

Purdue University Main Campus Combined Research and Extension Plan of Work 2022-2026

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I. Plan Overview

1. Executive Summary

Agriculture plays a significant role in Indiana's economy with more than 188,600 jobs from ag-related businesses which add \$14.9 billion to Indiana's total GDP (Indiana University Kelly School of Business). It represents an area of economic growth and development, not only in research, but in technology, new products, and stakeholder health. To meet these challenges, the Purdue College of Agriculture has organized its Plan of Work to be consistent with our stakeholder needs which are identified in seven critical issues: 1) Global food, security and hunger, 2) Climate change, 3) Sustainable energy, 4) Food safety, 5) Childhood obesity, 6) Human, family, and community health and well-being, and 7) Natural resources and the environment.

Our Plan of Work is complex as the funding weaves its way through several institutions working on traditional and emerging research programs, across many unique stakeholders served by Extension, while preparing the workforce of tomorrow. Hatch, Animal Health, and McIntire-Stennis research projects offer a unique overview of individual, departmental, and team research at Purdue. Purdue faculty in the College of Agriculture, College of Veterinary Medicine, and selected Departments in the College of Health and Human Sciences receive this funding, expanding our capacity to work beyond the traditional confines of "farming." Our team-oriented discovery efforts pull from expertise across many disciplines and engage like-minded partners, whether from industry, other academic institutions, non-governmental organizations, or government. The three colleges combined have over 350 faculty that conduct state-of-the-art research and teach more than 7,300 undergraduate and 700 graduate students. There are about 260 Extension Educators across the state located in each of the 92 counties of Indiana. Educator roles are in four program areas: 4-H Youth Development, Agriculture and Natural Resources (ANR), Community Development (CD), and Health and Human Sciences (HHS). Extension Educators with ANR specialties offer programs and information on agricultural production and financial management for farmers, food and fiber processors, manufacturers and consumers. They also provide expertise in environmental issues, natural resource conservation and land use. HHS educators help communities analyze, identify and meet the needs of families; train volunteers and paraprofessionals to assist in areas of critical concern to families; motivate people to become leaders in addressing community issues; and collaborate with agencies, community organizations, and educational groups to address the needs of families. CD experts work to increase community vitality, build leadership capacity, enhance public decision-making, and resolve public issues. A dedicated network of Extension Educators, parents, local leaders and volunteer staff, makes Indiana 4-H one of the most valued youth programs in the state.

Our Plan of Work is dynamic. With a solid focus on feeding 9 billion people by 2050, it becomes critical to fund and support new and emerging technologies that could be higher risk but in the long term create a significant impact in this area. Purdue faculty and Extension are continually evaluating new ways of working together and with stakeholders to identify innovative and transformative technology and programs to increase farmer productivity and consistent profitability, reduce environmental impacts, and increase the health of our stakeholders.

Our Annual Report of Accomplishments will continue to reflect the Research, Education and Economic goals of USDA: 1) Sustainable intensification of agricultural production, 2) Responding to climate and energy needs, 3) Sustainable use of natural resources, 4) Nutrition and childhood obesity, 5) Food safety, 6) Education and science literacy, and 7) Rural prosperity/rural-urban interdependence. Our Strategic Plan, reflecting the values of Indiana stakeholders, researchers, Extension, educators and staff, provides the guideposts for the work of the college. We will annually report on traditional and emerging science and programs that reflect these values.

College of Agriculture Strategic Plan Drives Plan of Work Focus

The College of Agriculture strategic plan concludes in 2020 and efforts are underway to begin designing the 2021-2026 strategic plan.

Our Vision: Purdue Agriculture will be the world's leading land-grant college of agriculture, food, life and natural resource sciences. We will embrace the land-grant ideal in all we do.

Our Mission: Purdue Agriculture will help make Indiana, our nation, and our world better through students prepared to make a difference; research with purpose, leading to discovery with impact; engagement/extension that strengthens lives and livelihoods; and an inclusive culture that supports excellence in all we do.

Our Values: We value passion for the students we educate, stakeholders we serve, the work that we do, the places we work and study. Stakeholder engagement with purpose, and the impact it makes possible. Creativity, bringing bold, new thinking to our scholarship and our work. Excellence, being the very best that we can be, in all we do. Diversity, in the fullest and richest sense of the word, across our people, our stakeholders, our ideas, our work. Respect, for all individuals, for all perspectives, for all missions.

The focus areas in the Strategic Plan are: 1) Build a sustainable and secure food production system; 2) Utilize molecular approaches to expand the frontiers of agriculture, food, natural resources and life sciences; 3) Develop a robust bio-economy to feed and power the world; 4) Enhance food and health; 5) Strengthen ecological and environmental integrity; and 6) Facilitate informed decision-making to improve economic and social well-being.

Strategic Plan for Research

To address these six focus areas, our goal is to create and support a community of engaged, productive, and collaborative scholars who are world leaders in their respective disciplines, pushing back the boundaries of science, and addressing society's most pressing opportunities and challenges through creative and high-impact disciplinary and cross-disciplinary research. Some examples follow.

Digital Agriculture

Developing a robust bio-economy to feed and power the world is going to require Smarter Agriculture™. Scientists in the College of Agriculture are using tools such as drones, rovers, and other innovative technologies to reap a new kind of harvest—the rich, massive data that will help farmers make better decisions in the future. The field is called digital agriculture, and these tools unlock a new era of plant sciences and data-driven farming that will transform both research and industry. It is about using data more effectively, making more quantitative and informed and better decisions using data and represents the intersection of many disciplines: plant science, engineering, computer science, data analytics, statistics, and even aviation technology. Scientists are working to create or develop new platforms to collect more data and take advantage of big data in agriculture. Within projects studying plant breeding, climate resilience, crop genomics, the environmental impact of agriculture, global food security, and more, Purdue researchers are adapting the cutting-edge technologies used by social media networks, search engines, and self-driving vehicles to agricultural use. From the Internet of Things (IoT)—a catchall term for web-connected devices that collect real-time data—to machine learning and computer vision approaches (which enable Facebook to identify faces in photos), these data collection and analysis methods will change the way food is studied, grown, and consumed.

Institute for Plant Sciences

Purdue researchers are expanding the frontiers of agriculture, food, natural resources and life sciences by working to move plant science discoveries from research to commercialization. A significant focus is on phenotyping. Although scientists have made significant advances in sequencing the genetic material of key crops, the technology to help identify how those genes are expressed in observable traits in plants (the phenotype) lags behind. Making the connection between genotype and phenotype can help scientists modify desirable plant traits, improving climate adaptation, enhancing crop yield and nutritional characteristics, and optimizing management technologies for weed and pest control. Phenotyping is not a new technique, but measuring characteristics such as plant height, nitrogen content, and photosynthetic activity by hand is time-consuming and laborious. Automated field phenotyping using sensors, configurable

harvesting equipment, and drones produces far more data in a shorter time frame, allowing researchers to more quickly close the gap between genotype and phenotype.

Strategic Plan for Extension

To enhance health and improve social well-being, Extension initiatives for Children, Youth, and Family are strengthening families, building effective parenting skills, supporting career preparation, promoting healthy living, and enhancing positive life skills. Addressing a sustainable and secure food production system, ecological and environmental integrity, and informed decision-making to improve economic and social well-being, Extension initiatives for Community, Economy, Agriculture, and Natural Resources are strengthening workforce, business, and economic development; expanding agriculture-related opportunities; fostering responsible land use and conservation of resources; creating quality communities; and increasing civic participation and local government education. These initiatives allow us to: 1) capitalize on our strengths and experience to advance, and accomplish, new goals; 2) focus resources to help us provide meaningful programs that address priority needs; 3) engage youth via Indiana 4-H and other youth-serving organizations to address important issues; 4) enhance the quality of programs to ensure optimal effectiveness and impact across Indiana, and 5) deliver programming relevant to current, and emerging, needs of all people across Indiana. Our goal is to be recognized as the premier institution engaging stakeholders across Indiana and beyond in identifying and addressing priority issues to enhance quality of life as well as the efficiency and/or effectiveness of organizations through research-based education. Several examples follow.

Workforce Development

For improving economic well-being, workforce development is at the core of Extension programming for youth, families, individuals, business, organizations, and agencies and communities in Indiana. Extension continues to make programs available for technical, professional and life skills training to help individuals for their first job, to prepare for or achieve their work-related certifications, licenses, CEUs, and other credentials, to develop positive life skills in families, and to provide youth and adults with opportunities to learn new science, technology, engineering, and mathematics (STEM) skills.

4-H Youth Development

Preparing our youth for economic and social well-being for the future continues to be a statewide priority. The 4-H Youth Development program provides opportunities, relationships, and support for youth to help them acquire the life skills necessary to meet the challenges of adolescence and adulthood. Youth development programs are aligned with specific mission areas including science, engineering and technology, healthy lifestyles, civic engagement, teen leadership, and college and career readiness. With nearly 13,000 adult volunteers involved in the Indiana 4-H youth development program, volunteer development opportunities are another essential part of this planned program. These volunteers are a vital component to positive youth development because of the on-going relationships established.

Promoting Healthy Living

Enhancing food and health, and improving economic and social well-being, are critical Extension efforts for healthy living at all ages. Indiana is near the top of the rankings of negative health issues, including obesity, smoking rate and the afflictions that accompany: diabetes, high blood pressure, cancer, heart disease, drug use, and stroke, Purdue Research and Extension programs focus on the impact of dietary intake and exercise on human health and chronic conditions, use and beneficial effects of phytochemicals, nutrient processing, and dietary intake to enhance health. Educational programs are provided for food and health care industries and for consumers. With a focus on mental health, Extension is continuing to expand programming capacity and availability for prevention through programs, partnerships, and inter-disciplinary approaches for communities, businesses, organizations, families and youth.

Building Strong, Vibrant Communities

Enhancing success in Indiana's communities is an Extension priority for informing decision-making to improve economic and social well-being for communities of all sizes and encompasses programs to increase community vitality, build leadership capacity, improve public decision making, and resolve public issues. As the digital economy continues to

expand, Extension is providing critical information and technical support designed to expand broadband access and adoption by rural households, business and rural communities across Indiana.

Intersection of Research and Extension

Across all six focus areas, as a land-grant institution, we strive to get our research into the hands of stakeholders during development when possible. On-the-ground feedback loops allow researchers to make rapid improvements on products that can impact the farmer. As Extension staff work with communities, we gain important information on where to focus attention toward future products and technology that impact farming, community health and well-being, supporting youth education and workforce development. A few examples are listed here.

Unmanned Aerial Vehicles (drones)

Purdue Extension and Research are leading the way in Indiana for a robust bio-economy to feed and power the world, including an emphasis on ecological and environmental integrity, via technology outreach through agricultural use of unmanned aerial vehicles (UAVs). Also known as drones, UAVs can improve precision, efficiency and depth of information. They are cost-effective and provide numerous benefits to Indiana's environment and economy. Extension is training and equipping Agriculture and Natural Resources Educators to fly UAVs over crop fields, pastures, forests and ponds across Indiana. Educators are quickly finding ways to help farmers and land and business owners gather more precise data and translate it into efficient, profitable and long-term success. In partnership with the Purdue Agricultural Centers, Extension is offering programs to train those interested in obtaining a license to fly UAVs for professional uses or hobbies.

Diversified Farming and Food Systems (DFFS)

The Purdue DFFS team, made up of an interdisciplinary group of faculty, staff, Extension educators, students, practitioners and partners, leads an integrated program that focuses on food and health to improve economic and social well-being. We work to connect programming, research and learning focused on urban agriculture, community wellness, local food, farmers markets, beginning farmers, small-scale farming, organic agriculture, and the Purdue student farm.

Youth Outreach and Engagement

PK-12 Council organizes the College of Agriculture's capacity to leverage its strengths in engaging youth through outreach and engagement efforts that look to the future for a sustainable and secure food production system, for food and health, and for ecological and environmental integrity. These activities address expanding the pool of students who are interested in, and prepared for, careers in food, agricultural, life, and natural resource sciences through these objectives: 1) Provide a vehicle for communicating our PK-12 work to the campus council, giving College of Agriculture PK-12 work visibility. At this point, our College likely has one of the most extensive PK-12 portfolios across campus, but is also the most decentralized and likely least visible as a result. 2) Provide a forum for better coordinating and leveraging PK-12 activity across the College. Look for gaps that provide new opportunities for innovation as well as connection to new PK-12 audiences. 3) Serve as a portal to College PK-12 activities that others in the College can link to when educational activities/engagement are part of grant proposals and other collaborative and interdisciplinary efforts. 4) Create a forum for sharing programs, speakers, and resources that are of interest to those who want to be engaged in PK-12 activities.

2. FTE Estimates

Year	1862 Extension	1862 Research
2022	78.2	273.2
2023	78.2	273.2
2024	78.2	273.2

2025	78.2	273.2
2026	78.2	273.2

II. Merit / Peer Review Process

Purdue receives federal formula funding for Hatch, Animal Health research and McIntire-Stennis for forestry research. Hatch, Animal Health, and McIntire-Stennis research projects offer a unique overview of individual, departmental, and team research at Purdue. The projects document the University's commitment to partnership with other land grant universities, the USDA, and the state of Indiana. Purdue faculty in the College of Agriculture, College of Veterinary Medicine, and selected Departments in the College of Health and Human Sciences who have a research appointment of 20% or more are required to submit a five-year plan of research. These five-year plans are peer reviewed under the direction of the office of Agricultural Research and Graduate Education at Purdue (ARGE) and submitted to USDA-NIFA for final review and approval. The review panel, consisting of three reviewers, faculty member department head, and Director of the Indiana Agricultural Experiment Station and Senior Associate Director of ARGE, meets with the faculty member and provides feedback on the project. Once the faculty member submits any revisions to the project based on the feedback, ARGE will then submit the project electronically through the REEport Project Initiation module. Faculty prepare online and submit Annual Progress Report plus a Final Report at the end of the 5-year period. The office of ARGE is responsible for ensuring that Purdue faculty members comply with Hatch peer-review procedures and for the quality of reporting submitted to REEport.

III. Stakeholder Input

1. Actions to Seek

Invite community input at public forums for the 5-year strategic planning cycle
 Meet with advisory committees including Dean's Advisory Council, Purdue Council for Agricultural Research, Extension, and Teaching (PCARET) and others
 Participate in stakeholder groups and activities, including Indiana Soybean Alliance, Indiana Corn Marketing Council, Indiana Pork Board, Indiana Crop improvement Association, Indiana Farm Bureau (e.g., Supper Series and annual meeting), Indiana Wine Grape Council, Production Agriculture Roundtable, and Corn and Soybean Showcase and others
 Conduct surveys of stakeholders and the public at the Indiana State Fair and the Purdue Agriculture Center (PAC) field days and activities, and via extension programs
 Communicate with a variety of marketing approaches including community-wide press releases and online news articles, newspapers, radio and TV, electronic and paper flyers, websites, newsletters, social media, emails, and postcards

2. Methods to Identify

Needs assessments statewide and across counties and programs
 Meetings with groups, coalitions, networks, and cooperatives
 Collaboration with agencies and organizations
 Marketing to target community organizations, agencies, coalitions and networks (providing them with information to share with their constituents) and to reach out to under-served and under-represented individuals, groups, and organizations, with some marketing in Spanish

3. Methods to Collect

Listening sessions in communities across Indiana
 Community forums in many counties statewide with roundtable sessions using the Global Café technique
 Meetings with advisory councils and stakeholder individuals and groups
 Focus groups and surveys with stakeholders

4. How Considered

Input will guide the 5-year strategic plan to identify emerging issues, set priorities, develop action plans, direct and redirect research and extension activities, and focus funding

Feedback will give direction to marketing and communication for public awareness, priority issues, and stakeholder benefit

IV. Critical Issues

1 Global food security and hunger

Description:

Domestic agricultural production, capacity to meet growing global food demand, and innovation in fighting hunger and food insecurity in vulnerable populations. Economics, community, food production systems, marketing/retail management, logistics/systems, business development, emerging technology. Crops, environment, productivity, biotic/abiotic stress. Disaster preparation, education, recovery. Hunger/malnutrition, food products, quality, & quantity. Livestock, environment, productivity, health & welfare.

Term: Long

Science Emphasis Areas

Sustainable Agricultural Production Systems

2 Food Safety

Description:

Provide safer food supply and reduce incidence of foodborne illness by addressing causes of microbial contamination and antimicrobial resistance, educating consumer & food safety professionals, and developing enhanced food processing technologies.

Term: Long

Science Emphasis Areas

Food Safety

3 Natural resources and the environment

Description:

Forests, land, water, soil, air quality, ecosystems, conservation, wildlife and fish, and sustainability.

Term: Long

Science Emphasis Areas

Environmental Systems

4 Climate change

Description:

Adapt to changing weather patterns and sustain economic vitality while reducing greenhouse gas emissions and increasing carbon sequestration in agricultural and forest production systems.

Term: Long

Science Emphasis Areas

Agroclimate Science

5 Sustainable energy

Description:

Develop optimum biomass, forests, and crops for bioenergy production; and produce value-added, bio-based industrial products. Non-food products and systems. Incorporate new theories and technologies into food production systems such as controlled environments.

Term: Long

Science Emphasis Areas

Bioeconomy, Bioenergy, and Bioproducts

6 Childhood obesity

Description:

Ensure nutritious foods are affordable and available, individuals/families are able to make informed science-based decisions about their health/well-being. Focus on policies, knowledge, skills and other aspects of healthy eating, exercise, etc. to control weight and reduce obesity for individuals, families or communities.

Term: Long

Science Emphasis Areas

Human Nutrition

7 Human, family, and community health and well-being

Description:

Policy/regulation about human, family, community health and well-being. Economics, community leadership, economic & community development, government operations. Family well-being, resources management, parenting & relationships, child development. Human health, nutrition & wellness, chronic diseases, environmental factors. Youth development, civic engagement, science, healthy living, universal, teen leadership, adult volunteer development.

Term: Long

Science Emphasis Areas

Family & Consumer Sciences

Human Nutrition

Youth Development