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Addressing current and future agricultural workforce needs to meet societal challenges – A USDA vision

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Abstract. The world's food systems and our ability to ensure global food security are being impacted by major challenges and risks, including climate change, diminishing land and water resources, changing incomes and diets, increasing urbanization, environmental degradation, and the need to ensure better health outcomes. We believe the solution to these pressing challenges lies in transformative discoveries, translation of discoveries into innovations and solutions delivered to the end users, and education of the pipeline of young people needed. From the educational perspective, there is need to incentivize young people to enter agricultural fields and to provide the rigorous education such that they have sustainable livelihoods. A recent study by Purdue University concluded that the United States will produce an average of 67,900 jobs per year between 2015 and 2020 for graduates with a bachelor's degree or higher in agriculture-related fields; however, there will only be an average of 35,400 new graduates in these fields. The Agricultural Science Workforce survey undertaken by the Coalition for a Sustainable Workforce concluded that the top-paying jobs would require graduate degrees, including PhDs. Recent analyses undertaken by the Science, Technology, Engineering, and Mathematics (STEM) Food and Ag Council indicates that during the next five years, the United States agricultural workforce is expected to grow by 4.9 percent, adding 33,100 new positions. All three studies indicate that there are significant shortages in several areas, including plant and animal breeding, crop and animal sciences, entomology and plant pathology, weed science, soil science, food science and engineering, natural resources engineering, and agribusiness. Additionally, with the aging farm population – the current average age of the American farmer is 58.3 years – there's a critical need to attract young people to produce food. This paper offers a few approaches that the U.S. Department of Agriculture (USDA) believes will ensure that a well-trained workforce is available and ready to undertake challenges associated with meeting the nutritional needs of a growing global population.

Keywords. Agriculture – Education – Food Production – Workforce Development – USDA.

Prise en compte des besoins actuels et futurs en capital humain dans l'agriculture pour répondre aux défis sociétaux – La vision de l'USDA

Résumé. *Les systèmes alimentaires mondiaux et notre capacité pour assurer la sécurité alimentaire globale sont confrontés à des défis et des risques majeurs, notamment le changement climatique, la diminution des terres et des ressources en eau, la modification des revenus et des diètes, l'urbanisation croissante, la dégradation environnementale, et le besoins d'assurer de meilleurs résultats de santé. Nous pensons que la solution à ces défis pressants repose sur les découvertes transformatrices, la traduction des découvertes en innovations et solutions offertes aux usagers finaux, et l'éducation dès maintenant des jeunes qui seront nécessaires pour ce faire. Sous l'angle de l'enseignement, il est nécessaire d'encourager les jeunes à entrer dans le domaine de l'agriculture et de leur fournir une éducation rigoureuse leur permettant de gagner leur vie de façon soutenable. Une récente étude de l'Université de Purdue conclut que les États-Unis produiront une moyenne de 67 900 postes de travail par an entre 2015 et 2020 pour des diplômés ayant un BSc ou plus dans les domaines liés à l'agriculture ; toutefois, il n'y aura en moyenne que 35 400 nouveaux diplômés dans ces filières. Une étude (Agricultural Science Workforce Survey) entreprise par la Coalition for a Sustainable Workforce a conclu que les postes de travail les mieux payés concerneraient des diplômes universitaires, y compris des PhD. Des analyses récentes menées par Science, Technology, Engineering, and Mathematics (STEM) Food and Ag Council indiquent que sur les cinq prochaines années, le marché du travail agricole des*

États-Unis augmentera prévisiblement de 4,9%, avec 33 100 nouveaux postes. Ces trois études montrent qu'il existe une pénurie significative dans plusieurs domaines, y compris en amélioration végétale et animale, sciences culturales et animales, entomologie et pathologie végétale, science des mauvaises herbes, science du sol, science et ingénierie des aliments, ingénierie des ressources naturelles, et agroindustrie. De plus, avec une population agricole vieillissante – actuellement l'âge moyen d'un agriculteur américain est de 58,3 ans – il est crucial d'attirer les jeunes vers la production d'aliments. Cet article offre quelques approches qui, selon le U.S. Department of Agriculture (USDA), permettront de disposer d'une force de travail bien formée et prête à affronter le défi de nourrir une population mondiale croissante.

Mots-clés. *Agriculture – Education – Production alimentaire – Développement d'une force de travail – USDA.*

I – Introduction

There is significant rethinking in the United States in regards to higher education in agriculture and transformative changes are called for to better prepare graduates for the future (NRC, 2009a). Kunkel *et al*. (1996) concluded that "the purpose of education in agriculture is to provide for the needs of society and industry in a changing world, to produce graduates with flexibility, diversity, perspective and values". Similarly, in *Agriculture and the Undergraduate* (NRC, 1992), the National Research Council asked how do we educate students to meet the demands of the world, such as global competitiveness and hunger, inequities in food distribution, as well as environmental and health issues (NRC, 1992). Building on this vision are recent and urgent calls for action, including the *Report to the President on Agricultural Preparedness and the Agriculture Research Enterprise* (PCAST, 2012a); *Achieving the New Vison for Agriculture: New Models for Action* (WEF, 2013); *Building a Common Vision for Sustainable Food and Agriculture* (FAO, 2014); and a report from The Chicago Council on Global Affairs (Bereuter and Glickman, 2015) that challenges the US to leverage the strength of its research infrastructure to introduce a major transdisciplinary initiative to train the next generation of agriculture, food, and nutrition leaders through research partnerships, work force development, and outreach services in developing countries.

According to the United Nations (UN, 2013), the world population is predicted to reach 9.6 billion by 2050, just 35 years from today. If this prediction is accurate, humankind's greatest challenge may be feeding this population. To feed a population of 9.6 billion, the Food and Agricultural Organization (FAO) projects that agricultural production (food, feed and fiber) will need to increase by 70 percent (FAO, 2009). In order to achieve this global food security, we will need to improve agriculture and its distribution, reduce waste, ensure safe food for us and our ecosystems, as well as use our crops effectively and nutritiously, while providing livelihoods to farmers and rural communities (Economist, 2011). Furthermore, it is estimated that about one-third of the world population (about 1 billion people) go hungry every day, crops are used for bioenergy and other industrial purposes, and the future demand for food will increase the pressure on scarce environmental resources.

As we look toward the future, our "education vision" needs to include "what is good agriculture?" The World Economic Forum concludes that the world needs a new vision of agriculture (WEF, 2013). We believe the solution to these pressing challenges lies in education, inspiring our young people to enter agricultural fields and providing the rigorous education these disciplines demand.

II – Scope

The National Institute of Food and Agriculture (NIFA) is one of the USDA's agencies that was created by the 2008 Farm Bill to catalyze transformative discoveries, education, and engagement to address agricultural challenges. NIFA is advancing science by focusing on six significant societal challenges: food security, climate variability and change, water, sustainable bioenergy, childhood

obesity prevention, and food safety (NIFA, 2014). To meet these challenges, a new generation of well-prepared, innovative scientists in the agricultural sciences and natural resources is necessary.

However, US education is not producing enough agricultural scientists to meet the growing demand. The number of students enrolled in production agriculture has been declining as well as the proportion of graduate students concentrating in agricultural sciences. Academic leaders in agricultural education are very concerned and industry leaders are spending increasing amounts of money to train new employees who have majored in other scientific disciplines to work in agricultural areas (AAAE, 2012). In general, US students are not interested in pursuing careers in science, technology, engineering, and mathematics (STEM), which have major implications for sustaining American competiveness and economies in agriculture and other industries (NSB, 2007).

Exacerbating the problem, the capacity of existing US students has been declining. American students are no longer ranked in the top 20 countries in math and science capability. Less than half of the ACT test takers are prepared to take college level math and science (ACT, 2014). Congress and federal agencies have been responding to the need to produce more STEM students. However, this may not translate into more students going into agricultural sciences and related sciences without additional incentive programs.

Education is one of the current Administration's priorities. In particular, President Obama emphasizes the need to "increase STEM literacy so that all students can learn deeply and think critically in science, math, engineering, and technology." He calls on the country to "address college completion and strengthen the higher education pipeline to ensure that more students succeed and complete their degree". The President also wants to "invest in community colleges to equip a greater share of young people and adults with high-demand skills and education for emerging industries".

Innovative colleges and universities have begun to develop programs to recruit students into agricultural sciences (OSTP, 2012). Programs like these must be expanded in order to meet the country's challenges in the agricultural and natural resource sciences and meet the societal challenges being addressed by NIFA. USDA is committed to meet a significant and growing need in agriculture – producing more agricultural scientists by helping to build a pipeline of talent that sustains America as the world's leader in agricultural innovation.

III – Guiding principles

America's food and fiber producers operate in a global, technologically advanced, rapidly diversifying, and highly competitive business environment (Pardey *et al*., 2013). Therefore, USDA is constantly helping agricultural producers and industry meet the needs of the nation and of the world. In addition, with the continuous changes of agricultural policies and farming methods, it is crucial that agricultural education evolves with them, pushing towards innovations rather than accepting conventions (ASPB, 2013; NRC, 2009b).

A supportive infrastructure including academic institutions, purposeful and mission-oriented curricula, engaged students at all levels, sound education policies, and budgetary commitments will be the key ingredients in defining any renewed vision to redefine agricultural education that is supportive of our grand agricultural challenges. While multiple USDA agencies are engaged at various levels in providing both formal and non-formal teaching, learning and training opportunities, NIFA serves as the lead USDA agency with legislative authorities that support agricultural education in a broader sense. These programs include funding to support education infrastructure at land-grant universities as well as ensuring that our education system is being responsive to the changing demographics across the country. In addition to 58 land-grant universities established through the Morrill Act of 1862, of notable mention are NIFA's programs that support edu-

cational activities in 19 historically black land-grants established via Morrill Act of 1890, as well as 34 American Indians colleges and universities authorized by Congress as land-grants in 1994. Education opportunities are also afforded to Hispanic populations through education programs targeted for numerous Hispanic serving institutions.

USDA's priority setting process for research, education, and extension activities includes feedback from its stakeholders. In 2013, USDA organized an education listening session that engaged a cross section of educators, policy makers, and community organizations. As a result, USDA received several excellent suggestions that can easily be considered as the guiding principles for USDA's education strategy.

Salient recommendations from the education listening session were**:** (1) teacher training is critical, (2) agriculture needs to transform its image – from the cow and cook club – to food, technology, conservation, and cutting-edge science, (3) students need to know that agriculture offers fun, interesting, satisfying, and secure jobs for graduates with 2-year technical degrees, BS and MS degrees, as well as those with PhDs, (4) blended learning (a mix of hand-on experience and formal education) is the best approach, (5) job shadowing, mentoring, internships, and scholarships are essential keys to students retention, (6) research grants must include teaching and outreach components. Even better, a new challenge area funding agricultural education should be added to the NIFA portfolio, (7) USDA needs to be more effective in listening and communicating with its stakeholders, (8) USDA needs to lead a national initiative on agricultural education that includes new curricula, audiences, and image for agriculture. USDA needs to make sure it's leading the industry and not letting others define the future of agriculture, food, and natural resource education, and (9) 4-H and Extension are good models for informal education and transferring knowledge and these models need to be effectively connected to the nation's food, cutting-edge science and technology, and conservation.

IV – What is the current reality?

College graduates in the United States are severely lacking basic skills (job skills) – especially problem solving, decision making and the ability to prioritize tasks (Silingo, 2015). Similarly, the Collegiate Learning Assessment Plus (CLA, 2015) found that 40 percent of college seniors lack the reasoning skills needed in today's workplace. In addition, the skills of graduates depended on their college major. Math and science students scored significantly higher than those in other disciplines. Furthermore, the Association of American Colleges and Universities Survey (APLU, 2015) found that employers consistently rated students much lower than students judged themselves. For example, 26 percent of employers said graduates had critical thinking skills compared to 66 percent of the graduates (students). These findings confirm what companies have long complained about – that many college graduates are not ready for work and the global job market.

In 2015, an employment outlook report released by NIFA and Purdue University (Goecker *et al.*, 2015) concluded that there is an average of 35,400 new United States graduates with a bachelor's or higher degree in agriculture-related fields, 22,500 short of the jobs available annually. Basically, there are not enough agricultural scientists to meet the demand. According to the report's projections, between 2015 and 2020, our nation expects to see 57,900 average annual openings for graduates with a bachelor's degree or higher in agriculture-related fields. The Agricultural Science Workforce survey concludes that the top-paying jobs would require graduate degrees, including PhDs (CSAW, 2013). Recent analyses undertaken by the STEM Food and Ag Council indicate that during the next five years, the US agricultural workforce is expected to grow by 4.9 percent, adding 33,100 new positions (SFAC, 2014). Taken together, these results indicate that most of the demand is in specialized areas, such as plant breeding/genetics, plant

protection, plant sciences, and animal sciences (Buchanan, 2014). One must not forget that the average age of the American farmer is 58.5 years and there were 4.3 percent less farms in 2012 than in 2007 (NASS, 2012).

These reports show that there is an incredible opportunity for highly-skilled jobs in agriculture, which will address some of the world's most pressing challenges, such as developing solutions to feed 9 billion people by 2050.

V – What are we doing?

The USDA's vision for education starts with helping students cross the K-20 continuum (kindergarten through college). We see these challenges and opportunities partitioned into three components, (1) learning and engagement, (2) workforce development – the next generation of farmers and scientists, and (3) capacity building. Improving these components will help USDA strengthen the science literacy and other 21st century skills into a pipeline between secondary and higher education so that our students will be better positioned for the global marketplace.

1. Coordinating Education across USDA Agencies

USDA's Office of the Chief Scientist through its Science Council chartered an Education Coordinating Committee to improve coordination of all USDA education activities and to leverage resources to build effective partnerships across the US federal enterprise. All seven USDA mission areas and the 12 agencies are represented in this education coordination effort. This committee developed the USDA's education portfolio around five common themes: (1) learning and engagement, (2) training and education, (3) internships, (4) capacity building, and (5) educational campaigns and outreach. In addition, the committee ensures synergy and best practices among these diverse agencies and their programs.

Each USDA agency contributes to the education portfolio and its activities. For example, the Agricultural Research Service (ARS), USDA's principal intramural scientific research agency, is involved in training the next generation of scientists through graduate assistantships, traineeships and mentoring. The National Agricultural Statistics Service (NASS) supports graduate fellowships, internships and provides statistics for K-12 education. The Economic Research Service (ERS) provides education-related research and data – socioeconomic data and research on education and the relationship between education, economic activity, as well as household well-being with a particular emphasis on the rural economy. In addition, ERS supports distance learning through a program that puts agency scientists into the classrooms of minority-serving institutions using interactive real-time video seminars.

The Food Safety and Inspection Service (FSIS) provide consumer education, which is coordinated at its Office of Public Affairs and Consumer Education. The Food and Nutrition Service (FNS) primary job is to educate consumers about food. FNS has a series of Web and printed content targeted at different age groups, including "Healthier Middle Schools," and "Nutrition Voyage." Another example is "Serving Up MyPlate," a new collection of classroom materials that helps elementary school teachers (grades 1-6) integrate nutrition education into math, science, English, language, arts, and health (FNS, 2012). This curriculum introduces the importance of eating from all five food groups using a variety of hands-on activities. Students also learn the importance of physical activity to staying healthy.

The Animal and Plant Health Inspection Service (APHIS) develops and applies scientific methods that educate consumers, protect the health of American animal and plant resources, and sustain agricultural ecosystems. Rural Development (RD) has no formal education programs, but

instead focuses on providing information to rural communities. One way this is done is through teaching the cooperative business model to secondary education level students using instructor guides and lessons. Finally, the Forest Service (FS) is engaged in educating the nation about forests, natural resources, and other conservation issues. FS conservation education includes outreach products that focus on educating children and families about conservation issues. For example, the "Natural Inquirer" is a middle-school science journal about America's forests and research that promotes active learning through the scientific process. Each year, the FS distributes more than 60,000 journals to classrooms across America.

NIFA is involved in educating and training the next generation of agricultural employees. These include: (1) the beginning farmer and rancher initiative to address the dearth in farming skills among new farmers, (2) education and literacy initiative to help develop the K-20 pipeline in the setting of formal education, and (3) 4-H and youth development programs to help engage youth in the entire food, agriculture, natural resources and human science spectrum.

2. NIFA's Beginning Farmer and Rancher Development Program

NIFA's Beginning Farmer and Rancher Development Program (BFRDP) was launched in 2009 to support local and regional training, education and outreach, and technical assistance to address the critical needs of beginning farmers. Training is offered in a variety of topics, including (1) production and management strategies to enhance land stewardship by beginning farmers and ranchers, (2) business management and decision support strategies that enhance the financial viability of beginning farmers and ranchers, (3) marketing strategies that enhance the competitiveness of beginning farmers and ranchers, and (4) legal strategies that assist beginning farmers with farm or land acquisition and transfer. BFRDP complements several programs offered by other USDA agencies to support beginning farmers. These programs provide for voluntary participation, offer incentives, and focus on equity in beginning farmer opportunities for all communities.

3. NIFA's Education and Literacy Initiative

In 2012, the President's Council of Advisors on Science and Technology (PCAST, 2012a) identified a few challenges and offered recommendations to boost agricultural research enterprise in the United States. PCAST concluded that the US Agriculture workforce challenges include (1) support for a well-trained workforce (primary concern); (2) the best students do not view agriculture as an attractive career option; (3) the industry has difficultly recruiting the technical employees for its research programs; (4) the talent pipeline begins well before college admission; (5) at the baccalaureate level, a comprehensive array of undergraduate programs relevant to agriculture and the food industry are needed and; (6) USDA, in collaboration with NSF, expand its national competitive fellowship program for graduate students and post-doctoral researchers.

In support of USDA's Goal of Education and Science Literacy as well as in responding to the PCAST's recommendations, NIFA recently launched a new Education and Literacy Initiative (ELI) offered through a competitive funding mechanism. USDA's guiding principal is that education must be more than learning facts. Students also must be offered the opportunity to be incorporated into and be involved in the discovery through delivery continuum, i.e., experiential learning in both the research (discovery) and extension (delivery and engagement) domains. The goal of ELI, therefore, is to produce graduates with skills needed to address the new challenges of the 21st century in food, agricultural, natural resources, and human sciences.

This program has now evolved with a focus on immersive learning experiences in non-formal education to help secondary school teachers identify and integrate successful lessons in their classes; enhance capacity of academic institutions to produce graduates with work-ready skills

with special emphasis on research and extension based experiential learning opportunities for undergraduates; and advance science by supporting graduate and postdoctoral education. The overarching theme that clearly echoes throughout USDA/NIFA education programs is that a robust workforce is essential if the United States is to face predictable and unpredictable challenges and opportunities in the food and agricultural sectors.

4. 4-H and Positive Youth Development

Headquartered at USDA, 4-H is the nation's largest youth development organization, empowering millions of young people throughout the United States. 4-H reaches every corner of our nation – from urban neighborhoods to suburban schoolyards to rural farming communities. 4-H started as an agricultural-based youth organization and has today evolved into an education program that focuses on citizenship, healthy living, as well as science and technology programs.

Through the land-grant universities and their Extension System, and partnering with the USDA and NIFA, as well as county governments and communities, 4-H helps shape youth in the United States like no other youth organization. The 4-H vision is to prepare young people to make a positive impact in their communities and the world. For example, a study conducted by the Tufts University (Lerner and Lerner, 2011) reported that participants in 4-H, compared to young people involved in other non-formal programs (i.e., Boys & Girls Clubs, Big Brothers/Big Sisters, YMCA, and scouting), had (1) better grades, (2) more wanted to pursue careers in STEM disciplines, and (3) planned and applied to college. Tufts research indicates that involvement in 4-H programs substantially increases life skills and youth development in a non-formal learning environment.

VI – What is the way forward?

The evidence indicates an acute shortage and immediate need for significantly more agricultural graduates than currently being produced in the U.S. There may not be an easy or a single solution to accomplishing this challenge. However, it must be addressed to ensure that our future workforce and next generation of scientists is indeed fully trained and equipped with the skill set needed to make innovations and discoveries in meeting future food demands and solving societal challenges dependent upon the agricultural enterprise (PCAST, 2012b).

Agriculture is much more than simply growing plants or raising animals. It has increasingly become a science and technology based complex, interdependent, and multifactorial enterprise. There is a clear convergence of biophysical and social sciences that seems to be working hand in hand in taking science and discoveries from the lab to the street. Governance of agricultural enterprise has to keep up with constantly changing social and regulatory oversight. Our workforce needs to be trained in "systems approach" as opposed to a silo-based training in a single subject matter expertise. Therefore, entities such as academia, industry, policy makers, funding agencies, and societal leaders – all have a distinct role to play towards a cohesive agriculture production system. Academia needs to be able to offer state of the art education and training that is clearly aligned with and supportive of the needs of production agriculture. Youth must be engaged much earlier through formal and non-formal education in activities that spark their interest in their joining and supporting both biophysical and social sciences aspects of production agriculture.

Community and technical colleges will be key players in that they work closely with local government, industry partners, workforce intermediaries, as well as community members to identify existing and emerging sectors workforce needs and prepare students accordingly. With 2014 enrollment levels of 12.8 million, the nation's 1,167 community colleges enroll 45 percent of all undergraduate students in the United States, 51 percent of minoritiy undergraduate students, as well as 36% of first generation college students, and are key to ensuring that the nation has the

workforce it needs (AACC, 2014). We must ensure that community colleges are an integral part of the agricultural workforce pipeline. Several US universities have developed 2 + 2 articulation programs with the community colleges so that a student interested in higher education can jump to a four-year college as a part of the agriculture education pipe line continuum.

Indeed, all such considerations need funding. USDA is committed to championing the worldwide funding of agricultural education, extension and research programs to increase productivity, minimize international trade distortions, improve rural education and job creation in developing countries, reduce food waste and find ways to meet the food needs of the world's chronically undernourished and malnourished population (Hofstrand, 2011). A recent review of USDA/NIFA competitive programs by the National Research Council (NRC, 2015) recommends that funding for NIFA's competitively awarded programs should be increased significantly. Such a support will further strengthen a diverse education portfolio within USDA and help establish partnerships with other federal agencies with common interests in supporting this education enterprise. USDA is playing a leading role in support of President Barak Obama's charge that "We must educate our children to compete in an age when knowledge is capital, and the marketplace is global."

USDA believes that innovation is a key ingredient – and that we educate to innovate. A USDA-funded research program developed submergence-tolerant rice bred to survive underwater (Xu, *et al*., 2006). This new rice yields are more than double the old varieties. It is predicted that 20 million farmers in India, and other flood-affected areas, will plant these new varieties. In this regard, the US agriculture has greatly benefited over the years from Cooperative Extension Service that has taken the innovative scientific discoveries to the streets for the benefit of the society at large. Indeed, USDA's investment in partnership with national and global entities has led the way in sequencing genomes of crop plants, domestic animals and microorganisms. These genome sequences are of great value for agriculture productivity, bio-based materials manufacturing, industrial bioprocessing, and biodiversity conservation as well as for disease diagnosis, treatment and prevention (Hoffman and Furcht, 2014). USDA is committed in ensuring that the next generation of scientists is available and ready to take advantage of cutting-edge discoveries to be unearthed during this genomic exchange era. Finally, discipline-based gaps in agricultural sciences expertise – for example, plant breeding, animal breeding, integrative plant and animal sciences, food process engineering, and pest management – need to be met through targeted training grants.

VII – Conclusions

Today, the world is facing major challenges. According to the United Nations (UN, 2013), the world population is predicted to reach 9.6 billion by 2050, just 35 years from today. If this prediction is accurate, humankind's greatest challenge may be feeding this population. To feed a population of 9.6 billion, FAO projects that agricultural production (food, feed and fiber) will need to increase by 70 percent (FAO, 2009). The world's food system is inundated by major challenges and risks, such as food security, agricultural sustainability, and economic opportunity.

The World Economic Forum concludes that the world needs a new vision of agriculture (WEF, 2013). Vision is basically rethinking what is possible. Therefore, the USDA is rethinking its agricultural education mission to present a framework for making transformative changes in higher education in agriculture. As we look toward the future – we have reached the point in history where we must answer two questions – "What's for Dinner?" and "Will there be food for tomorrow?" These basic questions clearly show the importance of agriculture. Finally, echoing Freudenberger's (1994) question, "Is there any subject more critical?"

We believe the solution to these pressing challenges lies in education, inspiring our young people to enter agricultural fields and providing the rigorous education these disciplines demand.

USDA's agricultural education pipeline takes an overarching approach through the involvement in 4-H programs that substantially increases life skills and youth development in a non-formal learning environment; provides immersive learning experiences in non-formal educational programs for secondary school educators, enabling them to identify and replicate best practices to enhance student outcomes in the food, agricultural, natural resources, and human sciences; engages undergraduates through experiential learning opportunities so that they are better prepared to join the workforce; and lastly, train the next generation of scientists through pre-and-post doctorate fellowship experiences.

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