

Update on Agriculture Research



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One of
NIFA's main
goals is to
support
high impact
science!





United States
Department of
Agriculture

National Institute
of Food
and Agriculture

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NIFA's Mission

Invest in and advance agricultural research, education, and extension to solve societal challenges

Goal 1:

Science

Catalyze
exemplary
research,
education, and
extension
programs

Goal 2:

People

Transform NIFA
into a model
agency with a
motivated work
force

Goal 3:

Process

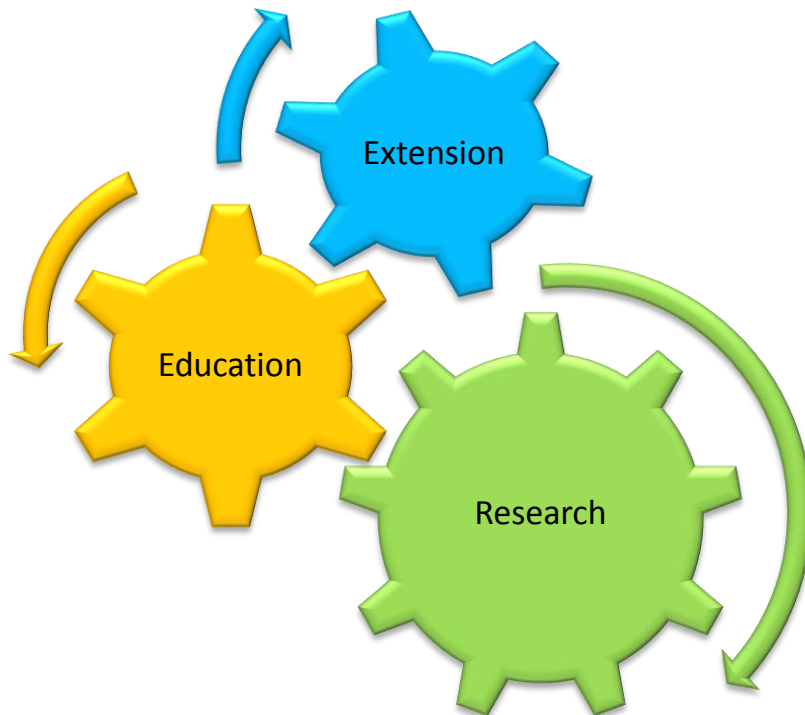
Institutionalize
streamlined,
effective policies
and processes

Goal 4:

Communication

Advance
America's global
preeminence in
food and ag
sciences

Helping to Solve Societal Challenges by Supporting:



- **Research** - Provide answers to the complex issues facing the nation and world
- **Education** - Strengthen schools and universities to train future generations
- **Extension** - Provide the knowledge gained through research and education to the agricultural workforce – from theory to practice

Discovery through Delivery Continuum

Discovery → Translation → Innovations → Solutions



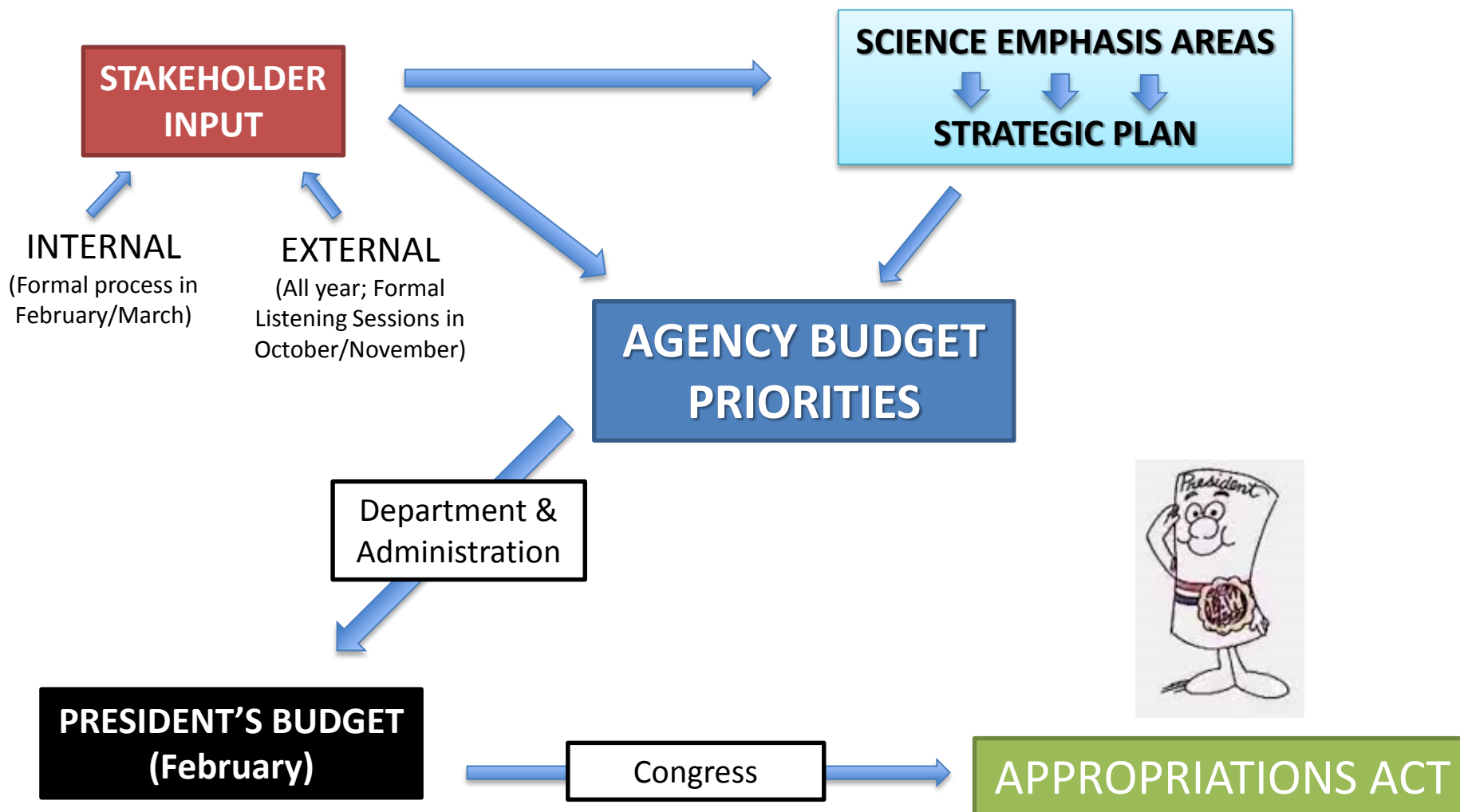
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Activities that Inform NIFA's Annual Budget





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NIFA

WE WANT TO
HEAR FROM YOU



NIFA LISTENS:

Investing in Science to
Transform Lives

NIFA Listens—Stakeholder Listening Sessions

- ✓ Hartford, Connecticut—October 11, 2018
- ✓ New Orleans, Louisiana—October 18, 2018
- ✓ Minneapolis, Minnesota—October 25, 2018
- ✓ Albuquerque, New Mexico—November 1, 2018

- Stakeholder Input Form on website
- NIFAlistens@nifa.usda.gov
- Comment period closes Nov. 30, 2018

<https://nifa.usda.gov/nifalistsens>

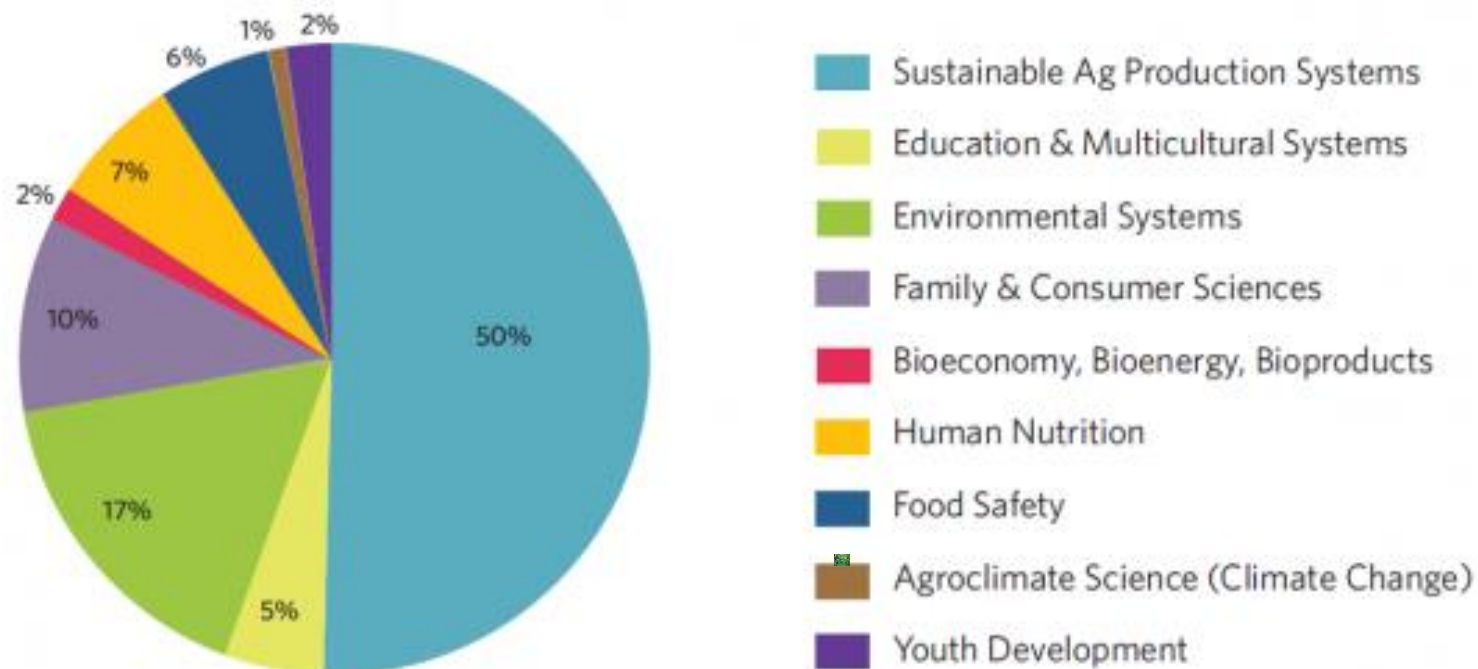
NIFA's Budget - 2018

Major Research Programs:

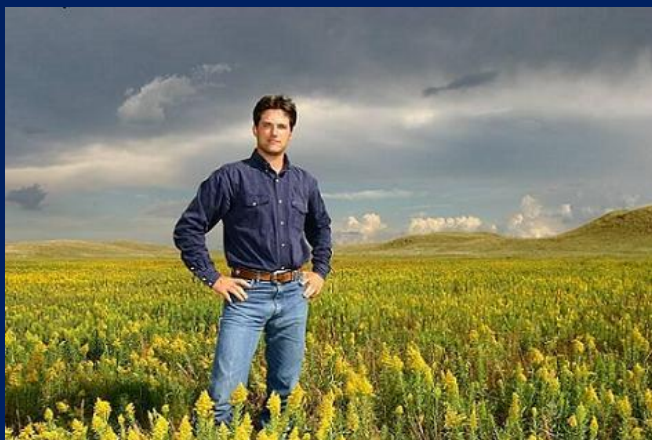
- Formula (**Capacity**) Programs - *Hatch, Smith-Lever 3(b) and 3(c), McIntire-Stennis, 1890/1994 Res./Ext. Programs* - **\$762 mil**
- Agriculture and Food Res. Initiative - **\$349**
- Minority-Serving Institution Programs - **\$166**
- Expanded Food and Nutrition Ed. Program (EFNEP)- **\$68**
- Food Safety Outreach Program - **\$5**
- Vet. Medical Services Act – Loan Repayment Program - **\$5**
- Children, Youth, and Families at Risk Program (CYFAR) - **\$8**
- Food Insecurity Nutrition Incentive (FINI) - **\$25**

Total Budget: approximately \$1.5 billion

COMPETITIVE FUNDING BY SCIENCE EMPHASIS AREA*



* estimated **\$643.4 Mil**



Agriculture and Food Research Initiative (AFRI)

- 2009 - NRI and IFAFS (**Initiative for Future Agriculture and Food Systems**) combined into a “premier” program called the Agriculture and Food Research Initiative (**AFRI**)
- 60% fundamental, 40% applied research (**up to 30% can be integrated [res., ed., and ext.]**)
- IDC cap currently up to 30%

AFRI - 2018

- **Education and Workforce Development - \$24 mil**
- **Foundational and Applied Science Programs (basic research) - \$182 mil**
 - Farm Bill Priority Areas
 - Exploratory Program
 - Critical Ag. Res. and Extension (CARE)
 - Food and Agriculture Cyberinformatics and Tools Program (FACT)
- **Sustainable Agricultural Systems (more applied research and often integrated – Res., Ed., Extens.) - \$80 mil**

Foundational and Appl. Sci. Program

- **Education and Workforce Development Program**
 - Pre- and Post-Docs
 - Secondary School teachers
 - Research/Extension Experiential Learning
- **Exploratory Program**
 - Deadline – LOIs accepted anytime t/o yr.
 - **\$200,000** (25% success rate)
- **Critical Agricultural Research and Extension Program**
 - **\$300,000**

Foundational and Appl. Sci. Program (cont.)

- The Food and Agriculture Cyberinformatics and Tools (FACT) Program

Focuses on data science to:

- Enable systems and communities to effectively utilize data
- Improve resource management
- Integrate new technologies and approaches

Foundational and Applied Science Programs:

- **Plant Health and Production and Plant Products***
- **Animal Health and Production and Animal Products**
- **Food Safety, Nutrition and Health**
- **Renewable Energy, Nat. Resources, and the Environment**
- **Ag. Systems and Technology**
- **Ag. Economics and Rural Communities**

AFRI – Foundational and Applied Science Prgm.

- **Plant Health and Production and Plant Products**
 - **Foundational Knowledge of Ag Production Systems**
 - **Pests and Beneficial Species in Ag Production Systems**
 - **Physiology of Agricultural Plants**
 - **Plant Breeding for Ag Production**
 - **Pollinator Health: Research and Application**

Sustainable Agricultural Systems (SAS)

Purpose: Promote the sustainable supply of abundant, affordable, safe, nutritious, and accessible food and other agricultural products, while enhancing economic opportunities and improving the long-term health and well-being of all Americans.

Coord. Ag. Projects **up to \$10 mil each.**

Applicants must address one or more of following 25-year goals:

- Increasing agricultural productivity
- Optimizing water and nitrogen use efficiency
- Protecting yield losses from stresses, diseases, and pests
- Reducing food-borne diseases
- Advancing development of biobased fuels, chemicals, and coproducts.

AFRI- Interagency Activities in FY18

- Plant-Microbe Interactions (with NSF)
- Breakthrough Technology – Early Concept Grants for Exploratory Res. (EAGERs with NSF)
- Ecology and Evolution of Infectious Diseases (with NSF, NIH, BBSRC)
- National Robotics Initiative (led by NSF)
- Cyberphysical Systems (led by NSF)
- Innovations at the Nexus of Food, Energy and Water (INFEWS with NSF)
- International Wheat Yield Partnership (BBSRC, USAID, and others)
- Dual Purpose Research (with NIH)
- Biomarkers for nutrition (with NIH)
- Feedstock genomics and Feedstock logistics (with DOE)
- Plant and animal health and production (with Irish agencies)
- Conservation practices economics (with NRCS)
- Economics of big data (with ERS)

International Collaborations

- **Binational Agriculture Research & Development**
- **Biotechnology & Biological Sciences Research Council**
- **Ireland Department of Agriculture, Food & Marine**
- **Ireland Department of Agriculture & Rural Development**

Pest Management Programs:

- **CPPM** - Crop Protection and Pest Management Program
 - ARDP** – Applied Res. and Develop. Prgm.
 - **Applied Research**
 - **Research-led**
 - **Extension-led**
 - EIP** – Extension Implementation Prgm.
 - RCP** – Regional Coordination Program
- **MBT** – Methyl Bromide Transitions Program
- **OTP** – Organic Transitions Program

Other PM Opportunities:

- **IR- 4** – Minor Crop Pest Management Program
- **SARE** – Sustainable Ag. Res. and Education Program
- **OREI** – Organic Ag. Res. and Extension Initiative (**\$19 mil.**)
- **SCRI** – Specialty Crop Research Initiative (**\$50 mil.**) + **\$25 mil** citrus res.

<http://www.NIFA.usda.gov/fo/funding.cfm>

21st Century Agricultural System Challenges

- **Agricultural Competitiveness**

- Improve crop and animal agriculture; enhance farm productivity and income; examine policies; supply chain; logistics; value-added products

- **Ecological Footprint**

- Water/land use, natural resource and environmental stewardship, greenhouse gases, variable climate/extreme weather, depleted soils

- **Bioeconomy**

- Replacements for petroleum-based products and enhance community economic well being

- **Health**

- Food safety, nutrition, obesity

- **Youth, Family, and Communities**

- Literacy, hunger, poverty, families/children, youth development, jobs and economic security

Sci. Breakthroughs to Advance Food and Agric. Res. By 2030 – Nat. Acad. Sci. Eng. Medicine

- **The potential of microbes (gut, soil, etc.) to increase efficiency and overcome obstacles in production.**
- **Advancements in genetic eval. and editing (CRISPR and other technologies) to accelerate evolution of food product.**
- **Expanding and analyzing the many pools of data involved in growing and producing food.**
- **Developing and improving sensors and biosensors across all agric. sectors to increase productivity and better target interventions.**
- **Examining, through transdisciplinary collaborations, entire systems in food production and finding the key to adapting and transforming them to overcome challenges and increase production.**

White House R&D Priorities for FY 2020 Budget Request (for American Agriculture)

Prioritize R&D that enables:

- Advanced and precision agriculture and aquaculture technologies.
- Use of embedded sensors, data analytics, and machine learning techniques to minimize agricultural inputs and maximize the quantity and quality of agricultural products.
- Agencies should prioritize investments in pre-competitive research regarding the safety of microorganisms, plants, and animals developed using gene editing, in order to greater leverage technology products for agriculture.

Other Research Topics Getting Attention:

- Invasive species
- Microbiome
- Vertical farming
- Big data analytics
- Precision agriculture
- Pesticide/antimicrobial resistance
- Unmanned aerial vehicles (UAVs)
- Biofuels
- Food loss and waste
- Gene silencing/editing techniques



NIFA Projects Related to Gene Editing

Slides – Compliments of Lakshmi K. Matukumalli

Plants



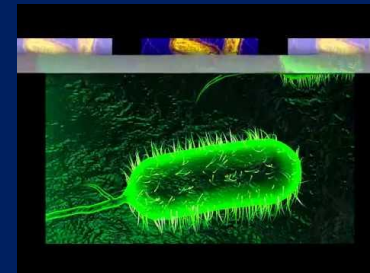
Animals



Insects



Microbes



NIFA Projects – Topic Areas

Improve Quantity,
Quality, or
Composition

Improve Protection
or Adaptability

Understanding of
Basic Biology

Environmental
Risks

Social Implications
of Novel
Technologies



Improve Wheat Yield

K-State researchers working with a suite of 25 genes controlling traits that affect yield. Using **CRISPR-Cas9 technology**, they have the ability to improve each of these genes before testing them in the greenhouse, and evaluating them in field conditions.



Multiplexed knock-out gene editing mutations of TaGW2, TaLpx-1, and TaMLO genes of hexaploid wheat generated in all three homoeologous copies resulted in a **substantial increase in seed size and grain weight**.

The project is a part of the International Wheat Yield Partnership (iwyp.org) program

Breeding new Peanut Varieties

Researchers at the Tuskegee University are **developing new Peanut cultivars with improved oil quality.**

Oils containing high percentage of linoleic acid are prone to oxidation, leading to rancidity, off flavors, and short shelf-life.

Oleic acid has 10-fold higher auto-oxidative stability than linoleic acid; therefore, high Oleic and low Linoleic peanuts have a longer shelf life.

Oils with high levels of oleic acid are also nutritionally beneficial.

Oleic acid levels increased through FAD2 gene expression modulation



Plant Protection through Gene Editing



Sweet Basil resistant to Downy Mildew (Rutgers U)



Citrus plants resistant to HLB (U of Florida, Clemson U)



Lettuce resistant to diseases through gene stacking (UC Davis)

Genetic Dehorning of Cattle

The genetic basis of Polled cattle (no horns) was recently attributed to two loci on Chromosome 1: Friesian (Pf) that is caused by a 80Kb duplication and Celtic (Pc) caused by a 212 bp duplication.

Recombinetics Inc used TALENs to create the Pc duplication in a cell line and used nuclear transfer technique to clone the polled cattle

UC Davis is analyzing the gene flow, stability of the polled gene in multiple generations and non-target effects

Recombinetics is also using gene stacking to introduce multiple genes (SLICK, PLAG1, DGAT1, MSTN and ABCG2) with beneficial traits into a single animal



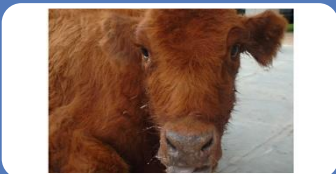
Animal Protection through Gene Editing



Pigs Resistant to Porcine Respiratory and Reproductive Syndrome Virus (Kansas State U and U of Missouri)



Pigs resistant to Swine Flu (U of Maryland)



Cattle Resistant to Bovine Respiratory Disease Syndrome (U of Washington)



Cattle resistant to Bovine TB (Recombinetics, Ireland, Northern Ireland)

Gene Editing – Social Implications

- Formation of beliefs about scientific issues: the case of GM foods (Santa Fe Institute of Science)
- Identifying gaps in public trust and governance recommendations for gene-edited foods (Iowa State)
- Gene drive applications to agriculture in Texas: knowledge, perceptions, and values (Texas A&M)
- Determining antecedents to consumer acceptance of scientific information to develop educational approaches on gene-editing technologies (U of Florida)



Thank you!

