

Missouri (Lincoln University of Missouri, University of Missouri Columbia Combined) Annual Report - FY2021

Report Status: Approved as of 07/19/2022

Contributing Organizations

Lincoln University of Missouri
University of Missouri Columbia

Executive Summary

Overview

University of Missouri- Columbia: University of Missouri Research and Extension contributed to better the lives of Missourians in 2021. Our program focused on food systems, natural resource management, and healthy people, families and communities. We developed and delivered high priority programs to address needs identified by our stakeholders despite declining state budgets.

We continued to incorporate the use of technology into innovative service and product delivery systems, online resources for our stakeholders, and data mapping, visualization, and reporting tools. Our Extension website had millions of page views and content downloads. Funding from grants, gifts, and fee generation exceed the resources appropriated from our state, federal, and county partners. Our goal is to be reliable, responsive and relevant. We accomplished that goal in 2021 by providing research-based knowledge to Missourians aligned with their priorities of improving the community economies, health, and education outcomes.

Lincoln University: In alignment with the USDA's top Research and Extension priority areas, Lincoln University's Cooperative Research and Cooperative Extension programs continue to integrate and support agricultural education programs that provide high quality, experiential education at both the graduate and undergraduate levels. The Extension and Research programs especially target underrepresented, underserved, small farmers and first-generation students, while also contributing to the diversity of the nation's future agriculture workforce. The Extension and Research programs continue to work with the state government and legislators to increase the level of appropriations to reach the amount required for the state match.

Five (5) critical issues of health, social justice and community development, environmental and natural resources, sustainable agriculture, and education and communication with underserved populations in Missouri have been identified as the integrative focuses for Research and Extension programming starting in 2020. The Research and Extension program has also launched five initiatives: organic farming and production, small ruminant production, industrial hemp production, food safety training, and forest ecosystem health, in an effort to meet the critical, growing needs of the State and stakeholders.

The LU Research program continues to conduct cutting-edge, impactful food and agriculture research through multi-institution and multidisciplinary collaboration. These programs seek to effectively address urgent, emergent issues and develop sustainable solutions to the problems facing Missouri's agriculture industry and rural communities as well as to strengthen the university's capacity to better address the needs of Missouri's small farmers, especially underserved farmers.

The Research program currently has five research focuses: 1) animal production; 2) soil health & crop production, 3) food nutrition & safety, 4) natural resource management, and 4) social economics.

Both Research and Extension have emphasis areas focused on small ruminants, aquaculture, soil health, specialty crops, food safety detection, water quality, forest health, and community development. Staff and faculty members in the program are actively pursuing extramural funding to support current efforts and leverage resources provided by federal and state partners.

LU Extension efforts aim to improve the education and economic opportunities to underrepresented populations in Kansas City; St. Louis; and Central, Southeast and Southwest Missouri. Programs in the areas of 4-H and youth development, family development, community development, health and aging, food and nutrition, and urban gardening assist farmers, families, youth and the elderly, as

well as communities through signature programs initiated by: 1) the Innovative Small Farm Outreach Program, 2) the Paula J. Carter Center on Minority Health and Aging, 3) the Innovative Learning Center on Positive Youth Development and 4) the Industrial Hemp Initiative.

Critical Issue: Workforce Development, Education and Communication with Underserved Populations

Underserved populations often suffer from lack of employment because of limited skill set and limited access to education. Extension and Research will address the issue through creating and customized curricula of training and education, adjusted to the specific needs of the population and targeted to the skill set needed by employers. Job readiness and the challenges associated with training and education of underserved populations, to increase and improve their skill sets for gainful employment.

Create an initiative in Southeast Missouri on Workforce Development, Education and Communication with Underserved Populations. Southeast Missouri will develop best practices and strategies for addressing the issues of Workforce Development, Education and Communication around the state.

To support this work, elements of Positive Youth Development to include improving outcomes for at-risk, high-risk, or underserved youth and reducing negative outcomes, such as juvenile delinquency, gang participation.

Provide conceptual-based skills for successfully bringing people together (often with diverse views and opinions) around common community-based and leadership issues.

Critical Issue: Educational Attainment

Missouri 4-H's statewide 34,467 agriculture project enrollments help to develop educated producers and consumers for the future by giving them the opportunity to gain knowledge and skills in the various areas of agriculture. As a result of participating in these projects, youth self-reported they feel that they are more educated consumers of agricultural products and are comfortable sharing their knowledge of agriculture with others. These opportunities also help youth to see themselves pursuing college and career opportunities relating to agriculture, one of Missouri's top industries.

Missouri 4-H Youth Futures clubs promote college and career readiness programming to youth in the urban areas of Missouri. The goal is to provide educational programming to youth that promotes the pursuit of a degree in higher education or hands-on job training upon completing high school. As a result, youth that participate in this program gained more knowledge of the college enrollment process, financial aid process, choosing a major, choosing between a two-year program, 4-year program, or trade school. Having these opportunities help youth to achieve their goals of attending a college/university or joining the workforce after high school. In 2021, there were 20 members that graduated from high school and all the students enrolled in and are finishing their first year of college.

Critical Issue: Environmental and Natural Resources

Missouri is a natural resource-rich state. With population growth, demand for increased food production, and economic development, there is threat to natural resource depletion and ecosystem degradation which is posing a challenge to sustain environmental health, future agricultural productions, and quality of life for people living in Missouri.

Approximately one-third of Missouri is covered by forest which has a significant economic impact. Forest health needs to be maintained for ecosystem service to be sustained.

Surface water pollution by agricultural chemical and manure inputs has become a human health and environmental concern. Water safety and quality improvement are critically needed.

Lincoln University Cooperative Extension and Research activities promote improved water management, increased energy efficiency, improved management of natural resources, partnering with environmental institutions, assistance in the areas of environmental and natural resource management activities in the state, forest health, and climate smart efforts.

Lincoln University Research and Extension Programs continued to conduct cutting-edge, impactful multidisciplinary research that effectively address urgent, emergent issues facing Missouri's natural resources ecosystems and rural communities and develop climate-smart, sustainable management practices for sustaining agricultural production, enhancing ecosystem health, improving water quality and safety, and safeguarding human health and quality of life for Missouri residents.

The LU Research and Extension Programs have currently funded seven (7) capacity research projects in environment and natural resources fields. Those research projects are focused on soil health, water quality and safety, environmental monitoring, remediation and risk assessment, watershed management, forestry health and management, and GIS/GPS applications. The research will help farmers

and rural communities adopt climate-smart management practices for environment or natural resource sustainability, promote environmental awareness and health and protect ecosystem and residents from contamination in Missouri.

In FY 2021-2022, the programs supported seven (7) faculty members. The research generated fifteen (15) peer-review journal publications, twenty-three (23) conference presentations on the topics. There are two (2) workshops, one (1) Field Day organized, with about 100 participants. In addition, over two million-dollar extramural grants were awarded, which leverage our resources in support of environmental research, extension, and education.

The LU Research and Extension efforts in this critical issue will help limited resource, underserved, minority farmers, landowners and rural communities implement climate-smart, sustainable management practices for agriculture and natural resource sustainability and improve quality of life for Missourians. In addition, the LU environment and natural resource research and extension efforts have provided great opportunities for undergraduate and graduate students training for experiential learning experience, research skills, and career in environment and natural resource management fields.

Critical Issue: Health

Good health is important for the overall physical, emotional, mental, and social health status of all people living in Missouri. Missouri is ranked number 39 regarding health out of all of the 50 states.

Lincoln University Cooperative Extension and Research are seeking to decrease the health disparities in underserved communities. These disparities in healthcare are thought to be related to social determinants such as the health literacy of families, lack of resources, barriers to adequate healthcare, and gaps in services and opportunities.

Activities will focus on comprehension and literacy of health information (youth, seniors and families), obesity reduction, hunger and poverty, addressing of family needs for different cultural backgrounds, values and roles, chronic disease reduction (cancer control, health screenings, etc.), increased movement and activity, and the health and wellbeing of Missouri seniors, particularly low income ethnic minorities, and the creation of an initiative in the Kansas City center focused on developing and compiling a compendium of health and fitness best practices and strategies as a resource for serving the target audience in Missouri.

Lincoln University Research and Extension efforts seeks to develop advanced technologies for the effective detection of food safety or contamination and decrease health disparities for underserved residents and communities. These disparities in health care are related to social determinants, such as the health literacy of families, lack of resources or barriers to adequate health care and gaps in services and opportunities.

The LU Research and Extension Programs have currently created six (6) capacity research and extension projects in human health fields. Those projects are focused on food safety monitoring, sensor detection technology for food contamination, biological pathogen control of fresh vegetables, safe food treatment & packing, nutritious and healthy food, drinking water and recreational water safety, and healthy lifestyle. The research and extension activities will help Missouri residents, especially underserved communities, improve food or water safety and lifestyle and safeguard human health and quality of life.

During FY 2021-2022, the programs supported six (6) faculty members. The research generated four (4) peer-review journal publications, three (3) factsheets, six (6) conference presentations, and one patent on the topics. There are two (2) workshops organized, with about 50 participants. In addition, over one million-dollar extramural grants were awarded, which leverage our resources in support of research, extension, and education in the fields.

The LU Research and Extension activities under this critical issue will help Missouri residents, especially underserved communities, decrease health disparities, improve food or water safety and lifestyle, and safeguard human health and quality of life. Additionally, the LU health science research and extension capacity projects have provided great opportunities for undergraduate and graduate students training for experiential learning experience, research skills, and career in health or food science fields. The results generated from this research have been disseminated to target audience through journal or factsheet publications, conference presentations, workshops, seminars, and direct or indirect contacts.

Critical Issue: Healthy Futures

According to America's Health Rankings (2022), Missouri is ranked 37th and faces significant health challenges. More specifically, Missouri is ranked 42nd in public health funding, 44th in behavioral health, 45th in nutrition and physical activity, and 44th in fruit and vegetable consumption. The COVID-19 pandemic has impacted Missouri families and their work lives. Individuals have avoided getting basic health care, and rural areas are challenged with limited access to primary care and behavioral health. Numerous lives were lost during the pandemic to COVID-19, opioid misuse, suicide, and unaddressed health related issues such as diabetes and heart disease.

There are endless opportunities for MU Extension to positively impact the health and well-being of Missourians at every stage of life. MU Extension has created partnerships and programs that foster innovation and interdisciplinary approaches to address health and well-being needs of Missourians. MU Extension is addressing mental health, behavioral, and lifestyle change through various programs and services. Programs such as Stay Strong, Stay Healthy; Taking Care of You; Matter of Balance; Tai Chi for Arthritis and Fall Prevention; Mental Health First Aid; Diabetes Prevention Program; Stanford Youth Diabetes Coaching Program; Question, Persuade and Refer; and Weathering the Storm in Agriculture are engaging individuals, families, and communities to cultivate positive health choices and behaviors.

MU Extension established a collaborative partnership between the MU School of Medicine and MU Office of Extension and Engagement that demonstrates the university's integrated approach to community health as well as its commitment as a land-grant institution to improve the health and well-being of all Missourians. Additionally, MU Extension is supporting the Next Gen Precision Health Initiative inspired by the National Institute of Health's focus on precision medicine and precision health. This partnership is critical to the success of this initiative as it combines research and innovation with high-touch MU Extension programming and specialists in communities across the state to help promote translational research.

Healthy ecosystems are the basis for healthy futures. The MU research program embraces the one health concept and this past year investigated all aspects of healthy futures -soil health, plant health, animal health and human health – as an integrated, interconnected concept. Information gathered from lab, greenhouse and field trials from across the state is helping formulate management decisions for natural and agroecosystems to ensure the sustainability of the socio-ecological system that we live in.

Critical Issue: Social Justice

In the state of Missouri, minority constituents are in a state of emergency regarding social justice and inequality. There is a lack of civic engagement along with civic responsibility when it comes to equally and consistently providing resources to all. Currently, our constituents are in a state of war with acquiring equal access to areas regarding education, public safety, technology, housing, food desserts, community development, social justice, unemployment, judicial equality, health disparities and community resources.

Lincoln University Cooperative Extension social justice mission is to improve the life and well-being of disenfranchised and underserved communities in Missouri by providing social, political, economic, legislative and educational awareness that supports upward mobility and holistic community development.

These goals are achieved by listening, offering research and education and empowering the target audience through activities such as asset mapping, increased awareness of social justice and social injustice, Social Justice Youth Academy (ages 8+), and Through the Lenses of Lincoln.

Critical Issue: Sustainable Agriculture

Missouri is an agriculture-based state. The continuous increase in food demands and global environmental changes lead to a serious risk to agricultural production systems and producers in Missouri. Under these situations, sustainability of farming and the agri-food system is crucial for the food security.

Research and Extension efforts focus on Agricultural system – soil, crop and farming. Crops includes field crops, specialty crops, horticultural crops (fruits and vegetables), production systems - conventional, organic and hydroponic, biotic and abiotic stress management, small ruminant (goat and sheep), poultry, aquaculture and remote sensing (use of unmanned drones).

Activities will reduce global hunger and improve food safety, develop value-added crops, crops that can grow better under climate changed environment (drought, heat and cold tolerance) and insect pest resistance, and crop diversification can increase small farms profitability; understanding natural genetic variations of germplasm and develop and promote crop and livestock varieties that can tolerate extremes of climate changes (help effective stress management) and disease resistance is critical; incorporate new technologies including genomics and nanotechnology to improve the production systems and biosecurity.

Lincoln University Research and Extension Programs continued to conduct cutting-edge, impactful multidisciplinary research that effectively address urgent, emergent issues facing Missouri's agriculture industry and rural communities and develop climate-smart, sustainable farming practices for agri-food production system in Missouri.

The LU Research and Extension Programs have currently funded seventeen (17) capacity research projects in animal and plant science fields. Those research projects are focused on health, breeding, production, nutrition, and disease control of small ruminants, breeding and operation system of fish production, small farm poultry management, crop breeding & genomics, value-add specialty crops, high-tunnel vegetable production, native plants and biodiversity, industrial hemp, integrated pest management, plant disease control, organic farming, and hydroponic operation system. The research will help farmers add new specialty crops and livestock for food supply or security and adopt climate-smart farming practices for agriculture sustainability as well as promote small ruminant industry, aquaculture industry, industrial hemp industry, and hydroponic operation in Missouri.

During FY 2021-2022, the programs supported seventeen (17) faculty members. The research generated thirty-five (35) peer-review journal publications, fifty-two (52) conference presentations, and eight (8) factsheets on the topics. There are over thirty (30) acre industrial hemp planted within Missouri, over 600 sheep & goats raised on farms, six (6) workshops, two (2) conferences, three (3) Field Day organized, with more than 300 participants. In addition, over three million-dollar extramural grants were awarded, which leverage our resources in support of research, extension, and education in the fields.

The LU Sustainable Agriculture Research and Extension efforts in this critical issue will help farmers and rural communities, especially limited resource, underserved, minority small farmers and rural communities, adopt climate-smart farming practices for food production and agriculture sustainability, increase farm income and profitability, improved their quality of life as well as promote small ruminant industry, aquaculture industry, industrial hemp industry, and hydroponic operation in Missouri. In addition, the programs have provided great opportunities for both undergraduate and graduate students training for experiential learning experience, research skills, and career in agriculture fields.

Critical Issue: Economic Opportunity

University of Missouri-Columbia Extension and Engagement continues to work with partners throughout the State of Missouri to tackle the economic and workforce issues that are impacting the state. Our programs in business development, community development, workforce development, and agricultural business counsel entrepreneurs, community leaders, and workforce actors about the latest trends impacting Missouri's economy and help them develop plans to address those challenges.

Through our business development programs, we continued to assist entrepreneurs in the creation of small businesses. In 2021, our programs led to the creation of 308 businesses, which led to 1710 jobs created and 29,132 jobs retained. Our programs also helped entrepreneurs successfully receive local, state, and federal contracts and worked directly with manufacturers directly to address the challenges they face due to competition from foreign companies.

We also established the Missouri Business Development Center for Agriculture, Food, and Forestry, via funding from the CARES Act. This is a collaborative program that brings new entrepreneurs into the agriculture and food space. The center brings together the business knowledge and resources of the Missouri Small Business Development Center (SBDC) and the research-based, agriculture-specific knowledge of MU Extension.

The heart of this new program is agri-business counseling. The team meets bi-weekly to talk about client needs and opportunities. Center faculty help business owners navigate grants and other programming. Though perhaps not flashy, it is important to note that the presence of a local county Extension office has been invaluable. It is through these local offices that fledgling business owners can access scanners, printers, and reliable internet service in order to apply for funding.

In 2021 the Missouri Business Development Center for Agriculture, Food and Forestry provided technical assistance and expertise to over 300 Missouri producers and agribusinesses. Those agri-entrepreneurs attracted more than \$40 million in private loans and grants and created at least 500 new jobs. Further, faculty from the center played a major role in bringing a new, large meat processor to the great St. Louis region. Though the facility will not be operational until 2024, it will bring 1,400 new jobs to the state.

MU Extension's work in building a 21st century workforce also took several important steps forward. We worked with BioSTL to help them better comprehend the workforce opportunities and challenges in the bioscience workforce will help them focus their efforts to greatly expand the bioscience workforce in the region. MU Extension also partnered with academic departments on campus on the development of non-credit certificate programs in areas of high-demand and need. These programs – which focus on Clinical Engineering and also Digital Skills – will launch in 2022 and serve as great examples of how we can partner across the institution to develop skills that lead to in-demand careers in Missouri.

Additionally, agriculture is the number one industry in Missouri contributing \$93 billion to the state's economy. Basic and applied research efforts at MU generated new knowledge that helped improve productivity and sustainability of major crop production systems in the state. Sustainability questions answered environmental, social and economic dimensions to help make informed decisions. Further,

our research helped improve basic understanding of animal physiology, genetics, reproduction, nutrition, growth, and animal well-being which was translated into improved animal production practices. Agricultural economics and policy research helped farmers, and the agriculture industry make production choices, policymakers to respond to agriculture issues, to lenders who must decide whether to make loans and to agribusinesses making investment decisions.

Merit and Scientific Peer Review Processes

Updates

Lincoln University:

Lincoln University Cooperative Research (LUCR) will implement a Peer Review Team (PRT) for capacity projects and resource allocation that will include both internal and external stakeholders. The review team will be comprised of both Lincoln University faculty/staff and partners with aligned mission, vision, values and background experience. The Peer Review Team will establish the criteria necessary for all proposals and project requests. The PRT will review proposal/project submissions and determine their feasibility based on an established proposal/project rubric developed by the PRT to ensure alignment with Lincoln University Cooperative Research's priorities.

The current state of knowledge, along with a literature review, stakeholder's inputs, and preliminary data (using federal and state databases), will form the basis for formulating Extension and Research objectives and directions. Before projects are implemented, proposed ideas will go through an in-house, peer-review process, followed by external peer reviews.

To identify, develop and evaluate new technologies and address solutions to critical issues, new technologies will be reviewed by intra- and inter-institutional scientists, including federal and state funding agencies and end users.

Stakeholder Input

Actions to seek stakeholder input that encouraged their participation with a brief explanation

University of Missouri: Stakeholder feedback is sought by the University of Missouri Research and Extension. Missouri state statutes establish elected and appointed County Extension Councils in each of the 114 counties, bringing together over 1,6000 Missourians from a variety of stakeholder and partner backgrounds, to meet monthly with faculty, providing guidance on university programming, and annually approving local plans of work. The county councils elect regional and state councils which provide regular feedback at all levels of the university. The Missouri Agricultural Experiment Station has advisory councils at their outstate Research, Extension and Education Centers (REECs) to solicit feedback regularly on research priorities. There is also a statewide strategic advisory committee to provide feedback on research.

Methods to identify individuals and groups and brief explanation

None

Methods for collecting stakeholder input and brief explanation

None

A statement of how the input will be considered and brief explanation of what you learned from your stakeholders

Lincoln University: The inputs and suggestions collected from stakeholders will be analyzed to help identify critical needs or priority areas for research and extension programs. The results will be used to direct new research projects and design new extension activities.

Highlighted Results by Project or Program

Critical Issue

Economic Opportunity

Creating Entrepreneurial Communities Conference

Project Director

Kimberly Shettlesworth



In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Outside of Missouri's metropolitan centers it can be difficult to sustain an entrepreneurial ecosystem conducive to the growth of locally owned small business enterprises. The objective of the Creating Entrepreneurial Communities Conference is to create a statewide network of communities focused on entrepreneurship and the development of strong entrepreneurial ecosystems.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The primary activity for the Creating Entrepreneurial Communities conference was the development and delivery of this conference. The first conference was held in Hannibal, MO on September 29-30, 2021. The conference brought together over 70 people from all corners of the state to learn about how communities can support entrepreneurial efforts; the tools that are available to help those efforts; and the broader economic and workforce trends that are impacting entrepreneurship locally and across the United States. Individual sessions brought together experts and practitioners who have worked to foster entrepreneurship in their communities to discuss the many aspects to creating entrepreneurial success in rural communities. Networking opportunities were also included in the conference, with activities developed to help build the network of like-minded communities across the state. With this success of this conference, a second conference is scheduled to be held in Hermann, MO on September 21-22, 2022.

Briefly describe how your target audience benefited from your project's activities.

The target audience for the Creating Entrepreneurial Communities Conference benefitted in multiple ways, but most notably because it is one of the first intentional efforts in Missouri to focus on rural entrepreneurial activity. Sessions were designed to bring together experts and practitioners focused on rural entrepreneurship to discuss what worked and did not work in supporting rural entrepreneurial ecosystems, and to build networks of like-minded advocates from rural communities who could learn from each other and apply these lessons to their communities. One of the survey responses from an attendee said "This has been a wonderful conference filled with tangible takeaways to put into practice almost immediately in my community. The connections have been invaluable." Furthermore, 77% of participants report that they intend to make use of new and/or existing regional and community assets to support entrepreneurship as a result of this conference. Helping build connections and make people aware of resources is a major component of this work as we try and build a culture of entrepreneurial support across the state.

Briefly describe how the broader public benefited from your project's activities.

Entrepreneurial success is a key component of economic and community vitality. Without strong networks of entrepreneurs, our communities and economy struggle to thrive. Building the supports necessary to encourage entrepreneurship is essential to building our communities. By focusing on rural entrepreneurship, this conference helps rural communities focus their efforts on building entrepreneurial networks, which ultimately can help build economic activity and community vitality across the state.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Covid and the continuing pandemic continued to impact activities, including attendance, at in-person events held in 2021. It created challenges in planning the conference and finding ways to ensure that connections are made while doing so in a safe manner.

Financial information- and help-seeking behavior, financial capability, and well-being

Project Director

Lu Fan

Organization

University of Missouri Columbia

Accession Number

1024004



Nothing Significant to Report

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Dr. Fan Lu left the University of Missouri 12/31/21 and I was just notified. I will be updating the ending date of the project. Jeri Lou

Missouri Agriculture Innovation Center

Project Director

Kimberly Shettlesworth

Organization

University of Missouri Columbia

Accession Number

7000157



University of Missouri FY2021 Results-- Missouri Business Development Center for Agriculture, Food and Forestry

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The Missouri Business Development Center for Agriculture, Food and Forestry, established through funding from the CARES Act, is a collaborative program that brings new entrepreneurs into the agriculture and food space. The center brings together the business knowledge and resources of the Missouri SBDC and the research-based, agriculture-specific knowledge of MU Extension.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The heart of this program is agri-business counseling. The team meets bi-weekly to talk about client needs and opportunities. Center faculty helped business owners navigate grants and other programming. Though perhaps not flashy, it is important to note that the presence of a local county Extension office has been invaluable. It is through these local offices that fledgling business owners can access scanners, printers, and reliable internet service in order to apply for funding.

Briefly describe how your target audience benefited from your project's activities.

This year, the Missouri Business Development Center for Agriculture, Food and Forestry provided technical assistance and expertise to over 300 Missouri producers and agribusinesses. Those agri-entrepreneurs attracted more than \$40M in private loans and grants and created at least 500 new jobs.

Briefly describe how the broader public benefited from your project's activities.

Faculty from the center played a major role in bringing a new, large meat processor to the greater St. Louis area. Though the facility won't be operational until 2024, it will bring 1,400 new jobs to the state.

Using Technology to Solve Food Supply-Chain Issues

Project Director

Kimberly Shettlesworth

Organization

University of Missouri Columbia

Accession Number

7001822



University of Missouri FY21-- Using Technology to Solve Food Supply-Chain Issues

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Imagine this:

- Empty or lightly stocked grocery store shelves
- Food processing plants unable to operate for a lack of trained workers
- Farmers unable to receive parts for equipment
- Soaring input prices due to limited transportation containers

Supply chain issues impact agriculture and every American every day.

Two specific objectives (solution-based) that address these issues are 1) harness digital technologies to reduce the labor and number of entities between food producers and consumers 2) train farmers, farm workers, and others in the food system about how to use those technologies.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We retooled our meat team to focus on worker training for small and medium-sized processors. Two new, customized mobile training units will arrive in Missouri in March 2022. Those state-of-the-art units demonstrate the newest technologies. We have a waiting list of processors who want us to train local workers.

We expanded our work in precision agriculture to help farmers and processors employ digital technologies. The technologies require less mundane labor and give greater managerial flexibility. Think robots, drones, artificial intelligence and a connected food system. Our training in digital agriculture covers innovations in plant and animal sciences as well as food processing.

Our Ag Business and Policy Team helps farmers cope with supply chain issues and find possible paths to direct marketing. That shortens the supply chain and adds resiliency to the food system.

Briefly describe how your target audience benefited from your project's activities.

Our programs counseled 270+ new agri-entrepreneurs with the goal of increasing local food supplies. Those new companies captured more than \$30M in private loans and grants. Success stories include our partnership with 150 local meat processors that have doubled red meat under inspection in Missouri in the last 24 months tinyurl.com/2revj4ph. Another emerging

technology related effort is our PaddockTrac monitoring system and management app for grazing systems
<https://grazingwedge.missouri.edu/>

Briefly describe how the broader public benefited from your project's activities.

Local food supplies have shorter supply chains, and technology related advancements often lower labor requirements, while improving environmental outcomes.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

This effort is an emerging one, but will grow substantially with agri-technologies.

Critical Issue

Educational Attainment

Closing Out (end date 09/07/2023)

NC1207: Collaborative for Research on Food, Energy, and Water Education

Project Director

Christine Li

Organization

University of Missouri Columbia

Accession Number

1025066



Benefits of Community Gardens for Underserved Farmers for Food, Energy, and Water

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The community gardens aim to improve the quality of life for the people encountering modern urbanization. The community garden is an important component that benefits refugees who have resettled in the US. Some Burmese refugees have been involved in different types of gardening programs for purpose of saving their food expenses and promoting social and health benefits. This study is exploring the social benefits to Burmese refugees who are involving in three different types of urban gardening programs including home gardens, community gardens, and a mixture of garden models.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The goal of the food, water, energy education (FEW) research is to compare the effectiveness of each type of garden program in promoting better socialization for the Burmese refugee community. During fall 2021, semi-structured interviews (Louise & Alison, 1994) were used to explore more in-depth discussions with Burmese refugees to understand their level of participation and satisfaction of participating in three different types of gardens. Additionally, garden managers were interviewed to gain a better understanding of their support for the garden as well as interactions with Burmese gardeners. The participants including gardeners and organizers from Columbia MO, Kansas City, Kansas, and Kansas City, Missouri were recruited through their organizational websites and snowball sampling methods. Snowball sampling methods were used to recruit the Burmese Gardeners because it is difficult to get access to their population due to Covid 19. The qualitative data were analyzed by using Nvivo for coding and data analysis.

Briefly describe how your target audience benefited from your project's activities.

Gardens are popular in many nations in both urban and rural areas. Gardening provides local food for households, increases environmental awareness, and contributes to strengthening family ties. Community gardens also create a space for friends and neighbors to meet and maintain local community relationships (Schupp & Sharp, 2012). Through time they have

remained popular because they continue to provide multiple benefits ranging from open space, greenery, and food sources for local communities. The results of this study may identify the most effective model of community gardens which can be socially beneficial to Burmese refugee populations.

Briefly describe how the broader public benefited from your project's activities.

The interview from interviewing Burmese refugees (n = 18) and community garden leaders (n = 3) provided unique insights into several challenges and benefits associated with diverse types of community gardens, home gardens, and community services to assist new immigrants. The four themes emerging from the data showed how gardening was beneficial, how gardening was challenging in a new homeland, challenges with new social and agricultural norms, and how different community groups attempted to help the refugees assimilate.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

NA

Critical Issue

Environmental and Natural Resources

[Correlating Soil Health Parameters, Agriculture Production and Environmental Services Across A Diversity of Landscapes and Production Practices In Missouri](#)

Project Director

Tim Reinbott

Organization

University of Missouri Columbia

Accession Number

1024850



Soil Health Update

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Since the first pioneers tilled the prairies and cut down the forest the soil has degraded to the point where many of the environmental services including rapid water infiltration have been compromised. Although reducing tillage can slow down the soil deterioration, reversing this process and building back soil to its original state is critical. Soil scientists refer to the ability of the soil to deliver environmental services to its fullest potential as soil health which is composed of three broad categories: soil biology, soil chemical properties and soil physical properties. Each of these properties can be measured and changes in overall soil health documented from different crop and land management programs.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

During the past year we have learned that soil physical properties such as water stable aggregates (WSA) can change more quickly than we had previous thought from cover crop management. We found significant improvement in WSA (soil structure) within two years of adding cover crops. This is important since the physical properties of the soil are the end result of the enhancement of the biological and chemical properties. By improving WSA more water from rainfall and/or irrigation will infiltrate into the soil rather than running off and causing soil erosion and nutrient loss. Other parameters of soil health such as soil biology (microorganisms such as bacteria and fungi) also increase with cover crop use attributing to the increase in WSA. What we also found interesting was that the previous year crop makes a difference on the soil biology with some crops such as soybean having less soil biology the next spring compared to corn resulting in lower WSA values. The improvement of soil physical properties such as WSA results in an improvement in the soil environment which enhances soil biology and nutrient turnover (soil chemistry).

At Sanborn Field (the 3rd oldest continuous research center in the world) we were able to connect how soil health affects corn water status can be detected by drone imagery. This is exciting since this research will allow us detect differences in soil health with drone imagery.

Non-technical summary of your project:

The University of Missouri research centers are located across major agricultural areas in Missouri representing a diverse mix of landscapes, forests, animal production and crop production systems. These research centers represent 8 different Major Land Resource Areas (MLRA) as identified by the USDA-NRCS. This diversity of the landscape and types of agricultural production is an ideal resource to examine differences in soil health parameters and demonstrate how modern technology can be utilized to detect differences in soil health and the environmental services that changes in soil health provides. Soil health has been given much attention the past several years as it attempts to bring together the chemical, biological and physical properties of the soil to provide improved crop production and environmental services such as improved soil and water conservation and soil water availability. MU soil scientists have demonstrated that water stable aggregate stability (WSA) and soil organic carbon (SOC) are the best composite representing overall soil health since they are the end product of many other soil chemical, biological and physical properties. The MU research centers are the home of many long-term research projects including the 3rd oldest in the world, Sanborn Field, which was established in 1888 and continues to have many of the same treatments of crop rotation and fertility that were originally established. Other long and medium-term studies have been established (10-25 years) which examine crop rotation, crop species, tillage, cover crops, manure, and fertility in grain, fiber, forage, and timber production systems. In addition, studies have recently been established (less than 5 years) that address many of these same questions giving a perspective on the short and long-term effects of those management practices. These short and long-term research projects provide an ideal opportunity to correlate soil health and crop production and also utilize the use of technology including drones to document the correlation of crop health and yield. Being able to detect differences in soil health based upon crop health is novel and can lead to a better understanding of soil health and how changes in crop management can affect soil health. Environmental services provided by differences in soil health can also be documented across different environments and cropping systems.

Briefly describe how your target audience benefited from your project's activities.

Farmers are interested in improving soil health but the benefits are not totally clear. Soil scientists are able to detect far more differences in soil health parameters than they can currently accurately interpret. This is not unusual for a newer technology and concept. For example, global positioning technology became available in the early 1990's but it took 20 years or longer for farmers and the agricultural industry to fully adopt and benefit from the technology. Soil health can be improved by several means and cover crops are one of those means. However, there are many questions to what extent how cover crops improve soil health and how they must be managed to optimize their benefit. The bottom line for adoption of cover crops and building soil health is profitability. If farmers are going to commit to improving soil health with cover crops and other management decisions, then knowing they those practices are beneficial not only to the environment but also to profitability are critical. A commitment to cover crops and building soil health is time consuming during the busiest times of the year, planting and harvest. Adding an additional step to either planting or terminating cover crops can be a pitfall of using them unless if a direct economic benefit can be demonstrated. Data gathered from this past years demonstrates that proper management of cover crops can improve soil health and environmental services resulting in more efficient yield.

Utilizing technology such as drone imagery on plants to access soil health quality help farmers to quickly and inexpensively compare and contrast how different crop and soil management techniques affect soil health and crop status. This allows farmers to determine the most environmental and economically sustainable practices on their farm.

Briefly describe how the broader public benefited from your project's activities.

The health of the community is tied to the health of the soil. If soils are poor quality and rainfall and soil and nutrients run off into the creeks and water impoundments then the communities health suffers. With poor soil health, drinking water is compromised and takes more dollars for refinement to remove nitrates and other contaminants. If streams and water reservoirs are filled with soil and other runoff then recreation including fishing and boating is compromised. By helping farmers and land managers to economically change soil and crop management to improve soil health, soil structure is improved resulting in less water, nutrient and soil runoff and more is soaked into the soil.

Project Director

Kimberly Shettlesworth

Organization

University of Missouri Columbia

Accession Number

7001823



University of Missouri FY21 Results-- Fall Risk Reduction Programs Help Adults Remain Living and Thriving Independently

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The Missouri Department of Health and Senior Services (DHSS) reports “falls” as the leading cause of injury deaths for people 65 and older, resulting in significant physical, personal, social and economic burdens. Missouri has the highest rate of injuries due to falls and the 4th highest prevalence of falls nationally. The Centers for Disease Control (CDC) estimates the economic cost of falls to Missouri is nearly \$883 million annually.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Falls risk reduction programs are needed for Missouri’s large and growing older adult population. Supporting and offering fall prevention programs through MU Extension and our partner network allows us to engage more older adults in evidence-based fall prevention interventions which decrease falling, the fear of falling, increase activity levels, and improve outlook on life. These short-term outcomes often lead to long-term benefits, such as increased independence, longevity, and reduced economic burden.

In 2021, this project offered 51 workshops, by 50 instructors, enrolling 461 participants in two safe, effective, community-based programs proven to decrease risk factors related to falls. Through this project we have reduced the percentage of older adults who report falling in Missouri, reduced the number of injuries related to falls, decreased the number of older adults who fear falling, reduced medical care costs, and increased the number of older adults meeting the physical activity guidelines.

Our goal was to increase the number of older adults and adults with disabilities participating in comprehensive evidence-based interventions such as a Matter of Balance and Tai Chi for Arthritis for Fall Prevention to reduce falls and fall risk. By increasing the number of older adults participating in evidence-based falls reduction programs, our program has substantial direct and indirect benefits on Missourians’ healthcare costs and quality of life. Although there is more work to do, in Fiscal Year 2021 we have made significant progress toward our goal of reducing the percentage of adults who report falling in Missouri to 25% from 27.3%.

Briefly describe how your target audience benefited from your project's activities.

The target audience for this project is adults and adults with disabilities 65 years old and older who want to improve their physical and mental health. This audience is significantly more at risk for falls and negative health outcomes of being sedentary than younger healthy adults. Participants benefited by increased total physical activity, increased physical activity self-efficacy, a reduced fear of falling, a decreased risk for falling, and an improved perception of general health. Ultimately, these outcomes may result in an improve quality of life, independence, and longevity. Finally, there was a social benefit to participants who interacted with instructors and other participants during workshops. Although we didn’t measure this, multiple comments by participants suggested that the social interaction may have been as important as the physical improvements. In similar programs, such as the Stay Strong Stay Healthy exercise program, we have measured the social and mental changes associated with community-based exercise programs and have found the changes are positive and significant. We can likely conclude that social and mental benefits are also present in the current project.

Briefly describe how the broader public benefited from your project's activities.

Most apparently, the broader public benefited from the reduced healthcare costs associated with fewer falls. The economic impact of falls is significant and has been quantified by the CDC as nearly \$883 million annually to Missouri. Less apparently, there are additional healthcare cost savings when older adults maintain general health longer through increases in physical

activity. By increasing access to evidence-based physical activity interventions, such as those implemented in this project (Matter of Balance; Tai Chi for Arthritis for Fall Prevention), our participants not only reduced their risk for falls but they improved their overall physical fitness. The negative health outcomes of low physical fitness and being sedentary has been well documented. Although it is difficult to monetize the additional savings of improved physical fitness, it is certainly significant.

Increasing the number of older adults participating in physical activity can lead to a more engaged community and a broader public appreciation for the benefits of physical activity and maintaining good health as we age. Anecdotally, multiple participants were recruited from others already enjoying the benefits of our programs. It is logical to think that the message of physical activity and health was permeated throughout the broader public as participants spoke with friends and family members about their experience and improvements.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Only minor challenges were encountered. The Matter of Balance Program requires two instructors to teach each class, which can be a barrier at times especially in very rural areas of Missouri. However, our partnerships with Oasis and the AAA's have helped us overcome this barrier by providing co-instructors. The Administration for Community Living grant afforded us the opportunity to train over 20 instructors in Tai Chi for Arthritis and Fall prevention from MU extension and an additional 20 instructors from community partners over the course of three years. MU extension state specialists conducted fidelity checks for instructors of these programs and provided constructive feedback on program delivery. Results from this project have been shared at the local level through county impact reports. Results have been shared nationally to the Administration for Community Living and National Council on Aging through grant reports.

Future endeavors include new partnerships, increasing capacity, and exploring sustainable funding mechanisms. New partnerships have developed with veteran and agriculture program leaders that will help us reach adults in need of programs and services that address physical and mental health. These partnerships will include securing funding to increase the number of trained instructors across the state. The Oasis institute and MU Extension also plan to apply for another grant from the Administration for Community living to establish robust networks with the goal of creating sustainable funding mechanisms for fall prevention program efforts.

Stay Strong, Stay Healthy: Understanding and Expanding the Benefit of Resistance Training for Older Adults

Project Director

Kimberly Shettlesworth

Organization

University of Missouri Columbia

Accession Number

7000158



University of Missouri FY21 Results-- Stay Strong, Stay Healthy (SSSH)

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Healthy aging encompasses physical and mental health as well as social engagement and is not solely the absence of disease (Rowe & Kahn, 1997). However, many older adults are not engaging in activities to support these important aspects of healthy aging, which is detrimental to individual and economic health. Not remaining physically and socially active can impact overall quality of life and can result in significant costs (cost of falls in MO is \$883,000,000) (<https://www.cdc.gov/falls/data/fall-cost.html>) and hardships on communities.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Community based resistance training programs like SSSH delivered through MU Extension help address these major aspects of healthy aging. With virtual, hybrid, and in person delivery options, participants from across Missouri (as well as other states) participated in strength training exercises twice per week for 8 weeks which focused on maintaining mobility and preventing disability and falls. MU Extension trained instructors reached more than 300 older adults in 2021. Together with three other states, over 500 older adults participated in the SSSH program. Working collectively, SSSH was consistently offered virtually throughout 2021. The virtual option engaged older adults who normally would not have had access to exercise instruction or social interaction, especially during the COVID pandemic. In addition, virtual programming allowed older adults to maintain their exercise schedule despite the barriers related to COVID, travel, or weather. Increasing options for older adults to remain active and socialize (weather in person or virtually) has positively impacted older adults' health and quality of life. Research on the effectiveness of the SSSH program in the short and long term was completed in fiscal year 2021. Upon follow-up, participants maintained or increased their physical activity 3 and 12 months following the initial 8-week SSSH program. These results were recently presented at the Central States American College of Sports Medicine conference. Continued research consistently illustrates the efficacy of SSSH on the quality of life of older adults which ultimately improves the greater community.

Briefly describe how your target audience benefited from your project's activities.

Greater than 90% of 280 older adult participants that completed the program reported they increased their knowledge about strength training and exercise, met strength training and flexibility recommendations, felt their overall health improved, and felt physically stronger. In addition, greater than 70% of participants improved 5 out of 5 physical health assessments which included flexibility, strength, and balance tests. The greatest improvements were seen in the dynamic balance and agility test (80%), and lower body strength and balance test (85%). An additional benefit was that participants were encouraged to engage in other types of physical activity such as walking or swimming. Many participants quoted how the group exercise program made it easier for them to socialize and the group encouraged them to keep exercising and taking care of their health. Most participants indicated they were not concerned with falling during daily tasks after the program. Strength, balance, activity, and remaining socially active help prevent falls, improve mental health, and keep older adults living independently longer (McPhee et al., 2016). These are all factors that SSSH has shown to positively influence.

Briefly describe how the broader public benefited from your project's activities.

Extension's Stay Strong, Stay Healthy program helps participants increase their ability to complete activities of daily living, physical activity, and improve strength, balance and flexibility, resulting in reduced risk for falls, better overall health and greater independence. These health benefits decrease the likelihood of a participant losing independence and entering a care facility, which costs on average \$58,000 per year in Missouri. The economic savings is significant, especially for smaller less affluent communities. SSSH helps older adults remain engaged and independently contributing to society and their communities. One unexpected outcome was that older adults became more familiar with utilizing technology. In the future, these older adults are likely more willing to participate in online programs such as SSSH.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Stay Strong, Stay Healthy instructors continue to work together to enhance their online teaching skills for this course. Opportunities exist for training field and instructors from other states on best practices for how to reach older adult audiences through online programming and teach them how to utilize technology to access evidence-based programs. County level faculty have communicated their efforts and successes with the SSSH program to local partners and through county impact reports. The SSSH team plans to expand to at least one new state, conduct further research to expand the evidence basis behind the program, and continue speaking with third party payors and health care providers about becoming part of their networks and services. Finally, the SSSH team will continue to conduct and publish peer reviewed research to improve the impact of SSSH on older adults' health. A randomized control trial on investigating the effectiveness of "virtual" SSSH is in the planning stage.

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Critical Issue

Healthy Futures

[Development of Advanced Metabolomics Technologies and their Application to Better Understand Plant Metabolism](#)

Project Director

Lloyd Sumner

Organization

University of Missouri Columbia

Accession Number

1026451



Report 2021: Development of Advanced Metabolomics Technologies and their Application to Better Understand Plant Metabolism

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The primary goal of this proposal is to develop a globally recognized program in plant and agricultural metabolomics at the University of Missouri. This program involves both the co-development of Dr. Lloyd W. Sumner's personal research program and the development of a new University of Missouri Metabolomics Core Facility that will provide metabolomics services to a large number of colleagues within the College of Agriculture, Food and Natural Resources (CAFNR).

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Non-technical summary of your project:

We propose to move an established metabolomics research program to the University of Missouri/MU and create a new metabolomics core facility that will provide support to agricultural research efforts at the University of Missouri. We then plan to expand these into a state, regional, national and international facility. Metabolomics can be summarized as the parallel analyses of large numbers of metabolites. Metabolites are the building blocks and energy sources necessary for life. Examples include sugars, fatty acids, amino acids and flavonoids. Metabolites are critical in plant growth, yield, quality and defense. Plants can't run away and they defend themselves using chemical warfare through the synthesis and secretion defense compounds to thwart herbivorous insects/animals and microbial pathogens. Plants and animals can't tell us how they 'feel' or how they are responding, but the analyses of large numbers of metabolites can. Thus, I often compare metabolomics analyses to a doctor's visit where the patient is sent to the lab for analyses to aid in the diagnosis. The clinical lab generally analyses 1 to 30 components; e.g. testing glucose levels to diagnose diabetes. However, metabolomics involves profiling hundreds to thousands of metabolite features which provides a much higher resolution biochemical phenotype that can be used as a diagnostic or mechanistic tool to better understand health, growth and quality in agriculturally relevant biological systems. This is essentially precision medicine for plant and animals. Current metabolomics approaches are providing substantial novel new information and understanding, but metabolomics or large-scale analyses of metabolites is not comprehensive. Estimates suggest that there are likely 150,000 metabolites in any individual plant species. Thus, modern metabolomics is far from comprehensive and there is still great scientific promise if we can further expand our depth-of-coverage. Thus, we are simultaneously pushing forward the scientific potential of metabolomics by continually developing new instrumentation and tools. This results in a push-pull method of success where current biological questions push the technology development, and the technology development enables or pulls new biological queries.

Briefly describe how your target audience benefited from your project's activities.

A new MU Metabolomics Center has been successfully created and is composed of the MU Metabolomics Core Facility and the Sumner Research lab that operate in an inter-related mechanism.

The Sumner lab develops advanced metabolomics technologies to further propel the scientific promise of metabolomics and elucidates the biosynthetic pathways of plant specialized metabolic pathways. These have included UHPLC-MS-SPE-NMR, UHPLC-MS-SPE-MicroED and UHPLC-timsTOF-MS/MS. These sophisticated instrumental ensembles provide higher-throughput metabolites identifications and greater depth-of-coverage.

The MU Metabolomics Core facility serves as a collaborative organization for the application of metabolomics in broad range of mammalian and agriculturally relevant species. The core facility processes approximately 2,000 analyses per year. Access to metabolomics technologies and applications has benefited a large number of collaborating faculty, staff and students locally, nationally and internationally. It is difficult to describe the success of all projects supported through this initiative. Thus, we include lists of collaborating faculty as well as agriculturally related published outcomes for 2020-2021 below.

The Metabolomics Center is in Phase 3 of 3 of its strategic development plan. A new Waters UHPLC-triple quadrupole mass spectrometer was purchased with MU institutional funds and installed in the fall of 2021. This new instrument replaces a similar but 13 year old instrument that was utilized for targeted metabolite analyses; i.e. plant hormones, animal drugs, animal feed, etc. The newer instrument has better sensitivity and is made available to collaborators through our MU Metabolomics Core.

Agriculture Related Collaborating Faculty:

Jim Amos-Landgraf (MU Vet Path): metabolomics of cancer in animal models

Michael Chapman (MU Biochem): MicroED for metabolite identification

Richard Dixon (U North Texas): plant lignin biosynthesis and specialized metabolism

David W. Emerich (MU BioChem): metabolomics of senescing soybean nodules

William Folk (MU Biochem): Metabolomics of *Harpagophytum procumbens*

Antje Heese (MU Biochem): plant metabolite transport

Arthur D. Jones (Michigan State U): identification of switchgrass saponins

Trupti Joshi (MU SOM Bioinfo): Metabolomics computational tools and databases

Chung-Ho Lin (MU Agroforestry): Walnut and Elderberry metabolomics

Abraham Koo (MU Biochem): jasmonic acid signaling and plant hormone analyses

Dennis Luhban (MU Biochem): metabolomics of botanicals

Robert Last (Michigan State U): identification of switchgrass saponins

Carol Lorenzen (Oregon State Univ): Metabolomics of Beef for quality assessment and consumer preference

David Mendoza-Cozatl (Plant Science): Metabolomics of phloem and metals

Basil Nikolau (ISU): Metabolomics for plant functional genomics

Paula McSteen (MU Plant Sci): Plant hormone analyses of plant

Brent Nannenga (Arizona State U): MicoED of plant metabolites

Michael J. Petris (MU Biochem): influence of copper transporters on nutrition and metabolism

Ronald Revord (MU Natural Resources) Elderberry genomics

Charles Rohla (Noble/OK): Metabolomics of Pecan and resistance to the fungal pathogen scab

Craig A. Schenck (MU Biochemistry) metabolomics of plant acyl sugars and specialized metabolism

Gary Stacey (MU Biochem & Plant Sciences): Plant hormone analyses and single cell metabolomics

Minviluz (Bing) Stacey (MU Plant Sciences): Metabolomics of soybean seed filling and amino acid composition

John J. Tanner (MU Biochem): proline metabolism

Andrew Thomas (MU Southwest Research Center) and Michael Greenief (MU Chemistry) Elderberry production and metabolism

Shuqun Zhang (MU Biochem): identification of plant signaling molecules

Gary A. Weisman (MU Biochem): ATP receptors and nutrition

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Briefly describe how the broader public benefited from your project's activities.

Benefits and products from Specific Aim #1 include a fully functional Metabolomics Center and Research Program located at the Univ. of Missouri, Columbia and in the Bond Life Sciences Center, Columbia, MO. The establishment and growth of the MU Metabolomics program has brought new metabolomics technologies, instrumentation and expertise to MU and agricultural faculty that enhance agricultural research related to plants, microbes and animal systems. The MU Metabolomics Center has enabled novel studies and experiments across a broad realm of agricultural sciences and makes the state of Missouri more competitive and successful. The expected products include a substantial number of scholarly publications, presentations, potential patent applications and new varieties as noted above for 2020-2021.

Benefits and products from Specific Aim #2 include the discovery and elucidation of multiple new genes and enzymes involved in the biosynthesis of triterpene saponins in legumes. Saponins have historically been considered as antinutrients, and a better understanding of their biosynthetic pathway will enable metabolic engineering of novel alfalfa varieties with improved fitness and nutrition. Similarly, we identified several potential antifungal compounds in pecan that might resistance to the major fungal pathogen pecan scab. These natural antifungal compounds have further benefits as organic antifungal treatments and metabolic engineering of pecan varieties with superior resistance properties.

Benefits and products from Specific Aim #3 include the development of novel integrated technologies that address the number one grand challenge in metabolomics which is higher throughput metabolite identification. These newer technologies are being applied to ongoing applications in the Sumner Research Lab and the MU Metabolomics Center to increase the biological content and depth-of-coverage of our metabolomics experiments. The research community already enjoys significant success with metabolomics and these advanced technologies will further enhance the scientific promise of metabolomics.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

There have been no major changes in the project. However, we do face a substantial challenge in recruiting and retaining quality staff at this time. Industry is currently hiring at an impressive rate, and they are luring our staff away by offering much larger salaries that are approximately twice that of ours. This makes recruiting and retention more challenging. MU has responded with recent salary increases for our Metabolomics Core staff, but these are still much lower than the current industry rates. Thus, we expect that this will be an ongoing challenge.

NC1023: Engineering for food safety and quality

Project Director

Bongkosh Vardhanabhuti

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University of Missouri Columbia

Accession Number

1023931



Developing protein-based ingredients with improved functional properties

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

With clean label trend, there is a need to develop biopolymer-based ingredients with improved functional properties. Recently, there has been increasing interest in Pickering stabilization properties of protein gels or particles. The majority of the studies focuses on emulsions while limited knowledge exists for Pickering foams.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Whey protein concentrate (WPC) is one of the major ingredients used in foods. WPC is an excellent foaming agent but it lacks foam stabilization property. Here, we employed processing methods including heating and ultrasound to develop WPC gel particles (WPC-P) with improved foam stability. The effects of protein concentration, pH, heating and sonication conditions on the physical and foaming properties WPC-P were investigated. Finally, we have identified the processing conditions that led to

improved foam stability. Results will be used to put together a multistate proposal to understand the mechanism behind Pickering foam and how to develop other biopolymer-based ingredients with improved foaming properties for clean label application.

Non-technical summary of your project:

The project at University of Missouri aims at developing fundamental knowledge that can be applied to create novel food ingredients and improve functional properties of existing food ingredients. Our approach focuses on novel extraction and ingredient interactions to optimize the properties of food ingredients when applied in food applications. In addition, we aim to determine factors that influence the digestion properties and bioavailability of nutrients and bioactive compounds. Our overall goal is to design food products having desirable quality and enhanced health benefits.

Briefly describe how your target audience benefited from your project's activities.

Research results will be presented at American Dairy Science Association Meeting in June 2022.

Briefly describe how the broader public benefited from your project's activities.

The dairy industry could apply the technology to develop protein-based ingredients for clean label applications. Fundamental knowledge gained can be applied to other protein ingredients.

Critical Issue

Social Justice

[Recovery Friendly Workplaces in Missouri](#)

Project Director

Kimberly Shettlesworth

Organization

University of Missouri Columbia

Accession Number

7001821



University of Missouri FY21 Results-- Recovery Friendly Workplaces in Missouri

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Missouri's rural counties are suffering from what has been referred to as "deaths of despair" – drug overdose, suicide, liver disease, and respiratory disease (from smoking). Despite millions of dollars set aside for opioid-related activities in recent years, Missouri experienced a significant increase in drug overdose deaths (2018). There are multiple, interrelated, and deeply-rooted social and economic determinants of the opioid overdose crisis. Not only is the opioid crisis a public health issue, but it is also an increasingly economic and workforce development issue. Research has demonstrated the significant economic and workforce impacts that have been caused by the opioid crisis. If a community does not have a healthy workforce and economic infrastructure, it is challenging to be a healthy and prosperous community.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Goal and objectives:

Goal: Create capacity and develop the framework and guidelines for training and technical assistance to businesses and labor organizations to be designated as Recovery-Friendly Workplaces (RFW).

Obj. 1: By December 31, 2020, conduct an economic analysis and literature review to disseminate across Extension (8) regions.

Obj. 2: By August 31, 2022, provide at least eight (8) convenings to employers, businesses & communities on Recovery Friendly Workplaces.

Obj. 3: By August 31, 2022, create guidelines for businesses and organizations to become designated as Recovery-Friendly Workplaces.

Briefly describe how your target audience benefited from your project's activities.

Employers and businesses – businesses and organizations will increase their understanding about substance misuse, behavioral health, and their connection to workforce challenges through trainings, a series of educational programs, and the creation and sharing of resources; create a network of businesses and organizations interested in creating healthy and safe work environments where employers, employees, and communities can collaborate to create positive change, eliminate stigma, and support recovery; and, retain a healthier, more productive, and more motivated workforce through the delivery of health and safety programs and practices.

Briefly describe how the broader public benefited from your project's activities.

In January and February, the Rural Opioid Technical Assistance (ROTA) team held five community conversations in every workforce region in Missouri. Local community leaders, workforce, business representatives, and social service agencies came together to discuss the Recovery Friendly Workplace (RFW) initiative and local community needs for training, technical assistance, and support. The ROTA team and Extension faculty in Labor and Workforce Development presented an overview of the Recovery Friendly Workplace program, explaining what it is, how communities might benefit from such programs, disseminated results of the Missouri State Chamber of Commerce Employer Survey that justified a need for workplace training, detailed current activities, and discussed next steps.

Feedback from one community indicated that several local businesses were hesitant to hire employees in recovery and are now offering interviews and indicating a new openness to changing their hiring practices. Pre- and post-surveys completed by participants showed a favorable response indicating the attendees would highly recommend the event to peers and colleagues and felt that the conversations were valuable to the development of Recovery Friendly Workplaces. ROTA staff are incorporating the needs identified by local communities into trainings and blogs and are meeting to plan a statewide follow-up meeting to address findings and feature RFW workforce leaders.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

COVID-19 impeded opportunities for us to meet in person for the community conversations. With the Omicron variant, we were able to pivot quickly and be able to accomplish our goals. Next steps include a statewide convening to launch additional educational resources and learning opportunities for organizations to become designated as Recovery Friendly.

[Missouri 4-H Career Readiness Program \(Juntos and Youth Futures College within Reach\)](#)

Project Director

Kimberly Shettlesworth

Organization

University of Missouri Columbia

Accession Number

7001656



[University of Missouri FY21 Results--4-H Youth Futures College within Reach](#)

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

MU Extension has set a goal that 60% of adults in Missouri have a certificate or degree by 2025. According to the Missouri Economic Research and Information Center, Missouri employers report that they are experiencing employee shortcomings in areas such as work habits, communication, problem solving and teamwork (soft skills). Missouri 4-H has committed to increasing engagement with students by providing educational opportunities while also introducing them to the university and the value of higher education.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Missouri 4-H is taking a twofold approach to college and career readiness.

First, college and career readiness pieces are woven into our regular programming even at the youngest ages. This can be as simple as discussing possible careers in enjoyed project areas and by working on soft skills, such as interacting with others and learning to express ideas.

Secondly, the Youth Futures program offers youth who face obstacles that might make success seem out of reach the opportunity to see college as an attainable goal.

Missouri 4-H Youth Futures is an extensive college orientation program that promotes college as an attainable goal for high school youth who may not necessarily consider college as an option, such as first-generation college students. The goal of this program is to help youth prepare for, enroll in and graduate from college.

Components of Youth Futures:

- Mentoring throughout the year

- Parenting sessions to equip parents with skills to help their youth

- The Youth Futures Experience where youth learn about:
 - Academic programs

 - Student life activities

 - College survival skills

- Rising Seniors Weekend

- Transitioning Seniors Conference

Also new this past year, 4-H Youth Futures SPIN (special interest) Club Mini-grants were given to 34 groups in Missouri. Through a generous grant from Anthem Foundation, the Missouri 4 H Foundation offers mini-grants of \$500 to \$5000 to implement 4-H Youth Futures SPIN Clubs across the state. These clubs offer a six-week college and career readiness program for Missouri youth to begin learning about higher education options; the steps necessary to enroll in college and what they can do now to prepare; how to maintain a healthy lifestyle; and exploring possible majors and career options.

Briefly describe how your target audience benefited from your project's activities.

Results:

34 sites received funding for SPIN Clubs

124 youth were involved in year-long Youth Futures Clubs

Over 1,350 youth have/will be involved in the Youth Futures Spin Clubs

Youth in the SPIN clubs learned: career exploration skills, college research skills, financial skills, interview skills, job seeking skills including resume writing, application and searching, and high school completion skills including course planning, study skills and stress management. Youth were able to experience colleges and careers through tours and trips. Youth were able to explore interests in science, health, nutrition, agriculture, and more.

Briefly describe how the broader public benefited from your project's activities.

Because of Missouri 4-H's programming in college and career readiness, youth begin exploring careers they might enjoy at an early age and practicing the soft skills needed in the workplace. As a result of the Youth Futures program, many youth who would otherwise be overlooked are given the support they need to succeed and become contributors to our workforce and economy.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Major changes:

In 2021, the SPIN Club Program Mini grants were introduced.

Problems encountered:

COVID Restrictions continued to have a major impact on programing. Some students and schools had less accessibility because of a lack of internet access

Opportunities for training and professional development provided:

Youth Futures College within Reach Spin Club training was provided to staff implementing SPIN Clubs.

How results are disseminated:

- o Annual Report

- o Youth Futures Conference with Stakeholders in attendance

- o Websites and facebook

New details for program during the next reporting period:

Increasing Juntos programing and training. Continuing support for Youth Futures with the National 4-H Mentoring Program Grant. Continuing support for Youth Futures SPIN Club Mini-grant with existing funds.

Critical Issue

Sustainable Agriculture

[Discovery of genetic resources and improvement of drought tolerance in soybean](#)

Project Director

Henry Nguyen

Organization

University of Missouri Columbia

Accession Number

1025525

★ New germplasm lines were identified for drought tolerance through screening for root system architecture and canopy wilting traits in two diverse soybean mapping populations.

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Drought is the most important factor effecting crop productivity in Missouri and limits production in large parts of the U.S. and the world. Drought causes severe reductions in average yields on a regional scale and can have devastating effects at the farm level. Most of the U.S. soybean acreage is non-irrigated and farmers are affected by drought annually. Varieties and germplasm need to be identified that show less yield loss from drought. Traits related to drought tolerance such root system architecture or greater water use efficiency should be identified and incorporated into elite breeding lines to reduce yield losses when water for optimum yield is inadequate. Our long-term goal is to improve soybean productivity under water deficits by providing drought tolerant germplasm lines and marker-assisted selection strategies.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

1. A core set of ~500 diverse soybean germplasm is being evaluated for root system architecture (RSA) in greenhouse conditions. Six biological replications were finished, and we are planning to perform six more replications in the coming months.
2. We are evaluating a core set of ~450 diverse soybean germplasm for canopy wilting under field conditions. These new genetic resources will be utilized for gene and marker discovery towards crop improvement programs.
3. Two drought tolerance loci were incorporated into an elite line and yield trial showed the gene incorporation lines had 12% yield advantage under rainfed conditions.

Non-technical summary of your project:

Limited water availability is the major abiotic stress factor affecting yield and stability of crop production. Several intensive crop production management strategies have been developed, but still drought is a major constraint in crop production and food security. Only below 10 percent of U.S. soybean growing acreages are irrigated and to sustain maximum soybean yield dissection of complex drought traits is the key factor. Improvement of soybean productivity with limited moisture through the modern tools of plant breeding and biotechnology provide more sustainable approach to tolerate drought. Screening for the natural genetic variation in key drought tolerance traits and characterization of those traits utilizing new genomic technologies will help discover potential genes and DNA markers. These genomic discoveries are increasingly important in crop improvement through next generation breeding programs to develop drought tolerant soybeans.

Briefly describe how your target audience benefited from your project's activities.

Our target audience are Farmers, Breeders, Researchers. The outcomes from our project will provide breeders with new germplasm resources for drought tolerance (lines for crossing and molecular markers for selection). The drought tolerance genes identified from this project could provide researchers information about how drought tolerant is regulated in soybean. The drought tolerant soybean varieties developed by soybean breeders with the assistance of our outcomes will ultimately benefit farmers in their soybean production.

Briefly describe how the broader public benefited from your project's activities.

The outcome from this project will help researchers, private/public breeders, and producers in dealing with reduced yields associated with drought stress. Drought-tolerant lines developed so far has shown the potential to increase yields by >10 bu/ac under flooding stress. Efforts are on-going to identify more genetic resources and stack them into the elite germplasm pool to develop stronger tolerance which leads to greater yield protection. The outcomes will help maintain the leading position of the US agriculture in soybean breeding and production in the world.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Major challenge is the unpredicted precipitations in 2021 growing season. This challenge may result in unsuccessful evaluation of drought responses of soybean lines in the field. To overcome this challenge, we will plant the diverse set at multiple locations to increase the chance of appearance of drought conditions.

Factors Influencing Digestion and Nutrient Use For Growth, Lactation, Reproduction and Development in Ruminants

Project Director

Derek Brake

Organization

University of Missouri Columbia

Accession Number

1023933



Effects of corn processing and cattle size on total tract digestion and energy and nitrogen balance

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The objective of this work was to measure nutrient digestion and energy balance across different corn processing treatments and sizes of cattle, and to evaluate the digestible to metabolizable energy relationship in cattle of different sizes fed diets to relatively high levels of energy intake. We hypothesized that nutrient and energy balance would be impacted differently between physical and chemical forms of corn processing and cattle size, and that energy intake more so than cattle size would influence energy available from different forms of processed corn.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

This study used 18 calves (295 ± 29 kg) and 18 yearlings (521 ± 29 kg) fed whole, cracked or steam-flaked corn (SFC) to evaluate nutrient digestion and energy balance across different types of processed corn and sizes of cattle. Cattle were fed a diet comprised of 75% corn (DM-basis) from whole, cracked or SFC to 2.5-times maintenance energy requirements. Subsequently, cattle were placed in individual stanchions and urine and feces was collected together with measures of gas production via indirect calorimetry. Data were analyzed using the MIXED procedure of SAS. There was no interaction of corn processing and cattle size ($P \geq 0.40$). Time spent ruminating (min/d) and rumination rate (min/kg DM intake; DMI) was not affected by corn processing or cattle size. Eating rate (min/kg DMI) was faster ($P < 0.01$) for yearlings compared to calves. Total tract starch digestion was greatest ($P = 0.01$) for cattle fed SFC (97.5%), intermediate in cattle fed cracked (92.4%) and least in cattle fed whole corn (89.5%). Dietary digestible energy and metabolizable energy (Mcal/kg DMI) were greater ($P \leq 0.05$) for cattle fed SFC compared to cracked or whole. A greater proportion of digestible energy was lost to heat production ($P = 0.01$) in cattle fed whole corn compared to cracked and tended to be greater ($P = 0.08$) in cattle fed SFC than cracked. Conversion of digestible energy to metabolizable energy in this study was more closely related to a dynamic model used to estimate metabolizable energy of feeds to dairy cows than to a linear model used to predict metabolizable energy of feeds to beef cattle. If library estimates of net energy for maintenance are correct, then retained energy (Mcal/d) should have been similar between each type of processed corn; however, retained energy was greater ($P < 0.01$) for cattle fed cracked compared to whole corn and tended to be greater ($P = 0.06$) compared to SFC. Yet, observed amounts of net energy based on measures of retained energy were not different ($P \geq 0.60$) between cracked and SFC. Nitrogen balance was not affected ($P \geq 0.30$) by corn processing or cattle size, although cattle fed cracked had numerically greater ($P \leq 0.35$) N retention. These data indicate that physical processing of corn provides greater net energy to cattle in comparison to whole corn.

Non-technical summary of your project:

Meat, milk and wool produced from ruminants account for more than half of the value of animal products produced annually in the United States. Feed is fermented in the ruminant stomach prior to absorption. Fermentation allows ruminants to be fed diets that are often indigestible to humans. As a result, food produced from ruminants adds to the available human food resources rather than competes for food resources like most nonruminant animal production systems (e.g., poultry, swine). However, fermentation alters the nutrients absorbed in comparison to the nutrient composition of the diet prior to ingestion. Correspondingly, little is known about how altered nutrient flows influences postgastric digestion of nutrients. Like nonruminants, a large amount of nutrients are digested and absorbed in the small intestines of ruminants. Yet, small intestinal digestion of starch is limited in ruminants compared to nonruminants. Detection of nutrients in the small intestine of animals likely plays an important role in regulating nutrient digestion in all animals. Additionally, nutrient detection in the small intestine of ruminants may have even greater impacts on nutrient digestion in comparison to nonruminants, because orofacial detection of nutrients (lingual taste, smell) differ from postgastric nutrients detected at the major site of digestion (i.e., the small intestine) in ruminants. A greater understanding of the role of nutrient detection in small intestine on nutrient

digestion in ruminants may provide a strong platform for synthesis of novel feeding strategies and technologies that can increase the efficiency of meat, milk and wool production. Furthermore, data from this project could help to reduce environmental impacts of food production from ruminants and improve animal health. Additionally, knowledge of nutrient to nutrient interactions in ruminants could provide a basis for development of therapies important to mitigating a number of different metabolic and eating disorders.

Briefly describe how your target audience benefited from your project's activities.

Current corn prices are very high in comparison to the previous 20 year average price. The work from this project provides farmers and ranchers with data that allow them to determine the value of corn processing when feeding growing or lactating cattle. Ultimately, these data are critically important to helping farmers and ranchers to optimize beef and milk production costs in the face of large corn prices.

Briefly describe how the broader public benefited from your project's activities.

These data provide information important to allowing cattle producers to optimize beef and milk production by understanding the impacts of processing corn grain prior to feeding cattle. In optimizing costs for beef and milk production there is opportunity to allow greater access to high-quality protein because lower production costs can translate to lower purchase prices for the broader public. Additionally, these data also provide important insight to how processing of corn grain influences environmentally reactive emissions (e.g., carbon dioxide, methane, ammonia) associated with beef or milk production. Ultimately, this information can be used to allow farmers and ranchers to simultaneously produce more sustainable and affordable beef and milk, which is currently of large importance because of large feed prices.

[Missouri Farm and Ranch Stress Programs and Mental Health Resources](#)

Project Director

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Organization

University of Missouri Columbia

Accession Number

7001829



University of Missouri FY21 Results--MU Extension Farm and Ranch Stress Programs

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Rural Missouri is facing a mental health crisis, fueled by growing economic and mental health challenges that are severely affecting the agricultural community. These stressors have contributed to substantial and critical mental health issues among rural Missourians, especially farmers and ranchers. Despite the clear mental health needs of rural Missourians, tools and support are often limited.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Through MU Extension's Farm and Ranch Stress Programs and using field tested workshops, rural participants were equipped with the tools to improve their own mental health, were connected to useful mental health resources and were given free access to one-on-one telepsychology (online therapy) sessions.

Briefly describe how your target audience benefited from your project's activities.

In 2021, Missouri Mental Health Programs provided a total value of \$54,790 to educate 1,112 participants in 66 classes, as represented in the following outcomes.

- o educated 368 participants in eleven (11) workshops at a value of \$9,200 and provided the 3 simple steps anyone can learn to help save a life from suicide.

Eleven (11)
\$5,240.

workshops prepared 131 participants with stress management training at a value of

equipped 593 participants with the skills to reach out and provide initial support to someone who may be developing a mental health or substance misuse issue and connected them to the appropriate care through 44 workshops at a value of \$29,650.

University of Missouri Psychological Services Clinic for Farmers, Ranchers & Rural Missourians offered brief, effective (evidence-informed) services tailored to help reduce the common stresses that farmers, ranchers and community members are facing. Rural MHT services began in late 2020 and, in 2021, the program provided more than 70 individual or group teletherapy hours to 9 clients from diverse racial/ethnic and socioeconomic backgrounds. After participating in MHT program, more than 80% of participants reported improved coping skills with reduced levels of stress. The Rural MHT program reached clients who might not otherwise access critical mental health services. Some participants reported that they now felt equipped to deal with daily stresses, while others were prepared to transition to a different therapist in order to continue their progress towards living a healthier life. Telepsychology sessions provided a cost saving to farmers, ranchers and farm families at a value of \$10,700.

Briefly describe how the broader public benefited from your project's activities.

Agriculture, forestry and related industries contributed nearly \$94 billion to the state's economy. Nearly 90% of Missouri's farms are family owned, and more than one in every ten Missouri jobs, (456,618), are in agriculture and forestry. Agriculture remains the backbone of Missouri's strong economy, supporting both rural and urban communities. As such, it is important to keep Missouri farmers and their families safe, healthy and productively involved in farming and farming-related occupations.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

During these unprecedented times MU Extension and the University of Missouri Psychological Services Clinic chose to stay connected to farmers, families and other stakeholders by offering free online trainings and providing telepsychology sessions using ZOOM and Microsoft Teams. Extension specialists focused their efforts on programs that were most effective in training and supporting participants.

Critical Issue

Workforce Development, Education and Communication with Underserved Populations

Missouri 4-H Agriculture Programs

Project Director

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Organization

University of Missouri Columbia

Accession Number

7001947



University of Missouri FY21 Results-- State 4-H Agriculture Programs

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

According to the USDA, only 11% of Americans are employed by the agriculture and food sectors. By connecting youth to agriculture now, Missouri 4-H strives to develop educated producers and consumers for the future. Through experiential learning opportunities and competitions, Missouri 4-H connects youth to the diverse sectors and opportunities in agriculture

and helps them identify possibilities for deeper involvement.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

In evaluations of our 4-H agriculture programs and events, participants reported:

95% are educated consumers of agricultural products

95% are comfortable sharing knowledge of agriculture with others

89% are an advocate for the agriculture industry

83% are seeking a career in agriculture

Briefly describe how your target audience benefited from your project's activities.

Youth participating in 4-H agriculture projects are developing knowledge and skills surrounding agriculture that will aid them in their future college and career endeavors.

Briefly describe how the broader public benefited from your project's activities.

With a total of 34,467 agriculture related project enrollments (doesn't account for duplicate youth), 4-H youth are learning the knowledge and skills they need to be contributing members of their community.

Type

Projects / Programs

Projects / Programs without a Critical Issue