

Land-grant Impacts

Writing effective impact statements

Engaging with existing resources

Sara Delheimer

sara.delheimer@colostate.edu

mrfimpacts.org

WHAT IS IMPACT?

Impact is a change in:

- Knowledge
- Behavior
- Condition (economic, environmental, or social)

Change can affect:

- Individuals
- Families, communities
- States, regions, nations...



WHAT IS AN IMPACT STATEMENT?

A brief summary in lay terms of the difference a project or program has made

- So what?
- Who cares?

WHY IS IMPACT REPORTING IMPORTANT?

- Accountability
- Influences funding and other decisions
- Raises awareness, interest, and support
- Catches attention



WHO USES IMPACTS—and HOW?

Land-grant universities

- Fulfill state/federal reporting requirements
- Record/archive for future uses
- Track progress
- Bolster proposals and funding requests

Communicators Media

- Get ideas for stories
- Prepare pitches, press releases, articles, speeches

Decision-makers Elected officials Funding agencies Donors

- Show return on investment
- Influence decisions

Community members

- See what institutions are doing
- See progress on issues they care about



HOME > DATA

NIFA Reporting System

SHARE



NIFA has established the NIFA Reporting System (NRS) in collaboration with Land-Grant Universities and other partners. This tool provides data management and reporting for capacity funded research projects and Extension programs.

Impacts



Search

↔ Advanced Options ▾



Parameters



within the last... ▾

s1069 🔍

Institution Based Filters

All Regions ▾

All States & Territories ▾

All Designations ▾

All Institution Types ▾



Search Impact Statements Searching Current Impact Statements publicly available in the system.

10 ⬆️



Using Drones in Agriculture and Natural Resources

This award-winning multistate team of researchers and Extension educators is developing and promoting the use of drones in agriculture and natural resources. Remote sensing with drones offers a promising new way to monitor landscapes, individual plants/animals, and stressors like pests.

Agricultural Systems

Showing 1 to 1 of 1 records



[Home](#) > [Research](#) > [Research Impacts](#)

Research Impacts



Research

[Research Areas](#)



[Research Impacts](#)





Managing nutrients for reducing bitter pit in 'Honeycrisp'

The Need



The Approach



The Impacts

We found that, due to poor function of the fruit xylem vessels, Honeycrisp fruits only take up half the calcium taken into Gala fruits, but they have much higher potassium levels in their peels. The imbalance of calcium to potassium underlies the high susceptibility to bitter pit in Honeycrisp. To ensure good fruit growth while reducing

1865 THE UNIVERSITY OF
MAINE
Research

UMaine Research News



UMaine MARINE: Pioneering Marine Research for Maine and Beyond

Published: November 6, 2023



The University of Maine is Among Six Universities Awarded \$1.4 million to Breed and Develop Resilient Potato Varieties

Published: November 6, 2023



The University of Maine's Collaboration with the Naloxone Distribution



Browntail Moths at UMaine: Researchers Shed Light on Maine's Ongoing Battle



Climate Adaptation & Resilience

Advancing adaptation and resilience in a changing climate

Strengthening our Forests with Stormwise

Researchers in the Eversource Energy Center rely on adaptive silviculture to help trees become more resilient to severe storms.

If a tree sways in the woods, how likely is it to fall? This is the question Amanda Bunce, a PhD student in the Department of Natural Resources and the Environment, is working to address with the Stormwise Program in the Eversource Energy Center.

Through this innovative approach, CAHNR researchers and the UConn Forest crew provide the Eversource team with information about roadside vegetation to improve the resiliency of Connecticut's power grid.

Bunce studies biomechanics, or how trees move in the wind, in forests across the state. These measurements help Bunce determine how likely a tree is to be damaged or fall in a storm.

Recent destructive storm events in the Northeast have inspired utility companies like Eversource Energy, researchers, and other collaborators to work together on management approaches that help adapt our forests. With disturbances like increased storm activity, these techniques better prepare communities in the face of our changing climate.

"This is one element of the Eversource Energy Center's overall work to keep Connecticut's power on," says Robert (Bob) Fahey, associate director of the Eversource Energy Center and Cloutier Professor in Forestry.



"Along with initiatives focused on sustainable energy, advanced outage prediction modeling, and workforce development, we're taking a holistic view to addressing these challenges," says Fahey.

Bunce first calculates a tree's frequency—the measure of how quickly the tree moves back and forth. Trees with higher frequencies—typically shorter thicker trees—tend to be more stable and less likely to fall during strong winds.

Displacement is another important factor that Bunce evaluates. This determines how far the tree sways in the wind. While a tree's frequency is always the same, regardless of how strong the wind is, its displacement depends on wind strength.

"It's important to us, because how far the tree sways is a big deal in regards to whether or not it falls down," Bunce says.

Luckily there are methods to help trees become more resilient—they need to "work out." For instance, gradually exposing a tree to more wind develops its resistance and makes it more resilient in a storm.

To do this, the team has applied their Stormwise prescription to forests around the state. This prescription involves assessing a roadside forest, and removing trees that are growing into the road, over powerlines, or are "stressed" in some regard. Stressed trees include those that are hollow, infected with fungus, or ridden with pests.

Next, healthy, well-balanced trees are selected for retention, and the team strategically opens patches in the forest around them to let in more wind. This frees up resources for the remnant trees, allowing them to grow stronger. This kind of technique is known as adaptive silviculture, a complex process of controlling the growth of trees to improve the overall capacity of the forest to handle change and disturbances like storms.

With more and more powerful storms on the horizon, the windy workouts strengthen Connecticut forests and resilience to climate change.

Drones aid in farm efficiency across Arkansas, U.S.

by Will Hehemann Special to The Commercial | August 22, 2022 at 3:17 a.m.



U.S. Agriculture

OUTLOOK

2017 EDITION



THE BIG PICTURE

UAVs' POTENTIAL TO
CAPTURE IN-DEPTH AG DATA

PLUS:

The FEDERAL FARM LOAN ACT
and a Century of Support for
American Farmers

Wasting Away

The Food Waste Problem and
What's Being Done to Fix It

INTERVIEW with
Rep. MIKE CONAWAY,
Chairman of the House
Committee on Agriculture





THE UNIVERSITY OF GEORGIA
**COOPERATIVE
EXTENSION**

Return on Investment

A REPORT FOR CONGRESSMAN AUSTIN SCOTT

UGA Cooperative Extension is working hard for your constituents. Here is a small sample of successful projects completed in your district this past year:

Improving tomato production

Scientists from the University of Georgia, University of Florida, Clemson University and North Carolina State University worked together over the last two decades to try to alleviate tomato spotted wilt virus.

The **RAMP (Risk Avoidance and Mitigation Program) Project** compiled data showing an estimated \$9 million loss in tomato and pepper crops between 1996 and 2006. Without resistant varieties, Georgia's tomato crop would have been wiped out.

Today, Georgia's vegetable industry, including the state's tomato and bell pepper fields, is worth \$781 million and accounts for about 10,200 jobs across the state, according to the most recent *Georgia Farm Gate Value Report*.

Assisting with income tax planning

UGA Extension conducted community outreach tax credit training, and the Colquitt County Extension agent collaborated with local and state groups to implement a **bilingual VITA site** in Colquitt County. Community agencies that participated in the training helped with the tax credit outreach and VITA initiative.

Agencies made their low-income clients aware of the available tax credits and VITA site locations to have their tax returns prepared for free. VITA site volunteers completed 93 tax returns with refunds totaling \$158,825, without charge to low- and middle-income taxpayers.

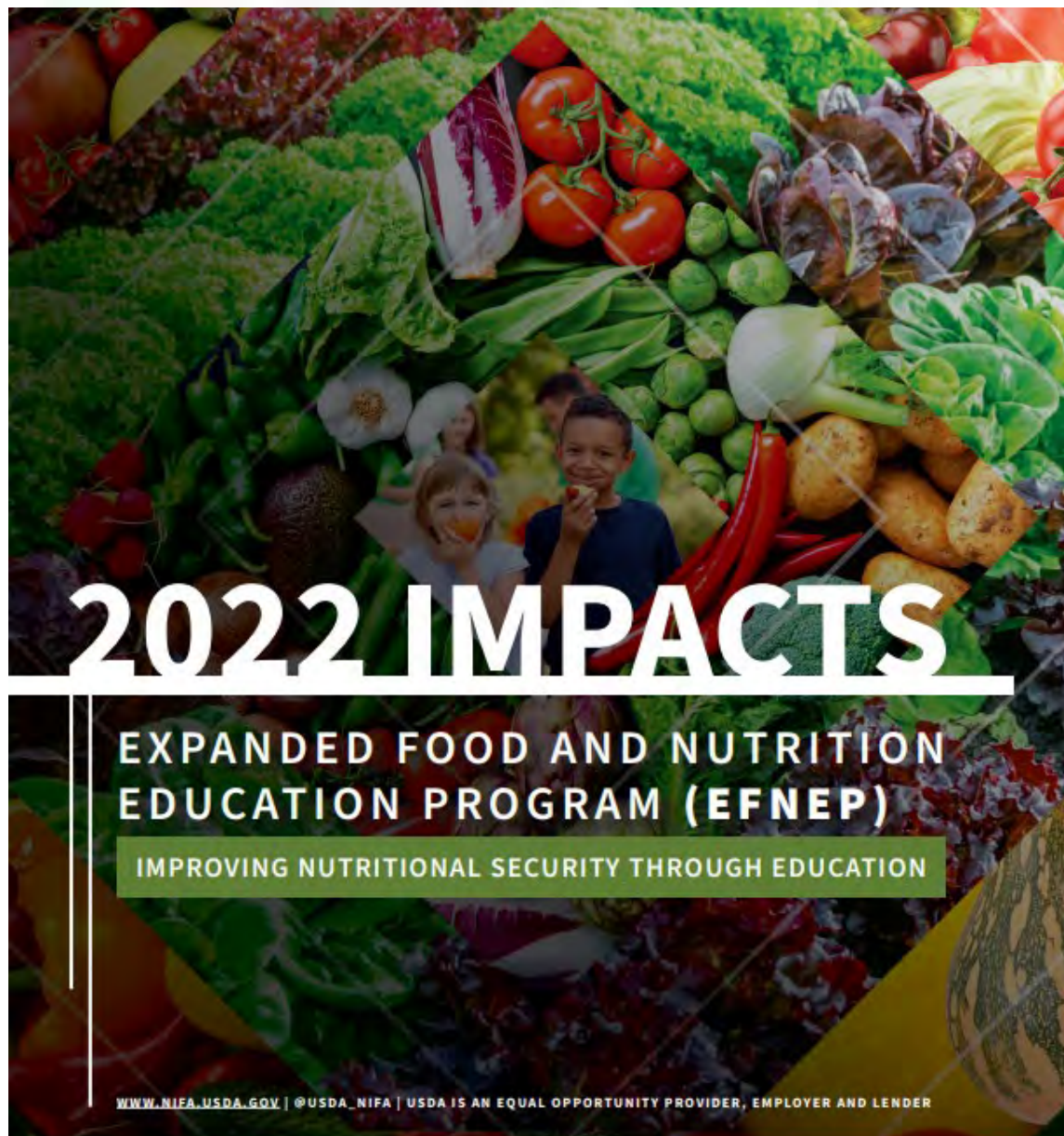
Providing quality drinking water

After a few resident well water samples from Monroe County and the surrounding area tested positive for uranium, local UGA Extension agents and state specialists offered educational programs to raise awareness of the issue and encourage more well water tests.

About **800 wells were tested for uranium**, with 39 wells testing positive for higher levels than recommended.



National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE



2022 IMPACTS

EXPANDED FOOD AND NUTRITION
EDUCATION PROGRAM (EFNEP)

IMPROVING NUTRITIONAL SECURITY THROUGH EDUCATION



Maggie Lawrence, Editor

November 8, 2023

Impact of NIFA-Funded Research and Outreach

What Makes a Carrot Orange?

Research at **North Carolina State University**

(NCSU) is unlocking the answer to the question of what makes a carrot orange. A NCSU study of the genetic blueprints of more than 600 types of carrot shows that three specific genes are required to give carrots an orange color. Surprisingly, these three required genes all need to be recessive, or turned off. [Learn more](#) about the NIFA supported research and how it sheds light on the traits important to carrot improvement efforts and could lead to better health benefits from the vegetable.



Massimo Iorizzo examines orange carrots to learn more about their pigmentation and domestication.

Photo courtesy of North Carolina State University.

Celebrating the Agricultural Impacts of 1890 Land-Grant Universities

Posted by Faith Peppers, National Institute of Food and Agriculture, Communications Director in [Equity, Research and Science](#)

Feb 23, 2021



USDA has a long history of investing in and supporting our nation's Historically Black Colleges and Universities. Photo source: Getty Images

USDA has a long history of investing in and supporting our nation's Historically Black Colleges and Universities (HBCUs). The [19 HBCUs established under the Second Morrill Act of 1890](#), along with the two HBCU land-grant universities established in the original 1862 legislation – University of the District of Columbia and University of the Virgin Islands – are a critical link in ensuring public access to





Multistate Research Fund Impacts Program

@MRFImpacts



It's [#FarmersMarketWeek](#)! A team of land-grant universities is helping growers boost sales. For example, workshops helped 900 farmers & farmers market managers set prices for produce. One year later, 75% had increased customer base & sales. bit.ly/Marketing-Prod...



Using Drones in Agriculture and Natural Resources

In order to maximize resilience and productivity, researchers, farmers, and natural resource managers need to know how plants and animals—and landscapes as a whole—are affected by changing environmental conditions and other stressors. This knowledge enables farmers and natural resource managers to respond quickly to stressors with appropriate, targeted mitigation tactics. This knowledge also guides researchers as they breed tougher plants and animals and develop better management practices and tools.

Remote sensing with drones—unoccupied or unmanned aerial systems—offers a promising new way to characterize landscapes, individual plants and animals, and their various stressors; however, regulations, costs, limited research and education, and other barriers have kept drones from being widely used for agriculture and natural resources.

Since 2016, land-grant university researchers and educators have worked to increase adoption of drones for remote sensing and precise management of agriculture and natural resources.

Working together as a multistate project has many benefits.

Regular communication fosters creativity and productivity and primes the group to respond quickly to emerging issues.

With diverse expertise and members in multiple states, this team can test drones in a wide variety of real-world agriculture situations. In contrast, most prior research has focused on drone use in a single field or a specific crop or stressor. Coordination spreads the workload, reduces duplication, and lowers some costs. Sharing information, equipment, and other resources helps overcome the limited capacity of a single institution.

With members at many universities, the team can tackle the lack of education in the classroom and among other researchers and Extension agents.



Environmental Stewardship

PHOTO: USDA

Taking Care of America's Forests

Forests are a critical part of life on Earth. They purify air, filter water, store carbon, provide food and shelter for a diverse array of plants and animals, and produce natural resources like timber, paper and medicine. Forests are also important places for recreation and cultural practices. But forests across the United States are under threat from pests, pathogens, deforestation, climate change, and other stressors. Land-grant university researchers and Extension educators are working to protect forests and the environmental, economic, and social benefits they provide.

Here are a few examples of that work:

- After the 2020 wildfires, many private forest owners in Oregon could not find seedlings or tree planters to reforest their property. Extension educators in **Oregon** have helped about 300 landowners, who need over 3.5 million trees, decide how to prepare their sites, select species and planting density, and plan for maintenance needs. They have also helped track down available seedlings and place orders.
- In Oregon, many landscapes benefit from occasional prescribed fires that reduce the amount of fuel that can feed devastating wildfires. To overcome resistance to and inadequate resources for prescribed burns, Extension educators in **Oregon** helped develop a training that gave forest owners and managers the knowledge and tools to implement prescribed burns and a support network to help carry them out. After the training, the number of planned prescribed burn acres had increased from only a few hundred acres to nearly 10,000 acres.
- Beech leaf disease eventually leads to tree death and should be managed as soon as possible, but infected plants are visually identical to uninfected plants in early stages. Researchers in **Ohio** developed a technique that uses near-infrared light, sensors and artificial intelligence models to determine which leaves are infected. This technology enables rapid response before outbreaks become severe and costly.

Continued

www.landgrantimpacts.org

ABOUT LANDGRANTIMPACTS.ORG | The Land-grant University System is a uniquely American institution and has operated successfully for more than a century. The website documents the collective and individual impacts of the national system of joint teaching, research, and extension institutions.

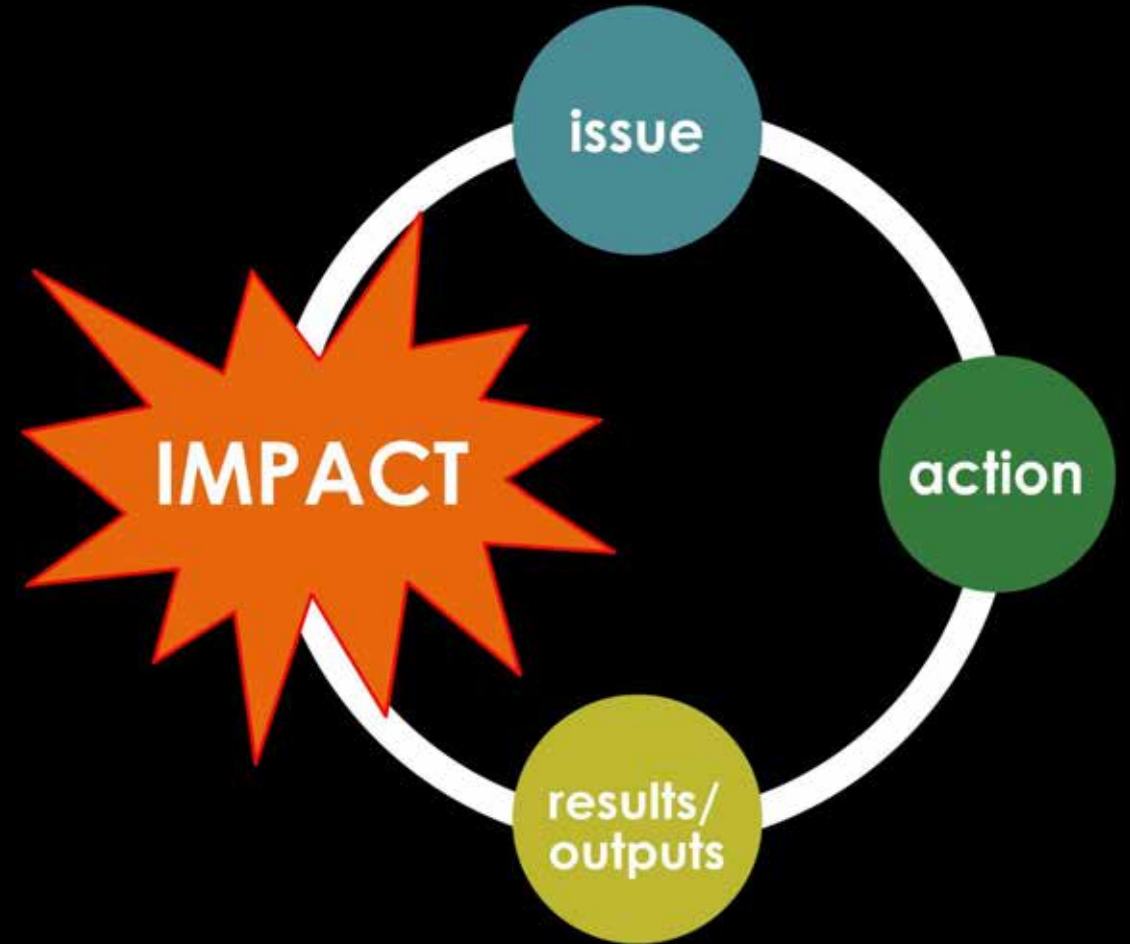
Prepared by the National Impacts Database writing team, and supported by the Association of Public and Land-grant Universities' Board on Agriculture Assembly. Some projects funded by USDA/NIFA.





QUALITIES OF GOOD IMPACT STATEMENTS

- Short
- Clear
- Do NOT use jargon
- Active voice
- Focus on impact
- Show the highlights
- Connect the dots

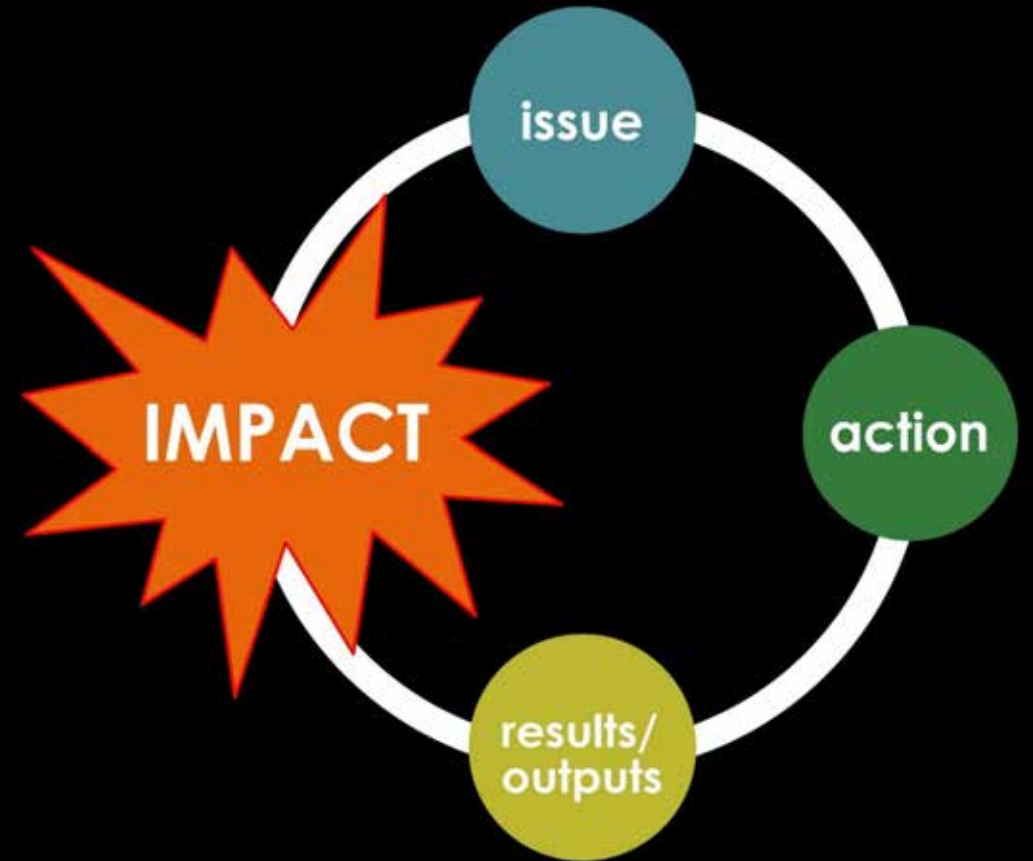


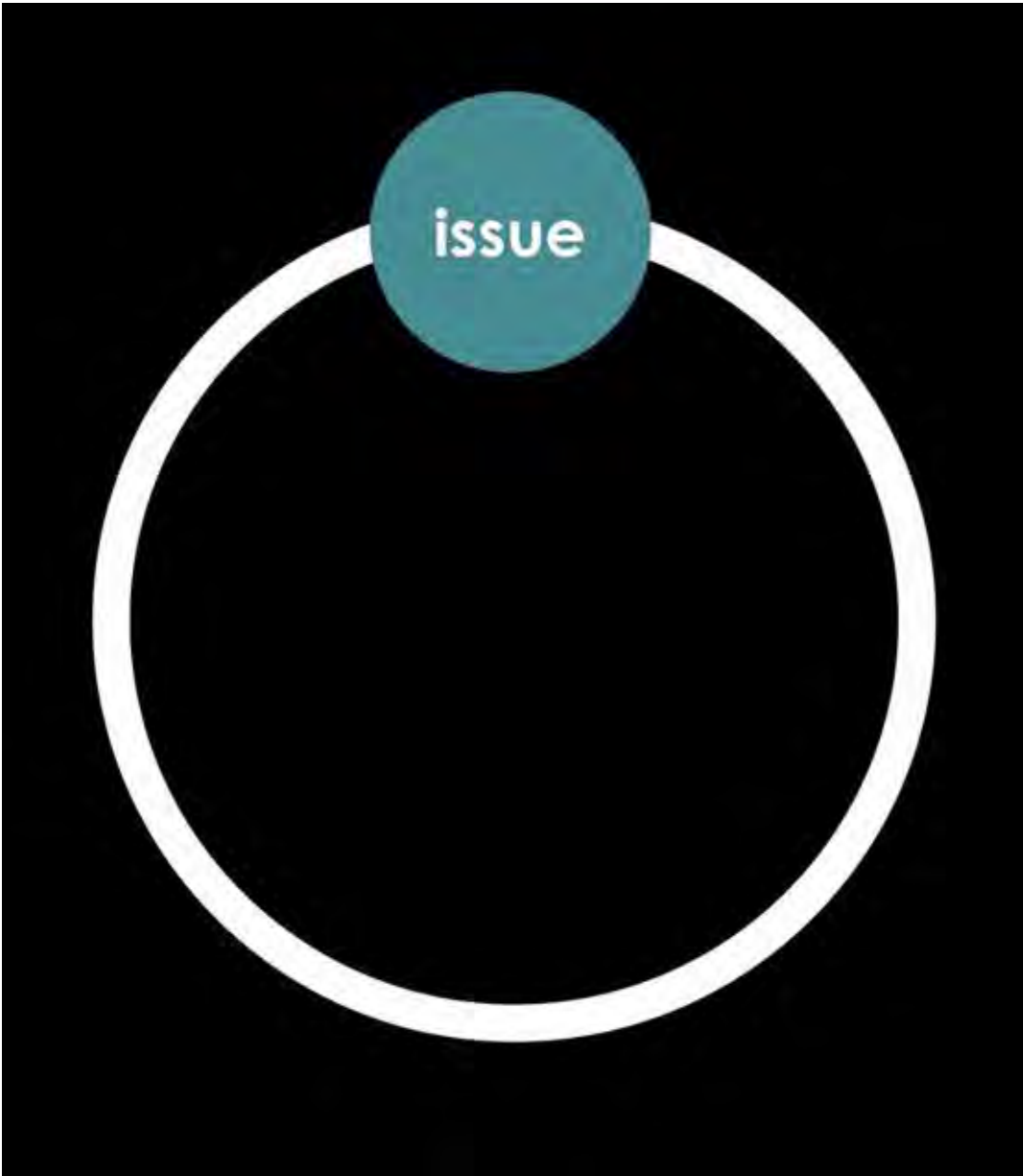
THE PARTS of an IMPACT STATEMENT

An impact statement connects four main parts:

- Issue
- Action
- Results/Outputs
- Impacts

*Terminology may vary





ISSUE

- What?
- Why?
- Who?

ACTION

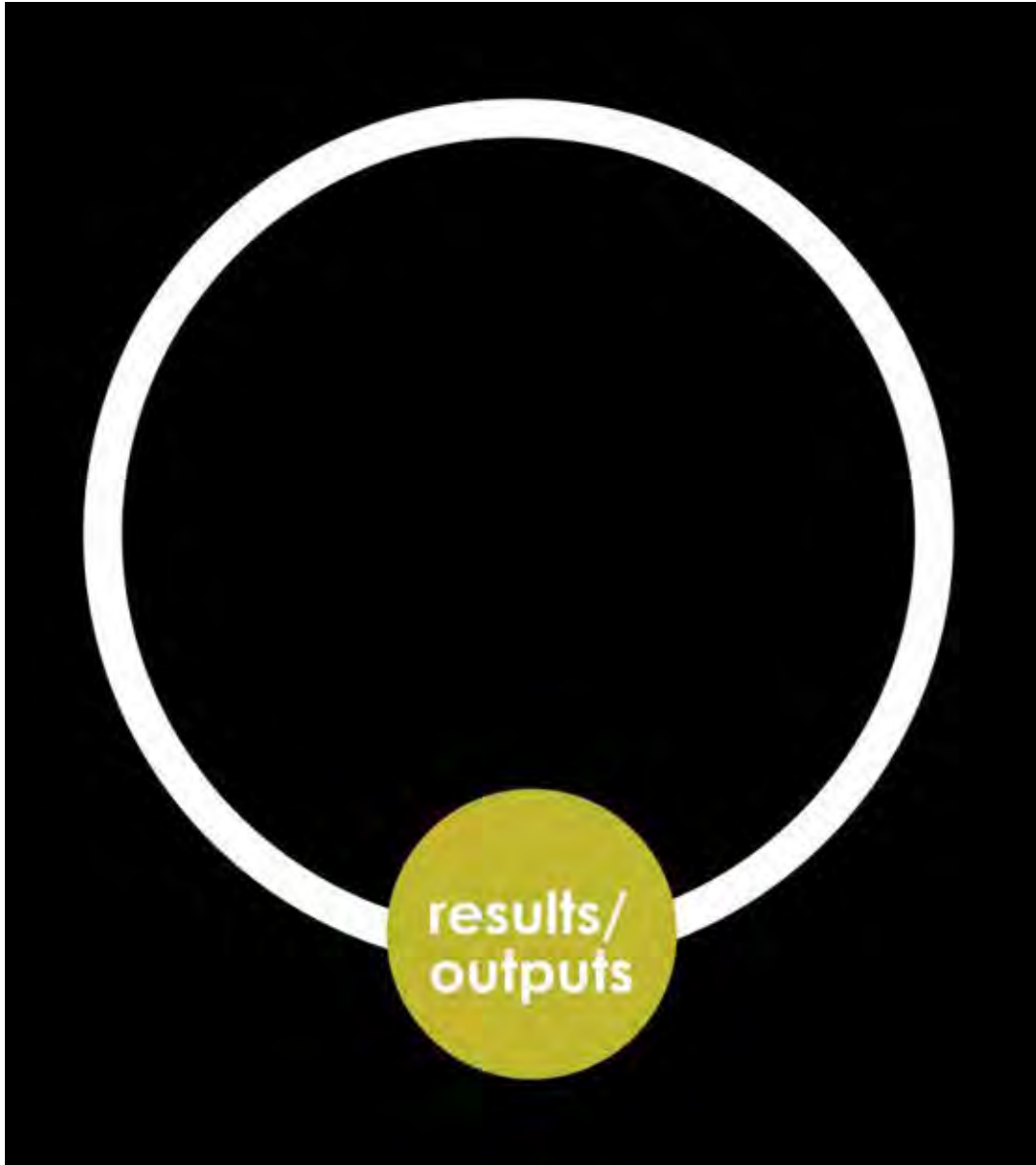
- What was done?
- Who was involved?



FINDINGS/OUTPUTS

- *Major* findings...
- *Useful* products, models, tools, apps, workshops, publications, educational materials...

...that led to change





IMPACTS

- What kind?
- Where?
- When?
- Who?
- How big/much?



PUBLIC VALUE

- Impact: can focus on program participants, individuals, study sites
- Public value: *general* public, *broader* areas, *entire* communities, *regional or national* economies

POTENTIAL IMPACT STATEMENTS

Show progress
toward impact

Use clear language:

- If...then...
- Might, could
- Estimated

Show calculations





**Qualitative
Data**

A Venn diagram consisting of two overlapping circles. The left circle is a dark gray color and contains the text 'Qualitative Data'. The right circle is a medium gray color and contains the text 'Quantitative Data'. The overlapping area in the center is white and contains the text 'vs'.

vs

**Quantitative
Data**

PLANNING TO REPORT IMPACT

- Build it in
- Everyone knows how the reporting process works
- Work together

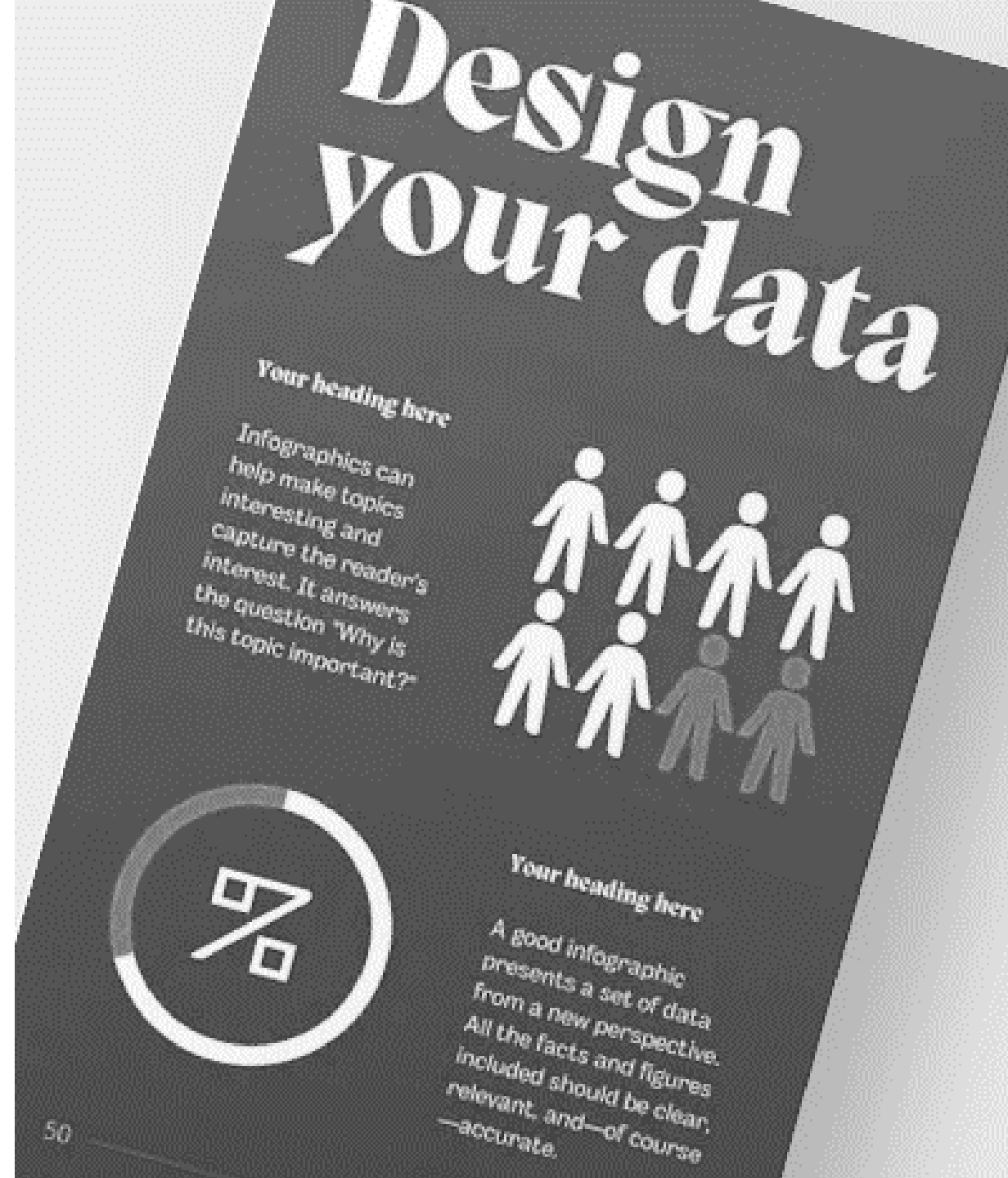


KEEP
CALM
AND
PLAN
AHEAD

FORMATTING IMPACT STATEMENTS

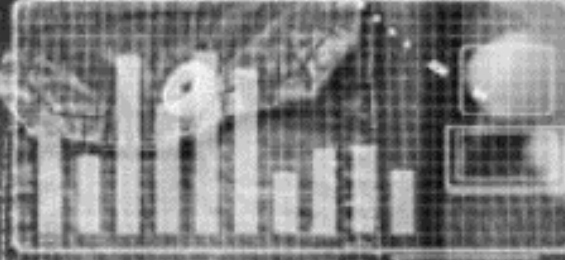
- 2-3 sentences per section
- 1 page at most
- Bullets
- Headings, fonts
- Links, attachments
- Visual aids

*Use free templates (Google Docs, Word/PowerPoint, Canva)



NIFA

REPORTING SYSTEM



1.7950067730e-1 -9.8714481390e-2
3.2744256450e-1 4.8233925280e-1
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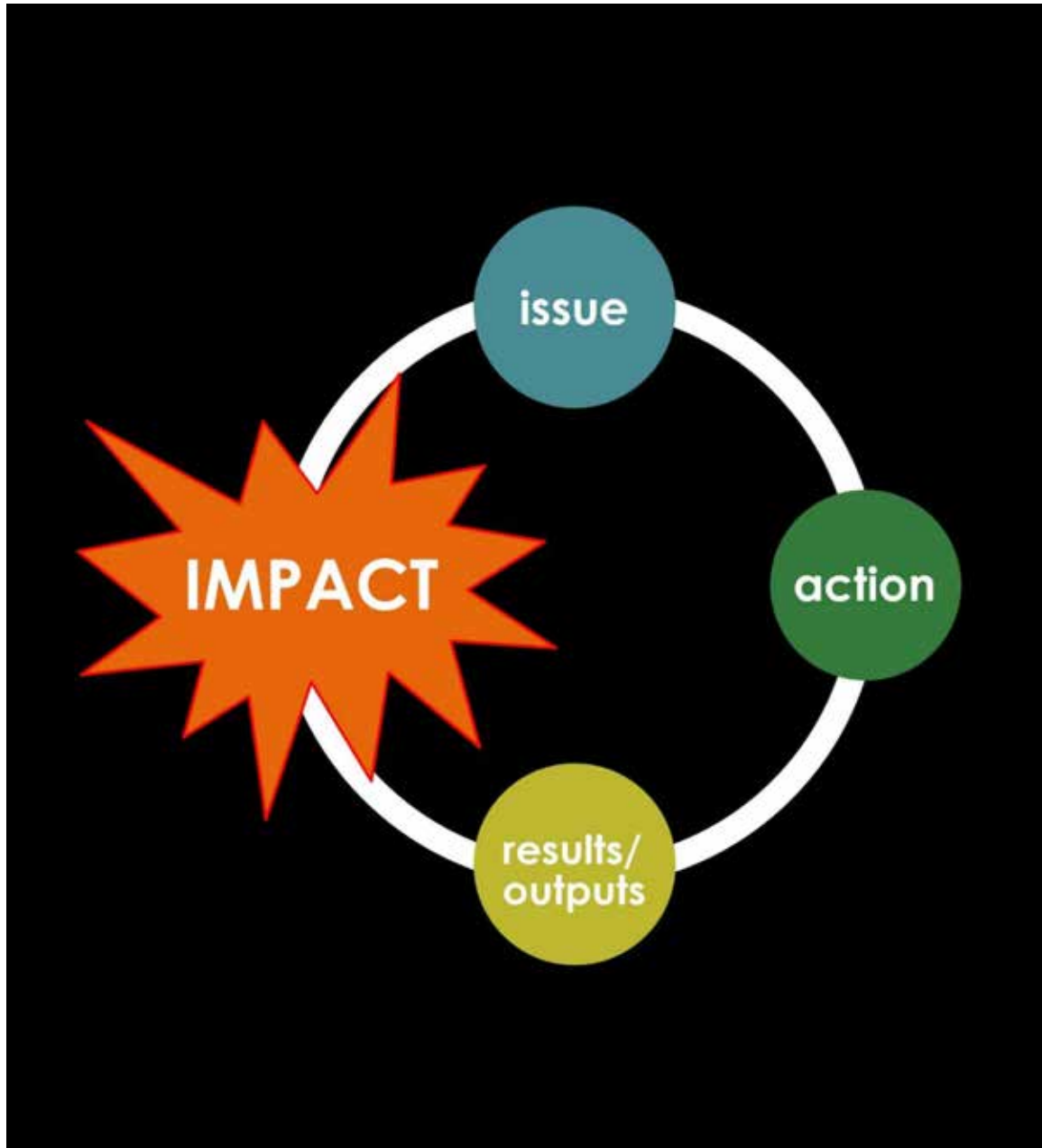
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3.2744256450e-1 4.8233925280e-1

NRS RESULTS REPORTS

Results = changes in knowledge, behavior, or conditions (impact)

Completed each year a project/program is active





NRS RESULTS REPORTS

- Issue
- How major activities helped achieve (or make progress toward) goals and objectives
- Benefits to target audience
- Benefits to broader public
- *Optional:* list publications, etc.
- *Optional:* “nothing to report”

Non-technical terms

Each field <8,000 characters

National Land-Grant Impacts Database





United States
Department of
Agriculture National Institute
of Food and
Agriculture

NIFA LAND-GRANT COLLEGES AND UNIVERSITIES

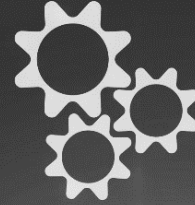


The National Impacts Database is a publicly accessible repository for impact statements from land-grant universities.

landgrantimpacts.org

Focuses on *impact*

Research *and* Extension



Not *just* NIFA




**Anyone can search,
anytime**



Quality control

SUBMITTING IMPACT STATEMENTS

ENTER THE DATABASE

 agcomms@aplu.org

FIND/ASSIGN YOUR INPUTTER

agcomms@aplu.org

Andrea Putman

Kim Scotto

1-2 inputters per institutions

Communicators, evaluators, admins*

*with impact training



Institution

Research - National

Other

National

Region

**Regional / National
Institutions**

Title

Relevance

Response

Results

Primary Funding Source

Select an option...



Secondary Funding Source

Select an option...



Urban Impact Statement

Statement Year

Select an option...



Submitter is Point of Contact

Primary Contact Name

Primary Contact Email

Impacts

Impact

10

Title

4-H Ambass

Breeding an

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Developing a
the wine gra

Washington

Sustaining A

Supporting C

2025 - Association

Statement

Research - National

Actions



IMPACT WRITING RESOURCES

- bit.ly/impact-writing
- bit.ly/NRS-FAQ
- bit.ly/NIDB-tips

LEARN THE PARTS OF AN IMPACT STORY.

Some impact reports or forms use different terms than the ones listed here, but the intent of all impact statements is the same; the basic principles outlined here still apply.





EXAMPLES



Impacts



1. Rumen-protected methionine (RPM) influences the inflammatory process by decreased expression of IL1 β , IL6, IL8, PTGES3, MUC1 and SOD1 in bovine cytological smear samples.

2. ...

Issue/Relevance: Necrotic enteritis is a fatal intestinal disease that afflicts mostly young broiler chickens and costs \$6 billion per year worldwide. Antibiotics are traditionally used to prevent and treat the disease, but due to concern about the emergence of antibiotic-resistant pathogens, nearly 4 billion chickens in the U.S. (about half of the total) are raised without antibiotics.

Action/Response: To provide these poultry producers with effective alternatives, Penn State scientists looked into flavonoids as a way to reduce inflammation, boost immunity, and improve performance. Penn State maize geneticists developed a new high-flavonoid corn variety, PennHFD, that can be used in poultry feed. Poultry scientists then tested the effects of a PennHFD-based diet in 400 chickens.

Findings/Results/Outputs: Poultry Science researchers found that chicks fed a PennHFD-based diet had a 48% lower incidence of intestinal lesions, higher body weight gain, and a 23% lower mortality rate than the chicks fed the control diet. These findings pave the way for a patent to develop a PennHFD-based therapy to prevent and treat necrotic enteritis.

Public value: Researchers expect this treatment option will begin making a difference in the poultry industry in just a few years once research on dosage is completed. Controlling necrotic enteritis is key to sustaining poultry production and meeting demand for antibiotic-free chicken.

Resource link: <https://nidb.landgrantimpacts.org/impacts/show/6379>

Contact: John Smith (jsmith@psu.edu)

Funding: AFRI

Issue/Relevance: Significant yield and quality losses can occur if farmers dig peanuts too early or too late. Existing tools and methods for determining when peanuts are at the right maturity to harvest can be inaccurate and difficult to use.

Action/Response: University of Georgia scientists designed the Peanut Pod Blasting Method, a simple way to accurately determine peanut maturity and the best time to harvest.

Outputs/Results: Using this method, farmers have saved an average of 300 pounds of peanuts per acre and increased gross returns by \$60 per acre (based on the 2015 contract price of peanuts). Statewide, that's an extra 173 million pounds of peanuts worth an estimated \$35 million.

Public value: By developing a new, more accurate method to determine optimal peanut harvest time, UGA researchers have helped farmers meet growing consumer demand for high-quality peanuts. Georgia is a top producer of peanuts, and sustaining the industry also supports the state's economy.

Funding: Hatch/USDA-NIFA, Georgia Peanut Board

Contact: [John Smith](#)



In 2022, 25 West Virginia Cooperative Extension educators conducted EFNEP activities to address childhood obesity in 19 counties. They delivered over 50 events that reached 1,763 youths.”

Issue/Relevance: In West Virginia, youth obesity is higher than the national average, but many families lack access to knowledge about food and nutrition that can help them make healthy choices.

Action/Response: As part of the Expanded Food and Nutrition Education Program (EFNEP), instructors led a six-week course to teach 600 high school students in West Virginia about nutrition, meal planning, and cooking skills.

Outputs/Results: 85% of students showed improved knowledge and skills. For example, one year after the course, a mother reported that her son now helps plan grocery lists, cooks meals at home instead of eating fast food, and is training to be a chef. Over the past year, the family has saved money on food expenses, spent more time together as a family, and had better health reports at their check-ups. “I never dreamed a simple class could change my family’s daily life and future so much and help my wallet at the same time,” she said.

Funding: USDA/NIFA

Contact: Jane Doe (jdoe@wvu.edu)

Learn more: efnep.gov/westvirginia

The specialty crop industry faces issues like worker injuries and poor crop yield. Automated devices can help address these issues, but crops like fruits and nuts require special equipment that individual institutions have not had the resources to focus on. Working together, researchers at land-grant universities designed automated devices that have reduced injuries and boosted crop yield. Below are examples of this work.

IMPROVED CROP YIELD:

- A harvest-assist device designed by Penn State scientists increases the number of apples harvested per second by 50%.
- Farmers said a new mechanized pruning method recommended by Cornell University increased yields by 40% for an additional \$400 per acre.

REDUCED WORKER INJURIES:

- 60% of the tomato processing industry has adopted machines designed by University of California to inspect tomato juice. During a single season, the machines eliminate more than 200,000 repetitive motion hazards for workers.
- Penn State researchers designed a harvest-assist device that eliminated ladder falls and reduced the time apple pickers spent in dangerous postures by 50%.



Collaboration.



Innovation.



Communication.



Multistate Research Fund
IMPACTS

Science and Engineering for a Biobased Industry and Economy

Petroleum and other nonrenewable fossil fuels are commonly used for fuels, energy, plastics, industrial chemicals, pharmaceuticals, cosmetics, and other materials we use on a daily basis. But many of these products can be made using plant compounds, oils, and fiber. Dedicated feedstock crops are an important source of biomass and bioproducts. They can also be derived from food and agricultural wastes like corn stalks, wood chips, and nut and soybean hulls. Recycling agricultural wastes into bioproducts reduces the need for incineration, landfills, and other disposal methods that contribute to global warming and harm human health and the environment. Creating bioproducts from agricultural wastes also conserves land for food production and other needs and provides farmers additional revenue streams.

Biofuels and other bioproducts offer a way to improve energy security, food security, and national security while also cutting back on fossil fuel-related pollution and climate change. Biobased industries can also generate new jobs and economic activity nationwide.

At land-grant universities across America, scientists, engineers, and educators are working together to develop and provide the information, tools, technology, and skills needed to successfully deploy sustainable biobased systems.

The multistate structure provides numerous benefits.

Collaboration allows scientists with diverse expertise and skills to share knowledge and resources. Coordination reduces unnecessary duplication of efforts, and regular meetings help scientists stay on top of innovations and emerging issues. Connection and support also



Research Highlights

Researchers enhanced existing biomass feedstock, identified new biomass sources, and developed new bioproducts. For example:

- Low value lactose from large dairy manufacturing sites can be used to affordably produce PHA (a biodegradable biobased plastic with a wide range of applications including packaging films and containers) at commercial scales. *California*
- Pigments extracted from corn can be used as natural food dye that is safer than the commonly used petroleum-based Red 40 dye. *Illinois*
- Researchers extracted and patented antimicrobial compounds from lignin bio-oil. *Kentucky*
- Experiments could result in biobased nanocellulose that can be used to heal wounds. *Virginia*
- Forest residues could be used to create aerogel biosorbents that remove toxic heavy metals from water bodies. *Wisconsin*
- Genetically modified camelina uses nitrogen more efficiently and is more suitable for biofuel production. *Montana*
- Switchgrass and miscanthus can produce high biomass yields on low quality soils. *New York*
- Industrial hemp can be used in numerous bioproducts and has potential to be a major commodity crop in the southern U.S. *Kentucky*
- Duckweed is economically viable for New Jersey farmers. *New Jersey*

Researchers developed technically feasible, cost-effective, sustainable technologies for converting biomass into useful materials and identified reliable, economical systems for producing, storing, and transporting biomass. Specifically, researchers:

- Patented a way to create syngas from municipal solid wastes and switchgrass produces more gallons per year than traditional technologies and would result in an estimated \$33 million increase in a biorefinery's annual net revenue. *Oklahoma*
- Developed no-till production systems for sugar beets (commonly used for ethanol) that improve soil health and save farmers about \$110 per acre in fuel, machinery, and labor costs. *Montana*
- Identified a new co-fermentation strategy that drastically improves ethanol yield from cellobionate and glycerol. *California*
- Developed a microwave-assisted process that improves the yield and quality of bio-oil and syngas

- Developed techniques to modify lignin so it can replace petroleum in phenols and acrylates, which are used in antiseptics, resins, and more. *Tennessee*
- Identified a process for using plant oil extraction byproducts to create affordable, durable, biodegradable fast food packaging. *Kansas*
- Developed an algal-bacterial process to treat poultry processing wastewater so it is safe to use in hydroponic irrigation. *Alabama*
- Discovered a process that efficiently isolates cellulose nanocrystal and nanofiber from sawdust, prairie cordgrass, and corn stover so it can be used in biopolymers and "smart" fertilizer. *South Dakota*
- Developed new bioprocesses for producing high-value bioproducts from lipid feedstocks, organic wastes, and microalgae. *Hawaii*
- Outlined parameters for successful systems in which brine shrimp convert algae into higher value biomass for bioenergy production. *Missouri*
- Pioneered research on the way brown rot fungi breaks down cellulose, which has been advanced and patented by other researchers at national institutes and labs. *Massachusetts*
- Showed that biochar—the carbon and ash byproduct of heating biomass in the absence of oxygen—can be applied to land to improve soil health and sequester carbon in soil instead of releasing it as a greenhouse gas. *Michigan*
- Showed ethanol biorefineries how to improve long-term profitability by creating allulose (which is used as a low-calorie sweetener) in addition to ethanol during fermentation. *Illinois*
- Calculated that biogas made from anaerobic digestion of animal manure can be competitive with natural gas prices. *Iowa*
- Demonstrated the potential for carbon-negative bioprocessing. *North Carolina*

Models, pilot tests, technical reviews, and other efforts are facilitating the adoption of biobased systems. For example:

- Calculated the life cycle sustainability and costs of new biobased products and processes, which helps policymakers, farmers, and processing companies make decisions. *Michigan, Ohio*
- Helped establish startup companies to commercialize technologies that use agricultural and forestry wastes for bioproducts. *South Dakota*
- Developed commercial-scale systems to help with adoption of gasification technology. *Texas*
- Designed and modeled an algal pond system and a freshwater shellfish pond system that can sustainably produce biomass and biofuels while also capturing carbon; worked with Clemson University facility services to adopt the systems and reduce the campus carbon footprint. *South Carolina*

Workshops, simulations, publications,

What has this project accomplished so far?

Researchers are improving drone sensing and developing new drone-based systems.

This project continues to evaluate and identify the most reliable, cost-effective, and user-friendly drone platforms and sensors for monitoring and managing stressors in agriculture and natural resources.

To maximize the accuracy of the data collected, project members developed hardware, software, and detailed protocols for calibrating and using drones.

Researchers developed new drone-based strategies that can help:

- Scout pests and diseases in fruit, nut, and row crops and apply targeted treatment. These industries face major pest issues that are exacerbated by declining labor availability and increasing consumer demand for fewer chemical inputs. Drones can help overcome these challenges. *Clemson University, University of Georgia, Purdue University, Washington State University*

Project members are sharing their knowledge about drones.

Over the past five years, project members have shared their knowledge in many ways, including:

- Fact sheets to help stakeholders understand the regulations and licensing required for drone use.
- [Workshops on risk management](#) for current and potential drone users. *University of Arkansas, Clemson University, Texas A&M*
- Trainings to help forest land managers use drones for less labor-intensive estimates of timber value. *Auburn University, University of Florida*
- Extension workshops, programs, and materials. *University of Arkansas, Clemson University, The Ohio State University, Purdue University, Washington State University*

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