FEEDSTOCK DEVELOPMENT & PRODUCTION

Dennis Ray, Peter Waller, Raina Maier (Julie Neilson), Diaa El-Shikha, Kim Ogden, David Dierig, Colleen McMahan, Hussein Abdel-Haleem, Duke Pauli, Bill McCloskey, Kulbhushan Grover, Sangu Angadi

Feedstock Development and Production

- **Objective 1: Improve biomass quantity and quality through genetics and traditional breeding.**
  - ***Objective 1a: Exploitation of Apomixis - Guayule***

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (Bridgestone)

- Seed preparations for USDA variety trial in 3 locations, including seed cleaning, lab germinations tests of all accessions, seed dormancy treatment, and soil mix.
- Establishment of two variety trials at Bridgestone site in Eloy with measurements of stand counts, and plant heights.

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (Bridgestone)

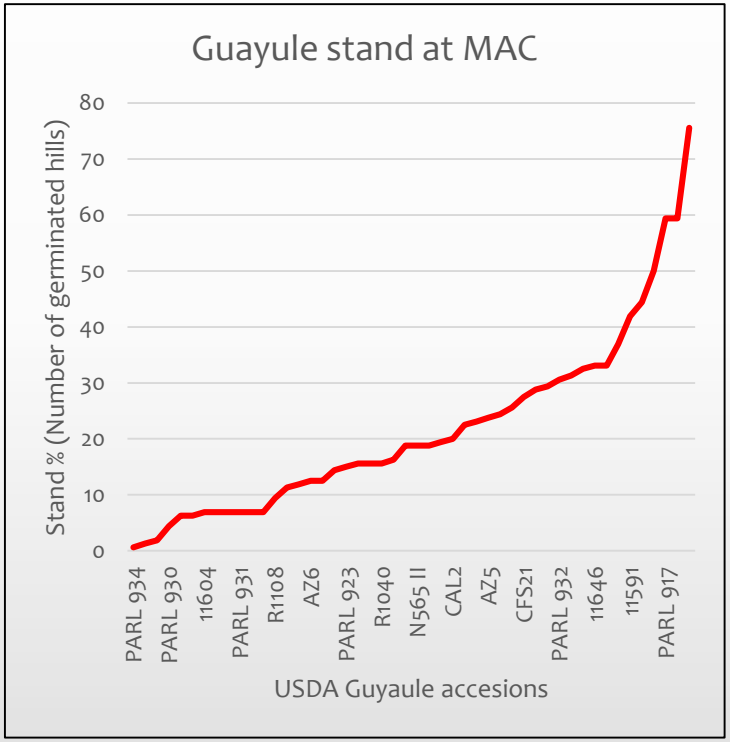
- Ploidy analysis on 30 of 55 accessions completed and available for GRIN.
- Leaf trichome density on 10 USDA accessions completed (see poster).
- Germination data collected on 25 of 50 USDA accessions at 10 different temperatures, ranging from 11/5 °C to 36/27 °C completed and available for GRIN.

Pedigree	2x	3x	4x	5x	6x	Total Plants
11600	0	15	49	0	0	**64**
11619	0	49	18	9	0	**76**
11635	1	0	92	1	0	**94**
11646	0	63	0	0	0	**63**
11693	0	1	94	1	1	**97**
11701	0	3	90	3	1	**97**
593	0	0	111	0	0	**111**
A48118	0	3	90	1	0	**94**
AZ3	0	0	130	0	0	**130**
AZ5	0	3	142	0	1	**146**
AZ6	1	1	158	0	2	**162**
CAL7	2	1	178	3	0	**184**
CFS16-2005	0	1	59	0	0	**60**
CFS17-2005	0	0	105	0	0	**105**
CFS18-2005	0	62	28	0	0	**90**
CFS21	0	0	79	0	1	**80**
N565	0	73	7	1	0	**81**
N566	0	2	6	113	0	**121**
N575	0	0	155	1	1	**157**
R1037	0	2	221	0	0	**223**
R1040	1	1	195	1	0	**198**
R1092	3	74	42	0	1	**120**
R1093	0	102	25	3	0	**130**
R1100	1	0	313	0	1	**315**
R1101	1	0	143	0	0	**144**
Total Plants	**10**	**456**	**2530**	**137**	**9**	**3142**

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (USDA-ARS, Maricopa)

Targets:
- Characterize USDA guayule collection.
- Deploy superior genotypes of guayule and guar to regional growers



Accomplishments:
- Establishment of guayule planting
- Explore direct seeding, the varietal response to.

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (UA)

- **First** planting**: summer 2017**
  - ***21 lines***
  - ***Variability noted***
  - ***Harvested at 1-year for rubber and resin***
- **Second planting April 2018**
  - ***48 lines***
- **Replant May 2018**
  - ***29 lines***

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (NMSU, Bridgestone)

Expanding the cultivation footprint by understanding cold stress and acclimation through metabolomics

- Collaborative effort
  - *Dr. Von Mark Cruz*
  - *Dr. David Dierig*
  - *Dr. Omar Holguin*
- **Guayule for Cold Tolerance**
  - ***-8°C and -9°C screening***
  - ***Time Course Data***

- Metabolomics by GC/MS
  - *Simultaneous analysis of 100's of metabolites from acclimated and non acclimated plants, and from plants that were tolerant to freezing temperatures*

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Development and Production

- **Objective 1: Improve biomass quantity and quality through genetics and traditional breeding.**
  - ***Objective 1b: Flowering to improve yield – guayule.***

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

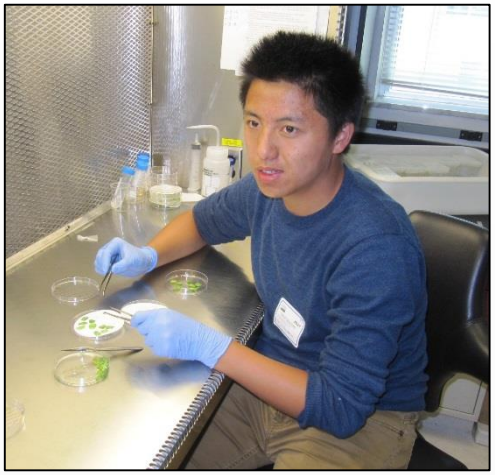
Feedstock Accomplishments (USDA-ARS, WRRC)

SBAR

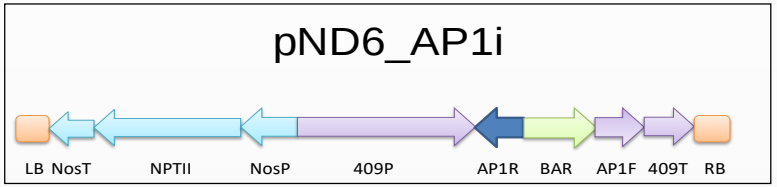
USDA United States Department of Agriculture National Institute of Food and Agriculture

Objective:
Reduce or eliminate flowers by controlled expression of flowering-related genes

Hypothesis:
Reduction of flowers in guayule will increase plant size and/or rubber yield.



George Chong, Project SEED intern



- ✓ **We have identified candidate genes for downregulation: APETALA1, SEPPATALA, FLOWERING LOCUS T (all transcription factors).**
- ✓ **Construct prepared and transformations underway for AP1i.**

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Development and Production

- **Objective 2: Develop high-throughput phenotyping to support crop expansion using remote-sensing methods to create interactive databases/tools.**

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

USDA United States Department of Agriculture National Institute of Food and Agriculture

Feedstock Accomplishments (Bridgestone)

- **Remote sensing measurements with high throughput tractor for NDVI, plant height and width, and leaf temperatures started.**

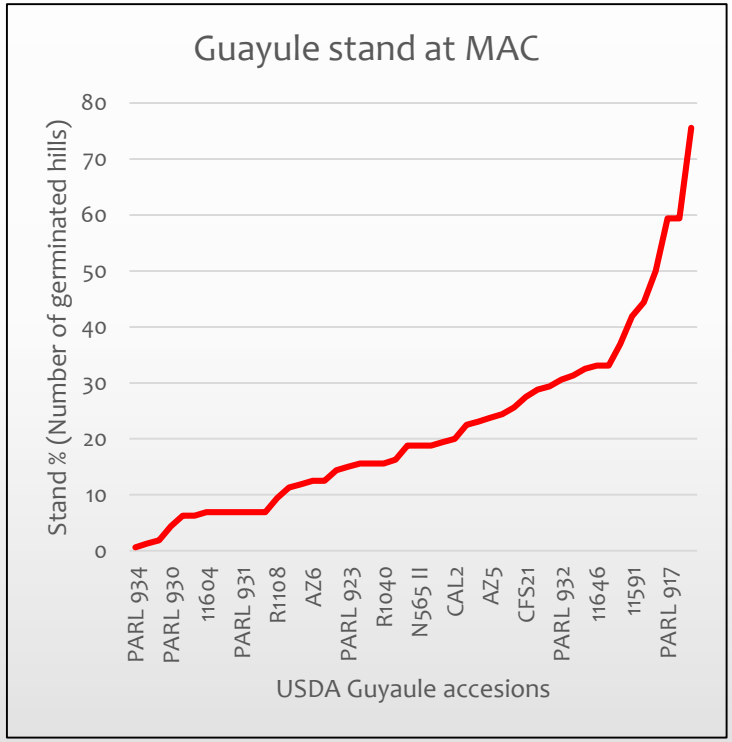
Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

USDA United States Department of Agriculture National Institute of Food and Agriculture

Feedstock Accomplishments (USDA-ARS-ALRC)

Targets:
- Characterize USDA guayule collection.
- Deploy superior genotypes of guayule and guar to regional growers



Accomplishments:
- Establishment of guayule planting
- Explore direct seeding, the varietal response to.

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Development and Production

- **Objective 3: Deploy superior genotypes of guayule and guar to regional growers.**

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (UA)

SBAR

USDA United States Department of Agriculture National Institute of Food and Agriculture

Guayule:

1. Screen guayule germplasm for root rot tolerance
2. Develop a protocol to produce herbaceous cuttings
   a. Increase plants with desirable genetic traits
   b. Test genetically identical seedlings
   c. Plant materials from which to increase seed

Guar:

1. Planted 32 lines to increase seed for regional variety trials
2. Planted crossing blocks
   a. Elite lines with
   b. Partial male sterile lines

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (NMSU)

- **Feedstock development**
  - ***Multiplication of guar germplasm.***

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Development and Production

- **Objective 4: Deploy agronomic production practices; identify agronomic information for salinity, herbicide, and nutrients to support production; provide irrigation apps using algorithms to growers.**

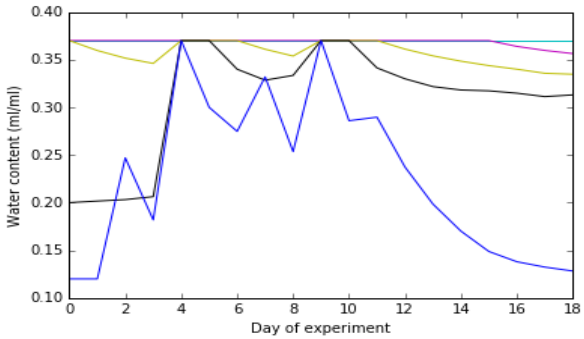
Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (Bridgestone)

- **Plant density study planted and thinned to 3, 6, 12, 18, 30” spacing between plants with 2 varieties.**

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (UA, Bridgestone, NMSU)



- Convert WINDS model to python and MySQL and implement model on web
  - *Model has been converted to python and MySQL, but is not yet running on the web. Model simulates the 100 neutron probe locations in the 30 irrigation treatments*
- **Installation of subsurface drip and flood irrigation systems for guayule irrigation experiments**
  - ***All irrigation systems were installed***
- **Irrigation experiments installed and running**
  - ***Thirty irrigation treatments in guayule and guar at Clovis, Eloy, and Maricopa currently in progress.***

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (UA, Bridgestone, NMSU)

- Irrigation studies - established by direct seeding at MAC and Bridgestone with neutron tubes installed and irrigation treatments started comparing drip and flood methods.

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (NMSU)

- **Production technology**
  - ***Response of guar to various irrigation regimes.***

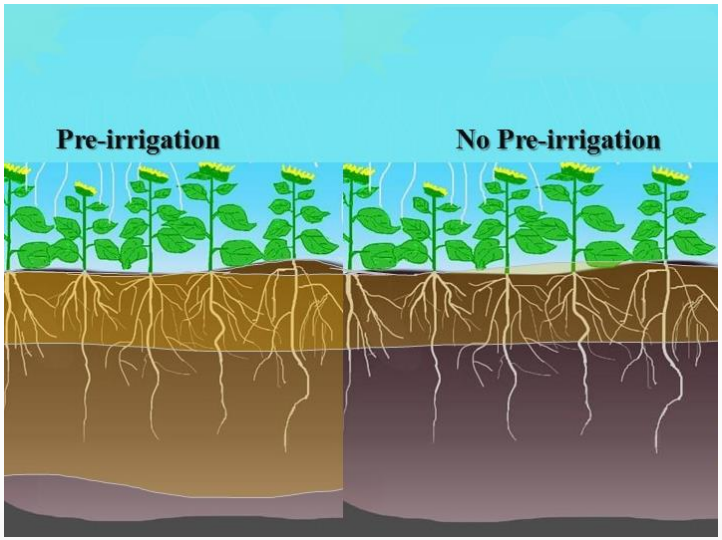
Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

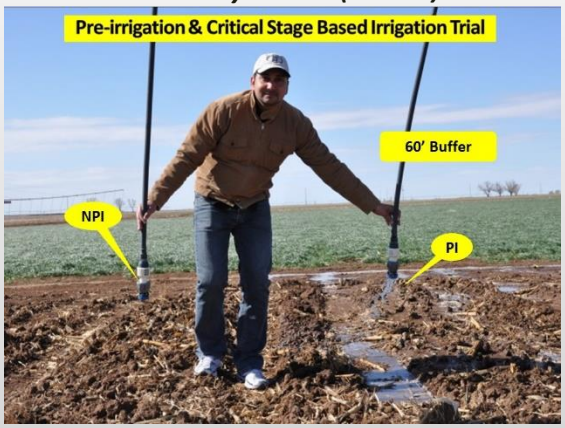
Feedstock Accomplishments (NMSU)

Pre-irrigation and Critical Stage Based Irrigation Trial

Experimental Design: Blocked Split Plot

- ***Main plot: Soil Profile***
  1. Pre-irrigation (**PI**) (6 inches)
  2. No-pre-irrigation (**NPI**) (depleted soil profile)
- ***Sub plot: cultivars and irrigation levels***
  - Cultivars: 2 (Kinman and Monument)
  - Irrigation levels: 4
    - *Full Irrigation (Irr)*
    - *No irrigation at vegetative stage (VStss)*
    - *No irrigation at reproductive stage (RStss)*
    - *Dryland (Rain)*





Progress:

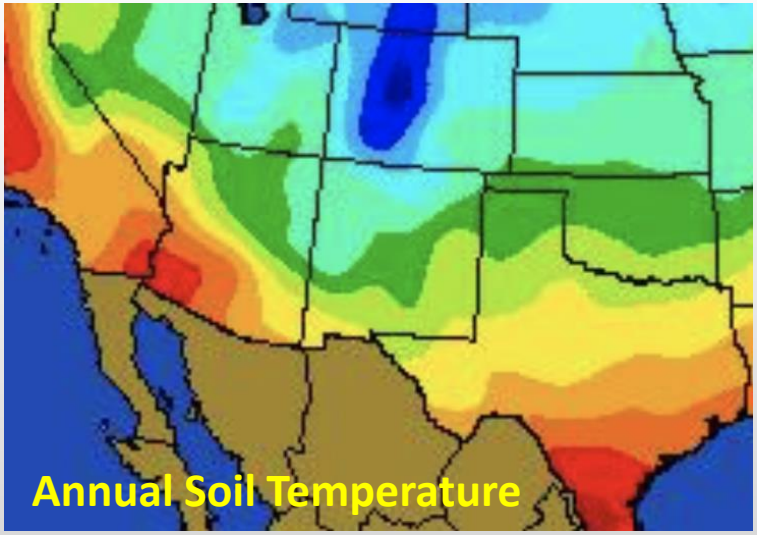
- ***Planted (re): July 3, 2018***
- ***Excellent crop establishment***
- ***Observations have started***
- ***Field day: August 9, 2018***
- ***Harvest: October 2018***

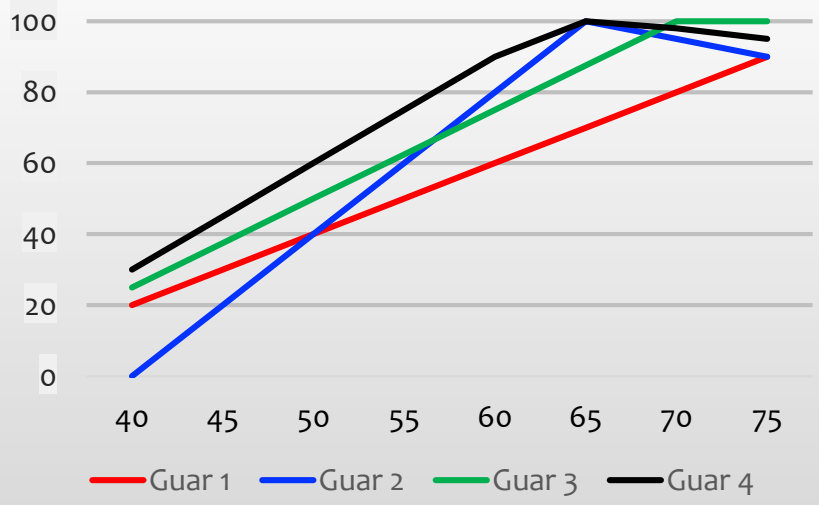
Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (NMSU)

Soil Temperature vs. Guar Germination

- Conducted during spring of 2019
- Cultivars: Kinman, Matador, Lewis, Judd69, Santa Cruz, Monument
- Germination Temperatures: 50, 55, 60, 65, 70, 75
- Incubators will be purchased in next few months





Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (UA)

Managing Weeds in Guayule

- Accomplishments – Year 1
  - ***Renewed 24c SLN labels***
    - Gramoxone
    - Fusilade
  - ***Collaborated with herbicide industry scientist***
    - Arranged tour of Bridgestone Eloy Farm and Mesa facility for Syngenta and FMC
    - Developed research protocols
  - ***Conducted Guayule Herbicide Tolerance Studies***

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (UA)

Managing Weeds in Guayule

- **2017-2018 Herbicide Tolerance Studies**
- **Preemergence herbicides**
  - *In fine textured soil (high clay and silt content at Eloy in Fall 2017:*
    - Dual Magnum, Spartan, Prefar, Prowl, Sonalan, Warrant
  - *In course textured soil (high sand content at MAC in Spring 2018:*
    - Dual Magnum, Spartan, Prefar, Prowl, Sonalan, Warrant
- **Postemergence herbicides at Eloy**
  - *Aim, Butyrac, Chateau, ET, Prowl, Spartan*

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Development and Production

- **Objective 5: Develop soil quality and health knowledge critical to environmental sustainability.**

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (UA)

Sustainable Feedstock Production: Soil Health

Raina Maier and Julie Neilson

- ❑ **Monitor impacts of agricultural management practices on the integrity of the arid soil microbiome**
- ❑ **Correlate soil microbiome dynamics with plant growth and productivity**

Year 1 Major Milestones

1. **Experimental design coordination**
   Guayule production: annual soil quality assessment (2018-2020) at two field locations (different soil textures) under six distinct irrigation treatments
2. **Protocol development: field sampling and soil analysis** Sampling depth, 10 – 30 cm by soil auger; coordination with **NMSU** for soil chemical analysis

Kyle Brown: PhD student

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Feedstock Accomplishments (UA)

Year 1 Major Milestones (field sampling)

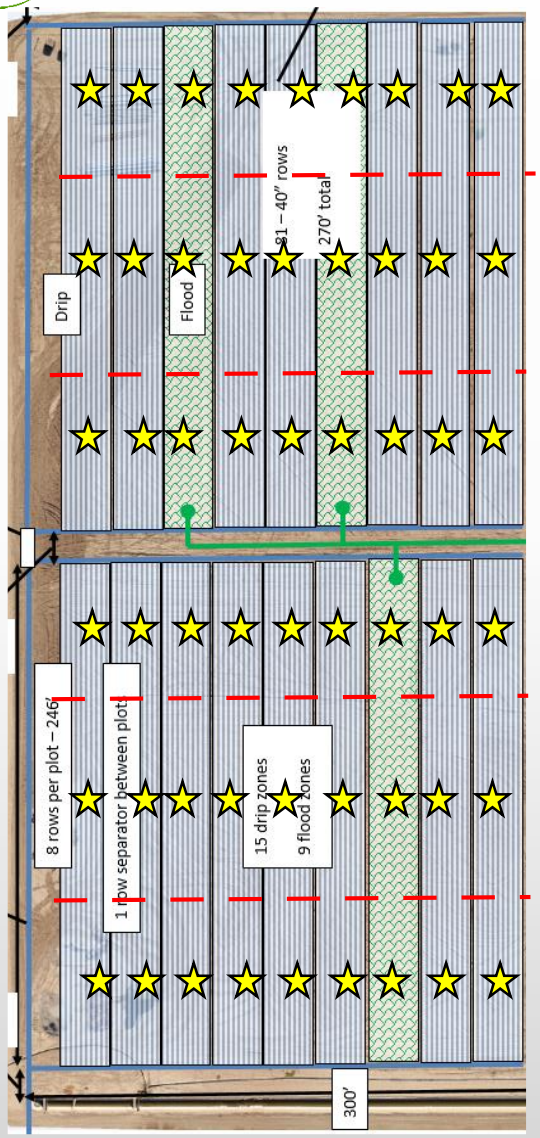
3. **Baseline soil quality assessment at planting time**
   Objective: Assess soil quality homogeneity across fields using 54 samples per field:
   Maricopa Ag Center and Bridgestone Ag Center
   (6 treatments x 3 field replicates x 3 samples/rep)
   - Chemical analysis with **NMSU** (pH, EC, OrgM, NO_3-N, P, K, cations, SAR)
   - Physical analysis: soil texture and moisture content
   - Biological analysis: DNA extraction for soil microbiome analysis

Guayule seedling size at sampling time

4. **Soil moisture variability (gravimetric)**
   MAC: 15.36% - 20.24% (17.54 ± 1.02%)
   Bridgestone: 22.95% - 30.08% (25.88 ± 1.55%)

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Field Sampling Map: Bridgestone



Stars: indicate sample locations
Arrow: samples collected at side of bed

For more information:
Kyle Brown, student poster session

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

POST-HARVEST LOGISTICS & CO-PRODUCTS

Neng Fan, Leslie Gunatilaka, Istvan Molnar, Omar Holguin, Catie Brewer, Umakanta Jena

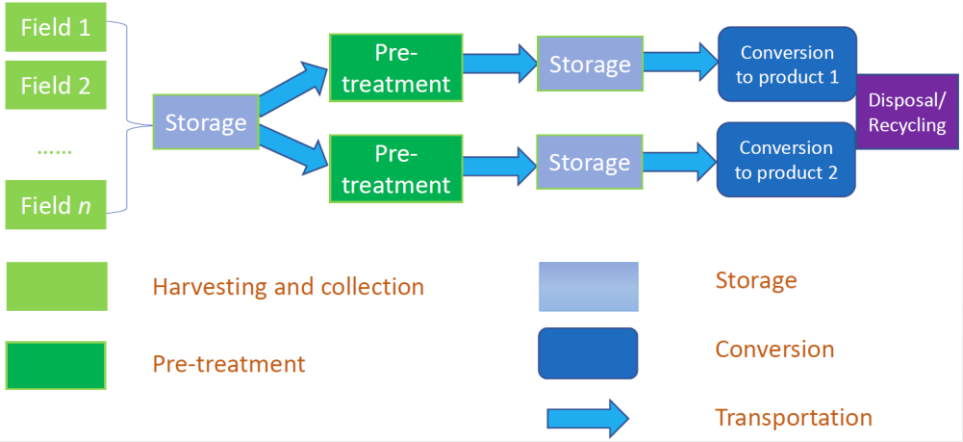
Post-Harvest Logistics & Co-Products Year 1 Accomplishments

- Fan Group (Transportation Models)
- Gunatilaka & Molnar Groups (Co-Product Chemistry)
- Holguin Group (Co-Product Chemistry)
- Brewer & Jena Groups (Bagasse Conversion)

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Optimization for Feedstock Logistics (Fan group @ UA)

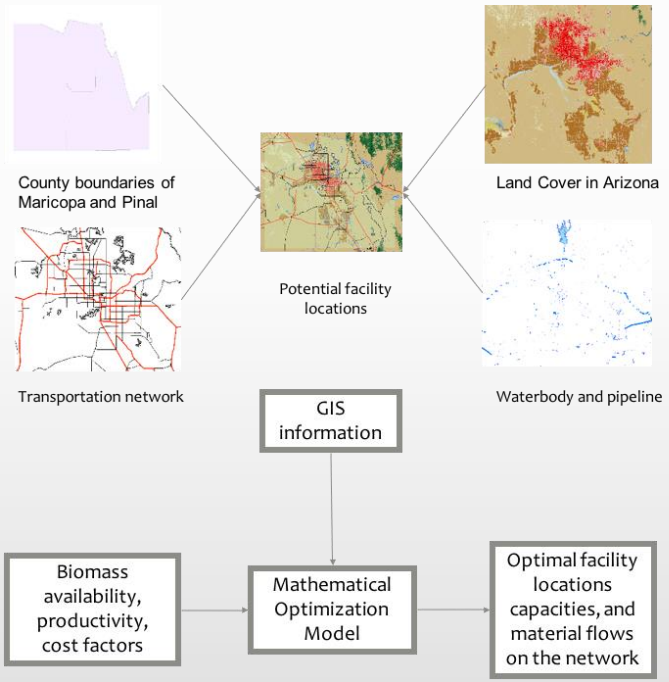
- "A Review on Optimization Models and Algorithms for Biomass Feedstock Logistics" – a literature review paper was finished and now is in preparation for journal submission



  - list of relevant problems
  - comprehensive review on existing literatures on optimization models and algorithms
  - discussion of challenges and research problems

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Optimization for Feedstock Logistics

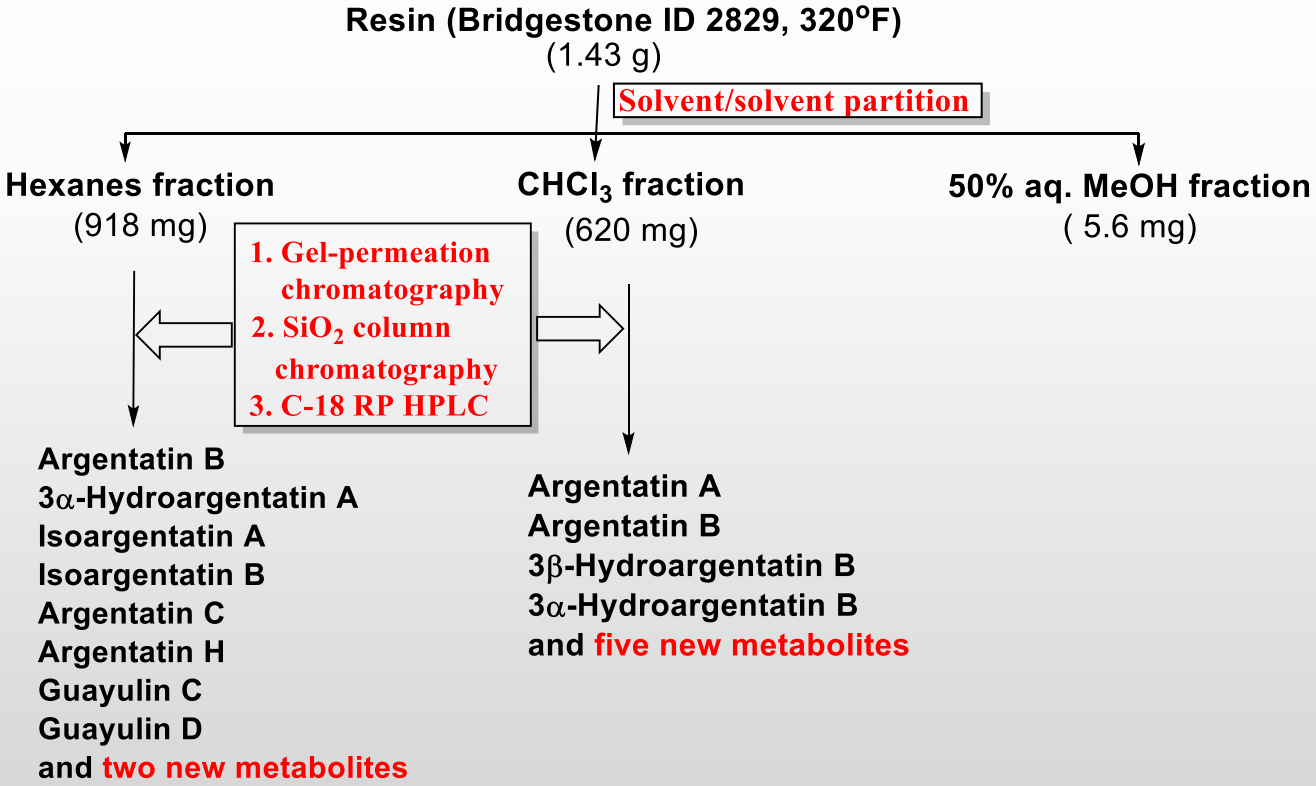


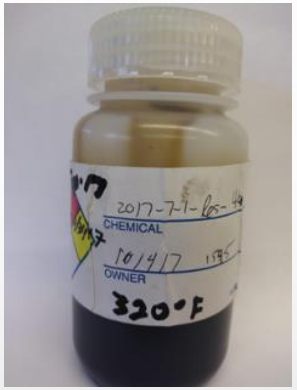
- A decision framework based on GIS information for facility location
  - Potential candidates (locations, capacities) for process or refinery plants, storage facilities, etc.
  - Economic cost-benefit analysis as an input for farms shifting to Guayule and Guar
  - Integration with road networks and water supplies
  - Stochastic mixed integer programming and algorithms

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Isolation & Identification of Major & Biologically-Active Co-Products in Guayule (& Guar) (Gunatilaka, Molnar, Xu, Chandrashekar & Liu @ UA)

Method development for extraction & isolation of guayule co-products



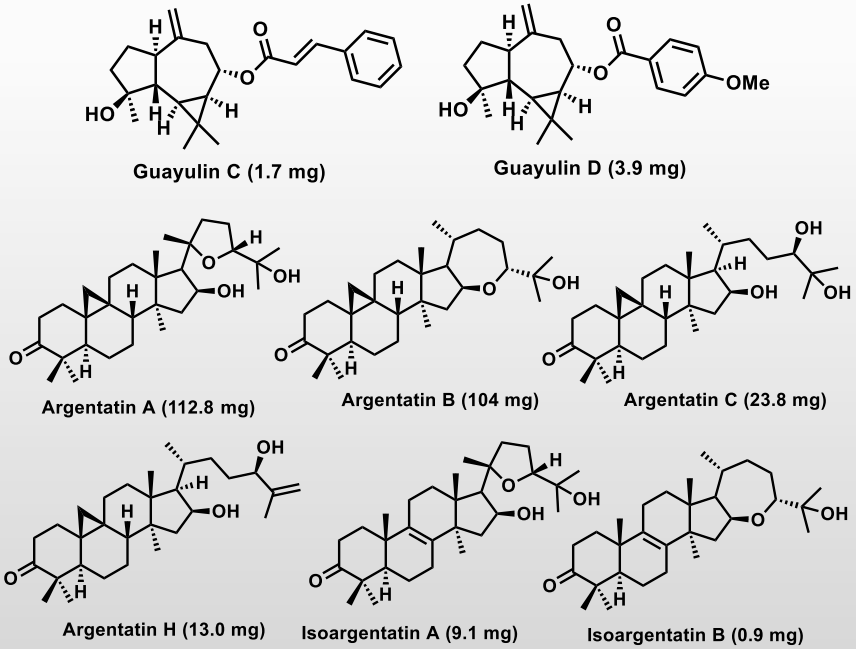


Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Isolation & Identification of Major & Biologically-Active Co-Products in Guayule (& Guar)

Isolate and elucidate structures of some key bioactive metabolites and major metabolites

Known Metabolites (8)



Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

USDA United States Department of Agriculture National Institute of Food and Agriculture

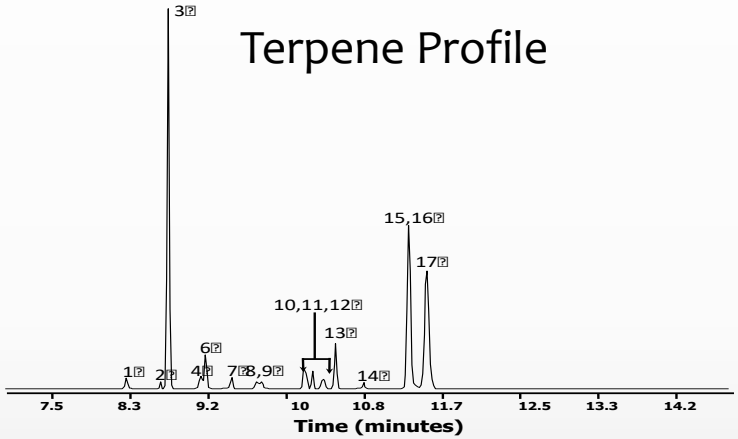
Chemical Analysis Support (Holguin group @ NMSU)

- Chemical characterization of co-products
  - Terpenes
  - Gums
  - Isoprenoids, waxes, etc.
- Biochemical characterization of bagasse
  - Proximate analysis
- Conversion products
  - Organics
  - CHNOS

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Biochemical Characterization
Increasing the Value

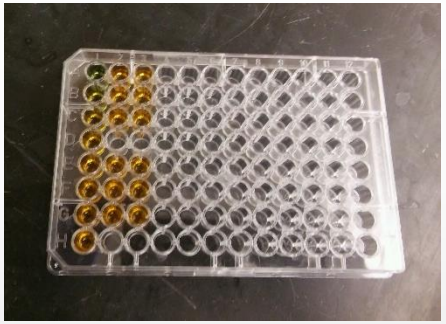
- Guayule
  - 18 terpenes identified in Resin
  - Evaluated resin small molecule complexity
- Guar
  - Guar gum yield enzymatic
  - Gum properties, size distribution, and Gal:Man ratios
- Bagasse
  - Trained researchers bulk biochemical analysis
  - Instrumentation training

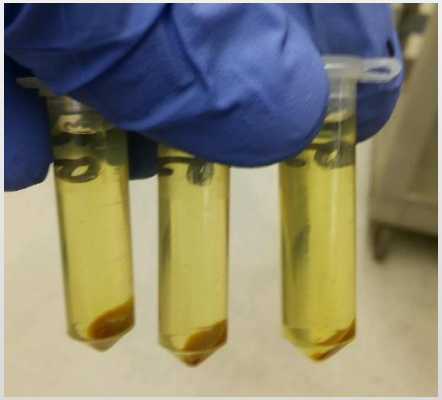


Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Bagasse Conversion (Brewer & Jena groups @ NMSU)

- Collected guar and guayule bagasse samples
- Set up NREL biomass characterization methods with Holguin group
- Literature review of guayule and guar processing, co-products, and lignocellulosic biomass conversion methods





Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Bagasse Characteristics

Guayule:

- 1% moisture
- 6% lipids
- 43% C, 7% H, 2% N, 2% S

Guar:

- 3% moisture, 3% ash
- 20.2 MJ/kg HHV
- 9.5% lipids, 29% carbs, 6% protein, 9% acid-soluble lignin
- 44% C, 6% H, 1% N, 1% S

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

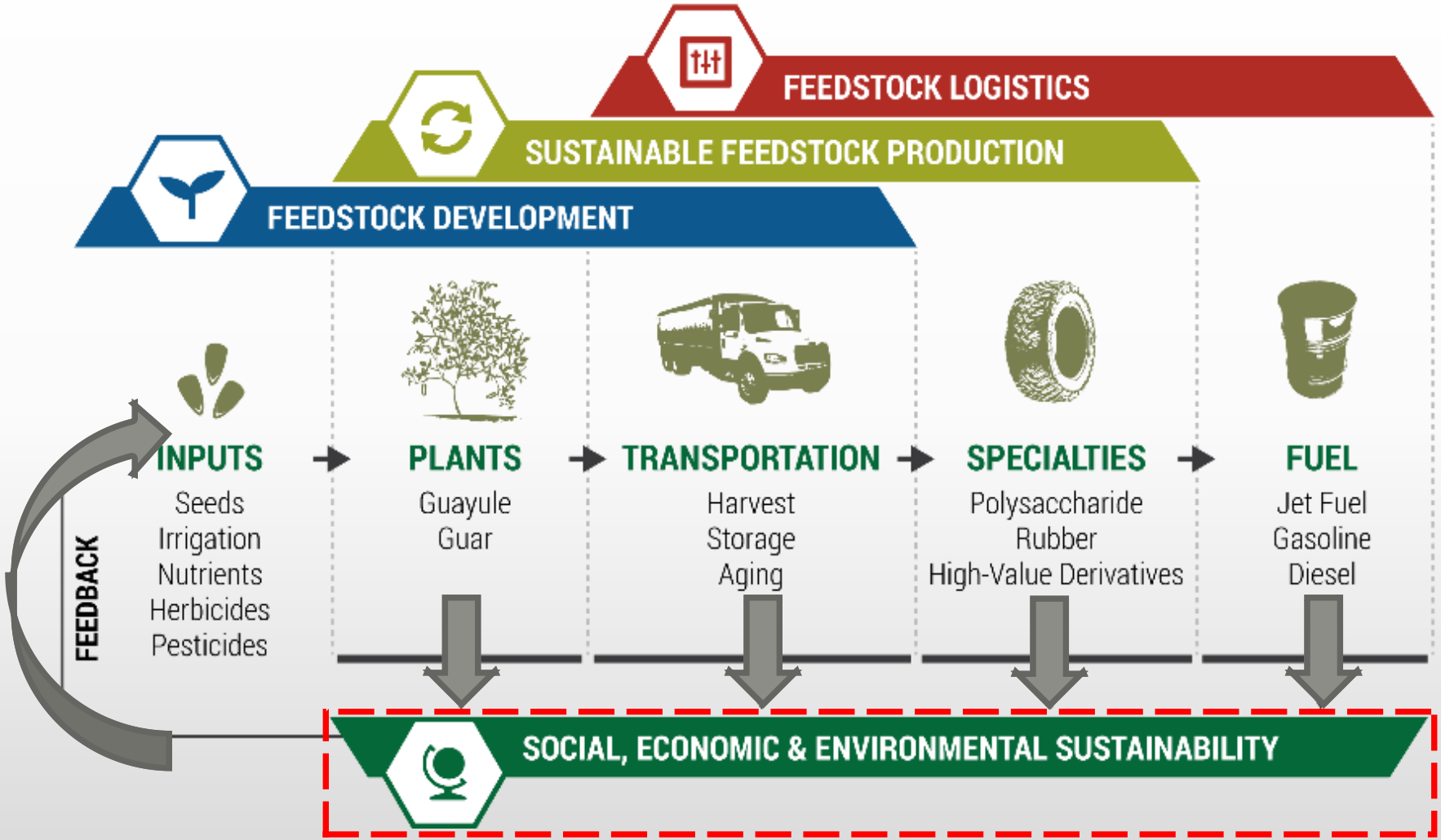
SYSTEM PERFORMANCE & SUSTAINABILITY

Trent Teegerstrom, Clark Seavert, Paul Gutierrez,
Jason Quinn, Amy Landis

Objectives
4.1: System model for sustainability assessment
4.2: Utilize data for model validation and provide data feedback
4.3: Interface with regional growers

SBAR

USDA United States Department of Agriculture | National Institute of Food and Agriculture

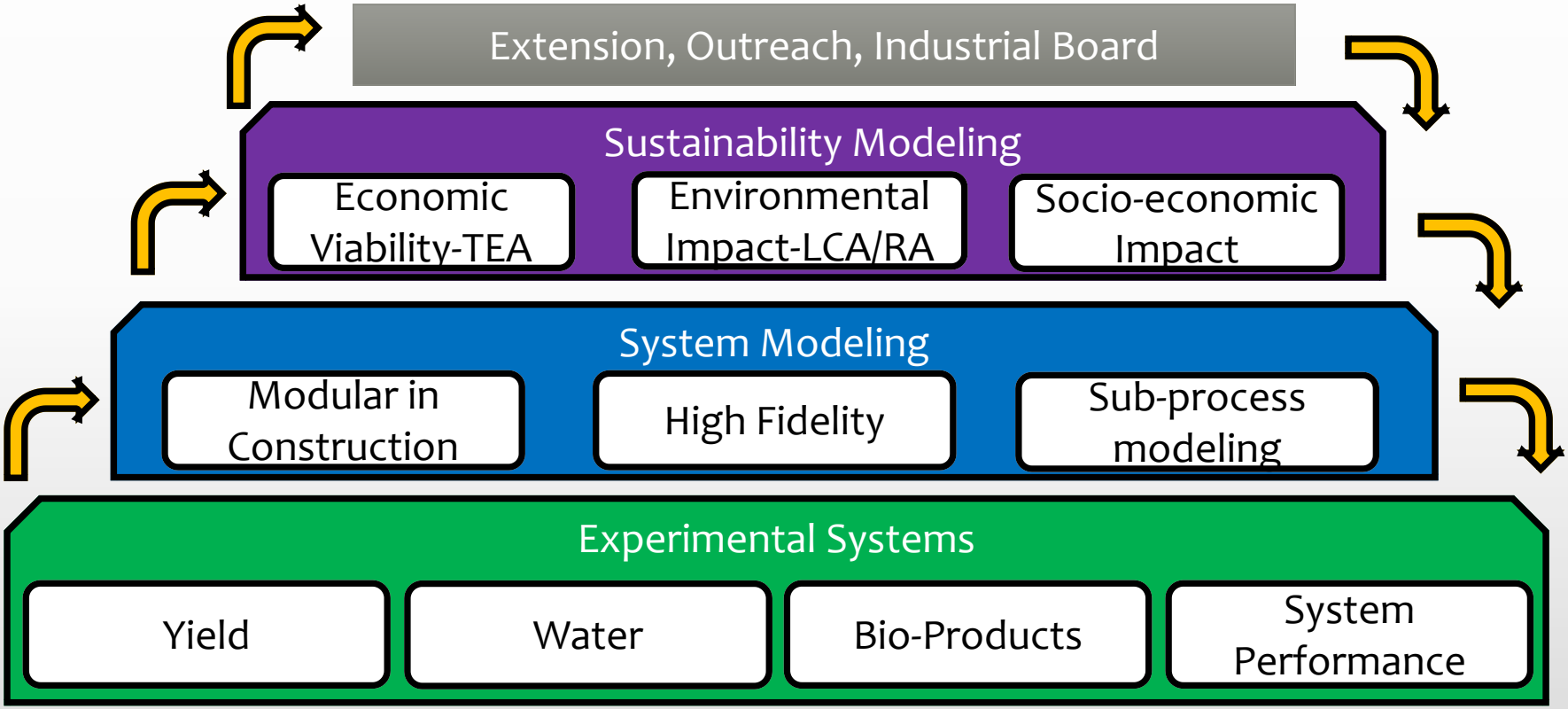


Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

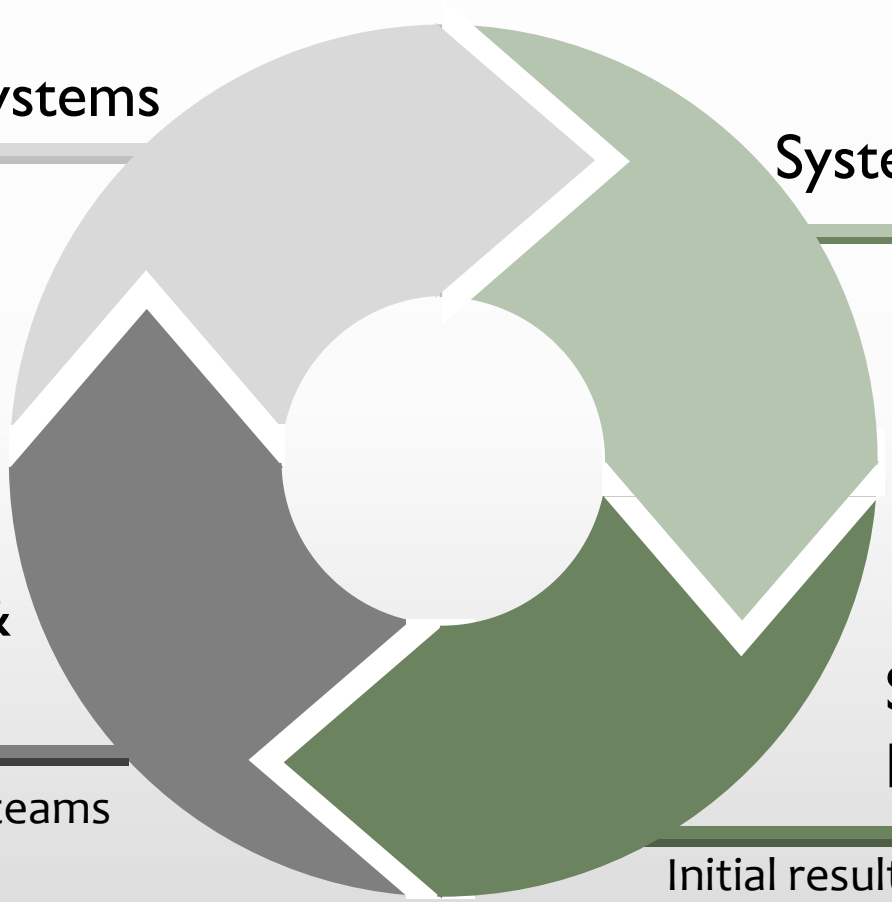
USDA United States Department of Agriculture National Institute of Food and Agriculture

Data Flow



Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Sustainability Team



Experimental Systems

Identified high-impact targets

System Modeling

1st order models complete

Sustainability Modeling

Initial results

- Costs/benefits of production
- Environmental Impacts

Data Feedback & Validation

Interfacing across teams

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

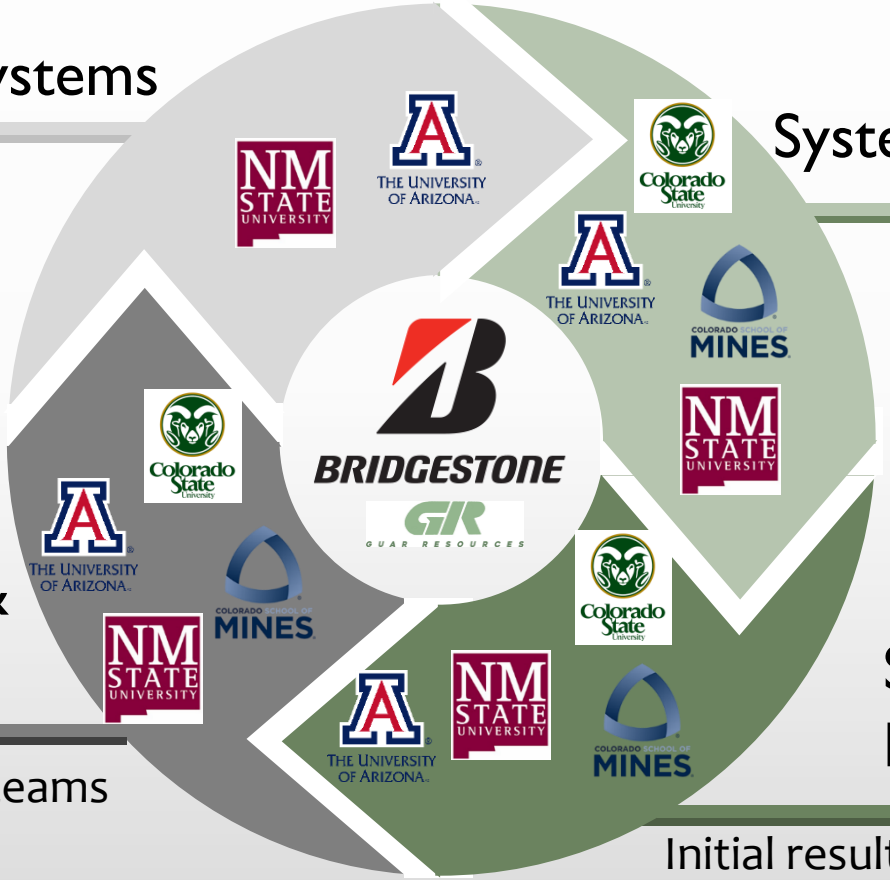
Sustainability Team

Experimental Systems

Identified high-impact targets

System Modeling

1st order models complete



Data Feedback & Validation

Interfacing across teams

Sustainability Modeling

Initial results

- Costs/benefits of production
- Environmental Impacts

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Sustainability Team











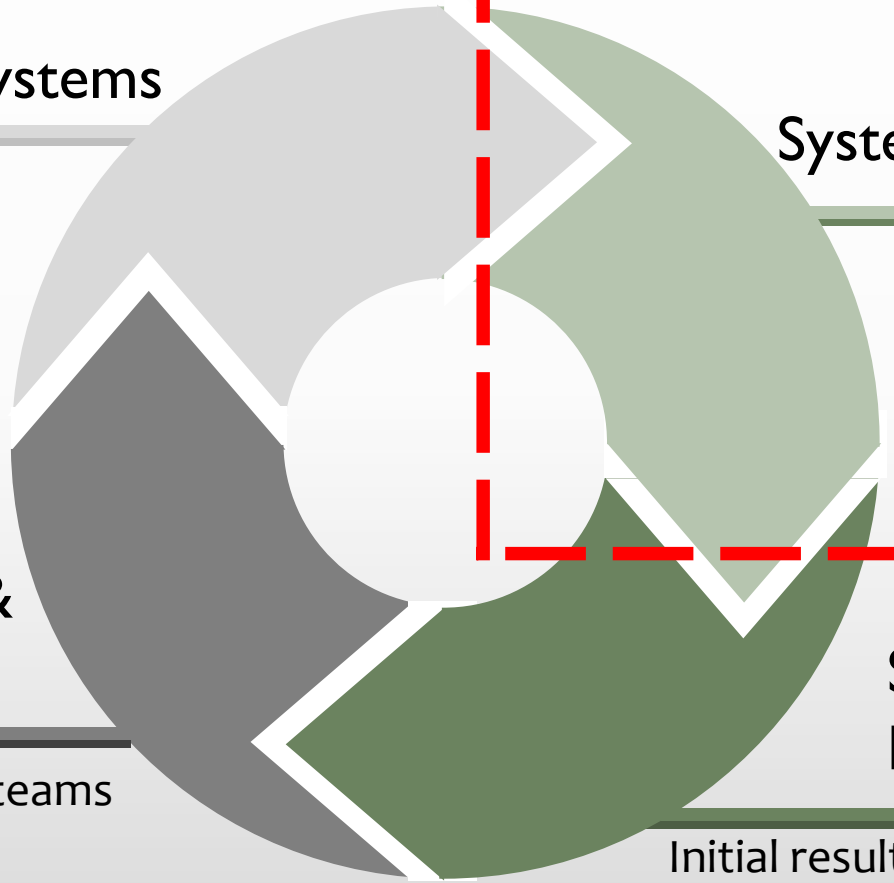






Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Sustainability Team



Experimental Systems

Identified high-impact targets

System Modeling

1st order models complete

Data Feedback & Validation

Interfacing across teams

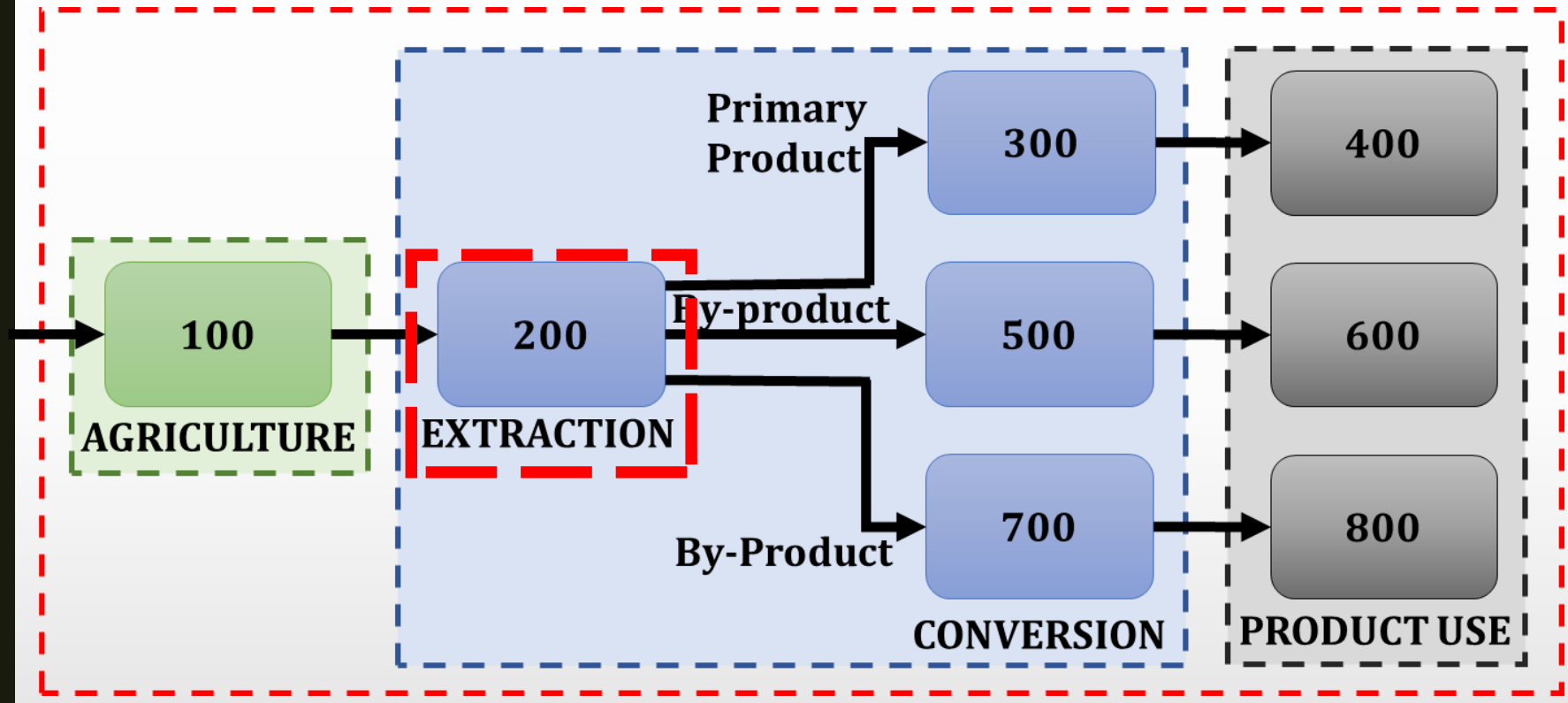
Sustainability Modeling

Initial results

- Costs/benefits of production
- Environmental Impacts

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

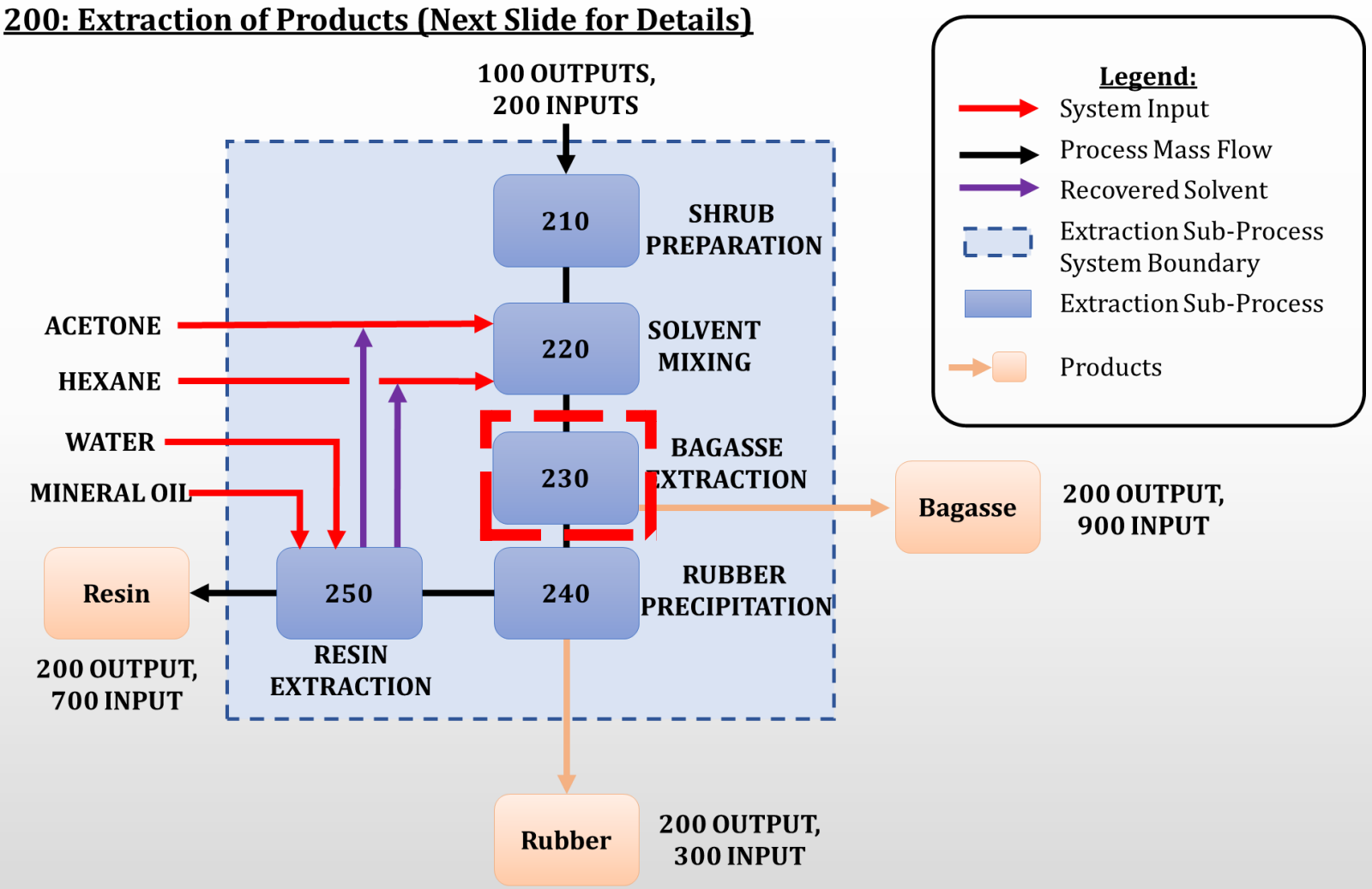
System Modeling



Economic and environmental assessment informed by system modeling

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

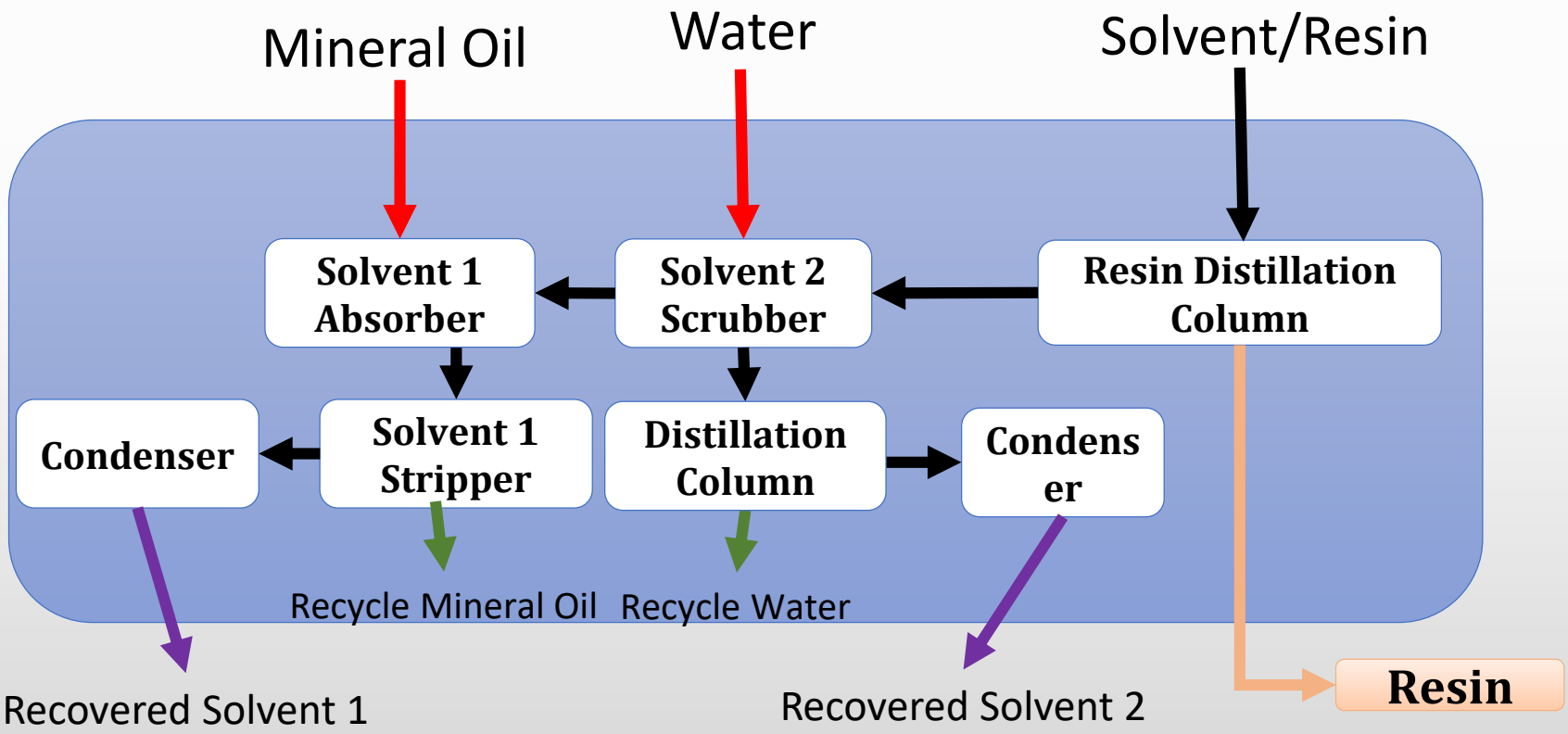
System Modeling



Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

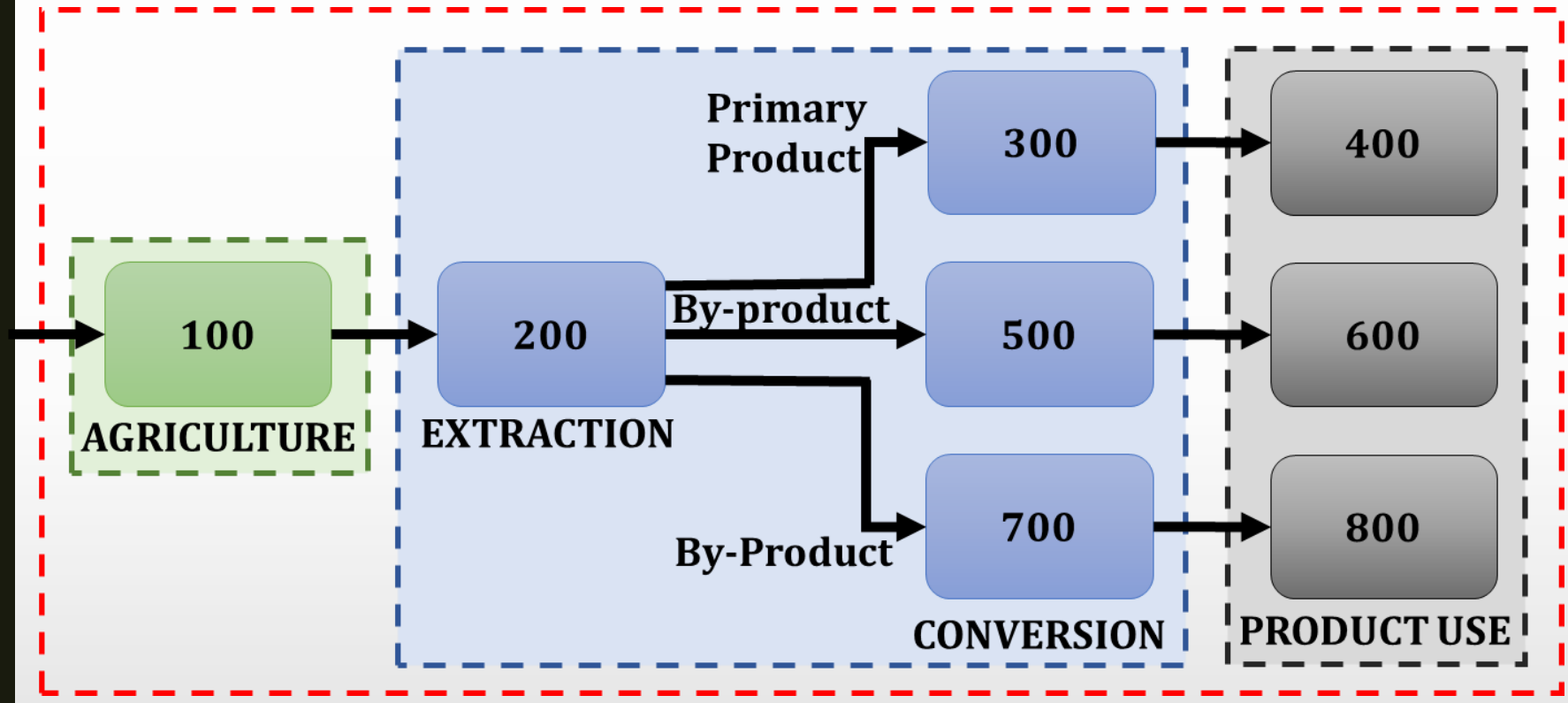
System Modeling

250: Resin Extraction



Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

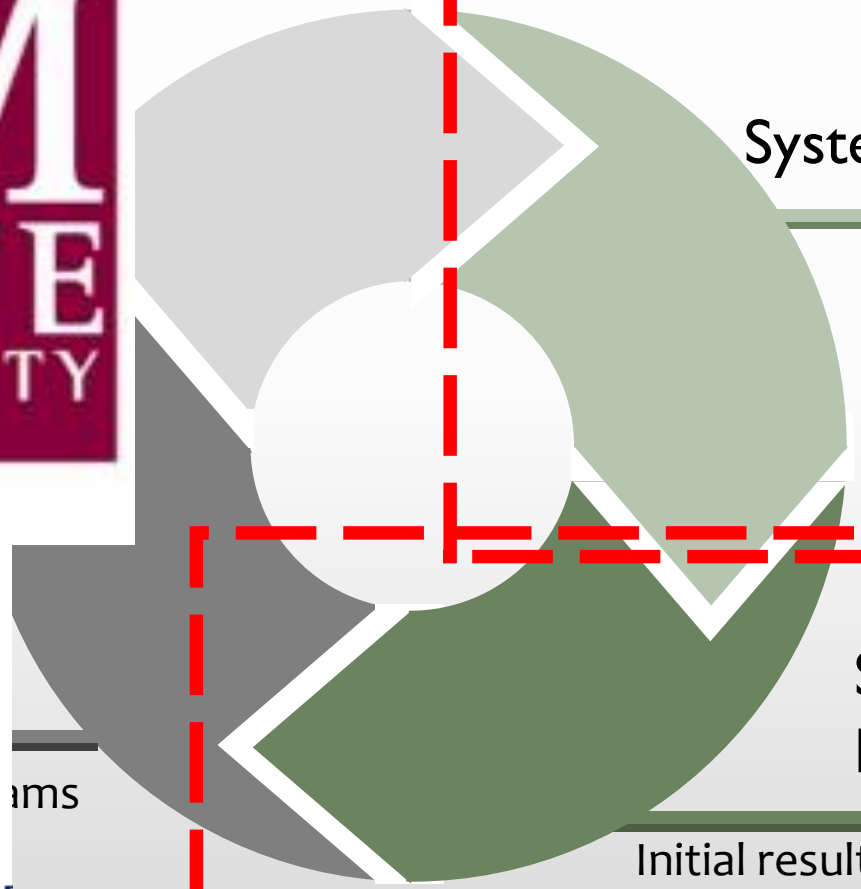
System Modeling



Economic and environmental assessment informed by system modeling

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Sustainability Team



System Modeling

1st order models complete

Sustainability Modeling

Initial results

- Costs/benefits of production
- Environmental Impacts

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

USDA United States Department of Agriculture National Institute of Food and Agriculture

Whole Farm Economic Analysis and Producer Decision Scenarios

- Perform whole farm analysis integrated with regional economic impact assessment
- Integrate data from project partners
- Comparison to traditional cropping systems
- Optimization of system cropping systems
- Sensitivity analysis

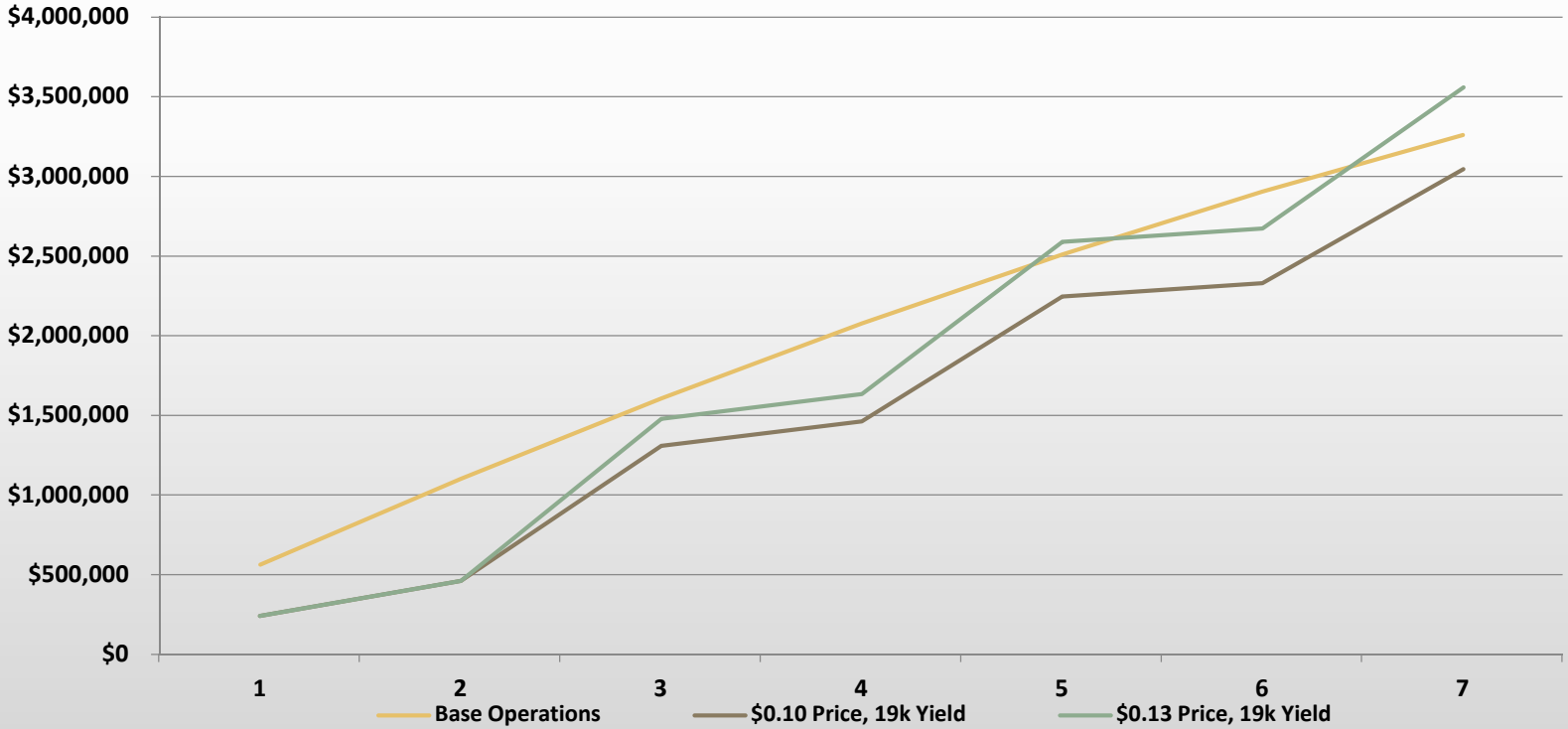
Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

USDA United States Department of Agriculture National Institute of Food and Agriculture

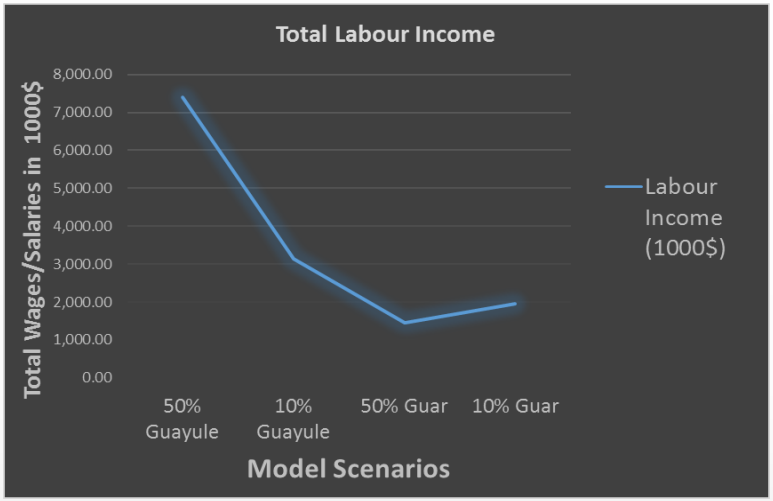
Whole Farm Economic Analysis and Producer Decision Scenarios for Guayule

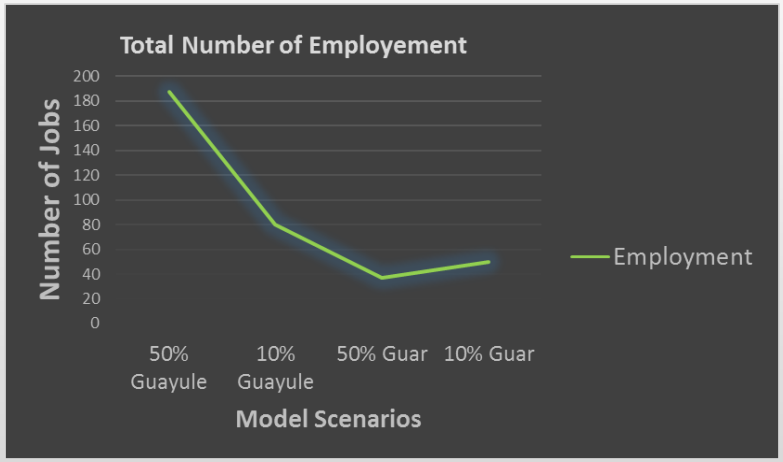
Whole Farm Cash Flow

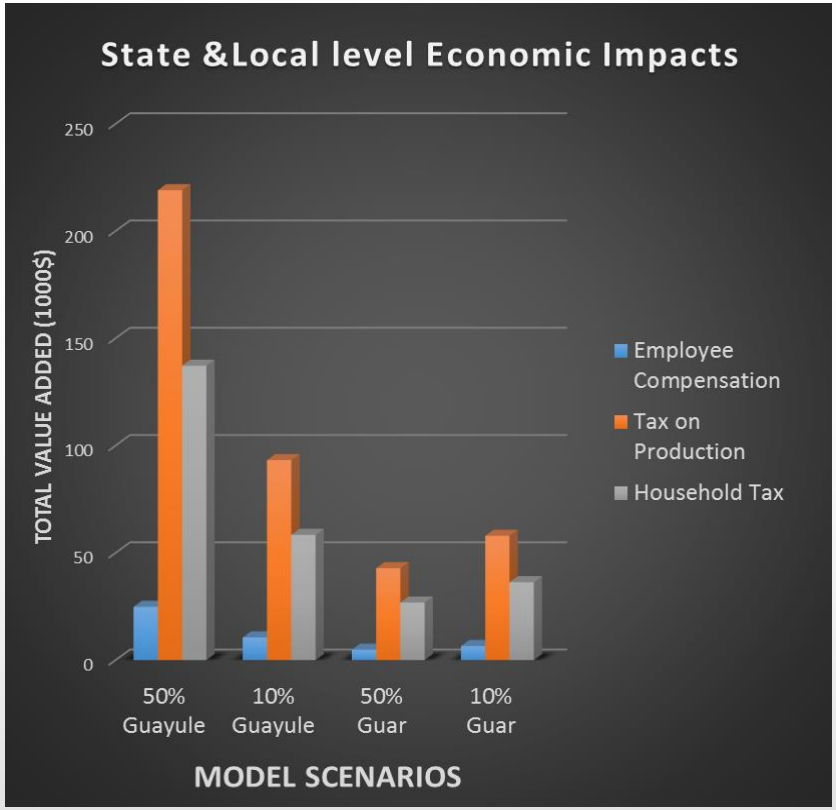


Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Economic Impact Estimates



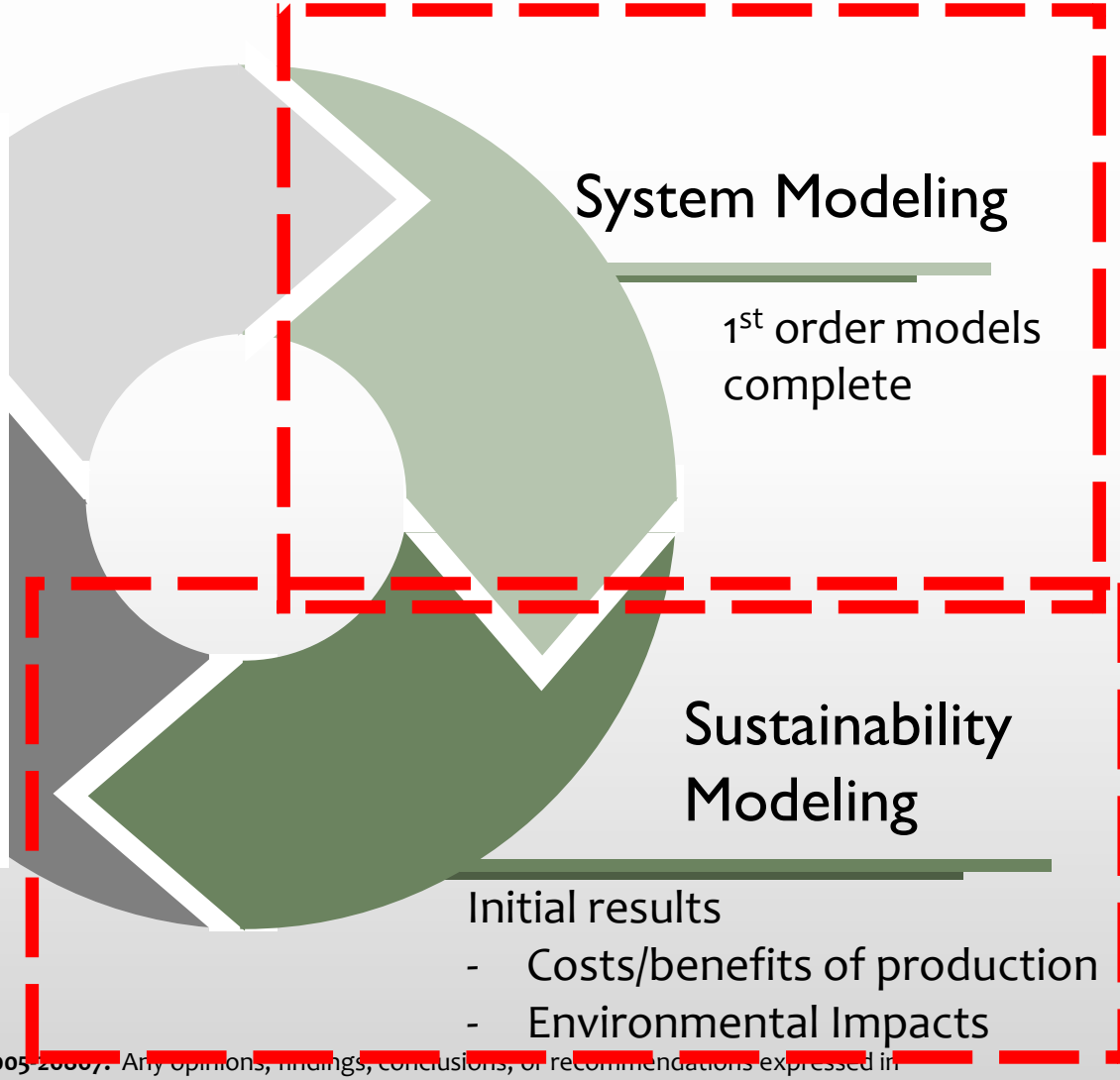




Using the case of a 1200 acre farm, Colfax NM

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Sustainability Team

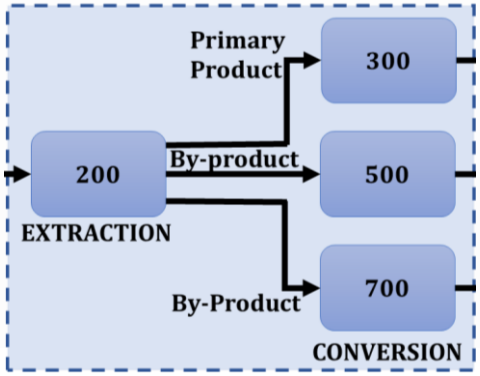


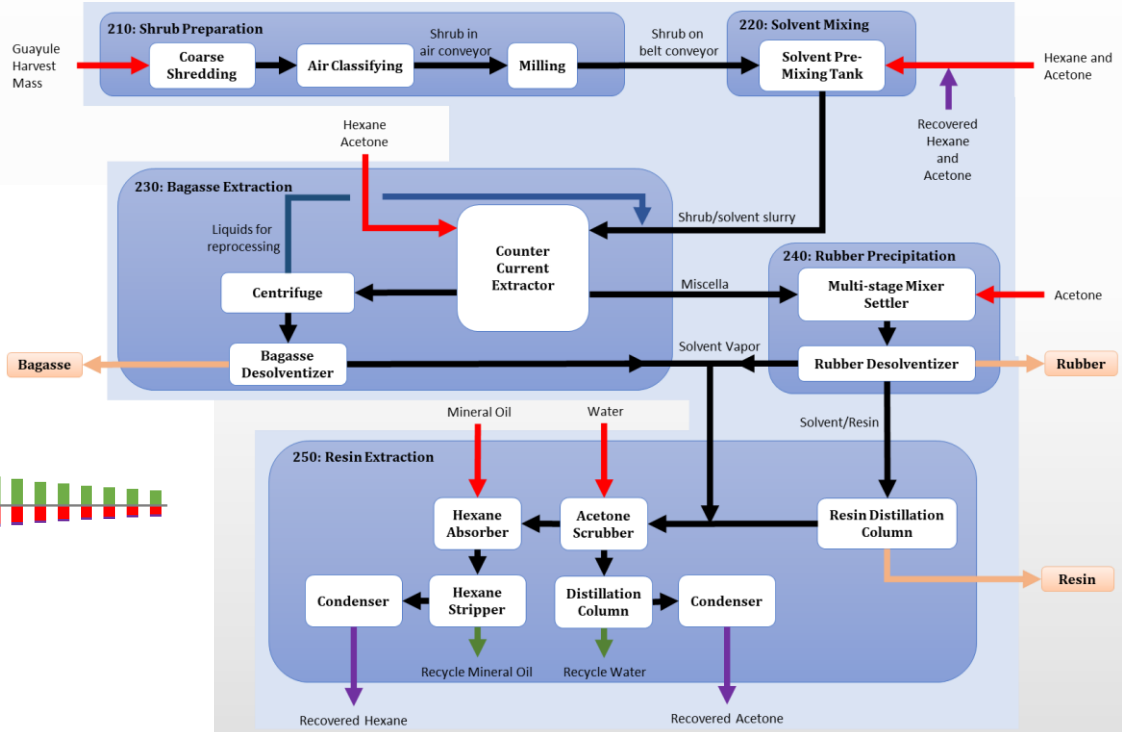
Funded by the NIFA-AFRI CAP Program - **2017-68005-26867**. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

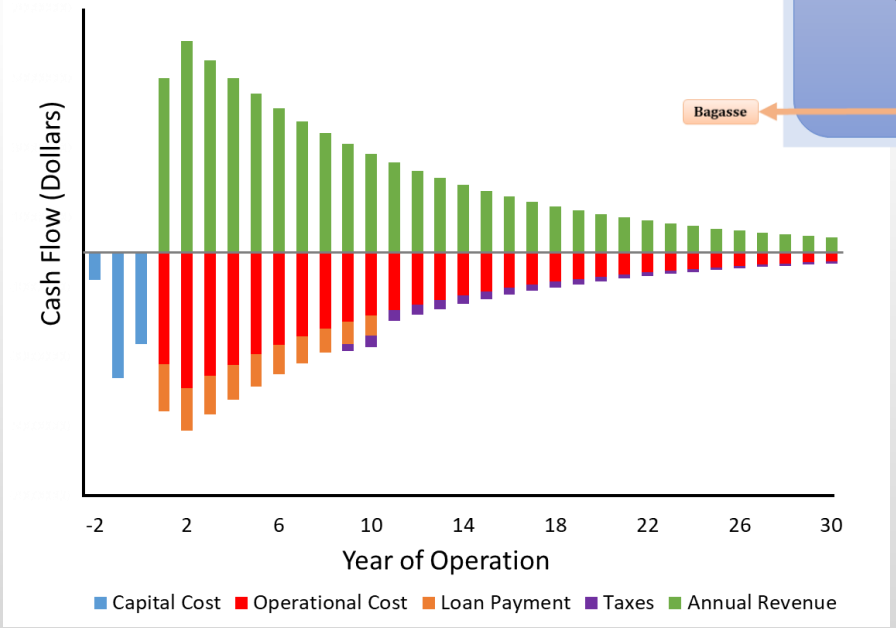
SBAR

USDA United States Department of Agriculture | National Institute of Food and Agriculture

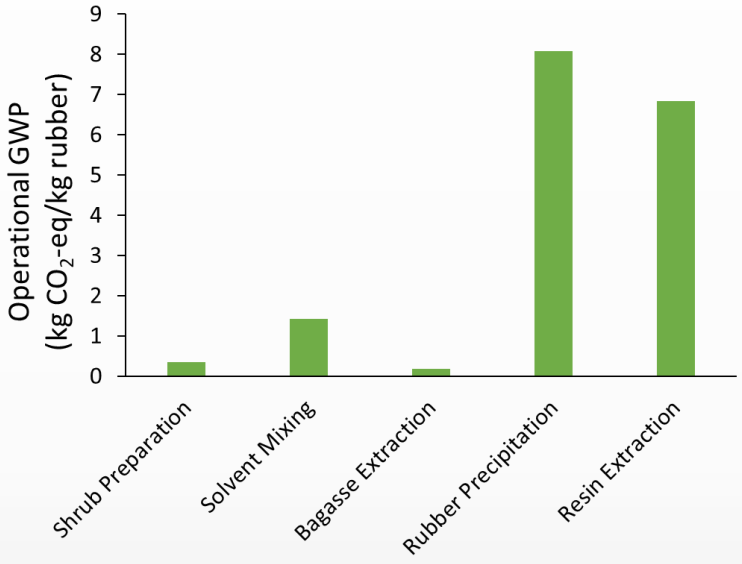
Colorado State University

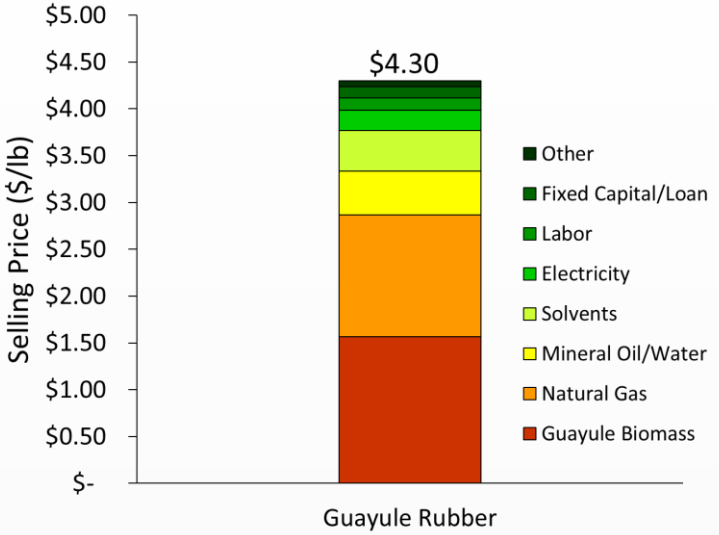


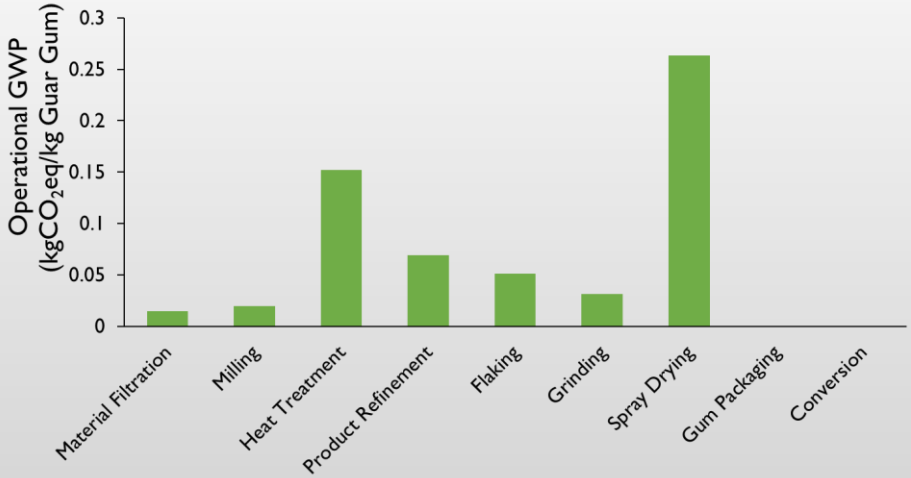


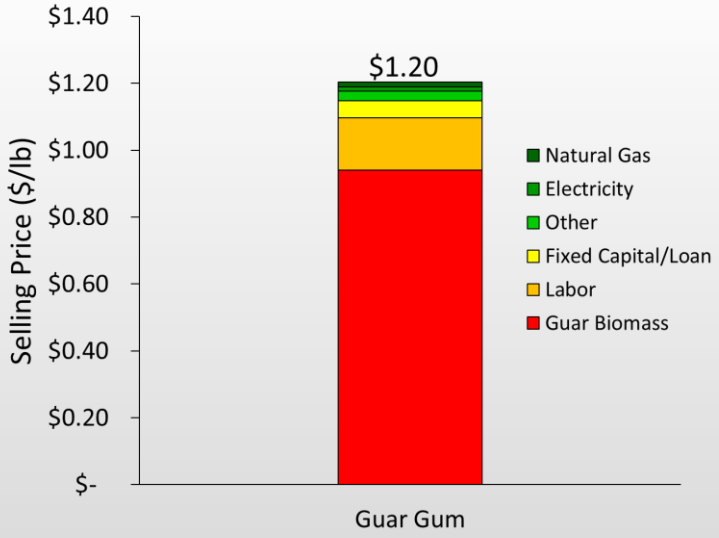


Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.







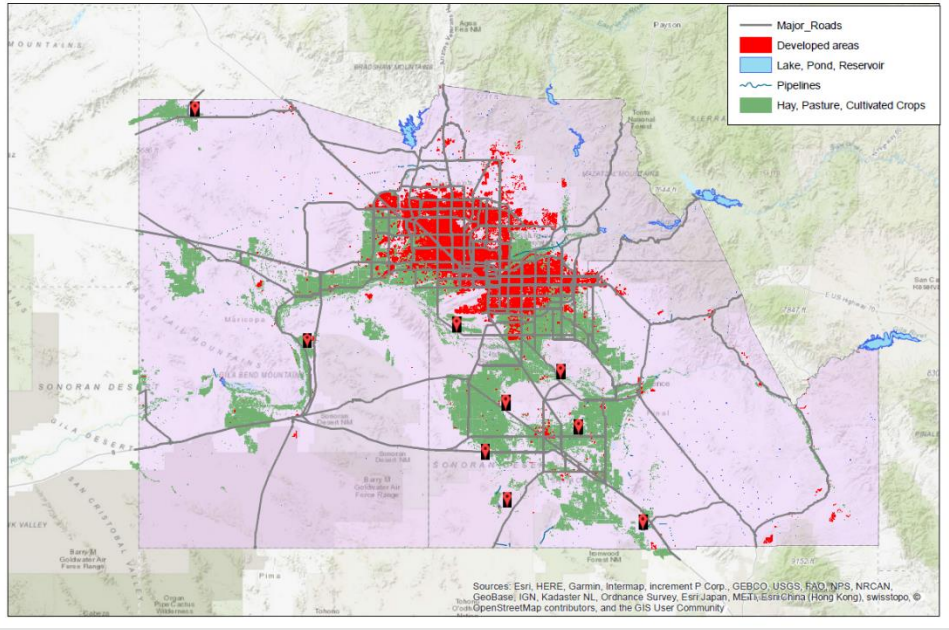


Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Sustainability Team

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867**. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

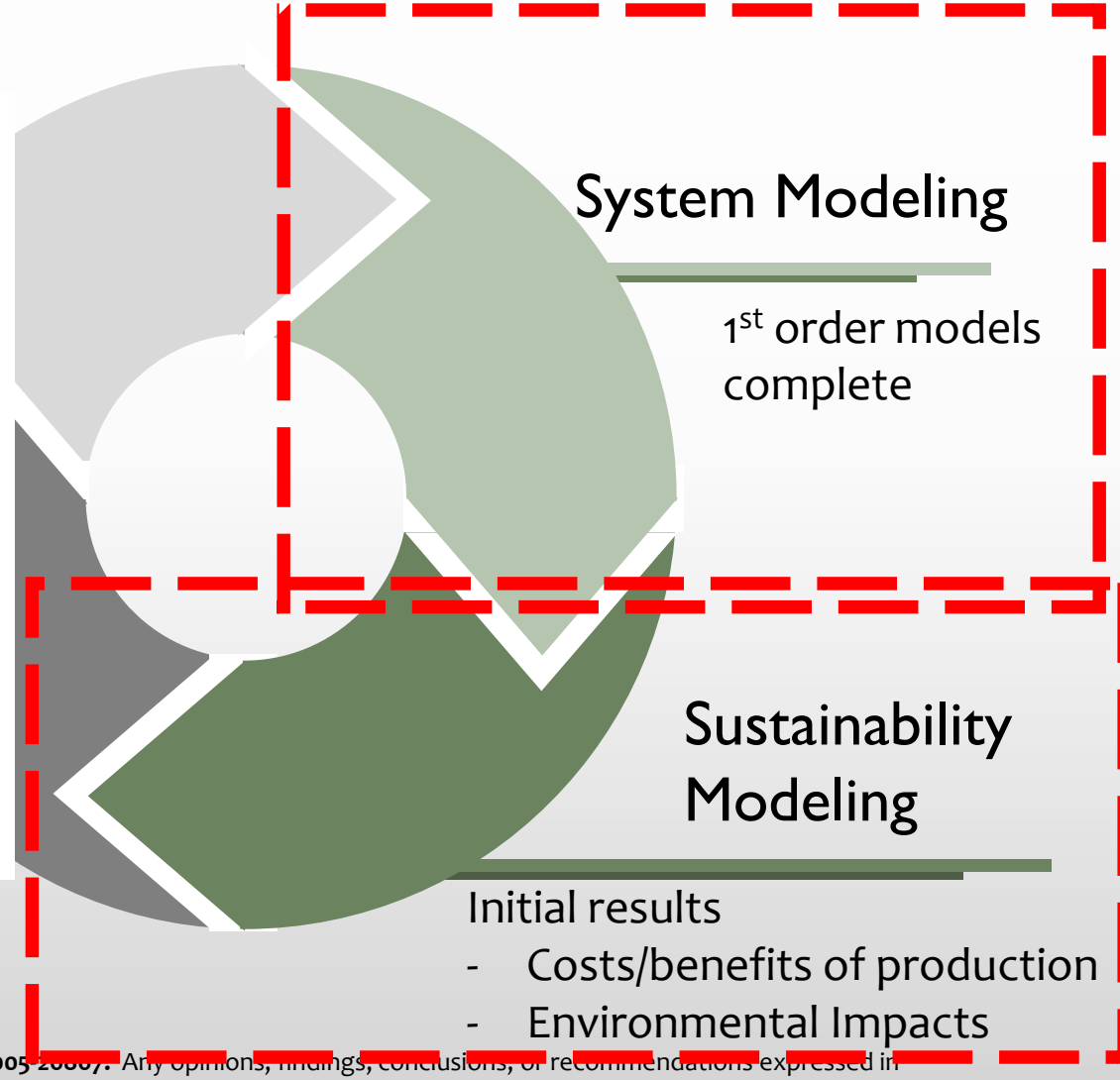
Optimization for Feedstock Logistics – Year 1 Accomplishments (Fan&Sun@UA)



- A decision framework based on GIS information
- Stochastic mixed integer programming models and algorithms
- Optimal decisions for facility location/ capacity and transportation routes in an economic and sustainable way

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Sustainability Team

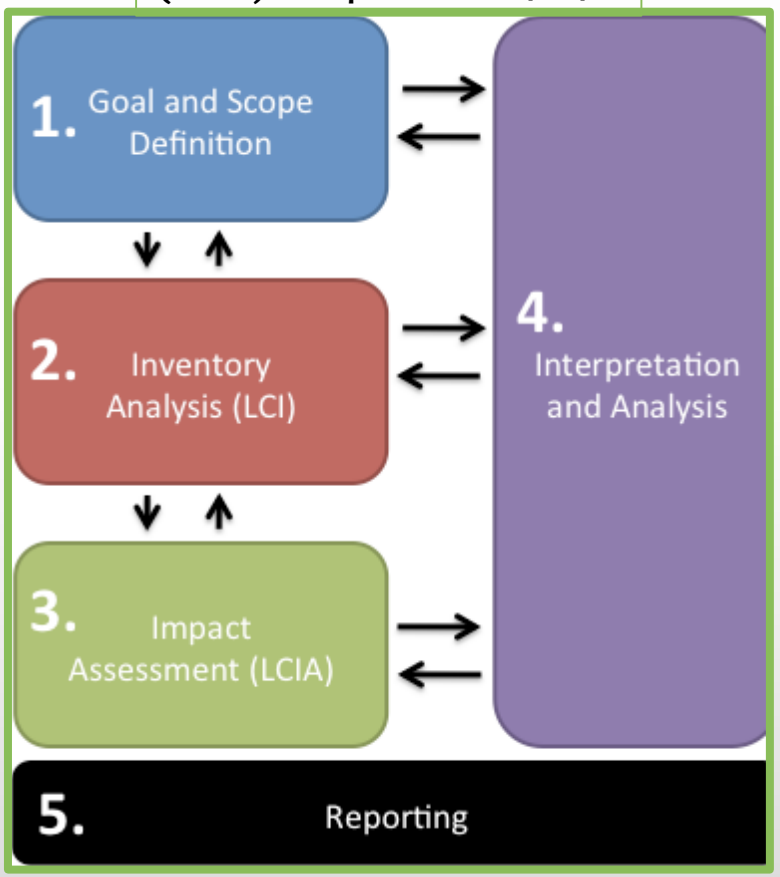


Funded by the NIFA-AFRI CAP Program - **2017-68005-26867**. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Principal Investigator: Amy Landis
Personnel: Pragnya Eranki
Students: VeeAnder Mealing
Institution: Colorado School of Mines

- SBAR Objective: 4.2 Integrate metrics and combine results from SBAR-developed data into sustainability models
- Sustainability
  - *3 Pillars: Environmental, Economic, & Social*
  - *Quantitatively assess environmental impacts*
  - *collaborate across the economic and social assessments*
- Progress made
  - *Data collection for Life cycle inventory dataset*
  - *Preliminary sub-process model for guar agriculture*
  - *Updated guayule excel model*

(LCA) Steps: ISO 14040

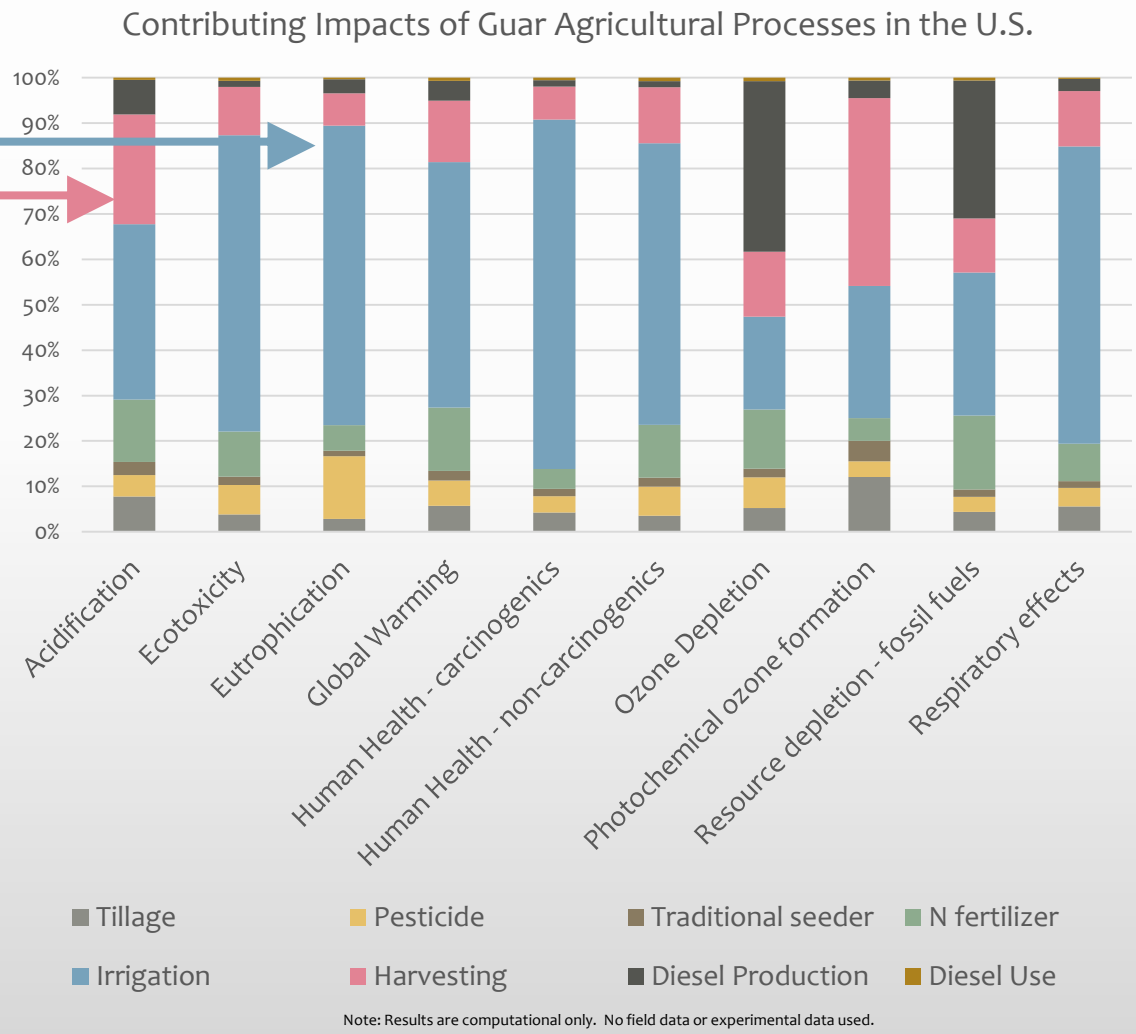


Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Preliminary Results & modeling data needs

Results

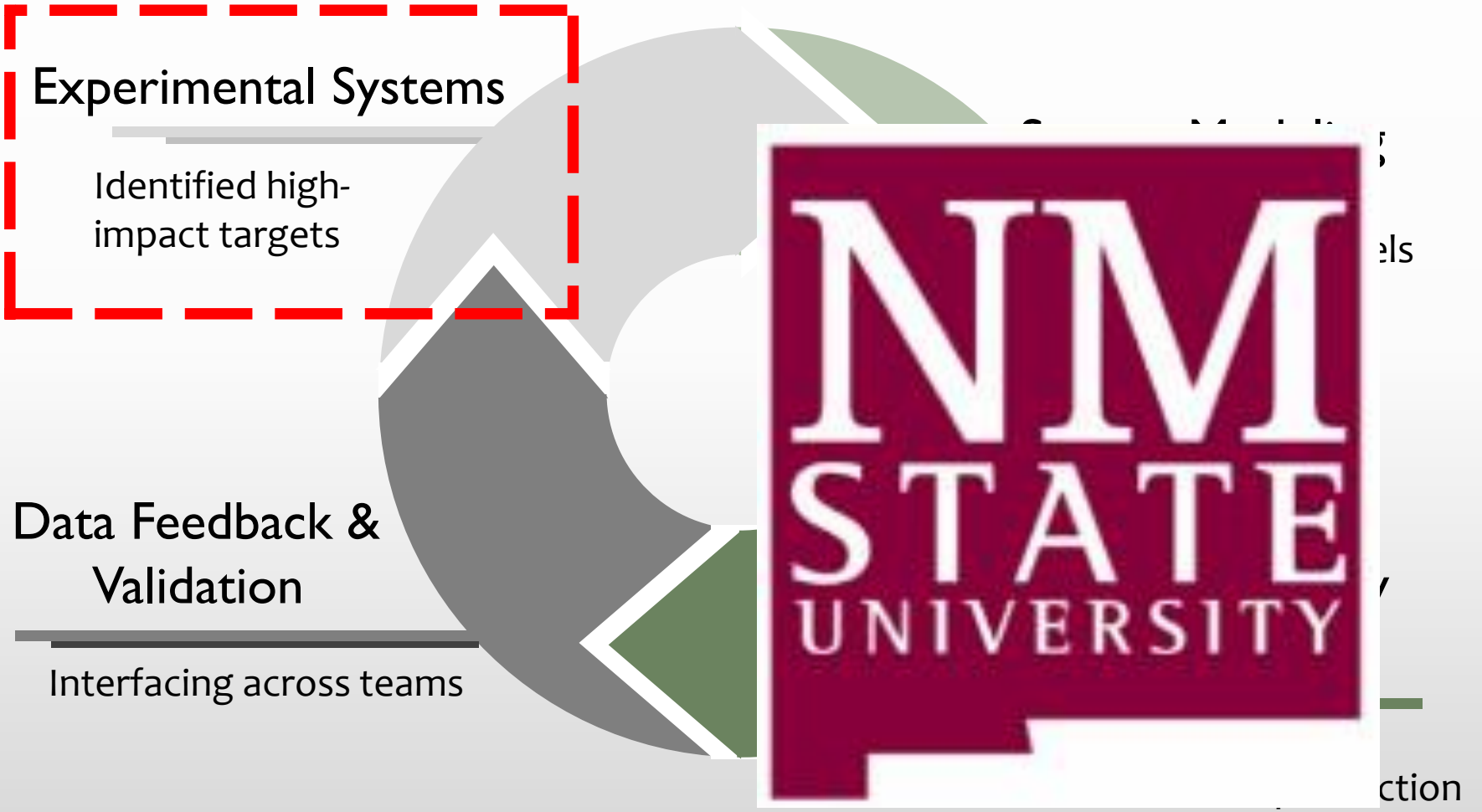
- Opportunity for improvement in guar agriculture: **Irrigation** & **Harvesting**



Note: Results are computational only. No field data or experimental data used.

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

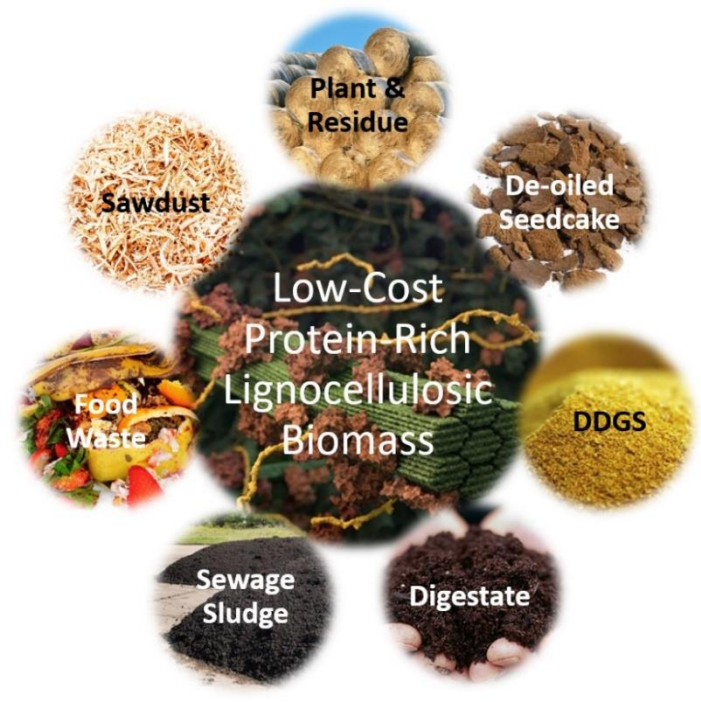
Sustainability Team



Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Bagasse Conversion – Year 1 Accomplishments (Brewer & Jena groups @ NMSU)

- Manuscript "Review on Conversion of Low-Cost Protein-rich Lignocellulosic Biomass into Advanced Biofuels" in preparation
- Literature review and data compilation for
  - *Guayule bagasse properties and conversion methods*
  - *Guar bagasse material estimates*
  - *High nitrogen lignocellulosic biomass*
  - *Hydrothermal liquefaction of lignocellulosic biomass*
  - *Other thermochemical and biochemical conversion technologies*



Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

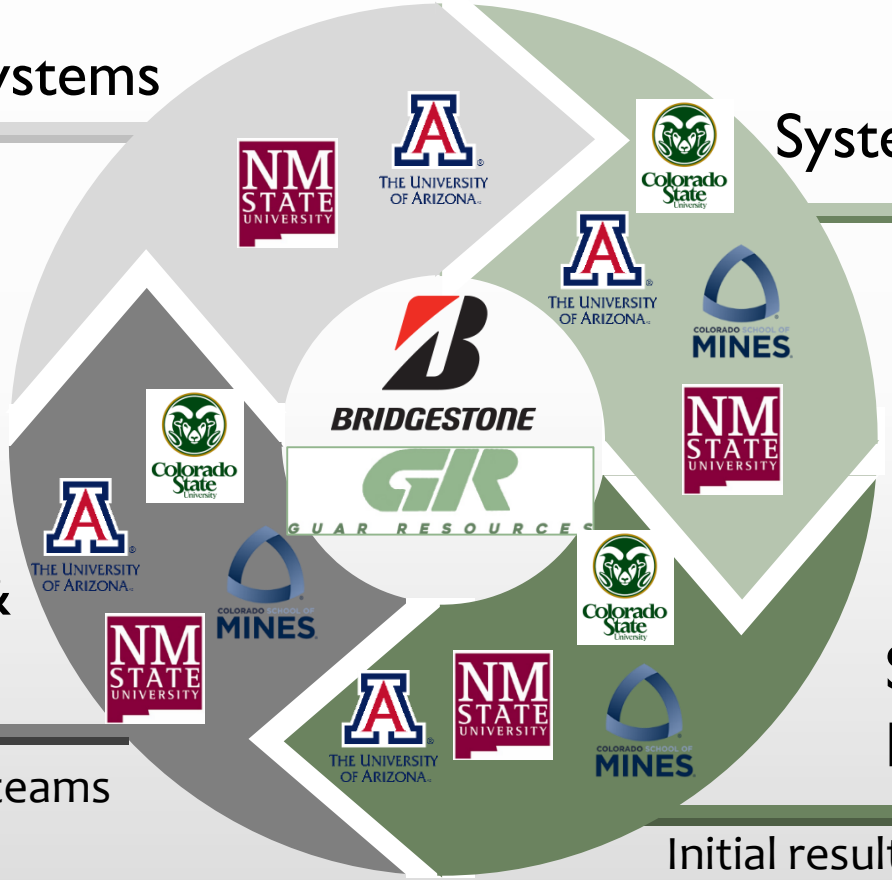
Sustainability Team

Experimental Systems

Identified high-impact targets

System Modeling

1st order models complete



Data Feedback & Validation

Interfacing across teams

Sustainability Modeling

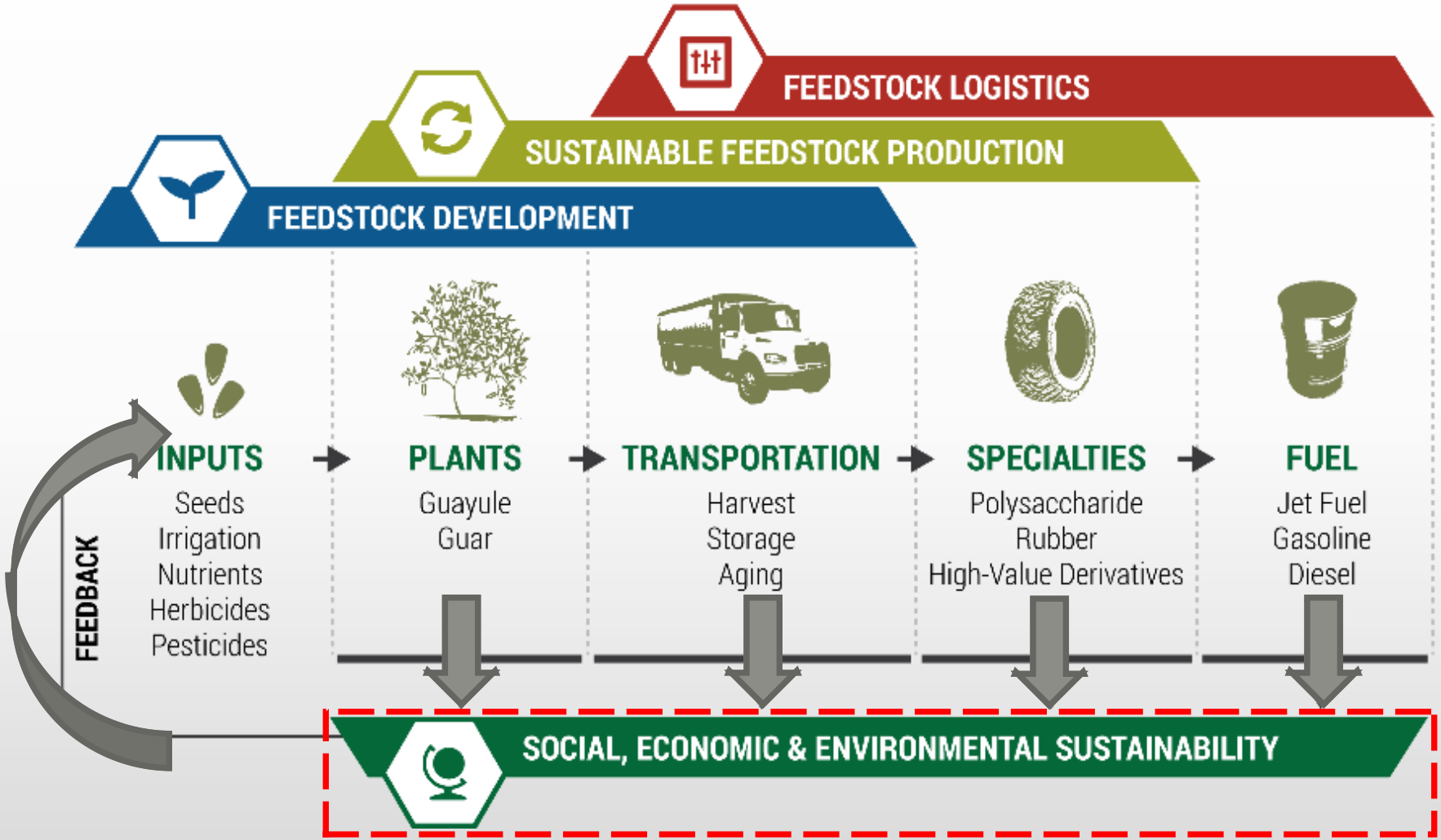
Initial results

- Costs/benefits of production
- Environmental Impacts

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

USDA United States Department of Agriculture | National Institute of Food and Agriculture



Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Year 1: Accomplishments

Objectives
4.1: System model for sustainability assessment
4.2: Utilize data for model validation and provide data feedback
4.3: Interface with regional growers

- High fidelity engineering process modeling
- Presentation of results at conferences (ACS rubber)
- Preliminary LCA environmental impact
- Increased understanding of economics
- Initial data integration

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Year 2: Goals

Our project mission is to build a sustainable bio-economy for arid regions to improve quality of life in rural communities and Native Nations.

- Data integration and collaboration across project
- Sustainability model integration
- Sensitivity analysis
- Optimization analysis of systems
- Data feedback to project team

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

EDUCATION

Sara Chavarria, Catie Brewer, Kim Ogden

Education Team – Year 1 Review

Sara Chavarria & Corey Knox – UA College of Education

Catie Brewer – NMSU Engineering

Torran Anderson & Cara Duncan – UA SBAR Coordinators

Stephanie Sikora – UA Institute for Energy Solutions

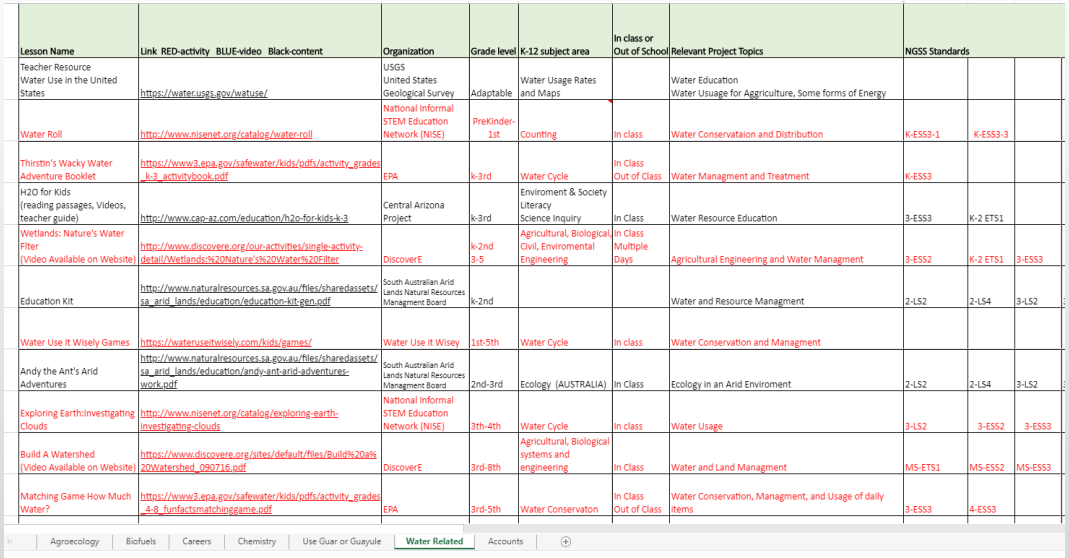
Istvan Molnar – UA Agriculture and Life Sciences

Kim Ogden – UA Engineering

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Year 1 Activities

- **Teacher Cohort 1- Recruitment:** 2 teachers and 2 fellows in New Mexico, 4 teachers and 4 fellows in Arizona.
- **Development of Teacher Resources:** Spreadsheet of lessons and activities with grade level, subject, duration, links, appropriate standards, etc. for physical and natural sciences, math, and engineering.
- **Professional Development:** Planned and executed the 2 week PD program for the 6 middle school teachers and the 6 graduate student fellows. Designed lessons for the PD program for our two target audiences: Middle school teachers and graduate student fellows.



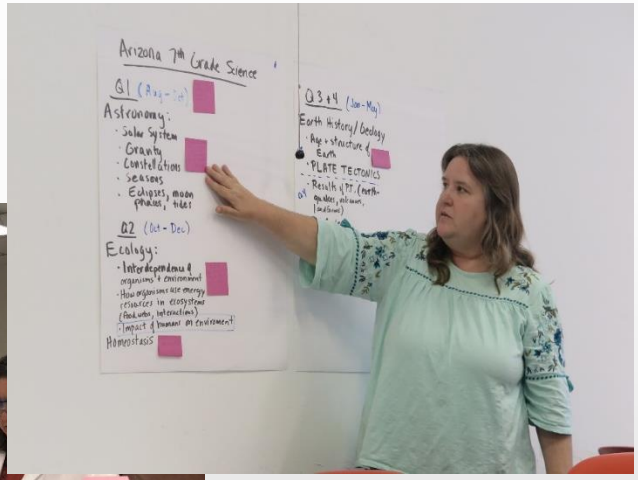
Lesson Name	Link RED-activity BLUE-video Black-content	Organization	Grade level	K-12 subject area	In class or Out of School	Relevant Project Topics	NGSS Standards		
Teacher Resource Water Use in the United States	https://water.usgs.gov/watuse/	USGS United States Geological Survey	Adaptable	Water Usage Rates and Maps		Water Education Water Usuage for Aggriculture, Some forms of Energy			
Water Roll	http://www.nisenet.org/catalog/water-roll	National Informal STEM Education Network (NISE)	PreKinder-1st	Counting	In class	Water Conservataion and Distribution	K-ESS3-1	K-ESS3-3	
Thirstin's Wacky Water Adventure Booklet	https://www3.epa.gov/safewater/kids/pdfs/activity_grades_k-3_activitybook.pdf	EPA	k-3rd	Water Cycle	In Class Out of Class	Water Managment and Treatment	K-ESS3		
H2O for Kids (reading passages, Videos, teacher guide)	http://www.cap-az.com/education/h2o-for-kids-k-3	Central Arizona Project	k-3rd	Enviroment & Society Literacy Science Inquiry	In Class	Water Resource Education	3-ESS3	K-2 ETS1	
Wetlands: Nature's Water Filter (Video Available on Website)	http://www.discovere.org/our-activities/single-activity-detail/Wetlands:%20Nature's%20Water%20Filter	DiscoverE	k-2nd 3-5	Agricultural, Biological, Civil, Enviromental Engineering	In Class Multiple Days	Agricultural Engineering and Water Managment	3-ESS2	K-2 ETS1	3-ESS3
Education Kit	http://www.naturalresources.sa.gov.au/files/sharedassets/sa_arid_lands/education/education-kit-gen.pdf	South Australian Arid Lands Natural Resources Managment Board	k-2nd			Water and Resource Managment	2-LS2	2-LS4	3-LS2
Water Use It Wisely Games	https://wateruseitwisely.com/kids/games/	Water Use it Wisey	1st-5th	Water Cycle	In class	Water Conservation and Managment			
Andy the Ant's Arid Adventures	http://www.naturalresources.sa.gov.au/files/sharedassets/sa_arid_lands/education/andy-ant-arid-adventures-work.pdf	South Australian Arid Lands Natural Resources Managment Board	2nd-3rd	Ecology (AUSTRALIA)	In Class	Ecology in an Arid Enviroment	2-LS2	2-LS4	3-LS2
Exploring Earth:Investigating Clouds	http://www.nisenet.org/catalog/exploring-earth-investigating-clouds	National Informal STEM Education Network (NISE)	3th-4th	Water Cycle	In class	Water Usage	3-LS2	3-ESS2	3-ESS3
Build A Watershed (Video Available on Website)	https://www.discovere.org/sites/default/files/Build%20a%20Watershed_090716.pdf	DiscoverE	3rd-8th	Agricultural, Biological systems and engineering	In Class	Water and Land Managment	MS-ETS1	MS-ESS2	MS-ESS3
Matching Game How Much Water?	https://www3.epa.gov/safewater/kids/pdfs/activity_grades_4-8_funfactsmatchinggame.pdf	EPA	3rd-5th	Water Conservaton	In Class Out of Class	Water Conservation, Managment, and Usage of daily Items	3-ESS3	4-ESS3	

Agroecology | Biofuels | Careers | Chemistry | Use Guar or Guayule | Water Related | Accounts

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Professional Development approach (2 weeks)

- 1/3 Information share (presentations, interviews with experts, research, debriefs & discussions, lab tours= weeks 1 & 2)
- 1/3 hands-on exploration of existing student activities (4-H – Week 1)
- 1/3 lesson/activity design (Week 2)



Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Professional development goals- WEEK 1

Teachers

-Overview/knowledge of Guar/Guayule and bio fuels.

-Develop connections between new content and existing curriculum

-Identify potential activities for their classroom

-Focus on ways of developing relevancy of topic to their particular students/community

Fellows

-Overview/knowledge of Guar/Guayule and bio fuels

-Identify connections to their own expertise and research interests

-Observe and reflect on curriculum development/hands on learning, and classroom management

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Professional development goals- WEEK 2

Teachers

-Develop an overview/mapping of existing curriculum with linkages to SBAR material

-Develop one draft activity/lesson related to SBAR with fellow

-Meet and develop schedule and activities for SBAR Fellow during the academic year.

Fellows

-Develop understanding of middle school science content

-Introduction to best practices in developing community connections related to SBAR, Science teaching and ELA strategies, and NGSS

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

PD Outcomes

- Teacher/Fellow pairs were formed, and schedules were agreed upon for academic year (including a visit to Bridgestone).
- Each pair developed and presented a lesson or lesson(s) and/or projects connected to SBAR project.
- A platform (Schoology) was developed to communicate information and share resources.
- A materials and supplies list was developed and is stored in Box.

Teacher – Grad Fellow partnerships

Teachers	Fellows
Priscilla Fischback (Apollo MS, AZ)	Holly Barton (Landscape Architecture, UA)
Jaime Camero (Walter Douglas ES, AZ)	Ashton Leo (Plant Sciences, UA)
Traci Klein (Valencia MS, AZ)	Matt Katterman (Ag/Biosystems E, UA)
Mellisa Walburn (Quail Run ES, AZ)	Arisbeth Ibarra (Environmental E, UA)
Tracie Mikesell (Mesilla Valley Leadership Academy, NM)	Meshack Audu (Chem E, NMSU)
Cathy Bradley (Sierra MS, NM)	Brian Treftz (Chem E, NMSU)

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Sneak peak at Cohort 1 lesson ideas/approaches

Cathy and Brian (NM): Weekly SBAR/Sustainability activities once per week in an **after school program—"Guardians of the Biosphere."**

- Lessons on **carbon footprint; Bioblast** and **Burning a nut** (fuel distillation).
- Building an outdoor **garden with guar and guayule.**
- Project focus on **irrigation for arid areas.**

Pricilla and Holly (Tucson): SBAR and sustainability themes have been integrated throughout the year.

- Lessons on **Ecosystem in a Bottle, Geothermal and Renewable Energy Debate, Fossil Fuels vs Biofuels**, and **Oil Extraction.**
- Social lesson: **Ancient Mayans** using GUAR rubber balls.

Traci and Matt (Tucson): will introduce an SBAR day of the week

- Topics include **biofuels,** sustainable **plants for an arid region,** growing **food and nonfood plants for biofuels,** and **farming and water issues in arid regions.**

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

EXTENSION & OUTREACH

Channah Rock, Sangu Angadi, Paul Gutierrez,
Kulbhushan Grover, John Idowu, Jerry Lopez

SBAR – Extension Grower-Focused/4-H YEAR ONE

Main Objectives of this group

- 5.1 Produce Extension bulletins and web materials to inform growers of agronomic and irrigation requirements. Conduct needs assessment of growers
- 5.2 Hold workshops throughout the region on sustainable practices to expand crop production to new rural regions and Native Nation lands. Use existing meeting to introduce project.
- 5.5 Involve youth in 4-H projects and STEM summer camps.

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Key Contributors

Leads/Co-PIs

- Dr. Channah Rock – U of A
- Dr. Jerry Lopez – U of A
- Dr. Paul Gutierrez – NMSU
- Dr. Kulbhushan Grover – NMSU
- Dr. Sangu Angadi – NMSU
- Dr. John Idowu – NMSU
- Dr. Trent Teegerstrom – U of A

Staff members

- Natalie Brassill
- Darien Pruitt
- Sarah Acquah
- Craig Bal
- Matt Katterman
- Cara Duncan
- Torran Anderson

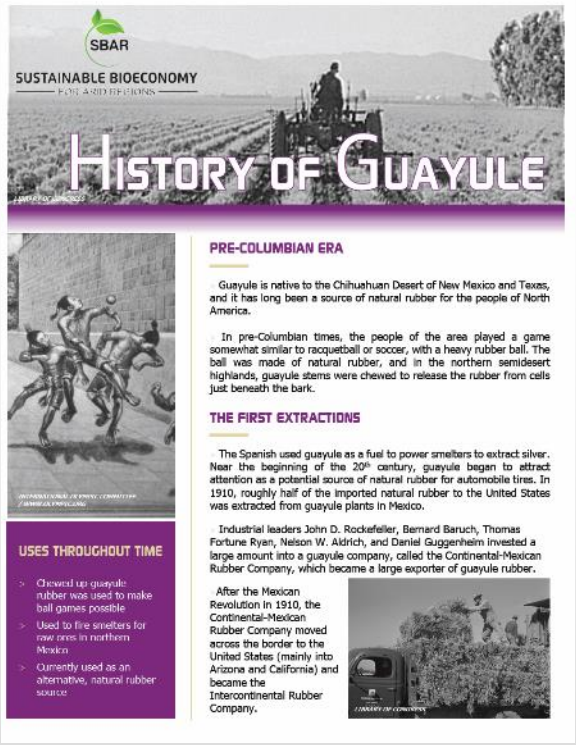
Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

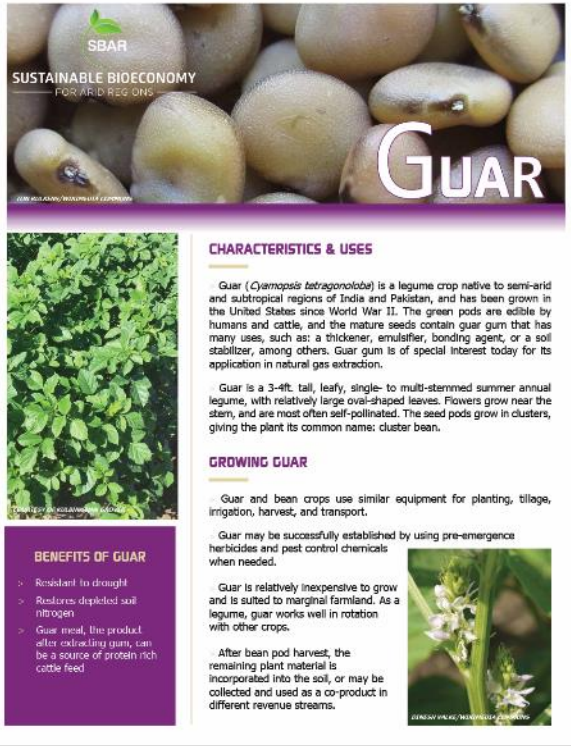
Major Decisions

- SBAR-EEO group met in Las Cruces, NM to discuss program goals and objectives (December 7-8, 2017)
- SBAR-EEO was split into three subgroups
  - SBAR-Extension Grower focused
  - SBAR-4H Focused
  - SBAR-Teacher PD Focused
- Each subgroup to be led by different PIs
- Each subgroup to meet once a month
- Combined group meeting to take place once a month
- Subgroups to provide reports during each large group meeting

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Objective 5.1 Three fact sheets available on Guayule and Guar





Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

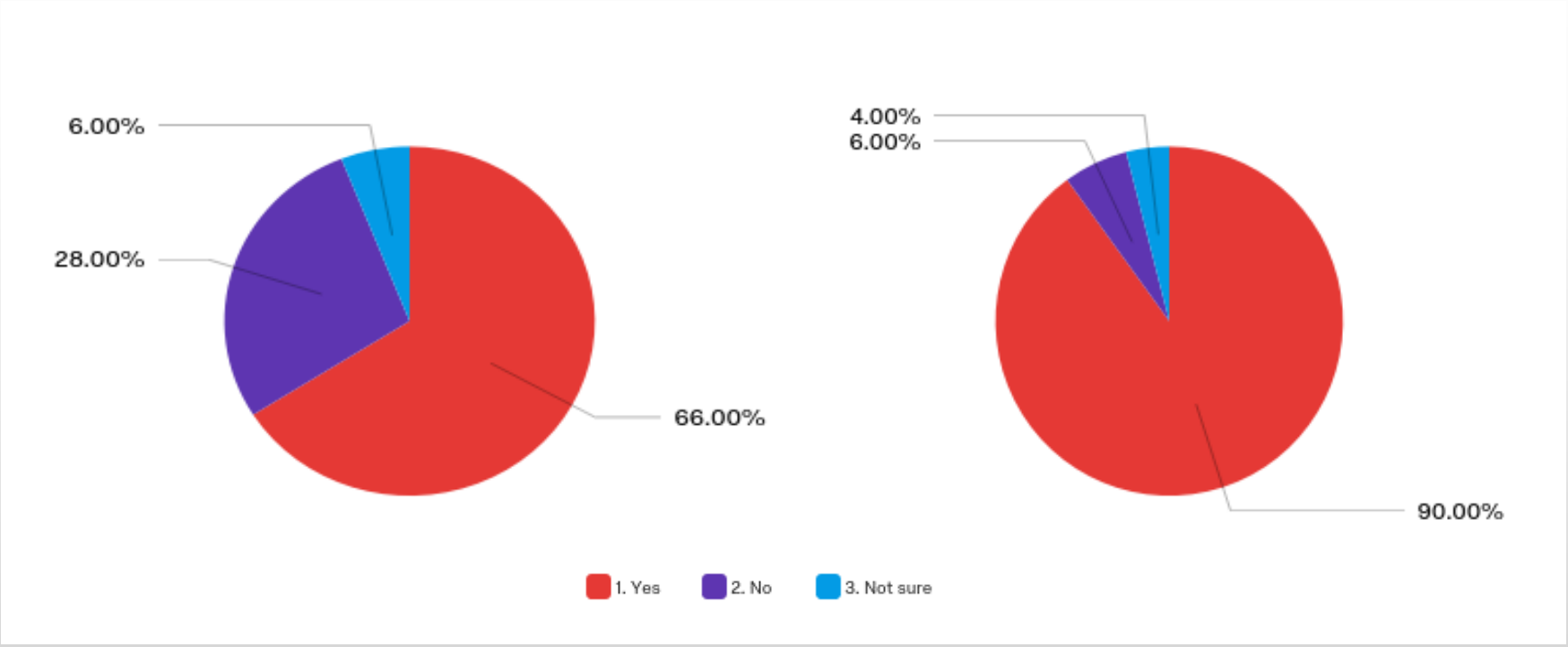
OBJECTIVE 5.1: NEED'S ASSESSMENT

- Arizona and New Mexico Regions
- Grower focus
- Terms, Ag practices, interest, questions/ concerns
- 100+ responses

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

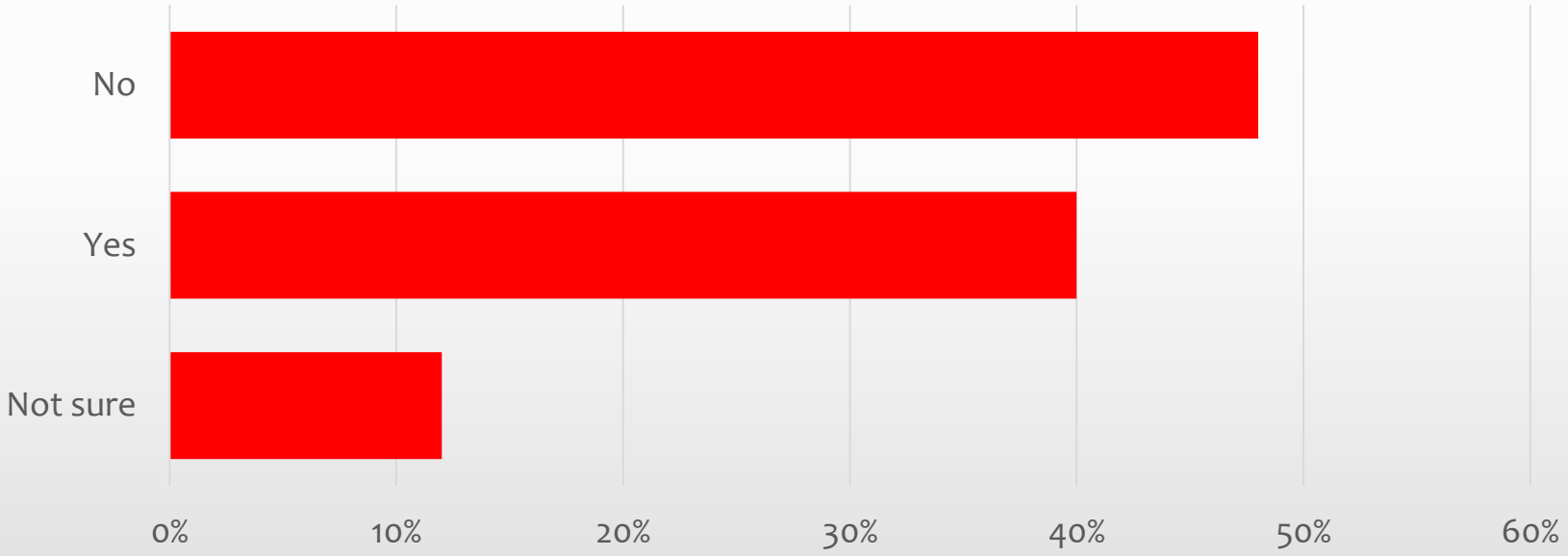
Terminology and Awareness

- Q5 - Have you heard of the crop Guayule (pronounced why-YOU-lee)?
- Q6 - Do you know what "biofuel" is?



Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Q7 - Are you aware that Arizona Cooperative Extension is supporting new biofuel and bio-product research on Guayule?

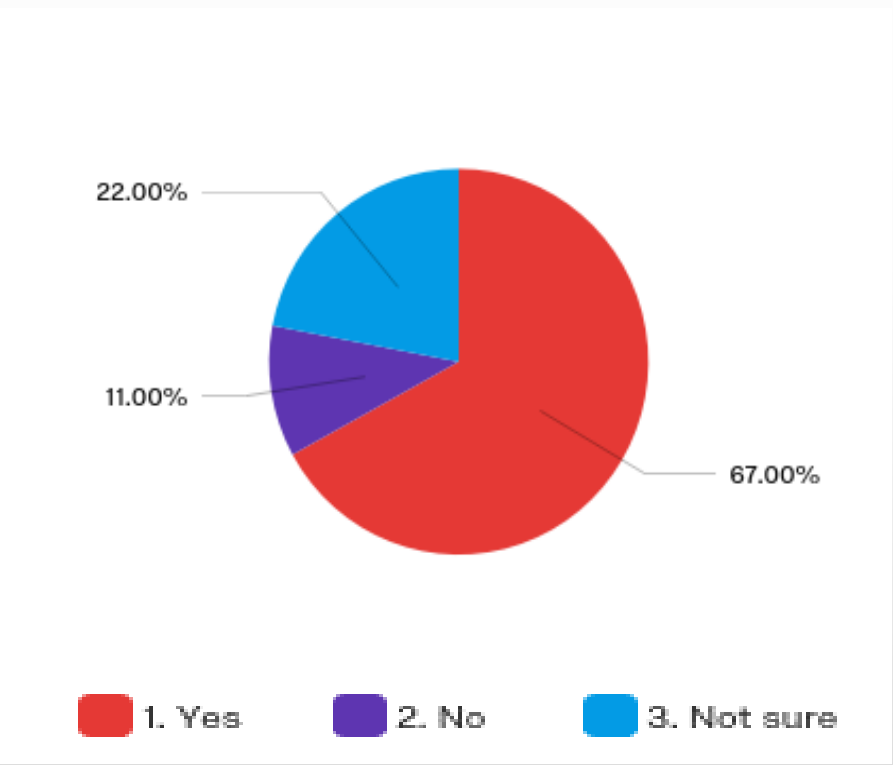


Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Sustainability Ethic

Q8 - Some suggested benefits of the production of biofuel and bio-product crops include promoting America's energy security, reduction in greenhouse gas emissions, protection of the environment, and financial benefits for farmers and agricultural businesses.

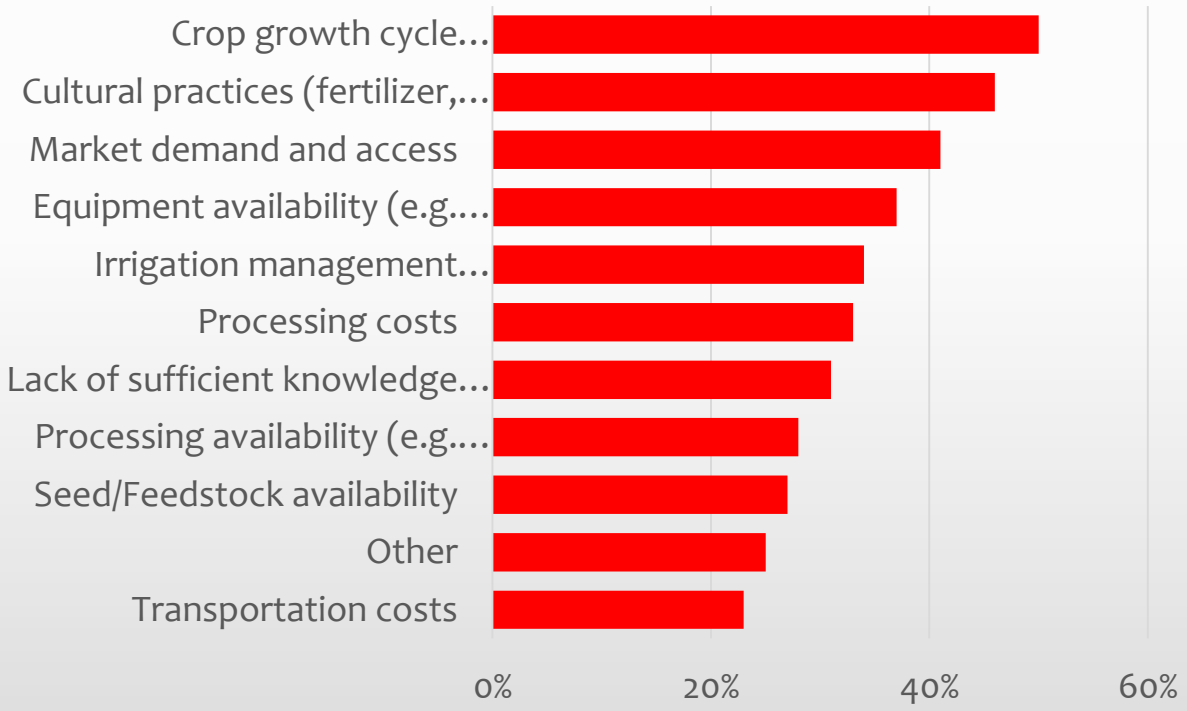
Taking that into consideration, are you interested in the production of biofuel and bio-product crops as a sustainable resource?



Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Questions/Concerns

Q9 - What are some of the questions that you will likely have, if converting some of your current farm land into Guayule? (check all that apply)



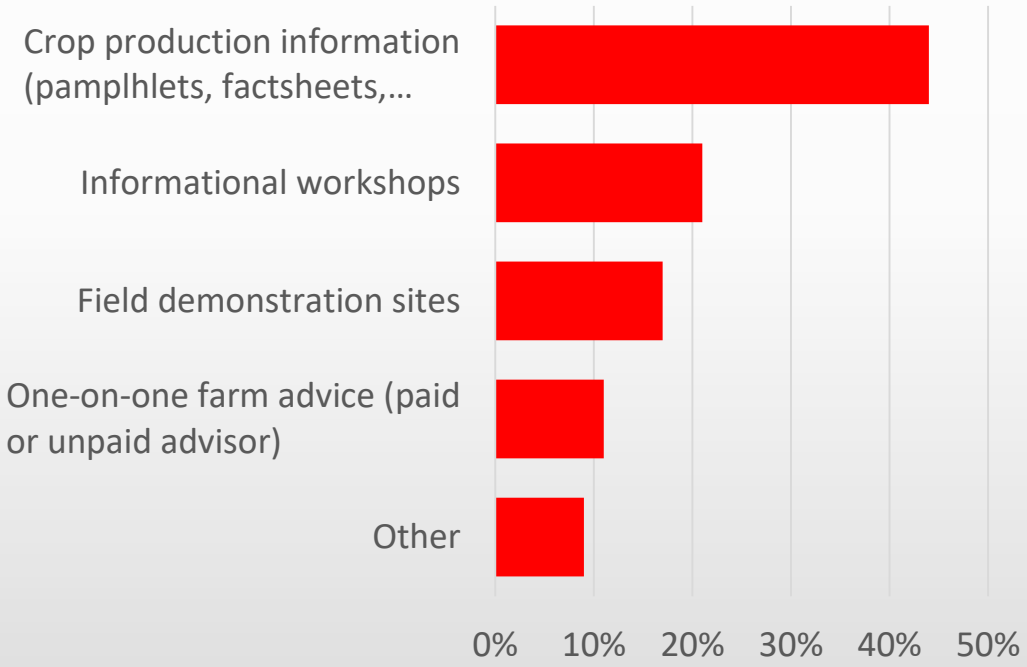
"Other"

- *What will farmer make?*
- *Is it worth tying up ground for 2-4 years?*
- *Pest, resistances, tolerant*

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

How do you want information?

Q10 - What would help answer your questions regarding biofuel or bio-product crops such as Guayule? (rank in order of most helpful (1) to least helpful (5)



"Other"

- *Visit rubber manufacturing facility to extract rubber from Guayule plants*
- *Value*
- *Cost*
- *Current growers*
- *Market share per acre*
- *Successful production and made money*

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Objective 5.2

- Hold workshops throughout the region on sustainable practices to expand crop production to new rural regions and Native Nation lands. Use existing meeting to introduce project.
  - *Benefits of Guar*
  - *Field Demonstration Examples*
  - *Activities*

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

USDA United States Department of Agriculture National Institute of Food and Agriculture

Producer Benefits of Growing Guar

- Drought tolerant legume
- Nitrate Fixating Crop
- Low irrigation costs
  - *(5 – 12 ac-in)*
- Low fertilizer inputs
- Low herbicide inputs
- Low insecticide inputs

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR Guar Demonstration Trials

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

On-station demonstration trial

- On-station Inoculum and Phosphorus Response Demonstration Trials with Guar set up at:
  - NMSU Agricultural Science Center in Los Lunas
  - NMSU Agricultural Science Center in Clovis


Guar Field in Los Lunas


Guar Plant in Los Lunas

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Guar Extension and Outreach:

On-Station Demonstrations/Agronomic Trials

- *Guar Phosphorus and Rhizobium Trial*
- *Guar Row Spacing Demonstration*
- *Guar Deficit Irrigation Management*
- *Guar Cultivar Demonstration*

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

USDA United States Department of Agriculture National Institute of Food and Agriculture

Conclusions from Guar Study

- Guar has the potential to become a profitable alternative crop in the southwest.
- Guar's drought tolerant qualities and nitrogen fixation abilities make it a potential crop to be used in rotation.
- If local producers can achieve the import price, guar could be a beneficial alternative crop.

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Producer Benefits of Growing Guayule

- Low Production Cost
- Desert adapted Plant
- Low herbicide inputs
- Low insecticide inputs

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Conclusion from Guayule Study

- Guayule has the potential to become a profitable alternative crop in the southwest.
- Guayule is well suited to the Southwest and has low maintenance costs

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Outreach Activities - Summary

Audience Demographic Parameter	Cumulative Project Total
Gender	
Males	338
Females	186
Race/Ethnicity	
Hispanic	69
Asian	45
Native American	106
African American	25
Anglo/White	279
Total People Reached through SBAR Activities	**524**

Total Reach via Tabling Events and Workshops (when captured): ***1,095 participants***

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Extension & Outreach Examples

Presentation on SBAR and Guar Project at NM State 4-H Conference.

NMSU On-Farm Demonstration on Guar.

Field Day on Guar at NMSU Lyendecker.

Information dissemination on SBAR- NMSU.

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Extension & Outreach Examples

- **SBAR Display Table** at the New Mexico Organic Farming Conference, February 15-17 (Approximately 150 people came to our display table each day)
- **SBAR Display Table** at the NMSU College of Ag. Open House Event, Las Cruces, New Mexico – April 14, 2018. Attendees (300)
- **SBAR Display Table and Presentation** at the SWIAA in Laughlin, AZ January 2018 (100 Native Americans)
- **Visited 6 farmers** in Chaves county, NM to discuss abo the SBAR project

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

NM Advisory Committee

Recruited so far:

- Three farmers
- Three extension educators

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

USDA United States Department of Agriculture National Institute of Food and Agriculture

Objective 5.5

- Involve youth in 4-H projects and STEM summer camps.

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Project Puente

- Total of 4 students
  - *2 USDA*
  - *1 UA MAC*
  - *1 UA Tucson*
- Highschool and Undergraduate
- Research and Extension Activities

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

4-H Summer Camp 2018
Biofuels Powering Your World

- Week long biofuel camp was implemented
  - Camp Schedule of 38 hours of activities
  - Logistics
  - Lab and classroom

- The Biofuel Camp curriculum was developed
  - 9 Lessons/Experiments
  - 1 biofuel project
  - Evaluation instrument developed
  - Supplies ordered

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

SBAR

USDA United States Department of Agriculture National Institute of Food and Agriculture

4-H Summer Camp 2018 Biofuels Powering Your World

- 9-students from diverse backgrounds were recruited
- T-shirts and lab coats were designed
- Lessons learned from first year implementation

Funded by the NIFA-AFRI CAP Program - **2017-68005-26867.** Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.