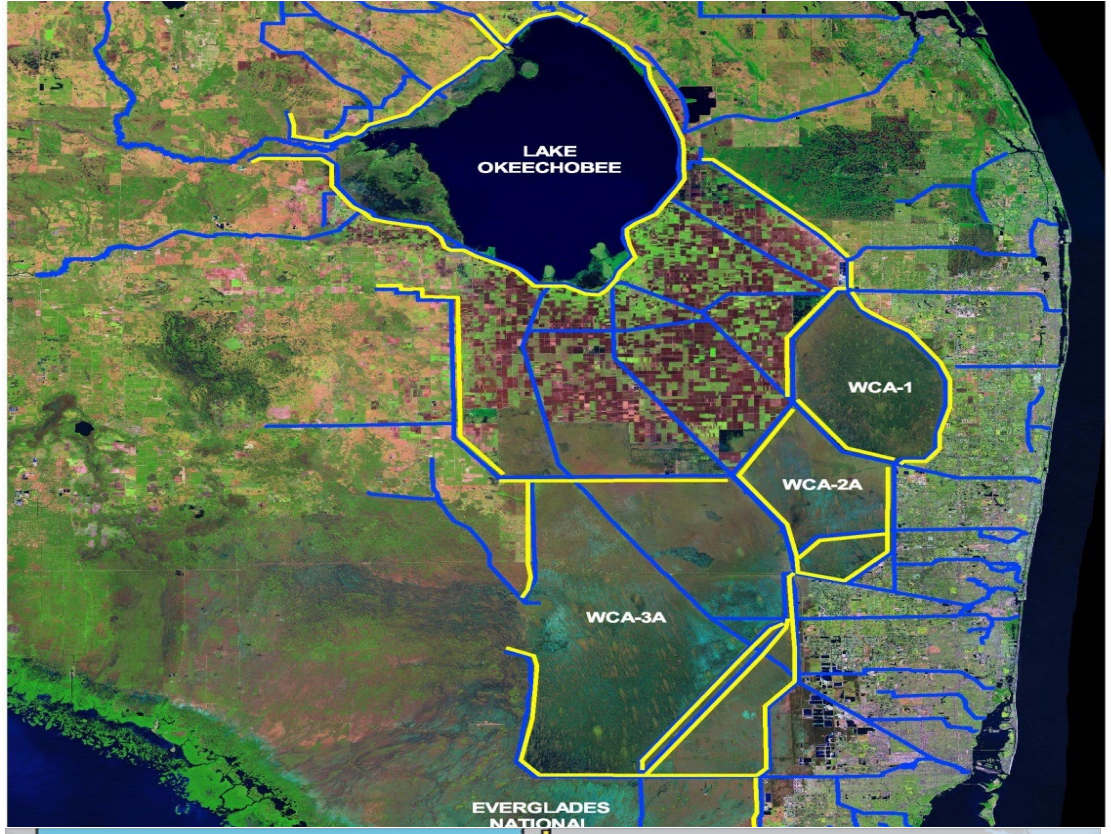
By: Roberto Ortez, Soil & Water Sciences, UF Undergraduate

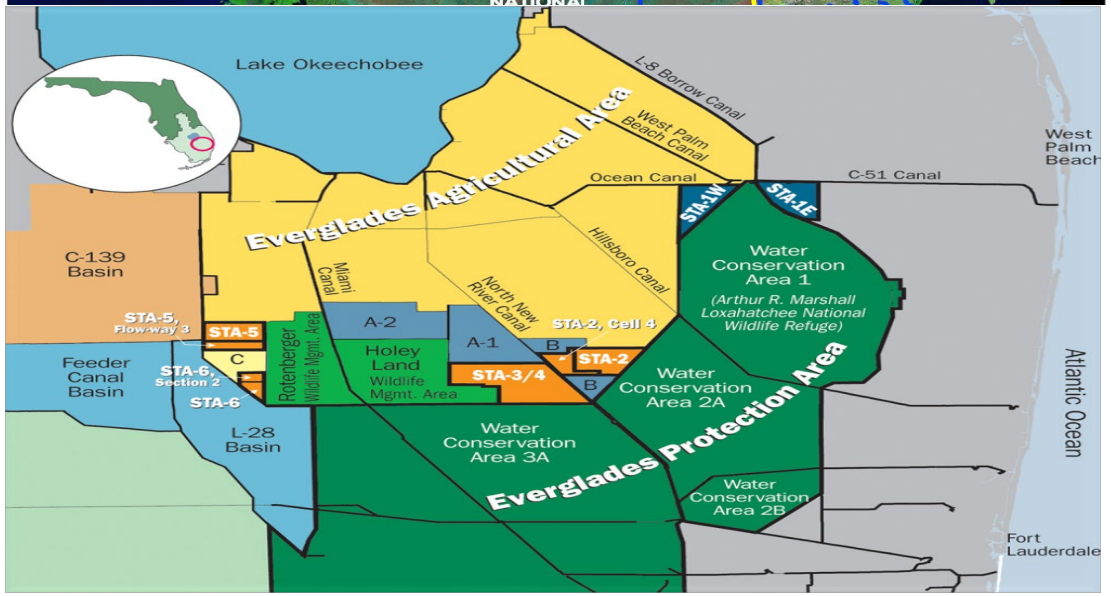
Soil Functions:

- Medium for Plant Growth: Physical support, water and nutrient retention
- Regulator of Water Supplies: Infiltration, Run-off, Storage, Purification
- Recycle nutrients: Retention of phosphorus and sink for carbon.
- Reactive Medium: Pore spaces act as reactions mediators. Histosols are highly porous.

South Florida Hydrology

- Water flows southward from the Kissimmee River, to Lake Okeechobee, and then to the Florida Everglades Click to add text
- Water once moved naturally by sheet flow. Now a complex systems of canals and ditches contains and conveys the water
- In the process water is filtered through various farms before arriving at STAs. This has prevented several metric tons of P from entering the Everglades





Keys to Soil Conservation

- ☑ Challenges: Rapid organic matter decomposition in newly aerobic soils lead to subsidence. Erosion.
- ☑ Solutions:
  - Organic matter input: litter, stalks, green manure
  - High density crops = reduced erosion
- ☑ Soil conservation ➡ Water conservation ➡ Environmental conservation

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Question and Answer Session

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