

# PIONEERING BOLD Agriculture Research

Foundation for Food and Agriculture Research



# Together We'll Go FFAR

Thank you for supporting FFAR's work to advance food and agriculture research.

Visit the FFAR website and connect with us on social media to learn more about funding opportunities, grant updates, impacts and the latest food and agriculture industry news.

Website: https://foundationfar.org/ Twitter: @FoundationFAR Facebook: facebook.com/FoundationFAR LinkedIn: linkedin.com/FoundationFAR

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# Letter from the Board Chairman

#### Dear Friends of the Foundation for Food and Agriculture Research,

As an inaugural member of the Board, and now Chair, it is an honor to witness the groundbreaking impact that FFAR's research is spurring within the food and agriculture sectors.

Since its establishment in the 2014 Farm Bill, FFAR has grown into an innovation powerhouse, convening unique partners and spearheading pioneering food and agriculture research. Over the past five years, FFAR has expanded its influence, committed 204 million dollars to over 140 grants and collaborated with more than 400 partner organizations. Our successes could not have been achieved without FFAR's strong network of partners and support from Members of Congress.

In accordance with the 2018 Farm Bill, FFAR unveiled a new strategic plan this year, which focuses FFAR's efforts toward leveraging impact on complex issues facing food and agriculture systems of the future. The strategic plan outlines the following goals to achieve this impact:

- 1. Build inclusive public-private partnerships to fund innovative food and agriculture research
- 2. Serve as a leading voice representing food and agriculture research.
- 3. Develop the scientific workforce for food and agriculture.
- 4. Further FFAR by strengthening the core and achieving financial sustainability through expanding resources.
- 5. Further FFAR's mission by honing a high-performing organizational culture and living our values.

As the food and agriculture industry advances, FFAR continues to support the next frontier of food and agriculture research. Thank you for your support and we welcome your partnership in food and agriculture research.

Sincerely,

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Mark E. Keenum, Ph.D. Chairman and Inaugural Member, FFAR Board of Directors President, Mississippi State University



# Letter from the Executive Director

#### Dear Friends of the Foundation for Food and Agriculture Research,

2019 was a year of significant achievements for FFAR. We continued to invest in pioneering research to address the growing challenges on the agricultural horizon – and this year FFAR awarded our 100th grant. The Foundation further celebrated our fifth anniversary and hosted our first signature event, Foster Our Future.

Research is the heart of FFAR's mission. This year we funded initiatives that bolster soil health, improve water use, increase crop yields and manage pests and pathogens. With our incredible network of over 400 partners, 2019 grants address livestock diseases, ensure access to nutritious foods, promote healthy practices, reduce food waste and engage local communities to make food systems more effective. I am excited to see how these grants will benefit the environment, support health and help farmers thrive.

A personal highlight of 2019 was my trip to the 68th annual Native American Indian Days in Browning, Montana, where I awarded our 100th grant to Blackfeet Nation and Montana State University for their research supporting food sovereignty and nutrition. FFAR presented an oversized check during the Grand Entry ceremony at the Pow Wow. It was especially moving to be joined by members of Blackfeet Nation, Montana State University researchers and congressional staff from Senator Jon Tester's (D-MT) office and hear about the importance of this research for them and their communities. Awarding the 100th grant was a historic milestone for us as a Foundation, and it was an honor to experience how the grant supports the Blackfeet Nation's rich cultural history. In addition to our research milestones, the Foundation celebrated our fifth anniversary in 2019 with a dynamic reception. Key stakeholders, including grantees and funding partners, spoke sincerely about FFAR's impact on them and their work. The evening wrapped up with a poignant endorsement of FFAR by Congressman Jimmy Panetta (D-CA). The reception was truly a meaningful tribute to FFAR's accomplishments, all in just five years.

To showcase food and agriculture research, FFAR hosted our first signature event, Foster Our Future. The event, which featured interactive exhibits and innovative discussion panels, was a wonderful success. We were thrilled to have US Agriculture Secretary Sonny Perdue kick off the event and hear Senator Pat Roberts (R-KS) speak beautifully about FFAR during the reception.

I am so pleased with the milestones we achieved in 2019. We realized these achievements through support from with our robust network of partners and Members of Congress. I am deeply thankful to our partners for their continued collaboration with FFAR.

As we look forward in 2020, with the coronavirus pandemic illuminating opportunities to improve the food system, FFAR continues to form lasting partnerships today to catalyze solutions addressing tomorrow's challenges.

Sally Rockey, Ph. D. Executive Director

# FFAR's Vision

We envision a world in which ever innovating and collaborative science provides every person access to affordable, nutritious food grown on thriving farms.

# FFAR's Mission

We build unique partnerships to support innovative science addressing today's food and agriculture challenges.

# Who We Are

The Foundation for Food and Agriculture Research (FFAR) was established by the 2014 Farm Bill to increase public investment in food and agriculture research through public-private partnerships. The 2014 law allocated the Foundation \$200 million and required that FFAR match every federal dollar with non-Federal funds. FFAR was allocated \$185 million in the 2018 Farm Bill with the same matching requirement.

FFAR identifies gaps in food and agriculture research and builds unique partnerships to fund bold research. The Foundation brings together academic, industry, governmental and non-profit partners to identify opportunities where increased investment will propel science into action.

While an independent non-profit, the Foundation complements and advances the United States Department of Agriculture's (USDA) mission and builds programs that are of mutual interest to USDA, FFAR and the agricultural community at-large.

# What We Do

# **Funding Bold Research**

FFAR worked with more than 121 funding partners in 2019 and awarded over 80 grants, which resulted in a more than \$85 million investment in food and agriculture research.

FFAR's research addresses food and agriculture concerns in six Challenge Areas:

- Soil Health
- Sustainable Water Management
- Next Generation Crops
- Advanced Animal Systems
- Urban Food Systems
- Health-Agriculture Nexus



# **Developing the Scientific Workforce**

FFAR also offers fellowships opportunities to equip the scientific workforce with expertise that will be critical for addressing future food and agriculture challenges. FFAR offers four workforce development programs:

- National Academies of Science Prize in Food and Agriculture Sciences
- New Innovator in Food and Agriculture Research Award
- FFAR Fellows Program
- Vet Fellows Program

The Vet Fellows Program is FFAR's latest scientific workforce development program. Launched in 2019, in partnership with the American Association of Veterinary Medical Colleges, the Vet Fellows Program is a three-month fellowship that supports up to 10 veterinary students to pursue research at the intersection of global food security and sustainable animal production.

# Stakeholder Engagement

FFAR's focus on collaboration necessitates stakeholder input at all project stages.

When developing a research program, FFAR seeks broad participation from the agriculture community, the FFAR Board of Directors and the USDA. The Foundation brings together farmers, ranchers, scientists, academics, researchers, philanthropists and members of industry and government to identify research gaps through FFAR Convening Events. Based on input from these convenings and other sources, FFAR designs scientific programs that generate real-world results.

FFAR further engages expert reviewers to evaluate the scientific merit of proposed research.

# How We Work: Developing Research Programs

FFAR builds scientific programs to advance agriculture research on specific topics and funds innovative projects through those programs.

# 1: Concept Development

Ideas for research programs stem from various sources:

- USDA
- Commodity and farm groups
- Research organizations and conferences
- Convening events

- FFAR stakeholders
- FFAR staff
- FFAR Board of Directors
- FFAR Advisory Councils

FFAR's Scientific Program Directors ensure alignment with organizational priorities. The respective Scientific Program Director consults with the USDA to ensure the program does not duplicate efforts. Program ideas are also evaluated based on various other factors, including:

- Mission alignment
- Innovation
- Potential impact across the food system
- Actionable outcomes
- Research needs
- · Interest/engagement from the private sector

FFAR's Executive Director reviews program concepts and decides whether the concept should be pursued.

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# 2: Concept Clearance

Each FFAR Challenge Area has an Advisory Council comprised of external scientists, agriculture practitioners and other stakeholders. The Advisory Council reviews and determines whether the prospective program concept aligns with the relevant FFAR Challenge Area and will yield actionable results that solve critical food and agriculture challenges.

A program may be further refined through conversations and input occurring at multiple venues, outlined in the Concept Development section above.



# 3: Program Approval

The program is presented to FFAR's Scientific Program Committee, a subset of Board members, for final approval. Scientific programs may be approved, rejected or invited to revise and resubmit. If approved, a program concept likely will become a FFAR program. Once a program is approved, it is publicly announced.

# How We Work: Funding Research

Once the research programs are established, FFAR funds innovative projects in those programs.



# Application Notification and Submission

Applicants can view and apply for funding opportunities within specific research programs on the FFAR website. The Foundation website includes information about each opportunity, including eligibility conditions, application procedures, research requirements, review criteria and timeline.



# **Application Review**

All submitted applications undergo a rigorous review process, including reviews by External Peer Reviewers and FFAR's Advisory Councils.



# External Peer Review

Applications are evaluated by independent External Peer Reviewers, who are scientific experts in the respective topic area. Peer Reviewers judge applications based on select criteria that may include:

Scientific or technical merit
Potential impact and relevance

- Project strategy and feasibility
- Innovation





- Advisory Councils are comprised of individuals with significant industry or scientific expertise in each of FFAR's Challenge Areas. Advisory Councils consider applications based on:
- Alignment with FFAR's priorities
- Portfolio balance
- Potential impact and relevance
- Merit across topic area

FFAR's Scientific Program Directors compile results from both the External Peer Review and Advisory Council Review and present recommendations to FFAR's Executive Director.



# **Executive Director Approval**

FFAR's Executive Director reviews the recommendations and determines final project approval.

## 



Projects are Awarded Once a project agreement is finalized with the grantee and matching funders, FFAR publicly announces the award. FFAR requires that research teams make results accessible to the public.

# How We Work: FFAR's Four Funding Mechanisms

# PERCENTAGE OF GRANTS AWARDED BY FUNDING MECHANISM



Request for Application (RFA) 59%



Direct Funds 24%



# The FFAR grants awarded in 2019 include:

# REQUESTS FOR APPLICATION (RFA)

# 60 GRANTS

FFAR issues a Request for Application (RFA) to solicit ideas from the broadest group of researchers. Some of FFAR's programs issue RFAs annually and others are a one-time opportunity. The highest quality proposals are selected for funding through a rigorous scientific review process.

# 6 GRANTS

PRIZES

FFAR offers prize competitions to solve an imminent problem in food and agriculture science. Prizes are awarded to individuals or organizations who meet the prize criteria and solve the food and agriculture challenge. Teams of experts and partners serve as the judging panel in creating criteria and selecting prize winners.

# 24 GRANTS

DIRECT FUNDS

When FFAR knows of a specific individual or organization that is wellsuited to conduct the necessary research, a proposal may be directly solicited from that organization. The proposal is subject to the same rigorous scientific review process and matching funding requirement as other proposals.

## CONSORTIA

# **11 GRANTS**

Food and agriculture research can be financially risky. FFAR establishes consortia to address common challenges recognized across the sector, where working in the precompetitive space provides solutions beneficial to all members and society. Consortia participants jointly determine research priorities, pool resources and knowledge and share research results.

# Research Impacts

# Grants funded by FFAR are yielding results. These initial research results have the potential for *transformative impact*.

#### Evaluation of Feed Additives to Mitigate the Risk of Viral-Contaminated Feed to Pigs

Initial results of a FFAR research grant to Pipestone Applied Research indicated five commercially available feed additives may stop the spread of deadly viral diseases in pigs. Three diseases, Porcine Reproductive and Respiratory Syndrome, Porcine Epidemic Diarrhea and Seneca Valley A endanger animal welfare, cost the US swine industry hundreds of millions of dollars annually and threaten the global food supply. The study confirms that these diseases can spread through contaminated animal feed.

This grant was funded in 2019 through FFAR's Rapid Outcomes from Agricultural Research (ROAR) program, which deploys funds research funding in response to emerging or unanticipated threats to the nation's food supply or agricultural systems.

#### Stolen Kiss - an advanced breeding solution for the animal welfare trait of genetic castration

In 2017 FFAR awarded a grant to Recombinetics, Inc. to end surgical swine castration. Since then, Recombinetics/Acceligen and Hendrix Genetics formed the "Alliance to End Surgical Castration of Swine." This venture developed an approach that prevents sexual maturation in swine without introducing any foreign material into the genes of pigs.

#### Realizing Increased Photosynthetic Efficiency (RIPE)

RIPE researchers yielded several results in 2019 including:

- identifying opportunities to improve cassava yields, which have not increased for more than fifty years in Africa.
- discovering a previously unexplained step in the specialized carbon dioxide concentrating mechanisms (CCM) of green algae that allows them to photosynthesize more efficiently than plants. This link provides an opportunity to develop a functional CCM in food crops to boost productivity.
- · stacking algorithms to improve predictions of yield-boosting crop traits
- developing tools can more quickly scan an entire field of plants to capture improvements in their natural capacity to harvest energy from the sun
- discovering that crops engineered with a photorespiratory shortcut are 40 percent more productive in real-world agronomic conditions







Senator Durbin (D-IL) and Dr. Sally Rockey tour the RIPE lab in Illinois

# Research Grants Awarded in 2019



# FFAR AWARDS BY CHALLENGE AREA







# SOIL HEALTH CHALLENGE AREA

The Soil Health Challenge Area catalyzes research to address knowledge gaps, fuel innovation and enable the adoption of soil management practices.

#### Grand Challenges Exploration with Gates Foundation



FFAR partnered with The Bill & Melinda Gates Foundation to support the 2019 Grand Challenges Explorations— Tools and Technologies for Broad-Scale Pest and Disease Surveillance of Crop Plants in Low-Income Countries program, which develops tools to improve crop pest and disease surveillance globally.

• Hanseup Kim, associate professor at the University of Utah, received a \$100,000 award to develop chemical sensors that can operate for a long period of time in a resource-limited environment.

• Ritvik Sahajpal, assistant research professor at the University of Maryland College Park, received a \$99,723 award to design a low-cost early warning system that combines machine learning algorithms, earth observation data and crop pest modeling to predict various crop threats.

• Paul Wagstaff, senior agriculture advisor at Self Help Africa in Ireland, received a \$97,400 award to build an

advanced algorithm that automatically analyzes satellite images for changes in leaf color and soil disruption to detect crop pests and disease. Grantee: The Bill & Melinda Gates Foundation

Total Grant: \$535,000

Principal Investigator: Hanseup Kim, Ritvik Sahaipal, Paul Wagstaff

Matching Funder: Organic Farming Research Foundation

FFAR Award: \$110,000

#### Foodshot Global GroundBreaker Prizes



FFAR and FoodShot Global awarded GroundBreaker Prizes to three individuals conducting research that improves soil health and enhances soil management practices.

- Keith Paustian received a \$250,000 GroundBreaker Prize to accelerate the global adaptation of his COMET-Farm tool systems, which provides sustainability metrics to inform land management decisions and promote regenerative and conservation-based agricultural practices.
- Gerlinde de Deyn received a \$250,000 GroundBreaker Prize to determine soil components that enhance plant productivity, improve nutrient absorption, suppress disease and reduce greenhouse gas emissions.
- Dorn Cox was also awarded a \$35,000 GroundBreaker "Seed" Prize to support his ambitious vision of using Open TEAM to collect environmental data, providing access to comprehensive global agricultural knowledge

to help growers make sustainable and profitable farm management decisions.

Grantee: Foodshot Global

Principal Investigator: Keith Paustian, Gerlinde de Devn, Dorn Cox Matching Funder: Organic Farming Research Foundation FFAR Award: \$110,000 Total Grant: \$535,000

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#### MOU with Organic Farming Research Foundation (2018)

FFAR is partnering with the Organic Farming Research Foundation to fund soil health projects that reduce environmental impacts and improve soil health. FFAR signed an MOU in 2018 and awarded/ announced the following grants in 2019. FFAR provided \$66,000 which was matched by Organic Farming Research Foundation for a \$132,000 investment.



Grantee: Montana State University Principal Investigator: Jeb Eberly FFAR and OFRF awarded a grant to Montana State University researchers to study the ideal amount of lentil seeds needed to improve soil health and ensure yields when the legume is used as part of crop rotation on organic farms.



Grantee: University of California Berkeley Principal Investigator: Timothy Bowles FFAR and OFRF awarded a grant to University of California Berkeley researchers to help farmers make more informed decisions about nutrient management, in particular which type of organic fertilizer to use and how to time fertility applications on diversified organic farms.

Grantee: North Carolina State University Principal Investigator: Alex Woodley FFAR and OFRF awarded a grant to North Carolina State University researchers to assess the viability of annual winter cover crop systems as an effective tool for weed and insect control.

#### MOU with Organic Farming Research Foundation (2019)

FFAR is partnering with the Organic Farming Research Foundation to fund soil health projects that reduce environmental impacts and improve soil health.

Grantee: Organic Farming Research Foundation

Principal Investigator: FFAR signed an MOU in 2019 and the grants will be announced in 2020.

FFAR Award: \$110,000



Matching Funder: Organic Farming Research Foundation Total Grant: \$220,000

## **Open Technology Ecosystem for Agricultural Management** (OpenTEAM)

Farmers are faced with an everexpanding assortment of decisionmaking software; however, these tools often do not "communicate", forcing farmers to input data multiple times. FFAR and its partners launched OpenTEAM, or Open Technology Ecosystem for Agricultural Management, a farmer-driven,



interoperable platform offering a suite of tools to support adaptive soil health management on farms of all scales, geographies and production systems.

Grantee: Wolfe's Neck Farm Foundation, Inc. Principal Investigator: Dorn Cox

Matching Funders: Wolfe's Neck Center, Stonyfield, Our.Sci, Regen. Network, UBC, MSU, Applied GeoSolutions, CSU, Cool Farm Alliance, Soil Health Partnership, CU-Boulder, General Mills FFAR Award: \$5,000,000 Total Grant: \$12,008,762



# SUSTAINABLE WATER MANAGEMENT CHALLENGE AREA

The Sustainable Water Management Challenge Area aims to protect an adequate supply of high-quality natural waters to sustain long-term agricultural production and other ecosystem services.

### Bridging the Genome-to-Phenome Breeding Gap for Water-Efficient Crop Yields (G2P Bridge)



The production of food and fiber consumes 70 percent of the world's water. To increase water productivity and efficiency, scientists developed a breeding approach that combines crop modeling, genomic prediction and managed-stress experiments to increase water-limited yields in corn. Kansas State University researchers are extending this breeding approach in underutilized crops like sorghum.

Grantee: Kansas State University Principal Investigator: Geoffrey Morris Matching Funders: Kansas State University, Pioneer, University of California FFAR Award: \$999,578 Total Grant: \$2,012,321

# IRRIGATION INNOVATION CONSORTIUM (IIC)

The Irrigation Innovation Consortium (IIC) is a joint initiative between private, public and university organizations to address water scarcity. The IIC funded seven projects in 2019. FFAR initially provided the IIC \$5 million in 2018, which is distributed through multiple grants over several years.

# Advancing Development of the Parallel 41 Flux Network for Real-Time Evapotranspiration Monitoring



Colorado State Researchers are using remote sensing and big data applications to improve irrigation water management.

Grantee: DWFI, Colorado State University Principle Investigator: Christopher Neale Matching Funders: The Climate Corporation Total Grant: \$49,987

# Toward pivot automation with proximal sensing for Maize and Soybean in the Great Plains



University of Nebraska-Lincoln researchers are developing a best management practice that could be automated for conventional irrigation and speed-control irrigation.

Grantee: University of Nebraska- Lincoln Principle Investigator: Derek Heeren Matching Funders: DWFI, USDA ARS Bushland, TX, Valmont Total Grant: \$50,000

## Optimizing Irrigation of Turfgrass Using Sensors, IOT, Lora Technology and Artificial Intelligence



Colorado State University researchers are conducting some of the first field studies specifically designed to improve irrigation management using internet-ofthings sensor technology coupled with machine learning and cloud computing.

Grantee: Colorado State University Principal Investigator: Jay Hamm Matching Funders: Aexonis and Toro Total Grant: \$50,000

# Deployment and Maintenance of Flux Towers in Kansas to be Integrated to the Parallel 21 Flux Networks to Support Multi-State Real-Time Evapotranspiration Estimates



Kansas State University researchers are deploying technology to provide realtime, quality data on processed crop and natural vegetation evapotranspiration.

Grantee : Kansas State University Principle Investigator: Eduardo Santos Total Grant: \$49,943.67

A Remote Sensing Approach to Identify Critical Areas in CA Orchards for Improving Irrigation Water Management through Precision Agriculture Technology



Utilizing satellite imageries, Colorado State University researchers are analyzing crop water status in critical summer months from 2017 to 2019 for all major fruit and nut orchards.

Grantee: Colorado State University Principle Investigator: Dilruba Yeasmin Matching Funders: WiseConn USA, Irometer Company, Inc. Total Grant: \$38,285

#### An Economic Impact Study of the Irrigation Industry

Very little data exists on the economic impact of irrigation manufacturing, distribution, consulting, design, installation and maintenance of irrigation technologies and products. The Irrigation Association is conducting an economic impact study that includes agricultural, residential and golf course irrigation.



Grantee: Irrigation Association Principle Investigator: John Farner Matching Funders: Irrigation Association Total Grant: \$100,000.

# Connecting Field Scale data to watershed health: the added power of sharing data

NEWBA researchers are creating easy and affordable tools to measure irrigation performance in a precompetitive space for producers.

Grantee: NEWBA Principle Investigator: John Heaston Matching Funders: Newba and Aquamart Total Grant: \$75,000





# NEXT GENERATION CROPS CHALLENGE AREA

The Next Generation Crops Challenge Area focuses on developing non-traditional crops, creating new economic opportunities for conventional crops, and increasing crop diversity and farm profitability.

### Corn Drought Resistance (funded by Crops of the Future)



Drought is an incredibly complex stressor that reduces corn production. Drought stress can reduce corn kernel size and lower crop yield. University of Wisconsin-Madison researchers are identifying the genes that affect drought tolerance and accelerating the development of drought-tolerant corn varieties.

Grantee: University of Wisconsin Principal Investigator: Shawn Kaeppler FFAR Award: \$850,000

Total Grant: \$1,700,000

## Increasing Crop Production by Connecting Models from Micro to Macro Scales



University of Illinois researchers are developing virtual plant models that examine the effects of environmental challenges on a molecular, cellular and organic level within a plant to accurately determine the best targets for genetic engineering. Researchers are building a computational platform that integrates multiple models to study a whole plant virtually. This project is an extension of the Crops in silico project; FFAR awarded a \$274,000 grant to Crops in silico in 2017.

Grantee: University of Illinois

Principal Investigator: Amy Marshall-Colon

Matching Funders: The Institute for Sustainability, Energy and Environment at the University of Illinois, NCSA FFAR Award: \$2,500,000 Total Grant: \$5,000,000





# ADVANCED ANIMAL SYSTEMS CHALLENGE AREA

The Advanced Animal Systems Challenge Area improves animal production through innovations in animal health, welfare and productivity, antibiotic stewardship and environmentally sound production practices.

#### Addressing Future Global Dairy Demand: Targeting the Gut-Liver Axis to Promote Heat Stress Resilience in Dairy Cattle



Heat-stressed dairy cows cost the American dairy industry an alarming \$1.5 billion annually, as dairy cows are unable to efficiently produce milk when their body temperatures are elevated. Cornell University researchers are identifying nutrition-based solutions that improve dairy cows' ability to adapt to extreme heat.

Grantee: Cornell University

Principal Investigator: Joseph McFadden

Matching Funders: Vetagro, Elanco, Berg & Schmidt, Balchem, Cornell University, Adisseo, AB Vista, Phibro FFAR Award: \$736,392 Total Grant: \$1,472,785

#### Environmental Enrichment Effects on Pig Welfare



Pigs are bright animals and their environment contributes to their health, welfare and productivity. USDA researchers are examining how environmental enrichment techniques can improve pig welfare. The research is assessing the pigs' welfare by measuring behavior, health and growth rates.

Grantee: USDA- Agriculture Research Service (ARS) Principal Investigator: Jeremy Marchant-Forde Matching Funders: Nestle, Tyson FFAR Award: \$75,000 Total Grant: \$150,000

Identifying Potential Causes of Late-Day Bovine Respiratory Disease in High-Performing Feedyard Cattle (Funded by International Consortium for Antimicrobial Stewardship in Agriculture)



Bovine Respiratory Disease in cattle, an infection of the lungs, is the most common and costly disease affecting cattle in North America. The Noble Research Institute is identifying potential causes of the disease by evaluating DNA, individual feed intake, rumen pH and rumen temperature.

Grantee: Noble Research Institute, LLC Principal Investigator: Myriah Johnson FFAR Award: \$186, 643 Total Grant: \$373,287

#### Improving Dairy Feed Efficiency, Sustainability and Profitability by Impacting Farmer's Breeding and Culling Decisions.



Feeding cows is costly, but cows that efficiently produce milk with less feed can reduce these costs. To improve dairy cow feed efficiency, Michigan State University researchers are using sensor technologies to predict feed intake and gather data from thousands of cows to select the most efficient cows.

Grantee: Michigan State University Principal Investigator: Michael Vandehaar Matching Funders: Council on Dairy FFAR Award: \$999,999 Total Gra

Total Grant: \$1,999,999

## MOU WITH THE NATIONAL PORK BOARD

FFAR made several awards in collaboration with the National Pork Board (NPB) for innovative research related to pig health, welfare and sustainability. In 2019, the FFAR and NPB co-funded research on technologies to advance the industry as well as environmental sustainability research. These awards are administered through the National Pork Board.



#### Accurate and Rapid Assessment of Pig Body Weight



North Carolina State University researchers are validating multiple, commercially available devices that measure pig body weight and determine their effectiveness or make recommendations to improve their use.

Grantee: North Carolina State University Principal Investigator: Jon Holt Matching Funder: National Pork Board FFAR Award: \$38,750 Total Grant: \$77,540

## Adaptation of Machine Learning Technologies to Predict Swine Production Outcomes to Assist in Disease Detection



Lowe Consulting researchers are adapting advanced analytical methods to make predictions about outcomes in swine production and detect disease.

Grantee: Lowe Consulting Ltd. Principal Investigator: James Lowe Matching Funder: National Pork Board FFAR Award: \$32,037 Total Grant: \$64,075

Assessing the effects of farrowing crate design and mothering phenotype on pre-weaning piglet survival and performance using imaging technologies



University of Nebraska-Lincoln researchers are examining how improving the quality of piglet space within a farrowing stall enhances the welfare and production traits of a sow and her litter.

Grantee: University of Nebraska-Lincoln Principal Investigator: Tami Brown-Brandl Matching Funder: National Pork Board FFAR Award: \$219,555 Total Grant: \$439,110

#### Developing an automated, real-time counting technology for pigs

Kansas State University researchers are developing a technology that counts pigs being loaded or unloaded out of a barn in real-time. This technology has the potential to increase the competitiveness of the U.S. swine industry by improving accuracy of pork production and increasing labor efficiencies of farm, processing plant, and clerical staff.

Grantee: Kansas State University Principal Investigator: Michael Tokach Matching Funder: National Pork Board FFAR Award: \$219,162 Total Grant: \$438,324

Development of an integrated computerized sensing system for reproductive management

University of Illinois researchers are developing an integrated computerized reproductive sensing system for managing the swine breeding herd. This technology will instantly identify animals, their production records, location and current reproductive status.

Grantee: University of Illinois Principal Investigator: Robert Knox Matching Funder: National Pork Board FFAR Award: \$108,874 Total Grant: \$217,749



# Improving sow management through lifetime behavioral monitoring using accelerometers



University of Minnesota researchers are developing a field-ready technology that guides pork producers in identifying sows that need discrete interventions, as well as monitoring the overall management of the sow herd.

Grantee: University of Minnesota Principal Investigator: John Deen Matching Funder: National Pork Board FFAR Award: \$125,740 Total Grant: \$251,480

Living Review- Environmental and Public Health Impacts of Swine Production



lowa State University researchers are developing a web-based location where producers, public health officers and community leaders can access research on the association between living near a confined animal feeding operation and community health outcomes.

Grantee: Iowa State University Principal Investigator: Annette O'Connor Matching Funder: National Pork Board, Pew Charitable Trusts FFAR Award: \$36,671 Total Grant: \$110,013

#### Prevention of Lameness in Sows: Early Detection and Mitigation

USDA-ARS researchers have assembled a multi-disciplinary team of scientists to develop early detection of sow lameness and test treatments to improve animal welfare.

Grantee: USDA, ARS, Plains Area Principal Investigator: Gary Rohrer Matching Funder: National Pork Board FFAR Award: \$214,105 Total Grant: \$428,217



Utilization of an advanced computer vision platform to identify changes in the physiological and behavioral changes associated with illness and aggressive/damaging behavior during the nursery and finisher phase

University of Nebraska-Lincoln researchers are utilizing a novel computer vision method, called Deep Feature-based Detection and Tracking Platform, to study pig behavior.

Grantee: University of Nebraska-Lincoln Principal Investigator: Ty Schmidt Matching Funder: National Pork Board FFAR Award: \$150,896 Total Grant: \$301,793



#### Novel Method for In Vivo Gene Editing of Vertebrate Embryos



Gene editing technologies can improve livestock production efficiency, animal welfare environmental sustainability and disease resistance; however, current methods are inefficient and expensive. University of California Davis researchers are developing a novel in vivo system for delivering gene editing machinery to early embryos.

Grantee: University of California, Davis Principal Investigator: Alison Van Eenennaam Matching Funders: Revive & Restore FFAR Award: \$50,000 Total Grant: \$100,000

#### Spatializing the Environmental Impacts of US Dairy Supply Chains



Dairy farming and milk production releases greenhouse gas emissions and impacts local water bodies. University of Minnesota's NorthStar Initiative for Sustainable Enterprise researchers are developing localized research models to identify local solutions that improve dairy production's efficiency and environmental sustainability.

Grantee: World Wildlife Fund Principal Investigator: Sandra Vijn Matching Funders: Walton Family Foundation FFAR Award: \$65,000 Total Grant: \$130,000

# ADVANCED ANIMAL SYSTEMS: EGG-TECH PRIZE PHASE ONE

As only female chicks can be used for egg production, male chicks are culled, creating waste and animal welfare concerns. Yet, if producers could determine the sex of an egg before it hatches, male eggs could be diverted to the human or animal food supply or used for vaccine production. FFAR and the Open Philanthropy Project are offering up to \$6 million prize to successfully develop technology that can accurately and rapidly determine a chick's sex early in the egg production process. Phase I Egg-Tech Prize awardees received seed funding to help compete in Phase II of the prize.

# A Microchip-Based Chemical Sensor for Early-Stage In Ovo Sex Determination Of Layer Chicks



SensIT Venture Inc. researchers are developing a chemical sensing chip that captures and characterizes the gases, or volatiles, released from an egg. The research team is also using machine learning to classify eggs by sex based on the volatiles.

Grantee: SensIT Ventures, Inc Principal Investigator: Thomas Turpen Matching Funders: Open Philanthropy Project FFAR Award: \$400,000 Total Grant: \$400,000

# En-Ovo Sex Determination by Fiber Optic Volatiles Analysis and Machine Learning



USDA-ARS researchers are using fiber optics and machine learning to analyze volatiles, gases released from an egg. The research team is also using proton transfer reaction mass spectrometry, a sensor that detects and analyzes the volatile's composition at a rate of 2000 samples per hour, to differentiate between male and female eggs.

Grantee: US Department of Agriculture-Agriculture Research Service Principal Investigator: Adam Rivers Matching Funders: Open Philanthropy Project FFAR Award: \$396,762

Total Grant: \$396,762

# Innovative Techniques for Fast In Ovo Sexing in Poultry by Detection of Gender Specific Volatiles

Katholieke Universiteit Leuven scientists are developing a non-invasive ovo sexing technique that registers volatiles, gases released from an egg, during incubation. The research team is also using a specialized sensor technology, gas chromatography mass spectrometry and selected ion flow tube mass spectrometry to sex the eggs based on the volatiles.



Grantee: Katholieke Universiteit Leuven Principal Investigator: Jeroen Lammertyn Matching Funders: Open Philanthropy Project and Katholieke Universiteit Leuven FFAR Award: \$315,370 Total Grant: \$650,842

# Multidimensional Spectral Mapping for Sex Determination of Avian Eggs

Microsale Devices LLC researchers are using multidimensional spectral mapping technology that shoots different wave lengths of light at the egg and detects the refracted light patterns. The research team is also using artificial intelligence to develop an optical fingerprint, or signature, that can determine the sex of eggs in less than five seconds.

Grantee: Open Philanthropy Project and Microscale Devices, LLC Principal Investigator: John Humphrey Matching Funders: Microscale Devices, LLC FFAR Award: \$269,029 Total Grant: \$457,918



Magnetic Resonance Imaging Meets Artificial Intelligence for Automated and Noninvasive In Ovo Sex Determination



Orbem Ai researchers are developing specialized technology using accelerated magnetic resonance imaging (MRI) technology and artificial intelligence to examine the organ development of embryos and detect physical differences between the males and females.

#### Grantee: Orbem.ai

Principal Investigator: Pedro Gomez Matching Funders: Open Philanthropy Project, Orbem.ai, Initiative for Industrial Innovators, Zeildler-Forschungs-Stiftung, EIT Food /Technical University of Munich, BMWi

FFAR Award: \$400,000 Total Grant: \$1,149,911

## Rapid and Non-Invasive Egg Sex Identification Using Artificially Intelligent Platform

A University of Minnesota researcher is using a 3D scanner to analyze the geometric shape of the eggs. The research team is also using proton transfer reaction mass spectrometry to analyze the volatiles, gases released from an egg. The 3D analysis and machine learning will allow researchers to recognize and identify egg sex based on various geometric parameters.

Grantee: University of Minnesota Principal Investigator: Abdennour Abbas Matching Funders: Open Philanthropy Project FFAR Award: \$400,000 Total Grant: \$400,000





# URBAN FOOD SYSTEMS CHALLENGE AREA

The Urban Food Systems Challenge Area advances viable solutions to complex problems by understanding multiple aspects of, and connections within, the food system. This research reduces food and nutritional insecurity through economically viable and sustainable solutions.

# A Community-Based Microfarm Aggregation Model for Transforming Agricultural Production and Enhancing Asset-Based Economic Development in Post-Industrial Urban Areas



Inconsistent access to affordable nutritious food is a problem that plagues communities nationwide. Ohio State University at Mansfield researchers are launching an urban sustainable food system project that increases access to fruits, vegetables and other specialty crops while supporting the local economy.

Grantee: Ohio State University Principal Investigator: Kip Curtis Matching Funders: Richland County Foundation, Ohio State University, Braintree, Mind Body Align, OSU Mansfield Urban Agriculture Co-Op, NECIC FFAR Award: \$962,600 Total Grant: \$2,068,336

### Employing Regional Produce Cooperatives to Enhance Household Nutrition and Reduce Food Insecurity



Millions of Americans struggle with food insecurity. Feeding America established Regional Produce Cooperatives to direct a greater variety of produce to food banks at a lower cost. Feeding America is evaluating whether the Cooperatives decrease food waste, shorten the time between source and distribution and increase access to produce.

Grantee: Feeding America Principal Investigator: Craig Gunderson Matching Funders: Target, University of Illinois, Rachel Ray Foundation, Feeding America FFAR Award: \$999,740 Total Grant: \$1,999,480

### Integration of Small Farmers into Technology-enabled, Rapid-response Fresh Food Supply Chains



Without information about current and future market demand, some farmers produce a surplus of food that is wasted. Arizona State University and New Mexico State University researchers are developing market intelligence and supply chain planning tools that enable growers to predict consumer demand and sell directly to consumers.

Grantee: Arizona State University Principal Investigator: Jesus Rene Villalobos Matching Funders: Arizona State University, New Mexico State University, A. Maltz FFAR Award: \$963,513 Total Grant: \$1,928,165



# HEALTH-AGRICULTURE NEXUS CHALLENGE AREA

The Health-Agriculture Nexus research area increases access to nutritious foods, reduces food loss and waste, advances plant and animal production systems and develops crops with high nutritional value. This Challenge Area supports innovative, systems-level approaches to reduce food and nutrition insecurity and improve human health in the US and around the globe.

### Blackfeet Innovation Pathways to Food Sovereignty: Sustainability through Indigenous Applied Research Partnerships



Despite the Blackfeet Nation's rich agricultural diversity, the Piikani people suffer from dietrelated health disparities and persistent poverty. Blackfeet Nation and Montana State University researchers are helping ranchers and farmers make cost-effective management decisions, investigate regional food systems and identify how traditional indigenous foods influence Piikani health.



Principal Investigator: Kristin Ruppel Matching Funders: Montana Healthcare Foundation, Montana State University, National Fish and Wildlife Foundation, FAST Blackfeet, Blackfeet Tribe FFAR Award: \$996,947 Total Grant: \$2,041,042

#### Farming & Food Narrative Project: Toward a More Productive Public Conversation



Scientists, environmentalists and farmers diligently educate the public about sustainable farming practices. However, their communication methods often do not comport with the public's oversimplified understanding of agriculture. FrameWorks Institute researchers are studying people's understanding of farming to develop new frames, metaphors and strategies that inform consumers about farming practices.

Grantee: IPM Voice

Principal Investigator: Michael Rozyne

Matching Funders: Wolf, DiMatteo + Associates, Farm Aid, FrameWorks, Michigan State University, Lee Halprin and Abby Rockefeller, IPM Institute of North America, IR-4 Project, Jean Mason, James D. Koan, member

Almar Orchards LLC, Marrone Bio Innovations, Northeast Sustainable Agricultural Working Group, Cornell University, Red Tomato, UB School of Architecture and Planning FFAR Award: \$150,000

Total Grant: \$300,269

#### MOU with GAIN



FFAR signed a MOU with the Global Alliance for Improved Nutrition (GAIN) to develop the Harvest for Health program, which identifies underutilized nutritious crops with the potential to alleviate food insecurity, explores opportunities for agricultural biodiversification and supports sustainable production.

Grantee: GAIN FFAR Award: \$70,000

Total Grant: \$140,000

# Reducing Food Waste by Re-Shaping Consumer Behavior Using Data-Informed, Dynamic Economic Incentives



Many consumers mistakenly interpret "best by" labels as an expiration date and discard food that is safe for consumption. Cornell University researchers are developing models that predict milk spoilage and shelf life as well as the effectiveness of interventions that predict when food spoils to prevent consumers from disposing of items that are still safe.

Grantee: Cornell University Principal Investigator: Martin Wiedman Matching Funders: CALS-Food Science, NYSDPO, Chobani, Cornell CALS FFAR Award: \$590,000 Total Grant: \$1,56 A Systems Approach to Reducing Consumer Food Waste

National Academy of Sciences researchers are convening a panel to recommend in depth strategies for food waste reduction based on behavioral change at the consumer level.

Grantee: National Academy of Sciences

Principal Investigator: Toby Warden

Matching Funders: National Academy of Sciences FFAR Award: \$336,951



Total Grant: \$673,902

IYSDPO, Chobani, Total Grant: \$1,564,276

# Consortia

FFAR establishes consortia to address common challenges recognized across the sector and provide solutions that have real-world impact. Consortia participants jointly determine research priorities, pool resources and knowledge and share research results.

In 2018 FFAR established the Irrigation Innovation Consortium (IIC) and Crops of the Future (COTF) Collaborative.

FFAR established four consortia in 2019:

- International Consortium for Antimicrobial Stewardship in Agriculture (ICASA)
- Precision Indoor Plants (PIP)
- Ecosystem Services Market Research Consortium (ESMC)
- Innovations in Post-Harvest Food Loss and Waste Reduction in the Global Food System

#### International Consortium for Antimicrobial Stewardship in Agriculture (ICASA)



ICASA is one of the largest public-private partnerships focused on antibiotic stewardship in animal agriculture. ICASA's research promotes the judicious use of antibiotics, advances animal health and welfare, and increases transparency in food production practices.

Matching Funders: Advanced Animal Diagnostics, the Beef Alliance, Cactus Research, the Foundation for Food and Agriculture Research, HyPlains Research and Education Center, JBS USA, McDonald's, the National Cattlemen's Beef Association, the National Pork Board, the Noble Research Institute, Pipestone Veterinary Services, Tyson Foods, US Roundtable for Sustainable Beef and Veterinary Research and Consulting Services. FFAR Award: \$7,500,000 Total Grant: \$15,000,000

### Precision Indoor Plants (PIP)



PIP is a public-private partnership that funds research to produce new flavorful, nutritious crops specially intended for indoor agriculture. By focusing on innovative science and technology, the consortium's research efforts will increase our ability to produce crops that are high-value, of consistent quality, and desired by consumers.

Matching Funders: Aerofarms, BASF, Benson Hill, Inc., GreenVenus, Fluence Bioengineering, PrivaFFAR Award: \$7,500,000Total Grant: \$15,000,000

#### Ecosystem Services Market Research Consortium



Ecosystem Services Market Research Consortium is the research arm of the Ecosystem Services Market Consortium (ESMC), to create an ecosystem services market. to compensate farmers and ranchers who adopt conservation management practices that bolster soil health, improve water usage and reduce greenhouse gas emissions.

Grantee: Ecosystem Services Market

Principal Investigator: Chad Ellis

Matching Funders: Tyson Foods, The Nature Conservancy, Soil Health Partnership, National Corn Growers Association, Soil Health Institute, Sand County Foundation, Nutrien Ag Solutions, National Farmers Union, Mars Incorporated, Indigo Ag., General Mills, Noble Research Institute, Anuvia Plant Nutrients, The Fertilizer Institute, Danone Soil Health Programs, Cargill, Bayer, Archer Daniels Midland Company, Land O'Lakes, Inc. FFAR Award: \$10,300,000 Total Grant: \$20,600,000

#### Innovations in Post-Harvest Loss and Food Waste Reduction in the Global Food System



More than 40 percent of fruits and vegetables in developing regions, including mangoes, avocadoes, pineapples, cocoa and bananas, spoil before reaching consumers. Through the Post-Harvest Food Waste and Loss Reduction Consortium, experts from across the globe are addressing social, economic and environmental impacts from food loss and waste.

Grantee: Iowa State University

Principal Investigator: Dirk Maier

Matching Funders: University of Maryland, Escuela Agricola Panamericana Inc. (Zamorano), FEALQ, KwameNkrumah University of Science and Technology, University of Nairobi, Wageningen University and Research,Volcani Center, Stellenbosch University, Rockefeller Foundation, Iowa State UniversityFFAR Award: \$2,783,872Total Grant: \$5,567,745

# Rapid Outcomes from Agricultural Research (ROAR) Projects

The Rapid Outcomes from Agricultural Research (ROAR) program funds research in response to emerging or unanticipated threats to the nation's food supply or agricultural systems.

## AFRICAN SWINE FEVER

FFAR and the National Park Board (NPB) together funded four research projects to mitigate the spread of African Swine Fever virus (ASFV). ASFV infection can have a disastrous effect on swine production, causing excessive mortality in pigs. Current outbreaks of ASFV in China and some European countries pose a significant threat to the global swine industry. There is no effective vaccine and treatment available. FFAR awarded NPB \$150,000 to distribute to the following projects:

## Development of ASFV-specific monoclonal antibodies and mAb-based blocking ELISA



Monoclonal antibody (mAb) is a key reagent for detecting of viral infection. Kansas State University researchers are developing and validating specific mAbs for use in ASF diagnostics and research.

Grantee: Kansas State University Principal Investigator: Ying Fang Matching Funder: National Pork Board Total Grant: \$99,317

Efficacy of Current High-throughput Sample Processing Methods for Detection of ASFV by real-time PCR (rPCR)



Kansas State University researchers are comparing the efficacy of several high throughput sample processing methods for detection of ASFV in oral fluids and blood samples.

Grantee: Kansas State University Principal Investigator: Dr. Juergen A. Richt

Matching Funder: National Pork Board Total Grant: \$108,823

# Oral fluid sample size for FAD detection at low prevalence in large commercial pens

Swine oral fluid samples are highly effective for the surveillance of a variety of pathogens, including ASFV. To optimally sample swine populations for foreign animal diseases, Iowa State University researchers are developing guidelines for rope sampling across the range of pen sizes coming into modern production systems.



Grantee: Iowa State University Principal Investigators: Jeff Zimmerman and Korakrit Poonsuk Matching Funder: National Pork Board Total Grant: \$141,536

# Understanding the survivability and infectivity of African swine fever virus in various environments

The feed supply chain can serve as a global transmission route for diseases. Kansas State University researchers are evaluating the time for ASFV inactivation in tissue culture media and in feed at different temperatures for up to 120 days.

Grantee: Kansas State University Principal Investigators: Megan Niederwerder Matching Funder: National Pork Board Total Grant: \$203,520



# **OTHER ROAR GRANTS**

#### Age Susceptibility and Lateral Transmission of Turkey Arthritis Reovirus



Turkey Arthritis Reovirus (TARV) is a poultry virus that infects up to 70 percent of US turkey flocks, causing lameness in turkeys and economic losses for producers. University of Minnesota researchers are tracking how the virus is spread and when to administer a preventative vaccine.

Grantee: University of Minnesota Principal Investigator: Robert Porter Matching Funders: Minnesota Turkey Research and Promotion Council, University of Minnesota FFAR Award: \$49,066

Total Grant: \$100,243

#### Biological Control of Cattle Fever Ticks in South Texas



The cattle fever tick, which can carry the deadly cattle fever pathogen, is reinvading regions of Texas. There is no vaccine or treatment for cattle fever, which can kill 70-90 percent of infected cattle. USDA-ARS researchers are studying parasitoids, predatory insects that prey on the ticks, to identify a natural biological control that could be introduced in Texas.

Grantee: USDA-ARS Principal Investigator: John Goolsby Matching Funders: Lee and Ramona Bass Foundation FFAR Award: \$25,000 Total Grant: \$50,000

### Biology and Disease Management Research in Response to the Emerging Corn Pathogen, Phyllachora maydis



In 2018, tar spot, an emerging disease affecting corn production in Illinois, lowa and Indiana, caused crop losses and economic damages. University of Illinois researchers are developing novel molecular tools to study the biology and epidemiology of tar spot.

Grantee: University of Illinois Principal Investigator: Nathan Kleczewski Matching Funders: National Corn Growers Association, Corteva, Wyffels, IL CGA, Purdue University FFAR Award: \$150,000 Total Grant: \$300,000

## Development of Prevention, Detection and Response Strategies for the Asian Longhorned Tick (Haemaphysalis Longicornis)

The increasing prevalence of the invasive longhorn tick threatens American farmers, livestock, companion animals and wildlife. University of Tennessee Institute of Agriculture researchers are mapping the tick's spread and developing response strategies to protect farmers, ranchers and their animals.



Grantee: University of Tennessee Principal Investigator: Rebecca Trout Fryxell Matching Funders: University of Tennessee FFAR Award: \$150.000

#### Epidemiology and Management of Cotton Leafroll Dwarf Virus (CLRDV)

Cotton is Alabama's most economically important crop. In September 2017, the cotton leafroll drawf virus (CLRDV) was detected in cotton crops. Auburn University researchers are developing timesensitive diagnostic tools to inform producers about disease onset, transmission and mitigation strategies.

Grantee: Auburn University Principal Investigator: Jenny Koebernick Matching Funders: Auburn University, Cotton Inc FFAR Award: \$149.999



Total Grant: \$300.000

Total Grant: \$301,490

## Evaluation of Feed Additives to Mitigate the Risk of Viral-Contaminated Feed to Pigs

Porcine Reproductive and Respiratory Syndrome, Porcine Epidemic Diarrhea virus and Seneca Valley A are deadly swine diseases that can spread through contaminated animal feed. Pipestone Applied Research is testing ten commercially available disease mitigants, or feed additives, to assess whether the mitigants can deactivate these and other swine diseases.



Grantee: Pipestone Holdings Principal Investigator: Scott Dee Matching Funders: ADM Animal Nutrition, Kemin, Purina Animal Nutrition. Anitox FFAR Award: \$150,000 Total Grant: \$300,000

# 2019 Events

FFAR hosted numerous events to identify gaps, generate scientific programs with real-world applications and highlight our research and partnerships.

# FOSTER OUR FUTURE

On February 5, FFAR hosted the inaugural Foster Our Future, which included interactive exhibits and inspiring discussions. Participants saw, heard and interacted with displays highlighting research FFAR supports and other scientific breakthroughs.

February 5, 2019 Ronald Reagan Building

FARMERS MATTER

# HARVEST FOR HEALTH CONVENING EVENT

From January 31 to February 1, FFAR hosted the Harvest for Health convening event to promote and strengthen linkages between resilient production agriculture, food and health. This event brought together food industry stakeholders to promote linkages between resilient production agriculture and food manufacturers. As a result of this event, FFAR signed a MOU with the Global Alliance for Improved Nutrition (GAIN) to develop the Harvest for Health program.

# AGRICULTURAL SCIENCES AND THE POTENTIAL FOR RESEARCH ON THE INTERNATIONAL SPACE STATION

On June 18, FFAR and the International Space Station (ISS) US National Laboratory cohosted a workshop focused on understanding plant stress and metabolism through research on the ISS.

# ORGANIC TRADE CENTER CONVENING EVENT

On September 10, the Organic Center and FFAR brought together farmers, researchers, policymakers, industry members and nonprofits to investigate the current landscape of tools available for farmers and build a scaffolding for prioritizing research projects to address the top needs of the community.

# FFAR 2019 PUBLIC CONVERSATION

Consistent with the law, FFAR's Public Conversation is an opportunity for the public and members of the food and agriculture community to hear from the Foundation's leadership and offer input on the Foundation's strategic research priorities. FFAR held the annual Public Conversation on October 11, 2019 at the American Association for the Advancement of Science in Washington, D.C.

# SMART URBAN FOOD SYSTEMS SUMMIT

From November 4 - 5, FFAR and New Lab co-hosted the Smart Urban Food Systems Summit. The Summit convened experts to uncover challenges facing urban and regional food systems and identify areas where partnerships and technologies can build comprehensive, resilient and accessible food systems.

# DISCUSSION ON DATA PRIVACY IN AGRICULTURE

On November 13, FFAR and Soil Health Partnership partnered to co-host a series of discussions focused on digital agriculture, specifically data privacy and data use. This event discussed the research and partnership needs to frame and develop a uniform data privacy policy that addresses stakeholder needs from farmers to industry to government.

# SEAWEED LIVESTOCK FEED INGREDIENT WORKSHOP

On November 20, FFAR, World Wildlife Fund and ARPA-E to host the Seaweed Livestock Feed Ingredient Workshop. The Workshop convened experts to examine seaweed's potential as animal feed and find systems-level opportunities for growth, utility and safety.

# CITRUS GREENING CONVENING EVENT

From December 3 to December 4, the National Institute of Food and Agriculture (NIFA) and FFAR hosted a Citrus Greening Event in Washington D.C. The meeting convened a cross-disciplinary group of experts to discuss Citrus Greening Disease and develop national recommendations for focusing funds, attention and energy to address the disease over the next five years.



# Scientific Workforce

FFAR's Scientific Workforce Development programs and fellowships support the next generation of food and agriculture scientists. In 2019, named a National Academy of Sciences Prize in Food and Agriculture Sciences winner, awarded eight New Innovators in Food and Agriculture Research Awards, selected the second cohort of FFAR Fellows and launched the Vet Fellows Program.

# NATIONAL ACADEMY OF SCIENCE (NAS) PRIZE IN FOOD AND AGRICULTURE SCIENCES

The National Academies of Science (NAS) Prize in Food and Agriculture Sciences was established by FFAR, in partnership with the Bill & Melinda Gates Foundation (BMGF), to recognize extraordinary contribution to agriculture and the biological understanding of species important to food and agriculture production. FFAR and BMGF established the NAS Prize in Food and Agriculture Sciences to elevate food and agriculture research and highlight the critical need for scientists working toward more productive, sustainable agriculture.

# 2019 PRIZE WINNER: DR. ELIZABETH AINSWORTH

Dr. Elizabeth Ainsworth, a USDA-ARS researcher and adjunct professor at the School of Integrative Biology at the University of Illinois, is the 2019 recipient of the NAS Prize in Food and Agriculture Sciences. Ainsworth's pioneering research focuses on how the world will eat in the face of climate change and other threats. Her research has revealed how man-made atmospheric changes affects the physiology and growth of crops around the world.

# **Elizabeth Ainsworth**

USDA Agricultural Research Service

For researching how climate change will affect crops.



NATIONAL ACADEMY OF SCIENCES



# 2019 NEW INNOVATORS IN FOOD AND AGRICULTURE RESEARCH AWARDEES

The New Innovator in Food and Agriculture Research Award provides early investment to launch young faculty members into successful scientific careers in food and agriculture. Investing in faculty members within the first three years of their careers allows them to pursue innovative ideas uninhibited by the pressure to secure funding.

# Harnessing multi-trophic chemical ecology to obtain sustainable pest control and improved soil health



Data suggests that the species of cover crop farmers choose impacts corn crop's resistance to pests and pathogens. Ali's research is discovering mechanisms that control interactions linking cover crops, soil fertility and corn pest and pathogen management to increase corn crop's resistance to pests and pathogens.

Grantee: Pennsylvania State University Principal Investigator: Jared Ali Matching Funders: Pennsylvania State University FFAR Award: \$300,000 Total Grant: \$600,000

#### Vulnerabilities of snowmelt-dependent irrigated agriculture



Sustainably managing water resources for irrigated agriculture is a major challenge in a world confronted by increasing food demand and a changing climate. Mueller's research is the first comprehensive investigation of how irrigated crop production relies on snowmelt water resources across the globe. This research

will heighten our understanding of snowmelt-dependent agriculture hotspots and how trends in water supplies and crop water demands influence water scarcity.

Grantee: Colorado State University Principal Investigator: Nathan Mueller Matching Funders: Colorado State University FFAR Award: \$177,754 Total Grant: \$355,508

# Metagenomic probes for the rapid identification of the microbiome community in a wheat rhizospheremodel system

Espindola Camacho's research uses cutting-edge, high-throughput sequencing to explain what affects plant health. Specially, Espindola Camacho is sequencing a plant's microbiome, a collection of bacteria, viruses and fungi that live on a plant, to determine those organisms that positively or negatively impact the plant.



Grantee: Oklahoma State University Principal Investigator: Andres Espindola Camacho Matching Funders: Oklahoma State University, Cowboy Technologies FFAR Award: \$120,000 Total Grant: \$240,000

# A Multi-scalar, Multi-objective Approach to Sustainable Water Management within Agricultural Systems

Marston's research is investigating complex human-water systems to providing solutions for sustainable water resources management. His work is exploring how water is used throughout the food production enterprise to reduce water use within the global food system.

Grantee: Kansas State University Principal Investigator: Landon Marston Matching Funders: Kansas State University FFAR Award: \$259,206



Total Grant: \$518,413



# Exploring plant-microbiome-environment interactions towards tailoring plant disease management



Traditional disease management strategies often fail to prevent recurring outbreaks. Potnis's research is testing a twopronged approach to transform disease management strategies and identify control approaches that are practical and profitable.

Grantee: Auburn University Principal Investigator: Neha Potnis Matching Funders: Auburn University, University of Florida FFAR Award: \$290,893 Total Grant: \$581,992

# A systematic approach to improve heifer selection and the sustainability of beef production.



Dyce's research is improving the efficiency of cattle production by identifying molecular markers that indicate reproductive potential. The use of these markers can provide a better understanding of the underlying causes of unexplained infertility within the cow-calf sector, leading to potential therapeutic options.

Grantee: Auburn University Principal Investigator: Paul Dyce Matching Funders: AAES, Alabama Cattlemen's Association FFAR Award: \$297,906 Total Grant: \$599,309

# Advancing apple production systems to boost health-promoting phytochemicals in fruit

Whitehead's research is developing new ecologically based management practices for apples that can boost the content of health-promoting phytochemicals in fruit. If successful, these technologies could be applied to a variety of crops to improve the quality of food and boost the nutritional benefits of fruits and vegetables.



#### Grantee: Virginia Tech

Principal Investigator: Susan Whitehead

Matching Funders: Virginia Polytechnic Institute and State University FFAR Award: \$300,000 Total Grant: \$600,000

#### Improving the nutritional quality of tomatoes

Cooperstone's research combines plant breeding/genetics, analytical chemistry, bioinformatics, and nutrition, enabling the development of tomatoes that are more beneficial for human health.

Grantee: The Ohio State University Principal Investigator: Jessica Cooperstone Matching Funders: The Ohio State University FFAR Award: \$299,042



Total Grant: \$598,908



# FFAR FELLOWS

The FFAR Fellows Program, sponsored by FFAR and North Carolina State University, funds 48 graduate students over three years to pursue bold research related to FFAR's Challenge Areas.



#### Alex Batson, Washington State University

Industry Sponsors: Pop Vriend Seeds, Rijk Zwaan, and Sakata America

The maritime Pacific Northwest is the only region suitable for spinach seed production in the US. Fusarium Wilt is a fungus, caused by *Fusarium oxysporum f. sp. Spinaciae*, that

limits the potential of spinach in the pacific northwest . Batson's research identifies and characterizes unique regions *F. oxysporum f. sp. spinaciae* to understand what makes spinach susceptible to this fungus.



# Scott Cosseboom, University of Maryland, College Park

Industry Sponsor: Maryland Wineries Association

The emerging grape industry in the US Mid-Atlantic is facing fungal diseases, which have not been well characterized. The lack

of understanding is threatening yields of this increasingly important commodity. Cosseboom is examining the fungal pathogens causing these diseases to help producers better understand and manage these diseases.



### Maria Gannett, Cornell University

#### Industry Sponsor: AMVAC

Weeds are an ever-present challenge for farmers, as they draw on the same nutrients the plants need. Current weed management strategies are overly reliant on chemical herbicides, which has led

to an increasing number of herbicide resistant weeds. Gannett is researching alternatives to chemical weed control.

### Natalie Goh, University of California, Berkeley

Industry Sponsors: BASF and the Chan-Zuckerberg Foundation

More advanced, scalable technology is needed to increase agricultural sustainability. Goh's research is developing technology that delivers genes to plants to improve crop performance.

#### Sihui Ni, North Carolina State University

Industry Sponsor: Syngenta

Meeting future global food production demand requires enhanced tools and technologies. Ni's research is developing technology to increase long-term crop yield.

#### Nate Korth, University of Nebraska, Lincoln

Industry Sponsors: Neogen and the University of Nebraska Food and Health Center

The human gut microbiome is a collection of bacteria, viruses and fungi in the human body that contributes to both health and disease. Korth's research is identifying components of

agricultural products, with a focus on crop plants, that alter the state of the microbiome. Korth is characterizing bacteria associated with health traits to develop diet supplements that improve human health.

#### Miriam Martin, Kansas State University

#### Industry Sponsor: Merck

In the US, animal surgical procedures, such as castrations and dehorning, are often performed in ways that negatively impact animal welfare. Martin is investigating the role of nonsteroidal anti-inflammatory drugs (NSAIDs) in controlling



pain during stressful events that include transportation, castration and dehorning to assist veterinarians in administering pain control.







#### Kelsey Peterson, University of Minnesota

Industry Sponsor: The Land Institute

The sunflower-like perennial, *Silphium integrifolium*, a next generation crop that promises numerous ecosystem services, is losing its pest and pathogen resistance

traits. Peterson is conducting a survey of the natural genetic variation of wild *Silphium integrifoliu* populations to assess where variation for pest and pathogen resistance exists.



#### Linda Beckett, Purdue University

### Industry Sponsor: ADM

Traditional corn-based diets for lactating dairy cows fail to meet the requirements for methionine and lysine, two critically essential amino acids, and prevent cows

from reaching their full potential for milk production. Beckett is determining the optimal combinations of feed for lactating dairy cows at several lactation stages and developing technologies to deliver these nutrients in a digestible form.



# Gwendolyn Donley, Case Western Reserve University

Industry Sponsor: Stephen J McHale Family Foundation

Massive resources have been invested into nutrition interventions, food programs and

other food-related policies. However, long-term, concrete changes in the target communities are few and far-between. Donley is reassessing nutrition programs, incentives and interventions through a systems lens to examine the effects our actions do and do not have within the food system and better understand where interventions have the greatest impact.



## Karlinton Flores, North Carolina State University

Industry Sponsor: Nicholas Aviagen Turkeys

Flores is working with poultry,

manufacturing their feed, processing the birds and analyzing large data sets to prove

that artificial intelligence tools can advance agricultural research and the poultry industry.



## Danielle Gelardi, University of California, Davis

#### Industry Sponsor

Biochar, a charcoal-like substance created by burning organic agriculture material, is added to soil to enhance plant growth and reduce the need for water and fertilizer.

Gelardi is investigating the effect biochar has on crop performance, environment and human health.

## Annemarie Krug, University of Illinois at Urbana-Champaign

Industry Sponsor: Kellogg's

Probiotics are the bacteria that live inside our bodies and benefit health, and prebiotics are the fiber that these probiotic bacteria eat to



survive. Krug is analyzing changes in the GI microbiota, cognitive function, sleep quality, mental health and 24-hour urinary free-cortisol concentrations. This study is expanding the literature and knowledge on the role of prebiotics and probiotics in human health.

# Krista Marshall, University of California, Davis

Industry Sponsor: Almond Board of California

Marshall is measuring how various management practices in 13 orchards

influence water conservation, nutrient use efficiency, nitrogen cycling, soil structure, carbon accumulation and storage and soil microbial communities to improve knowledge of soil health in orchard systems.

## Drhuv Patel, University of California, Berkeley

Industry Sponsor: Bill & Melinda Gates Foundation

With the growing threats of climate change and diminishing natural resources, farmers must do more with less – and fast. Patel's

research is using genetic engineering to improve photosynthetic efficiency, improve water use and maximize crop yield.

#### Innocent Ritte, Tuskegee University

Industry Sponsor: BASF

Cowpea is one of the principal legumes widely cultivated as a vegetable crop and a dry bean in semi-arid regions of the world. Cowpea productivity may be hindered by increasing temperatures and diseases. Ritte

is identifying cowpeas with drought-tolerance and disease resistance to improve yields in a changing climate.

# Danielle Stevenson, University of California, Riverside

### Industry Sponsor: Corigin

Arbuscular mycorrhizal fungi on plant roots improve yields, reduce the need for water and fertilizers and protect crops from pathogens. Stevenson's research is

addressing knowledge gaps preventing the fungi's most effective use and application.







40 I Foundation for Food and Agriculture Research

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# FFAR VET FELLOWS

The Veterinary Student Research Fellowships to Address Global Challenges in Food and Agriculture, sponsored by FFAR and the Association of American Veterinary Medical Colleges, is a three-month fellowship that provides veterinary students with opportunities to pursue research related to global food security and sustainable animal production.



#### Laura Raines, Auburn University

Bovine viral diarrhea virus is an infectious viral disease in cattle that impacts reproduction and causes mortality in calves. Raines is examining prenatal testing methods to identify pregnant cattle that carry the virus and control the incidence of persistently infected calves that are

responsible for further disease spread.



#### Lauren Riggs, Colorado State University

Bluetongue virus and epizootic hemorrhagic disease virus are transmitted by insects and infect ruminant animals, including cows, that absorb nutrients through plant-based food and have complicated stomach systems. Riggs is examining the viruses to determine how

simultaneous infections affects their evolution and replication rate to mitigate the spread of disease.



#### Sarah Kreuger, Kansas State University

Anaplasmosis is the most prevalent ticktransmitted disease in cattle worldwide. In the US, the Lone Star tick (LST) is rapidly expanding its range and is the most common tick found on cattle. Krueger is examining whether LST contributes to the spread and development of

anaplasmosis, which could inform disease management and treatment strategies.



#### Macon Overcast, Ohio State University

Livestock and wildlife, land-use patterns and other factors influence the development and spread of antibiotic resistance in agricultural environments. Overcast is using computer models to better understand how to mitigate this public health threat.

#### Cara A. Newberry, University of California, Davis

Antimicrobial resistance can cause life-threating infections in humans and livestock. Newberry's research in Iringa, Tanzania is assessing the prevalence of antimicrobial resistant E. coli in local chickens and evaluating risk factors that could influence transmission to humans.

#### Roel Becerra, University of Georgia

Early diagnosis of infectious diseases in foodproducing animals is key to preventing them from spreading. Conventional testing methods require expensive equipment, expertise in preparing specialized samples and significant time to generate results. Using existing technology,



Becerra is developing tools to accurately and efficiently diagnose diseases like *Avian Pathogenic Escherichia coli* and *Salmonella spp* to help producers control and prevent the spread of disease.

#### Shelby Nichole Crump, University of Illinois

Infertility or limited fertility jeopardizes the efficiency and longevity of dairy cows. Crump is examining several pregnancy-signaling pathways in cows to improve reproductive performance.



### Preston A. Cernek, University of Wisconsin-Madison

Digital Dermatitis (DD) affects about 90 percent of US dairy herds and is associated with decreased milk production, lameness and infertility. Early detection and prompt treatment offer better prognosis, but early detection of DD on commercial dairy farms is difficult. Cernek

is creating a digital tool for early DD detection on commercial dairy farms.

## Hayley Masterson, Washington State University

Masterson is traveling to Mexico to collect geographically distinct microorganisms of Babesia bovis, a tick-borne parasite that infects cattle in tropical regions and causes significant economic losses for farmers. Masterson's is identifying proteins common to different



Piroplasmosis is a blood-borne disease that affects a range of wild and domestic animals, primarily in Africa and Europe. Current tests cannot effectively detect carrier animals and cannot easily distinguish different

strains that may or may not be harmful. Koo's research uses nextgeneration genetic sequencing technology to discriminate between Piroplasmosis species and distinguish harmful strains of the virus.







# FFAR FINANCIALS

# ASSETS

Cash and cash equivalents	\$12,997,054
Certificate of deposit	200,248
Contributions receivable	1,484,604
Award match receivable	82,950,052
Investments	334,089,076
Security deposits	141,586
	\$431,862,620
LIABILITIES AND NET ASSETS	
Liabilities	
Accounts payable	\$80,462
Grants payable, net of discount	148,280,257
Accrued expenses	350,906
Conditional grant	260,412,449
Deferred rent	602,015
	\$409,406,089
Total net assets	22,136,531
Total liabilities and net assets	\$431,862,620

# STATEMENT OF ACTIVITIES

/ear Ended December 31, 2019	
REVENUE	
Recognition of deferred appropriation	\$40,428,670
Matching award revenue, net	39,824,337
Investment income, net of fees	15,510,173
Consortia contributions	485,363
Contributions	18,327
Event revenues	76,907
Other revenue	23,737
Total revenue	\$96,367,514

# **EXPENSES**

Program	
Grants and awards program	\$77,037,667
Supporting services	
General and administrative	2,403,257
Development	777,107
Total expense	\$80,218,031
CHANGE IN NET ASSETS	\$16,149,483

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# **REVENUE BREAKDOWN**



42% Recognition of Deferred Appropriation

41% Matching Award Revenue

16% Investment Income

# 1% Other

Consortia Contributions Event Revenues Other Revenue Contributions

# **EXPENSES BREAKDOWN**



1% Development

3% General & Administrative

96% Grants & Awards Program



# 2019 CONTRIBUTORS

Thank you to all the organizations who generously supported FFAR's mission to advance food and agriculture science. FFAR is grateful for the matching funders for each grant awarded in 2019, and to the following organizations and individuals who supported our projects, programs and events:

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# **ON THE HORIZON**

# **Coronavirus Response**

FFAR restructured the 2020 Vet Fellowships in response to the coronavirus pandemic. FFAR and the Association of American Veterinary Medical Colleges are expanding the 2020 program to include five additional fellowships for pandemic and zoonotic research.

FFAR is also funding emergency food system supplemental awards.

# **Agriculture Climate Partnership**

In February 2020, FFAR, the US Farmers and Ranchers Alliance and the World Farmers Organization formed the Agriculture Climate Partnership, an initiative mobilizing farmers, ranchers, scientists and partner organizations to develop and implement emissions-reducing innovations at scales and rates previously unimagined.

The Partnership is mobilizing scientists and farmers to unlock the climate-solving potential of our farmlands and transforming US agriculture to be net negative for greenhouse gas emissions by 2030.

# **ICASA Call for Submissions**

The International Consortium for Antimicrobial Stewardship in Agriculture (ICASA) opened calls to develop, improve and/or validate animal-health monitoring or rapid in-field, pen-side or animal-side diagnostic tools.

ICASA is also issuing a call to for research concepts related to metaphylaxis, an approach to controlling infectious diseases in animals. This research opportunity is related specifically to beef cattle and pigs.

# Precision Indoor Plants (PIP)

Precision Indoor Plants, a consortium established by FFAR in 2019, is producing new flavorful, nutritious crops specially intended for indoor agriculture. PIP will be making several direct fund awards to various organizations in 2020.



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