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Agriculture of the Future: People, Places, and Products

NIFA's Role

USDA NIFA

NATIONAL INSTITUTE OF FOOD AND AGRICULTURE

USDA Science

- **Several agencies**
  - –NIFA is the extramural funding agency
  - –Intramural research-
    Agricultural Research Service, Economic Research Service, Forest Service
- **Budget**
  - –~ $3.8 B Research/Education Investments
  - –~ $2 B in extramural support and the rest in intramural support
- **NIFA's science functions**
  - –Research
  - –Education
  - –Extension- formal nationwide outreach system

NIFA in Numbers

$1.95 Billion Budget (FY21)

~74+ programs (budget lines)

- **Different budget lines, each with its own scope and mandates**
- **Formula vs competitive vs capacity vs directed …….**

>2300 Annual Awards

>300 NIFA staff currently on board

+ ~60 in Admn and Financial Mgt Unit of REE (AFM)

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NIFA's science breadth

Food → Processing and Distribution → Consumer use of food → Nutritional Security

- Technology
- Human Capital
- Natural resources

- Consumer Preferences
- Marketing
- Education

Inputs → Production Systems

- Technology
- Human Capital
- Natural resources

- Crops
- Farm animals
- Forests

Feedstocks → Processing and Distribution → Consumer Use of bioproducts → Economic Security

- Technology
- Entrepreneurship

- Preferences
- Marketing
- Education

Agriculture of the Future

Food

Sufficient

Sustainable

Safe

Affordable

Nutritious

Culturally compatible

Climate Change

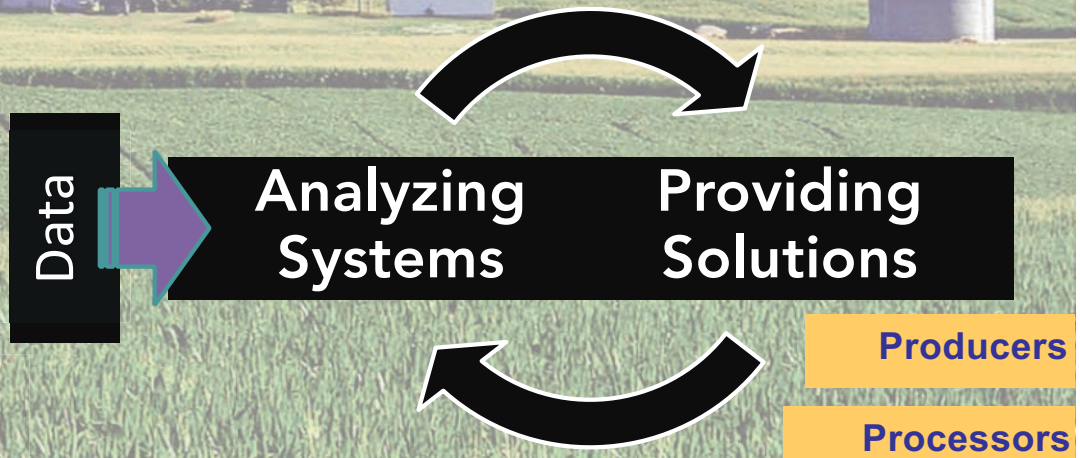
Nutrition Security

Expanding Market Opportunities

Equity

Holistic View of Agricultural Systems

- **Productive**
  - –40% increase in production
  - –Produce what we need
- **Profitable**
- **Environmentally Sustainable**
  - –50% reduction in footprint
- **Resilient and Robust**
  - –To disruptions



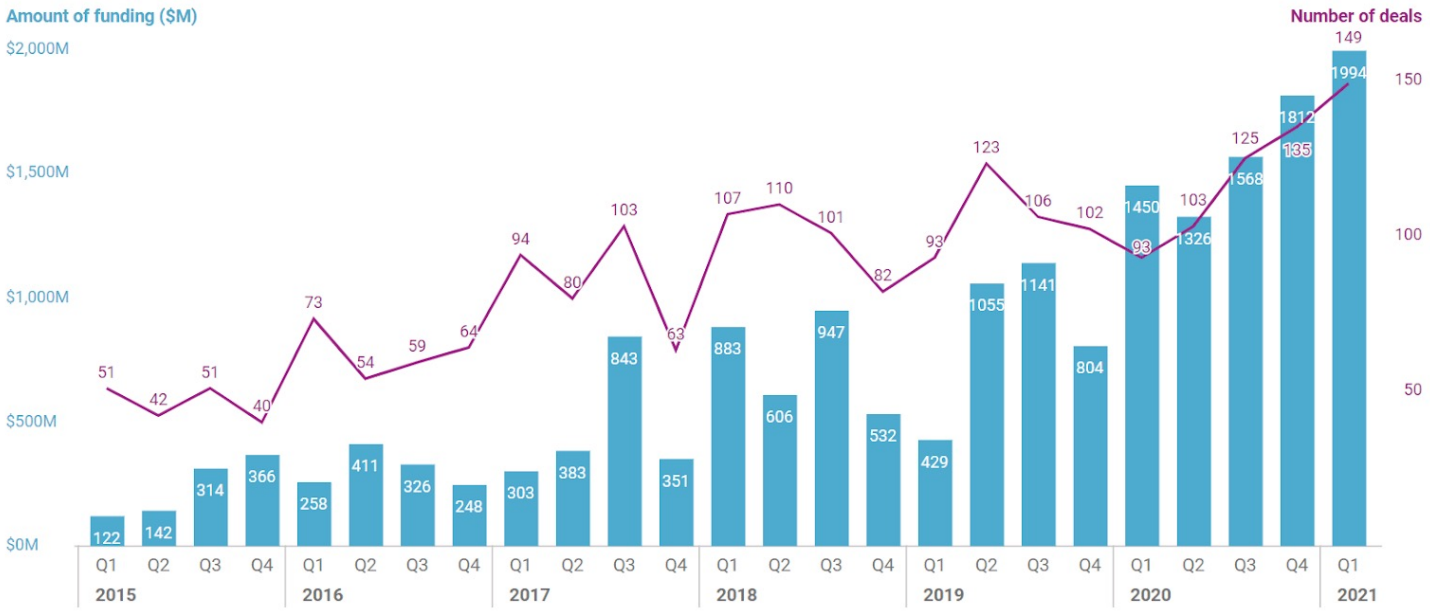
Changing Face of New Agriculture
People and Players
Products
Places
Technologies
Information

New Players- Venture Capital, Startups, and Information Companies

AGTECH FUNDING & DEALS

Agtech deals and funding hit new highs in Q1'21

Quarterly deals and funding ($M) to agtech companies, Q1'15 - Q1'21 (swipe to see full data)



Created with: CBINSIGHTS Source: CB Insights

Google

Microsoft

IBM

amazon

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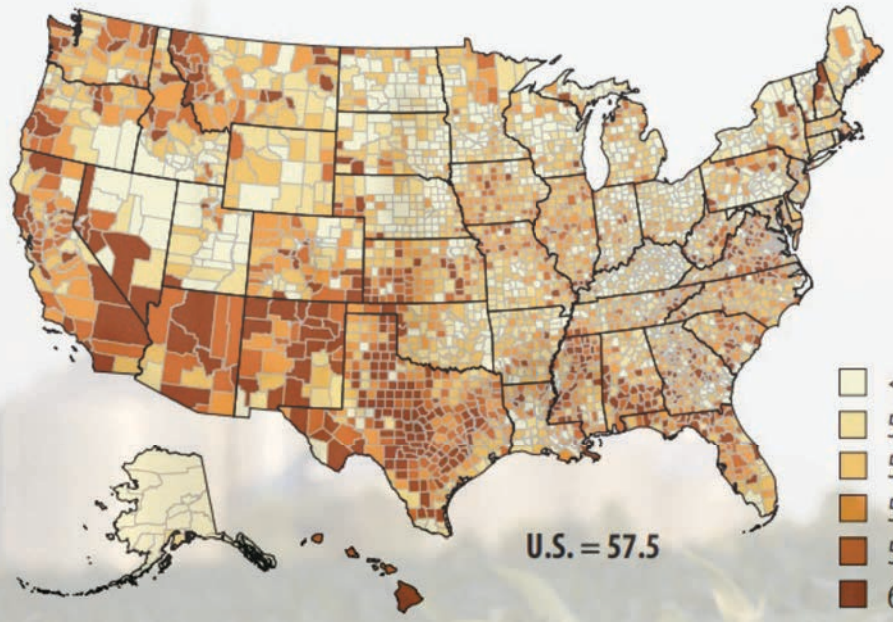
NIFA

Average Age of Producers by County, 2017



On average, producers are older in southern states and younger in Midwestern states.

In 2017

88% Male
95% White

57.5 years average
27% with less than 10 years exp.

NASS data

Beginning Farmers and Ranchers
Development Program
AFRI
Small and Medium
Size Farms

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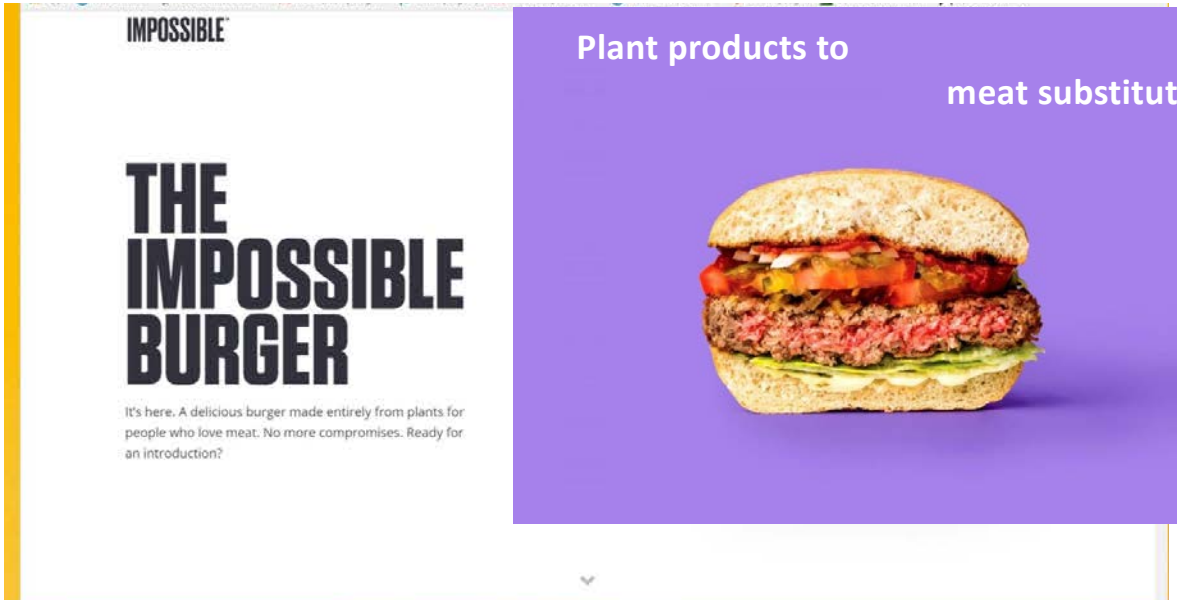

- Made from plant proteins
- Raised $180 million from Bill Gates, Google Ventures, Open Philanthropy Project, amongst others
- Burger uses about 75% less water, generates about 87% fewer greenhouse gasses, and requires around 95% less land than conventional ground beef from cows.
- On menu in many high-end restaurants, Air New Zealand and now in Burger King and grocery shelves!

THE WALL STREET JOURNAL.

BUSINESS

Startup to Serve Up Chicken Strips Cultivated From Cells in Lab

'Clean meat' developers say it avoids towering costs of feeding, caring for livestock; Tyson takes note

Bay Area startup Memphis Meats says it has developed the world's first chicken strip grown from self-reproducing cells. Photo/Video: Emily Prapuolenis/The Wall Street Journal

By JACOB BUNGE

48 COMMENTS

Lab-grown meats

- Beef
- Chicken

GFI joins Representatives DeLauro and Clark in celebrating USDA funding of the first-ever National Institute for Cellular Agriculture at Tufts University

The $10 million award will enable the creation of the first-ever U.S. government-funded cultivated protein research center of excellence and represents U.S. Department of Agriculture (USDA)'s first

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Urban Agriculture

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Vertical Farming

NIFA

- NIFA Urban Agriculture Program
- $10 million in FY2018 Farm Bill

Changing Face of New Agriculture

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NIFA Investments in Mechanization and Automation

Program Code	Total
[A1521] Agricultural Engineering	$6,790,392
[A7302] Cyber-Physical Systems	$11,730,778
[A7301] National Robotics Initiative	$10,263,297
[A1541] Food and Agriculture Cyberinformatics and Tools	$7,474,759
[A7303] AI Institutes	$24,024,904
[SCRI] Specialty Crop Research Initiative	$10,952,182
[CDRE] Citrus Disease Research and Extension Program	$4,274,523
	$75,510,835

Precision Crop Load management for apples

Mobile Remote Sensing and AI-guided Precision Management for Turfgrass Water Conservation

Wireless monitoring for animal welfare in swine

Increasing the Level of Autonomy for Agricultural Robots

Customizable Fleet of Autonomous Co-Robots for Aquaculture

Sustainable precision dairy farming

Data Deluge allows Systems Research

DNA/RNA

High throughput phenotyping

Climate

Sensory

Precision agriculture

Nutritional

Consumer

Economic

Educational

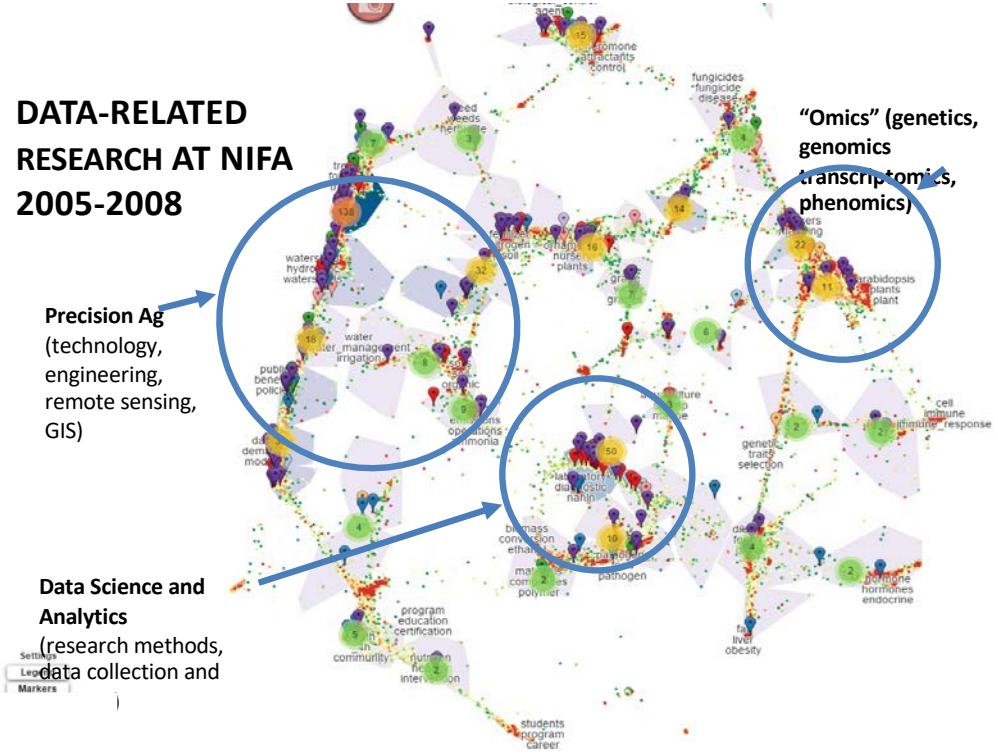
Analyzing Systems

Providing Solutions

- Producers
- Processors
- Consumers
- Researchers

Data Investments By NIFA

DATA-RELATED RESEARCH AT NIFA 2005-2008

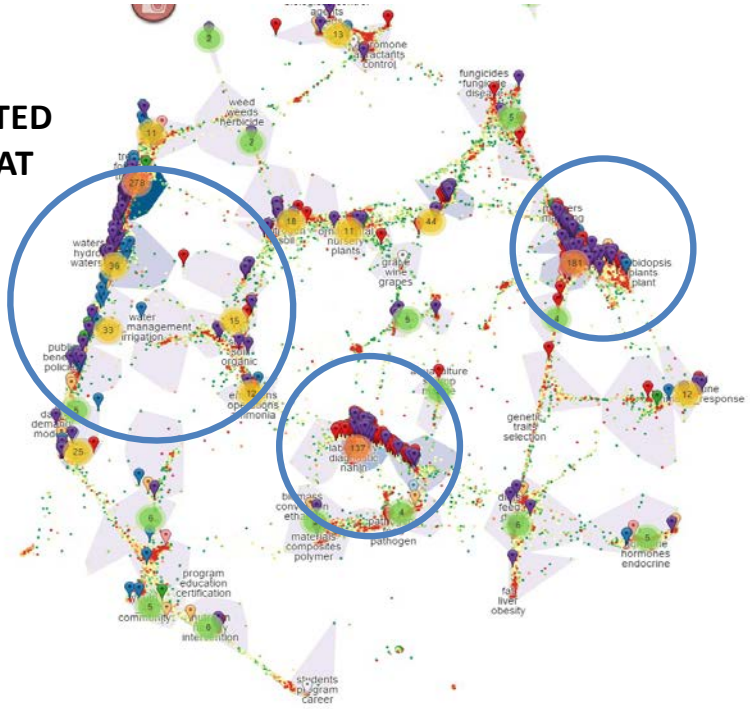


Precision Ag (technology, engineering, remote sensing, GIS)

Data Science and Analytics (research methods, data collection and

"Omics" (genetics, genomics transcriptomics, phenomics)

DATA-RELATED RESEARCH AT NIFA 2012-2015



Areas of increased research intensity in precision ag, data science and analytics, and "omics" related

Input from Data Summit and Ideas Engine

Focus on Open Data FAIR principles:

Findable, Accessible, Interoperable, and Re-usable

- **Community Building**
  - **–Standards, Ontology, and Common data resources**
- **Small data to Big data in public domain**
  - **–Value, Incentives, Digitization, Policies**
- **Infrastructure**
- **Training and Education**

NIFA's Data Opportunities

Design and Implementation

Build scalable data infrastructure and management systems

Conceptualize Open Data FAIR principles (findable, accessible, interoperable, and re-usable) for data

Develop standards and best practices with other Federal and international organizations to address tradeoffs in data availability, privacy, ownership, and value

Analysis

Develop data-integration and data-quality tools to improve analytic capability

Design and implement new algorithms and methods for depicting massive data

Build integrative models to facilitate dialog and collaboration

Technologies

Connect multiscale data

Bridge real-time distributed and parallel data systems

Create new methodologies and frameworks for tracking and processing data

identify new approaches to data archiving and sharing

Applications and Human-Technology-Data Interactions

Examine how agricultural data and computer systems are used to improve human-human, human-technology, and human-decision experiences

Integrate visualization with statistical and analytic techniques to support discovery and analysis

Engage students and professionals, teams, universities and public/private sectors

Develop decision support tools that use diverse data sources and Big Data analytics to create best value to US agriculture

NIFA's Data Science Progress

2016

- Broad Stakeholder Input
- Data Summit

2017

- Domain Workshops
- Catalytic Projects

2018-

- Data science research
- Data science education

2019-

- NSF Collaborations
- Data science informal education

2020-21-22

- AI Institutes in digital agriculture

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NIFA

Data Science Application Example

UVA BIOCOMPLEXITY INSTITUTE

Proceedings News Events

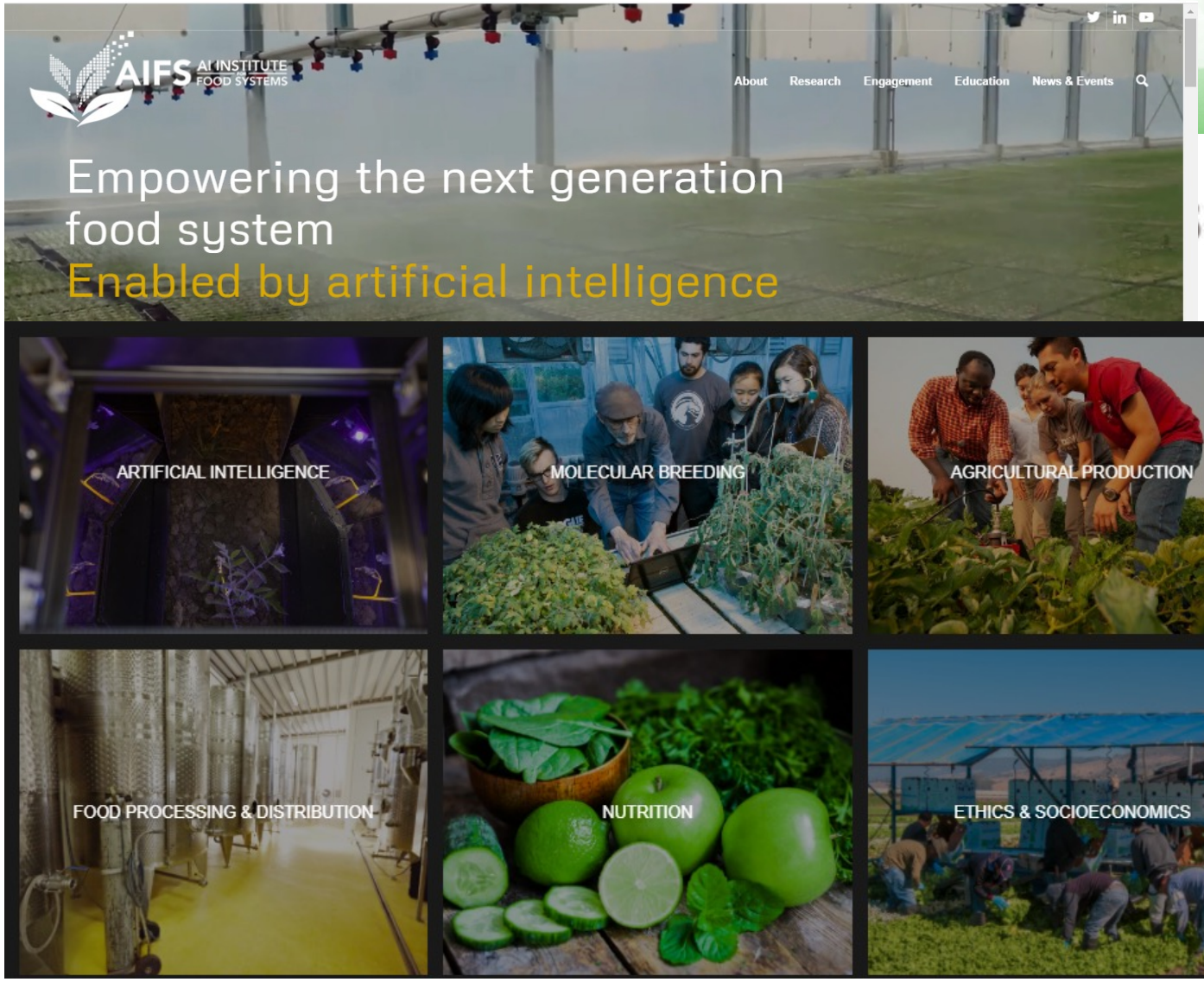
Collaboration with VT, Iowa State, and WSU Extension

Social and Decision Analytics | Community Well-being

Towards a National Community Learning Network to Advance Economic Mobility

Contacts

Sallie Keller



NIFA

UC DAVIS

Berkeley
UNIVERSITY OF CALIFORNIA

Cornell University

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

USDA

UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

Ilias Tagkopoulos

AIFARMS
Artificial Intelligence for Future Agricultural Resilience, Management, and Sustainability

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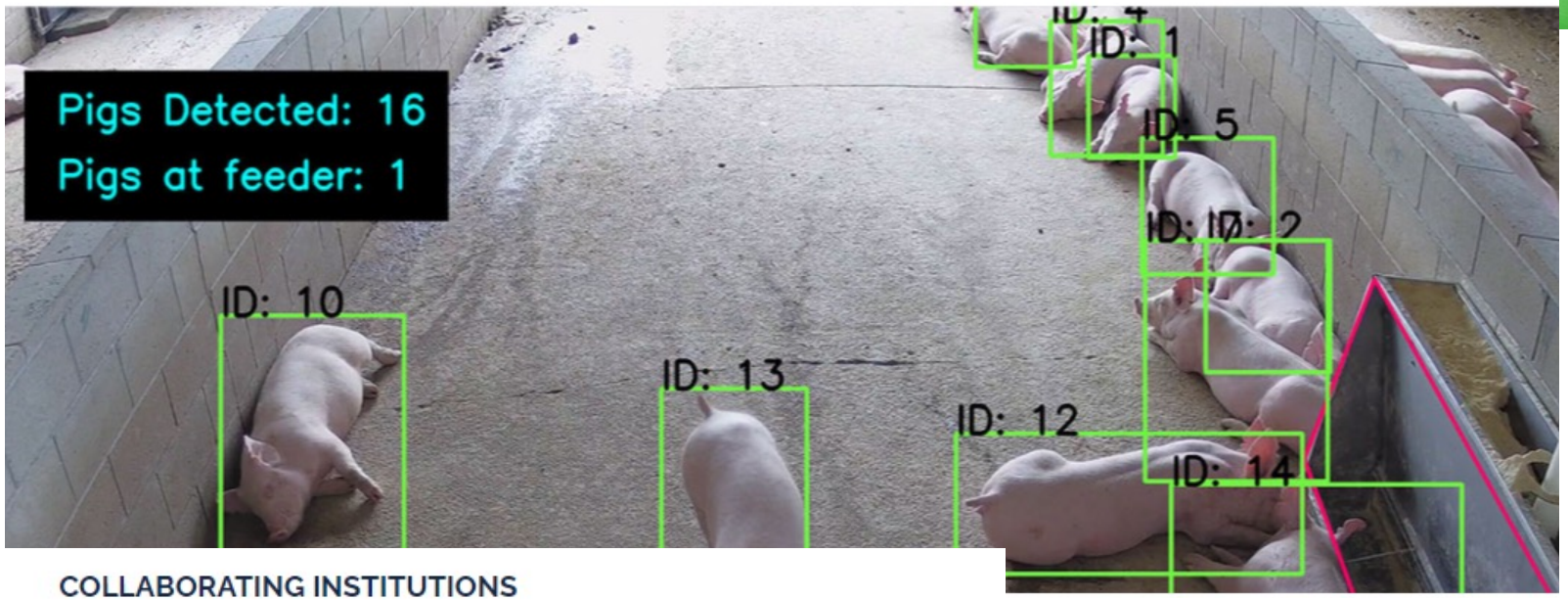


NIFA

- Autonomous Farming
- Labor Optimization for Livestock
- Environmental Resilience
- Soil Health

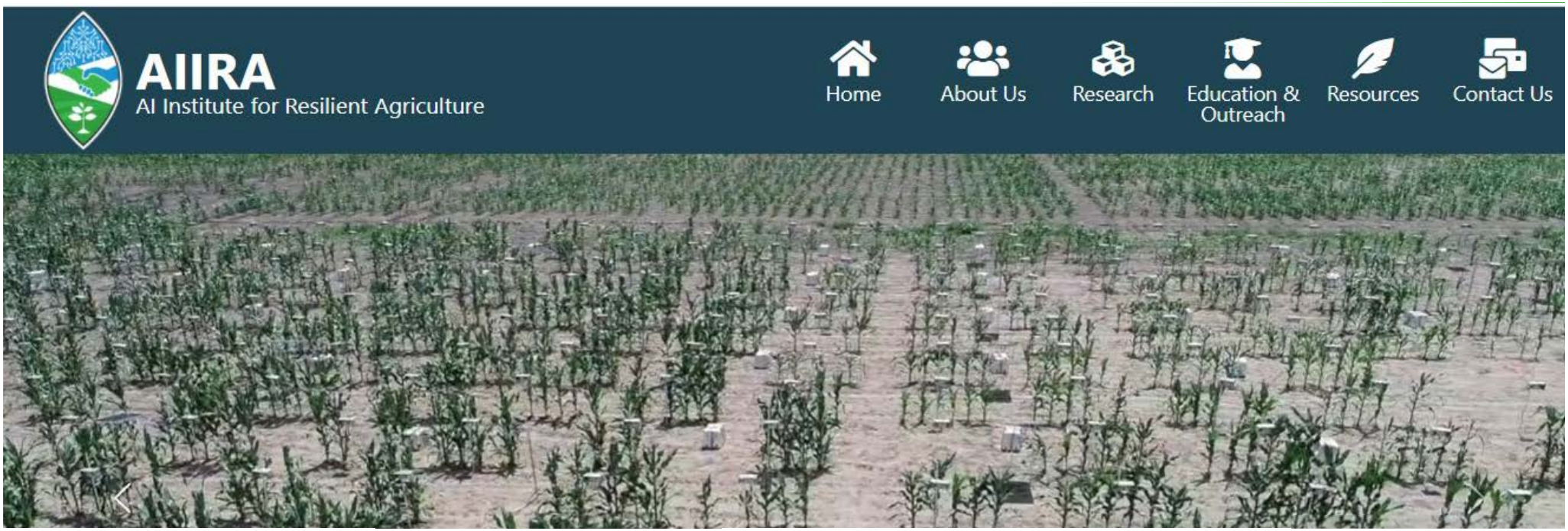
COLLABORATING INSTITUTIONS

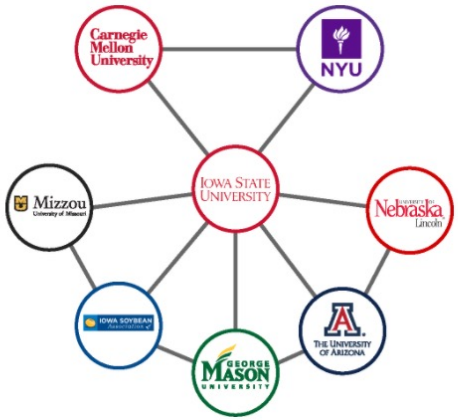
THE UNIVERSITY OF CHICAGO
MICHIGAN STATE UNIVERSITY
TUSKEGEE UNIVERSITY
ILLINOIS
Argonne NATIONAL LABORATORY
ILLINOIS Center for Digital Agriculture
DONALD DANFORTH PLANT SCIENCE CENTER
USDA ARS

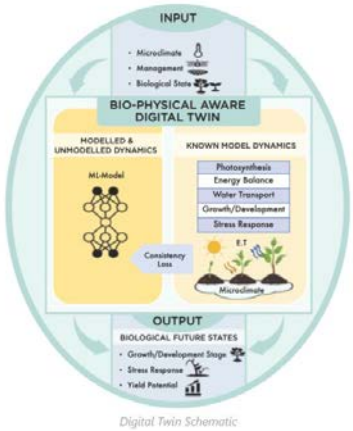
PARTNERS

EARTHSENSE
Microsoft
IBM

Vikram Adve







Digital Twin Schematic

Digital Twins at the plant and field scales

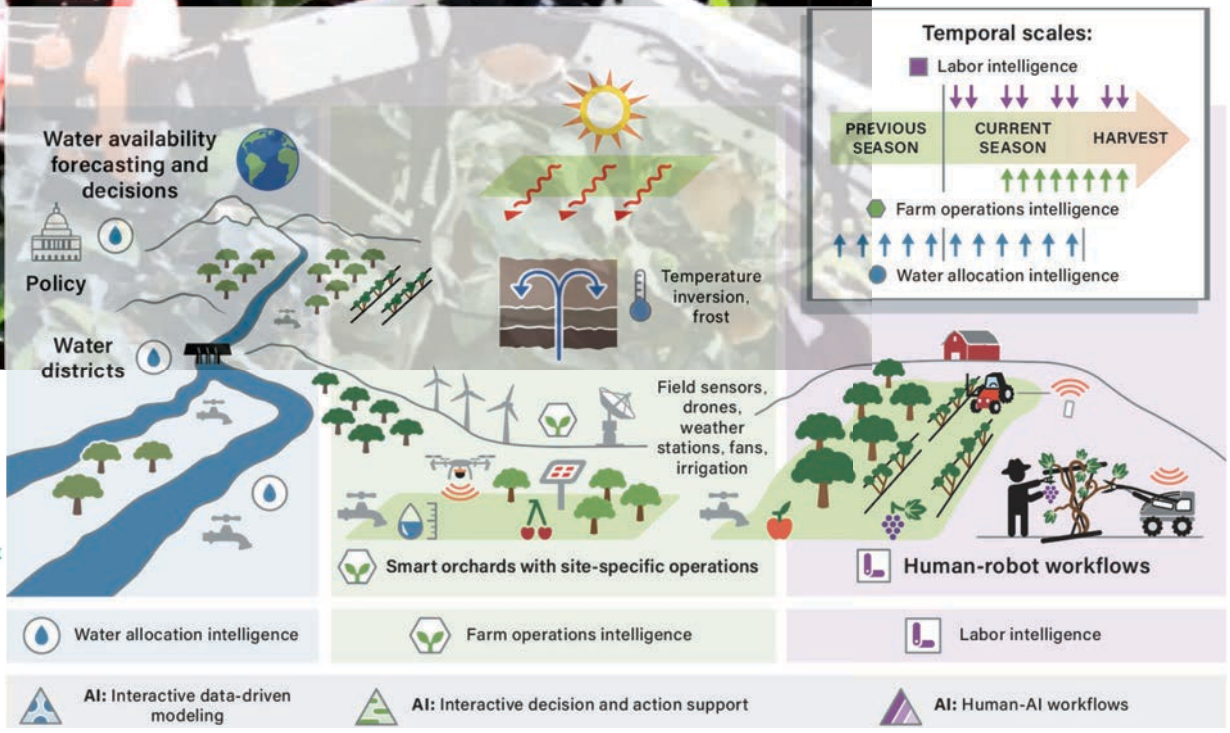
Baskar Ganapathysubramanian

AgAID

AI Institute for Transforming Workforce & Decision Support

ANANTH KALYANARAMAN

NIFA



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