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Big Data and The Future of Agriculture

Sonny Ramaswamy



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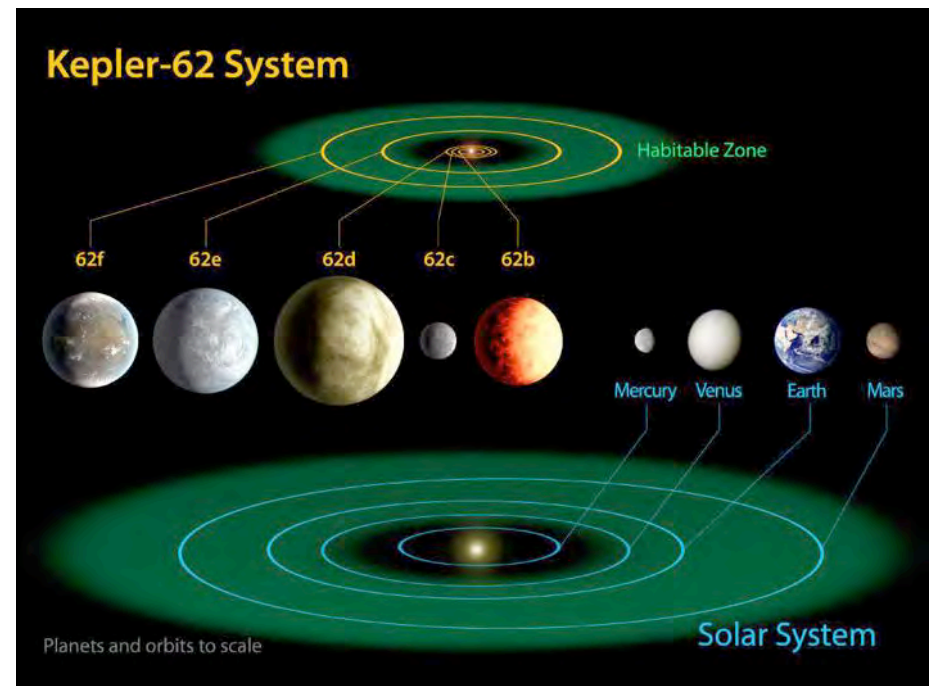
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Interstellar, The Movie

- *"The world doesn't need any more engineers. We didn't run out of planes and television sets... we ran out of food."*
- Starring: Matthew McConaughey and Anne Hathaway

Kepler Habitable Zone Mission





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Nutritional Security An Existential Threat



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Malthusian Necessities of Life

Food, Shelter, Fiber, Fuel > 9 billion



CLIMATE CHANGE



**LAND & WATER
CONSTRAINTS**



**INCREASING
URBANIZATION**



**ENVIRONMENTAL
DEGRADATION**



**MINIMAL
ECOLOGICAL
FOOTPRINT**



**CHANGING
INCOME & DIETS**



**POSITIVE HEALTH
OUTCOMES**



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Hurricane Katrina
28 August 2005
1445 GMT
GOES-12 visible

Population

Climate

Extreme Weather

Hunger

Land & Water Resources

Changing Incomes & Diet

Health

Funding

Poverty

Anti-Science

Pipeline

Anti-Intellectualism

<http://rsd.gsfc.nasa.gov/goes/pub/goes/050828.katrina.gif>



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Path Forward

- Transformative discoveries
 - Internet of Agricultural Things
 - Big Data
- 21st Century Extension
- Farming systems
- Education
- Policies, regulation, marketing
- Human dimensions
- Communications



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#InternetOfAgThings

21st Century Farm



<http://tinyurl.com/nmcub2m>



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Supply Chain



- On Farm Production
- Soil Health, Water, Nutrients
- Pests/Control
- Energy
- Traceability and Tracking
- Supply Chain Management
- Processing
- Inspection
- Transportation
- Storage

- Retailers
- Inventory
- Access
- Smart Refrigerators
- Food Safety
- Ripeness
- Shrink Wrap
- Waste
- Smart Services
- Etc.

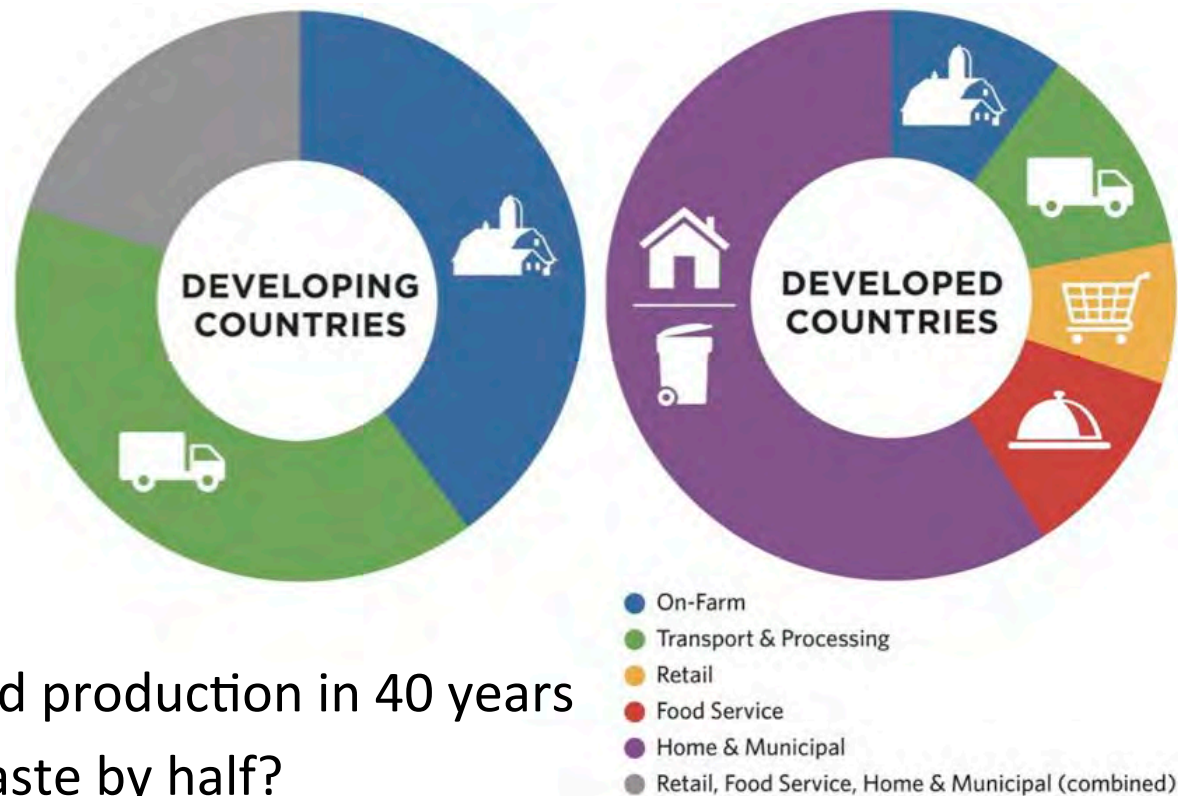


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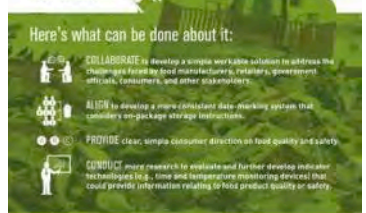
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Food Waste and Food Loss



- Double food production in 40 years
- Cut loss/waste by half?
- Impact climate change





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Precision Foods

- Individual genome, epigenome, microbiome
- Plant/animal genome, epigenome, microbiome
- Wearable sensors
 - FitBit, Apple Watch
 - Athos, Hexoskin, Gymi
 - Google contact lens
- Food analysis
- Lifestyle
- Behavior





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#BigData



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Big Data: Milieu

- Analytics
- Informatics
- Evidence-Based Tools
- Meta-Analysis and Synthesis
- Complex Systems
- Computational Sciences
- Data Engineering
- Data Mining
- Cloud Computing
- Implementation and Evaluation
- Data Security and Cybersecurity
- Predictive Modeling
- Data Visualization
- Decision Analytics
- Embedded Systems
- Machine Learning
- Multidimensional Data
- Network Science
- Sensor Networks
- Spatial Analytics
- Bandwidth
- Cyberphysical Systems



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Big Data: Opportunities

Cochrane Collaboration – <http://www.cochrane.org>

Transparent, Collaborative, Participatory



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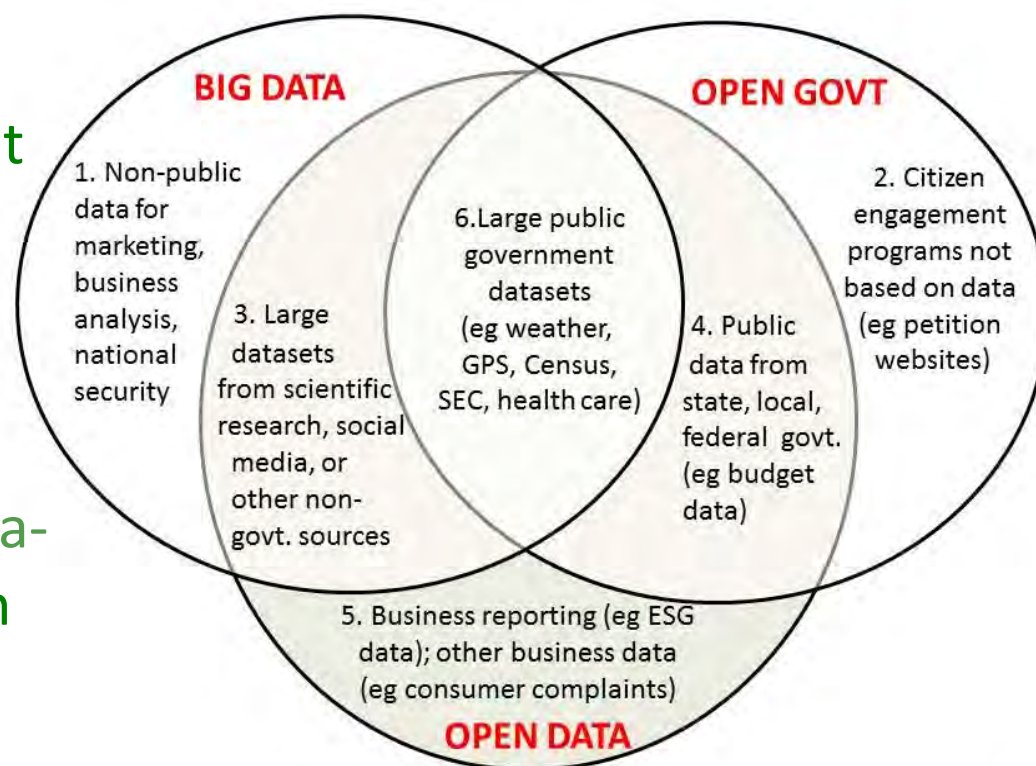
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Big Data: Opportunities

Open Data is a powerful, evidence-based tool for long-term sustainable development by improving economic opportunities for farmers and health of consumers.

Open access to research, meta-analysis, and open publication of data are vital resources for nutritional security.





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Big Data: Challenges

- Ownership
 - Open Ag Technology Systems
- Decision Support Tools
- Cost
- Bandwidth
- Quality
- Curation
- Disambiguation
- Connectivity
- Cybersecurity
- Storage



http://www.lsi.com/PublishingImages/LSI_blog_Bigdata_V1.jpg



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USDA Activities

USDA Open Data Initiative

- Implementation of OMB 13-13
- Implementation of OSTP directives
 - Publication of Scholarly Articles: PubAg
 - Release of Scientific Data: Ag Data Commons

Supporting Global Open Data Action

- Open Data Policy
- Access to USDA Data
- Collaboration and Cooperation
- Minimizing Duplication



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GODAN Framework

Global Open Data for Agriculture and Nutrition

- Promotes **global** efforts for **unrestricted availability, accessibility, and usability** of agriculture and nutrition **data**
- Encourages **collaboration** and **cooperation** among existing agriculture and open data efforts to **avoid duplication**
- Seeks to bring together **stakeholders** to **solve** long-standing global **problems**



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GODAN Framework

Global Open Data for Agriculture and Nutrition

A few of the successes in just over a year

- 120+ partners
- 3rd International Open Data Conference
- Publication with 14 cases studies
- Planning for Africa and Global conferences



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Nutritional Security



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We are **drowning** in information, while **starving** for wisdom. The world henceforth will be run by **synthesizers**, people able to put together the right **information** at the right **time**, think critically about it, and make important **choices** wisely.

E. O. Wilson, Entomologist, Author, Pulitzer Prize Winner



<http://www.cnmeonline.com/wp-content/uploads/2013/04/data-illustration-computing-cover-370x229-300x185.jpg>



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Humans Matter