



United States
Department of
Agriculture

National Institute
of Food
and Agriculture

<https://nifa.usda.gov>
@usda_nifa

INVESTING IN SCIENCE | SECURING OUR FUTURE | WWW.NIFA.USDA.GOV

21st Food Systems and Education

Sonny Ramaswamy



United States
Department of
Agriculture

National Institute
of Food
and Agriculture

<https://nifa.usda.gov>
@usda_nifa

INVESTING IN SCIENCE | SECURING OUR FUTURE | WWW.NIFA.USDA.GOV

An Existential Security Threat



Drivers

- Nutritional Security
- Environment and Natural Resources
- Positive Youth Development
- Literacy and Education
- Families and Community
- Mental Health and Opioids
- Active Duty and Veteran Needs
- Rural Economic Development
- Demographic Changes

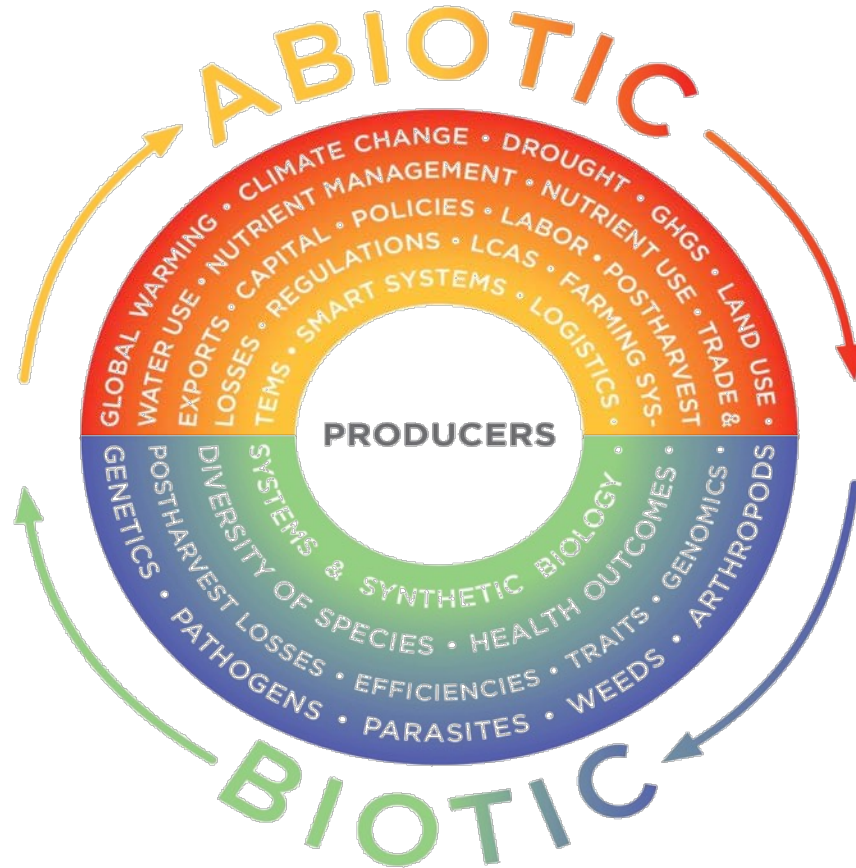


United States
Department of
Agriculture

National Institute
of Food
and Agriculture

<https://nifa.usda.gov>
@usda_nifa

INVESTING IN SCIENCE | SECURING OUR FUTURE | WWW.NIFA.USDA.GOV





Path Forward

- Transformative discoveries
- 21st Century Extension
- Farming systems
- Education
- Policies, regulation, marketing
- Infrastructure
- Human dimensions
- Communications



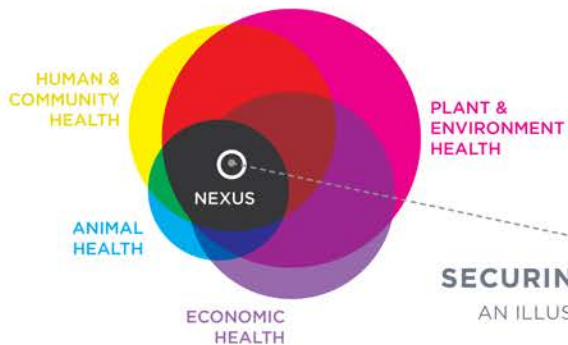
NIFA Focus

- Vision
 - Catalyze transformative discoveries, education, and engagement to address agricultural challenges
- Discovery through Delivery Continuum
 - Discovery → Translation → Innovation → Solution

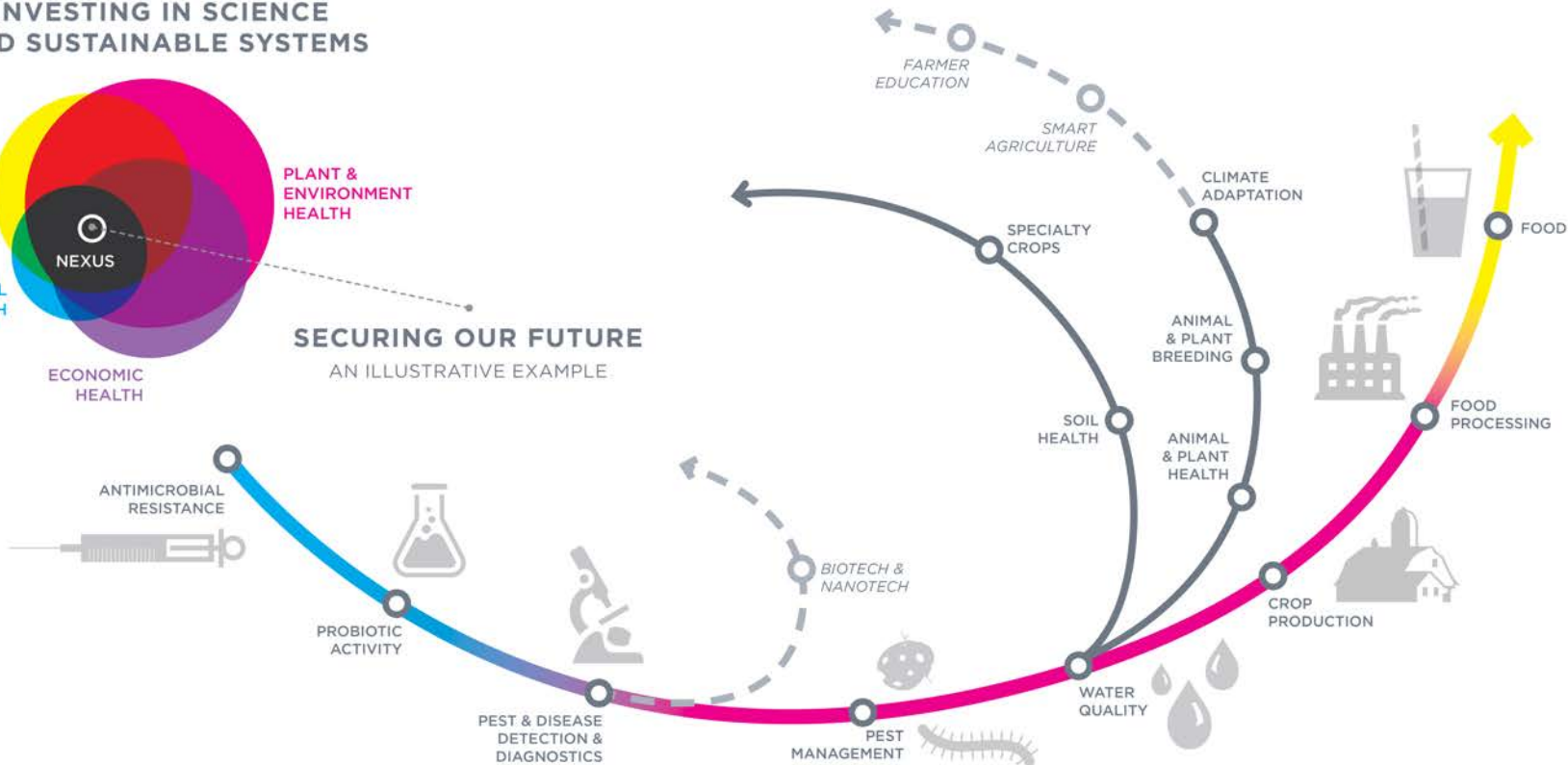
User Inspired Science, Transforming Lives

THE NEXUS OF AGRICULTURE AND HEALTH

INVESTING IN SCIENCE AND SUSTAINABLE SYSTEMS



SECURING OUR FUTURE AN ILLUSTRATIVE EXAMPLE





United States
Department of
Agriculture

National Institute
of Food
and Agriculture

<https://nifa.usda.gov>
@usda_nifa

INVESTING IN SCIENCE | SECURING OUR FUTURE | WWW.NIFA.USDA.GOV

Sustainable Nutritional Security



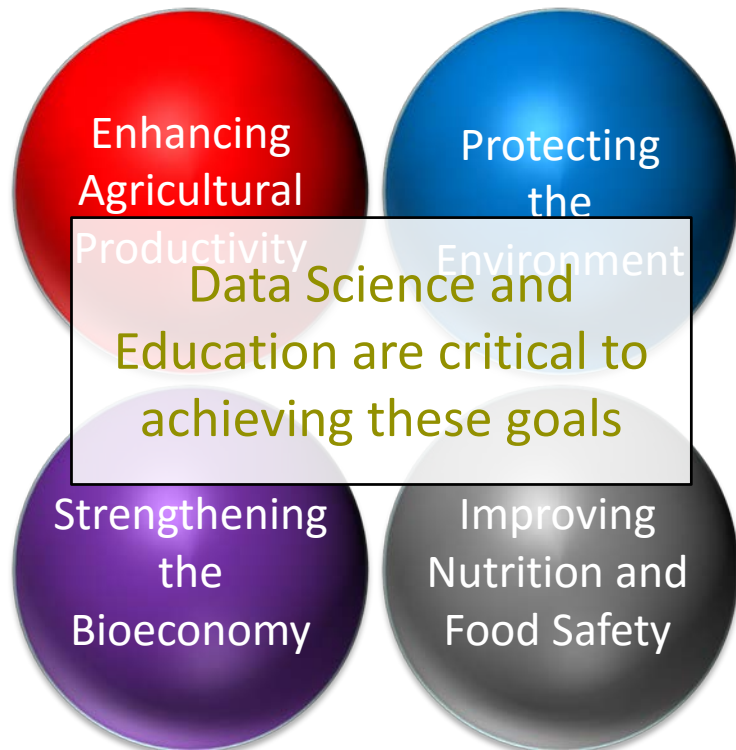
Ecological Footprint of Food and Agriculture



NIFA's vision is to help facilitate approaches – including biophysical, behavioral, social, regulatory, and policy – to reduce footprint by at least 50 percent in the next 15-20 years



Systems Approaches for Sustainable Agricultural Systems





Enhanced Productivity to Profitability

- Abiotic Variables
- Biotic Variables
- Genotyping and Phenotyping Technologies
- Statistical and Quantitative Genetics
- Observational Science to Information Science to Predictive Science
- Genome Editing, Heterosis, Doubled Haploids
- Systems and synthetic biology
- Productivity and Efficiency
- Traits

Food Waste and Food Loss



- Americans waste approximately 40% of the food they buy
- Double food production in the U.S. since 1970
- Cut loss/waste by half?
- Cut water loss
 - One quadrillion liters/year
- Impact climate change
 - 1.4 kilograms (kg) CO₂-eq capita⁻¹day⁻¹; emissions of 33 million cars/year

Precision Foods

- Individual genome, epigenome, microbiome
- Plant/animal genome, epigenome, microbiome
- Wearable sensors
 - FitBit, Apple Watch, Google Contact Lens
 - Athos, Hexoskin, Gymi
 - Verily, ActiSmile, Medtronic
- Food analysis
- Lifestyle
- Behavior



Smart Systems: Opportunities and Challenges

- Cyberphysical Systems
- Robotics
- Drones
- Sensors: Biological, Bio-NEMS, Bio-MEMS
- Big Data

Farm



Food Systems

Table

Path Forward: Education



We have schools to teach the art of manslaying

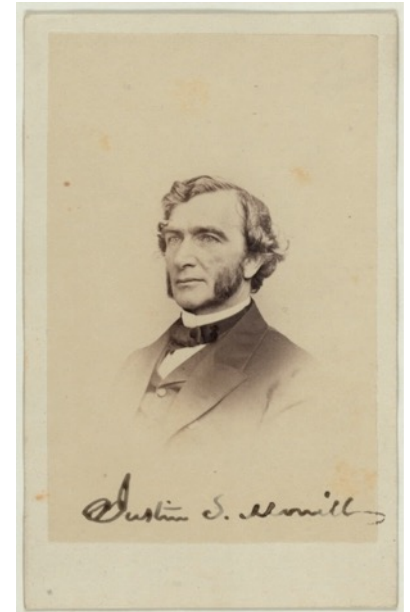
Shall we not have schools to teach men the way to feed, clothe, and enlighten the brotherhood of man?

Justin Smith Morrill, April 20, 1858

1862: An Act donating Public Lands to the several States and Territories which may Provide Colleges for the Benefit of Agriculture and the Mechanic Arts

“...without excluding other scientific and classical studies and including military tactic, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education... .”

<http://memory.loc.gov/cgi-bin/ampage?collId=llsl&fileName=012/llsl012.db&recNum=534>





1893: Committee of Ten – National Education Association meeting in Saratoga, NY

“... science should be based on direct experience with the physical world rather than the words of teachers or textbooks. ... recommended teachers guide students’ thinking and one week be set aside for laboratory instruction and one afternoon per week be set aside for out-of-door instruction.”



United States
Department of
Agriculture

National Institute
of Food
and Agriculture

<https://nifa.usda.gov>
@usda_nifa

INVESTING IN SCIENCE | SECURING OUR FUTURE | WWW.NIFA.USDA.GOV

2006: Cognitive and Noncognitive Abilities

James Heckman, Jora Stixrud, Sergio Urzua

“... cognitive and noncognitive abilities determine social and economic success. noncognitive skills ... explain why early childhood programs, like Headstart and the Perry Preschool program, are effective. ... they do not boost IQ but raise noncognitive skills and therefore promote success in social and economic life.”

http://www.nber.org/papers/w12006.pdf?new_window=1



Innovations in Education

Start at a younger age

- Use land-grant model in schools?
- Enhance partnerships between schools and colleges/universities?
- Resurrect Home Economics curricula?
- Promote (mandate?) AITC curricula?



Path Forward

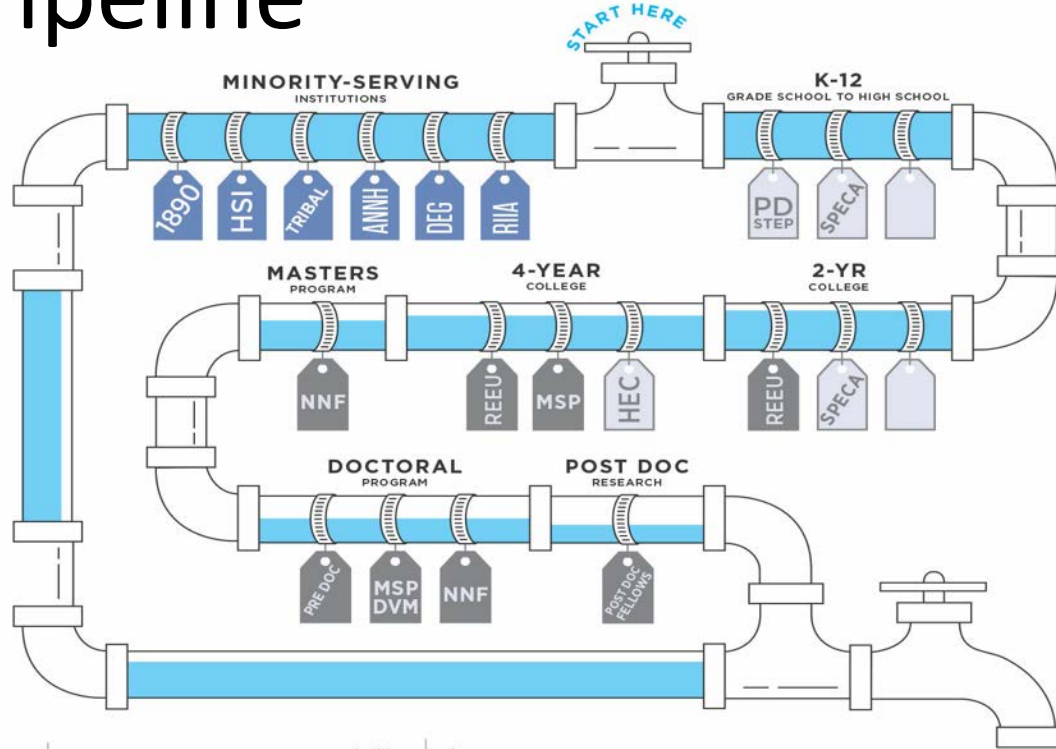


Education Domains

- Workforce
- Scientific cadre
- Extension cadre
- Producers



Leaky Pipeline



KEY

- supports teachers & faculty
- supports students &
- builds capacity

please see page two for program descriptions



NIFA Supports Research and Education to Sustainably Achieve Global Nutritional Security



INCREASING

photosynthetic, water use,
and nutrient use
efficiency in crops
and animals



DIVERSIFYING

the product stream
through novel crops,
organisms, and processing
technologies



PROTECTING

these products against
predators, parasites,
diseases, and pathogens
to ensure food safety



DEVELOPING & DEPLOYING

the industrial, physical,
and digital technologies
to revolutionize planting,
cultivation, harvest, storage,

PREPARING the next generation of agriculture professionals through education, training, and leadership development.



United States
Department of
Agriculture

National Institute
of Food
and Agriculture

<https://nifa.usda.gov>
@usda_nifa

INVESTING IN SCIENCE | SECURING OUR FUTURE | WWW.NIFA.USDA.GOV



...think anew, and act anew.

- Abraham Lincoln