

Food and Agriculture Cyberinformatics and Tools

NIFA's Initiative for Data Science in Agriculture

2018 Database Integration Workshop

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Agriculture of the future needs to feed a crowded, hot, flat and complex world



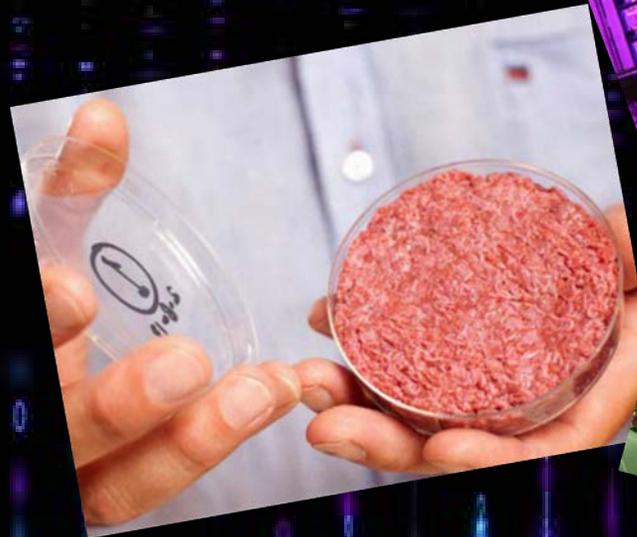
- Growing population
- Climate change
- Globalization
- Complex demands

10 B people

by 2050

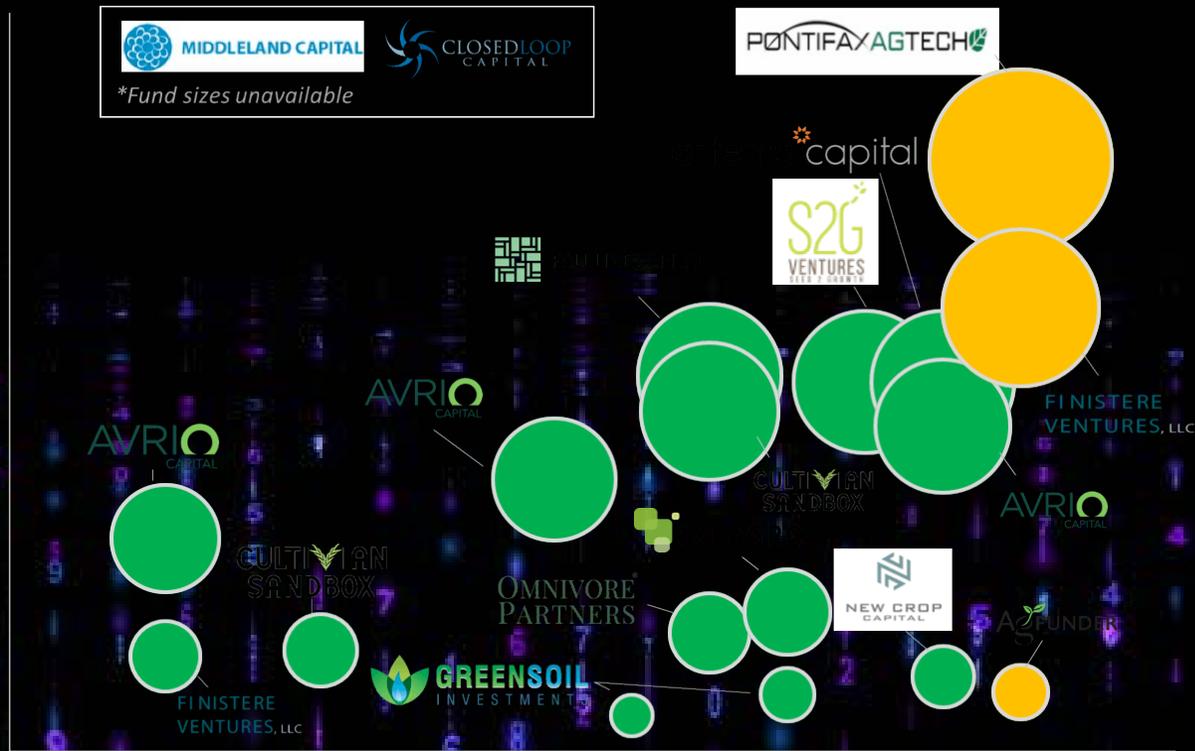
A New Narrative for Agriculture

- People and Players
- Products
- Places
- Technology
- Information/Data



New Players: Venture Capital and Information Companies

AGTECH FUNDS (2006-PRESENT)



Google

Microsoft

IBM

amazon



Premier Crop Systems

New Players



Marc Douglas
Illinois, USA

Bartolomiej Banasiak
Oborniki, Poland

Inka-Donata Müller-Scheeßel
Bütow, Germany

Sam Tretheway
Brisbane, Australia

Bevan Clarke
Bolgart, Australia

Marcos Montans
Paraná, Brazil

Corbin Schuster
Freeling, Australia

- Modern machines, cutting edge science, digital technologies and a keen sense of business are the tools many have mastered.
- Move away from “training and mentoring” to understanding what ag driven by new generation needs to look like

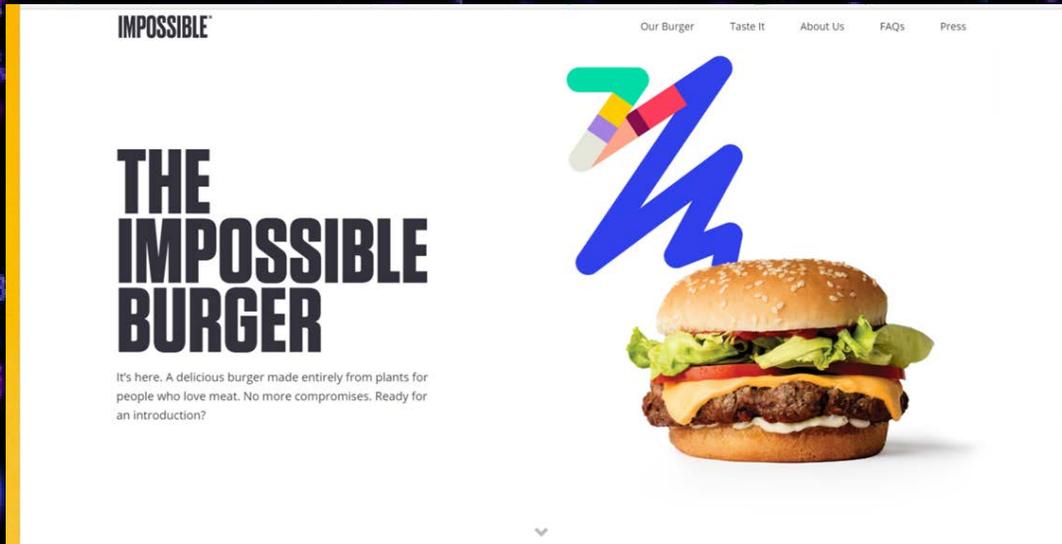
- ▶ Social media activity of farmers allows farmers to connect with 98.5 percent of the U.S. population not on a farm and provide these people with an inside look.

Source: USDA, European Parliament

US	76%	between 18-35 years
UK	53%	
Australia	33%	

New Products

- » 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



Tacos made with lab-grown chorizo.



THE WALL STREET JOURNAL

Home World U.S. Politics Economy **Business** Tech Markets Opinion Arts Life Real Estate Search

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

LEADING FOR HIGH PERFORMANCE

April 23-28

UNIVERSITY OF VIRGINIA DARDEN SCHOOL FOUNDATION EXECUTIVE EDUCATION

REGISTER NOW

Recommended Videos

1. Tony Robbins says this is how to get rich when the market tanks
2. Facebook Live: The Need to Censor Violence
3. E.U. Court Rules Private Companies Can Ban Head Scarf
4. China Doesn't Want

New Places: Urban Agriculture





New Places: Vertical Farming

Technology is transforming...

Retail Industry



Consumers

Homes



Consumers

Production



Producers

Food Industry



Manufacturers



A Four-Letter Word

DATA

Data Across the Food Supply Chain



Genome

Phenotyping

Geospatial

Precision ag

Environmental

Climate

Economic

Distribution

Processing

Food properties

Consumer

Nutrition

Food Safety

Food Properties

Food Flavor



- Extensive collections
- High throughput methods

Generation and Collection

Handling

- Cyberinfrastructure
- Transfer, storage, security
- Standards and metadata
- Ownership, privacy

- Mining
- Synthesis
- Visualization
- Decision Support

Data to Impacts



Observational Science to Information Science to Predictive Science

Challenges Managing Agricultural Data

- Not all domains in the supply chain are rich in data
- Non-digital or fractionated data
- Standard ontology not available
- Uneven accessibility
- Unresolved privacy and ethics issues
- Inadequate or non-existent infrastructure
for coordinated data storage and data exchange
- And on and on....



Data Summit: *Changing the Face, Place, and Space of Agriculture*

- **2016**
 - Announced NIFA's Food and Agriculture Cyberinformatics and Tools (FACT) initiative (October 2016)
 - Gathered input on needs (Ideas Engine)
 - Chicago – overlapping with Midwest Big Data Hub meetings
- **2017**
 - Solicited workshop proposals
 - Funded workshops
Big Data for (Sm)ALL Farmers, G2F, Privacy)
- **2018**
 - Continued development



Stakeholder Feedback

- **Data infrastructure and management (24%)**
- **Applications and use of data; entities affected by data (17%)**
- **Creation, collection, provenance, and characteristics of data (10%)**
- **Training, programs, student, and knowledge needs around data**
- Federal agencies, principles, and protocols associated with data
- University, team, community, and public/private aspects of data
- Data producers, engineers, scientists, and researchers of data
- Big corporations/commercial entities (Facebook, Amazon, Google, Microsoft, Apple, Oracle) in data
- Privacy, security, confidentiality, and quality data issues
- Biological and interoperable data systems
- Bibliometrics, altmetrics, text and data mining
- Data sharing, repositories, and analysis

Based on modeling conducted, stakeholder comments grouped into 12 major meaningful clusters

NIFA Listens Input

- **Systems**

- Interconnected nature of systems
- Economic, social, agricultural, ecological, and technical

- **Solutions**

- Data and technology to better manage agricultural systems
- Extension, education, and community development as central to improving agriculture.
- Need to strengthen communication between research and extension.

- **Online**

- 840 participants

- **In Person**

- 75 speakers
- 395 attendees



NIFA's Data Opportunity

Data design and Implementation

Build scalable data infrastructure and management systems
conceptualize Open Data FAIR principles (findable, acceptable, interoperable, and reusable) for data

Develop standards and best practices with other Federal and international organizations

Analysis

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

Design and implement new algorithms and methods for depicting massive data

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 BigData analytics to create best value to US agriculture

FACT Roadmap

• Focus on Open Data FAIR Principles



- ▶ Community Building
- ▶ Data Design and Implementation
- ▶ Analysis and Technology
- ▶ Small data to big data in public domain
- ▶ Training and education

2016

Stakeholder Input

- Ideas Engine
- Data Summit

2017

Refining Priorities

- Domain Workshops
- Catalytic Projects

2018

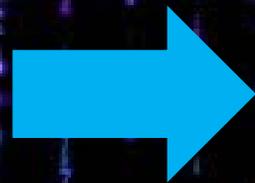
AFRI Priority Areas

FACT REEUs

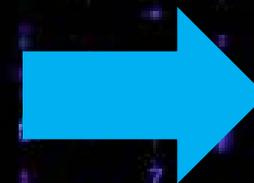
Innovation through SBIR

FACT Summit, Workshops, Listening Sessions, and **YOU** Help to Develop Science Priorities

- Summit
- Ideas Engine
- Workshops
- Listening Sessions
- PD Meetings



- Research Projects
- Networks
- Analyses
- Written records



Priorities in
Request for
Applications

Opportunities for Research



- **AFRI Foundational and Applied Science**
 - **Agricultural Economics and Rural Communities**
 - Small and Medium farms
 - Agricultural Systems and Technology **Since 2013**
 - **FACT: Food and Agricultural Cyberinformatics and Tools** **\$24M in 52 \$500K grants**
- **Organic Research and Extension Program**
- **Specialty Crops Research Initiative**

Opportunities for Education, Extension, Innovation

- **Education**
 - AFRI Education and Workforce Development
 - Fellowships
 - Research and Extension Experiences for Undergraduates
 - Beginning Farmers and Ranchers Development Program
- **Extension**
 - AFRI Critical Agricultural Research and Extension
- **Innovation**
 - SBIR- Small and Mid-Size Farms





Thank you

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Priorities for Research and Integrated Projects

Data Design & Implementation

- Build scalable data infrastructure & management systems
- Conceptualize FAIR principles for data (Findable, Accessible, Interoperable, and Reusable)
- Develop standards and best practices

Analysis

- Develop data integration and data quality tools
- New algorithms and methods for analyzing and interpreting big data
- Build integrative systems models to facilitate dialog and collaboration across disciplines

Technologies

- Connect multiscale data
- Bridge real-time distributed and parallel systems
- Create new methodologies & frameworks for tracking and processing data
- New approaches for data archiving and sharing

Applications & Human Interaction

- Human interactions with data and systems
- Data visualization for analysis and discovery
- Engage students, academics, professionals, public/private
- Decision support tools/big data analytics for US agriculture

Priorities for Coordinated Innovation Networks

- Cohesive, multidisciplinary communities to address bottlenecks
- Synergistic activities to develop data standards
- Communities working on multiple aspects of data-supported problem to result into a multidisciplinary network solution
- Networks among public and commercial entities from relevant disciplines
- Promote collaboration among research and education, leveraging domestic and international (share expertise, resources)
- Networking strategies for connecting public and private sector, students, foster societal engagement

