

Was bedeutet die vierte industrielle Revolution für das Wirtschaften und die Arbeitskräfte?

Die Zukunft der Pflanzenproduktion

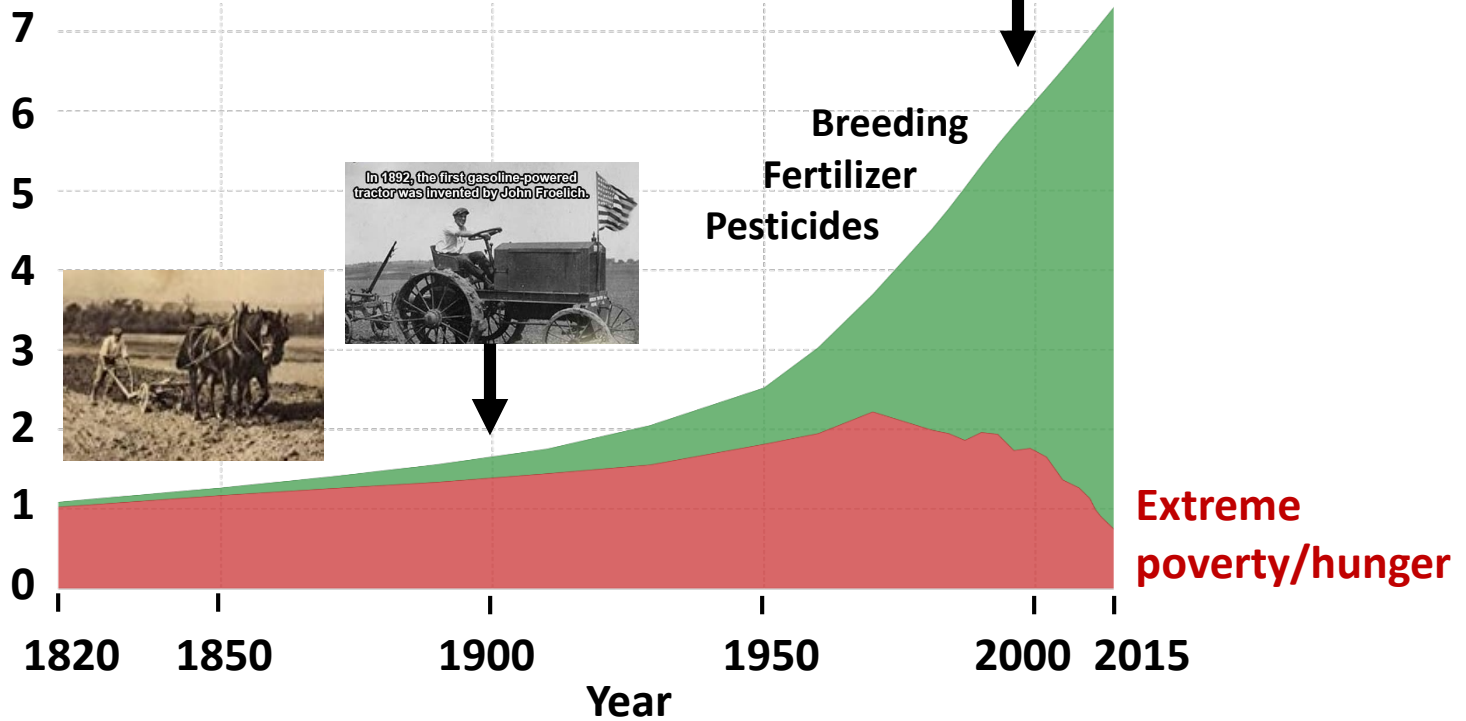
Senthold Asseng

Technical University Munich

- 1. Ag trends**
- 2. Digital ag (Future farming)**
- 3. New food production systems**
- 4. Summary**

Agriculture & population growth

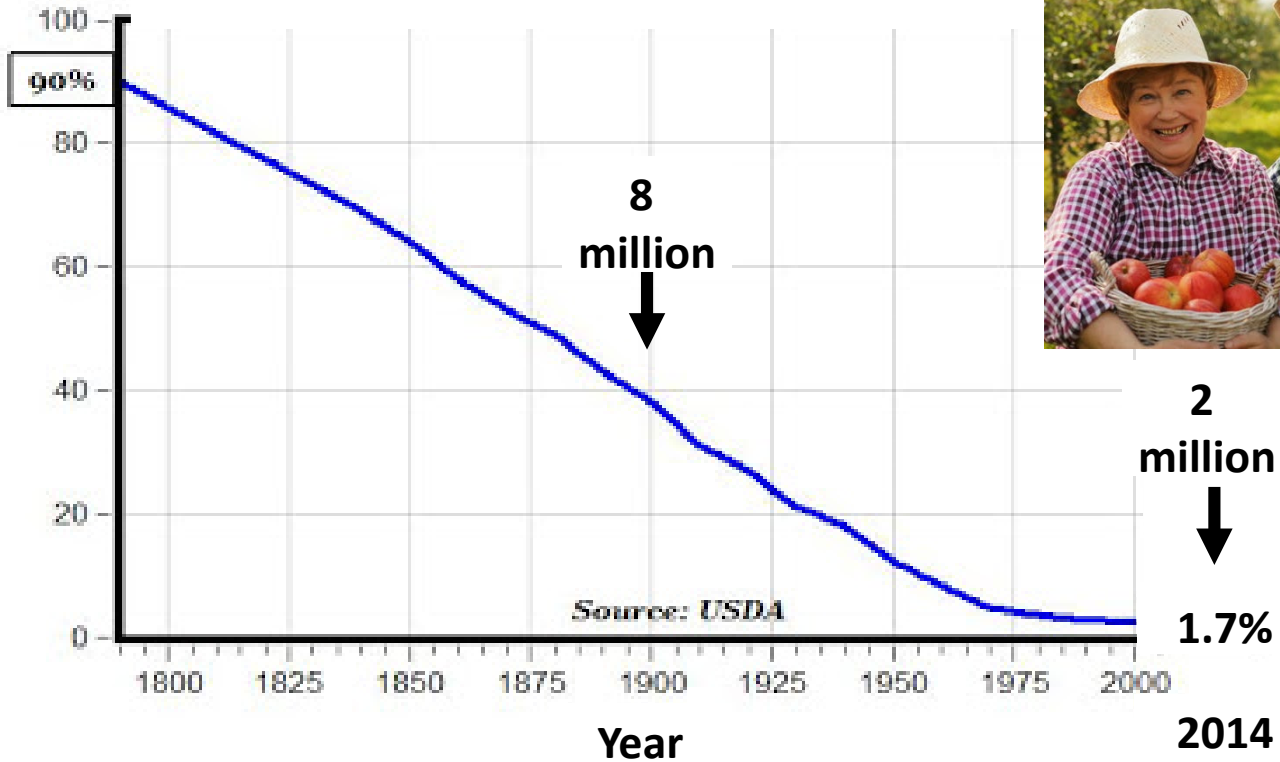
Global population (billion)



World Bank 2016, Bourguignon and Morrisson 2002

Where are the farmers?

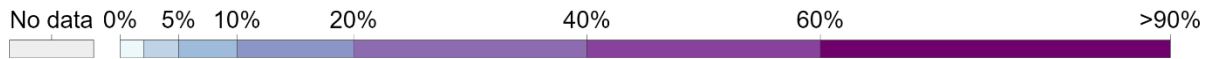
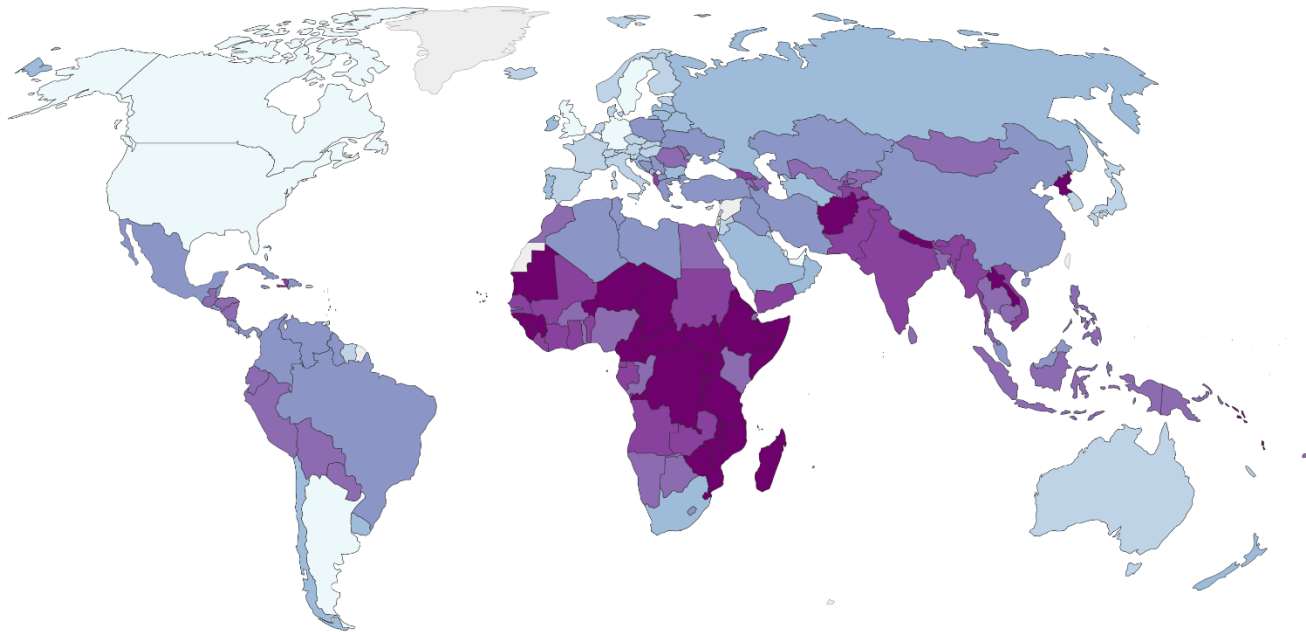
Farm Jobs in % of total US Jobs



- **Germany:**
 - 1900**
 - 38%**
 - 2012**
 - 1.6% (IMA, 2013)**

Share of the labor force employed in agriculture, 2017

Share of persons of working age who were engaged in any activity to produce goods or provide services for pay or profit in the agriculture sector (agriculture, hunting, forestry and fishing).

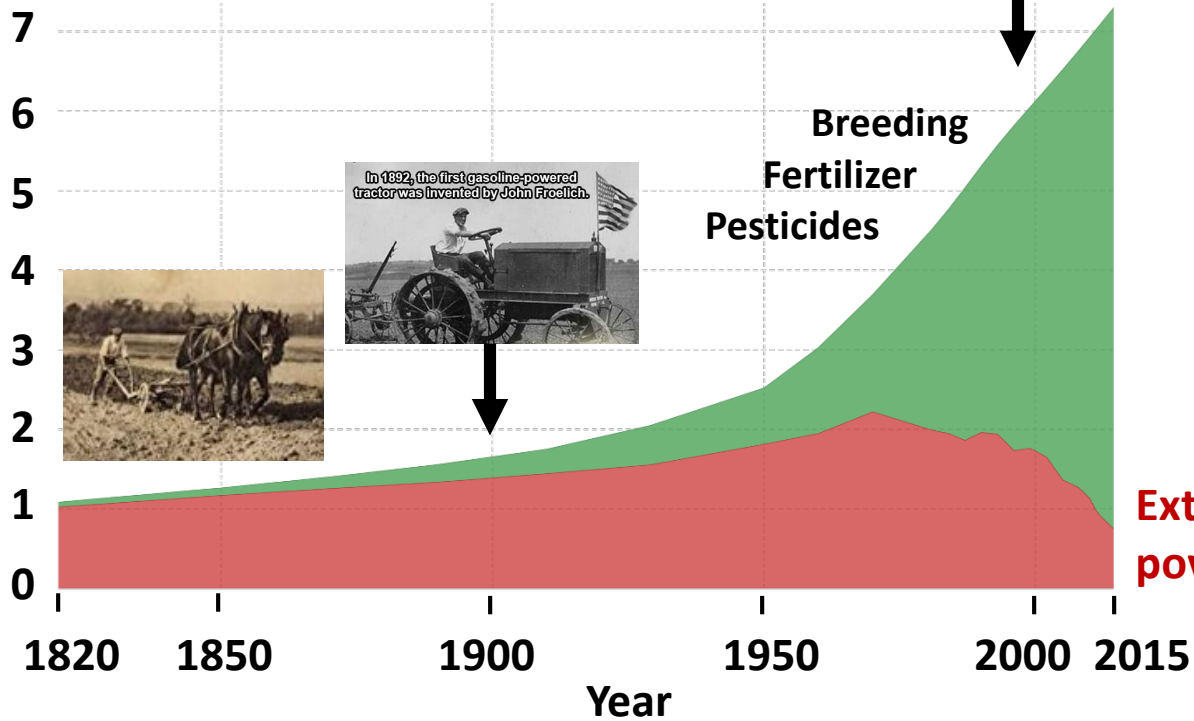


Source: World Bank

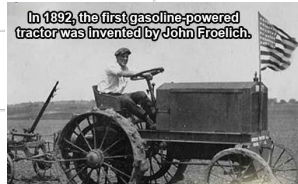
OurWorldInData.org/employment-in-agriculture • CC BY

Agriculture & population growth

Global population (billion)



- Soil compaction
- Erosion
- Fertilizer loss
- Pesticide loss
- Climate change

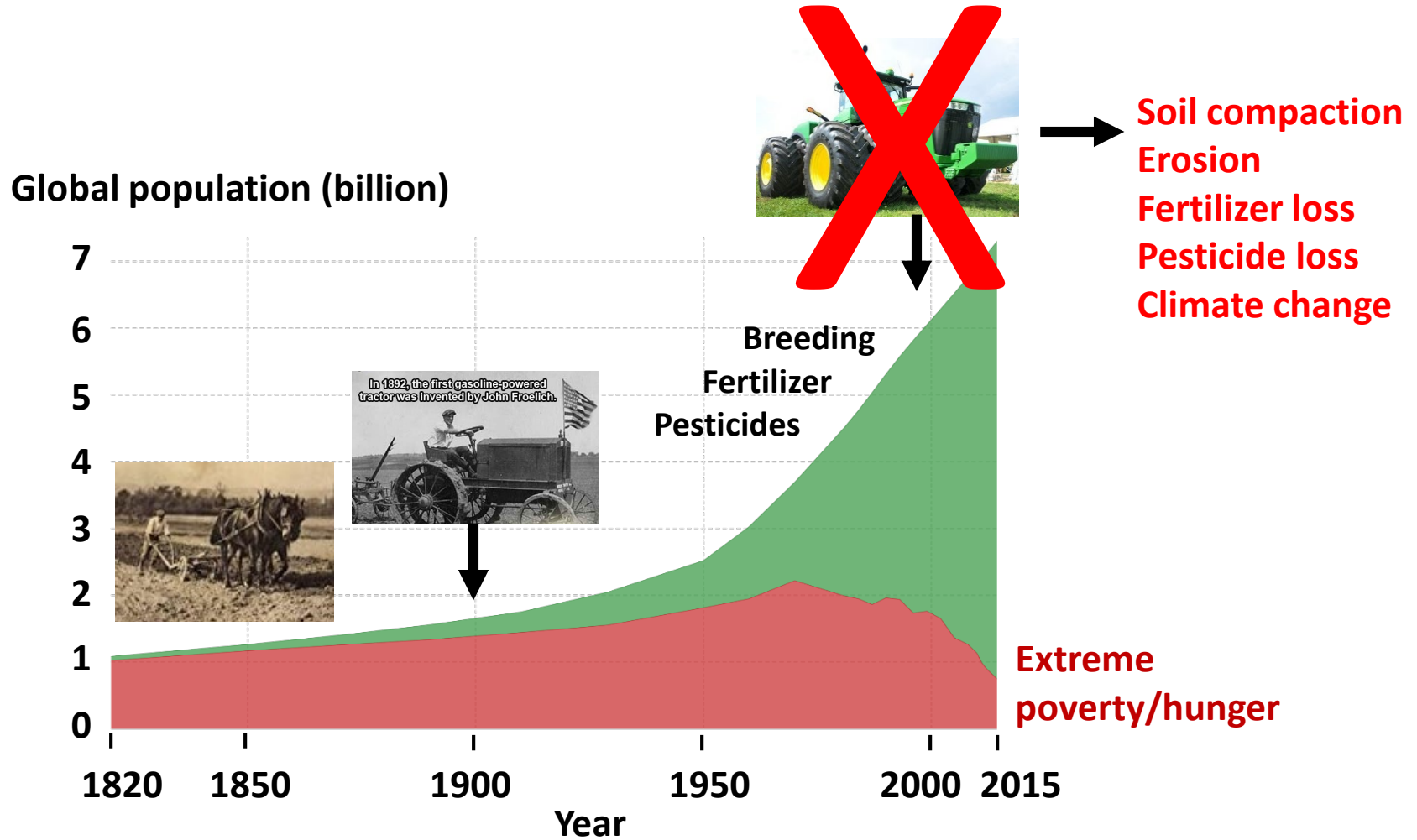


Breeding
Fertilizer
Pesticides

Extreme
poverty/hunger

World Bank 2016, Bourguignon and Morrisson 2002

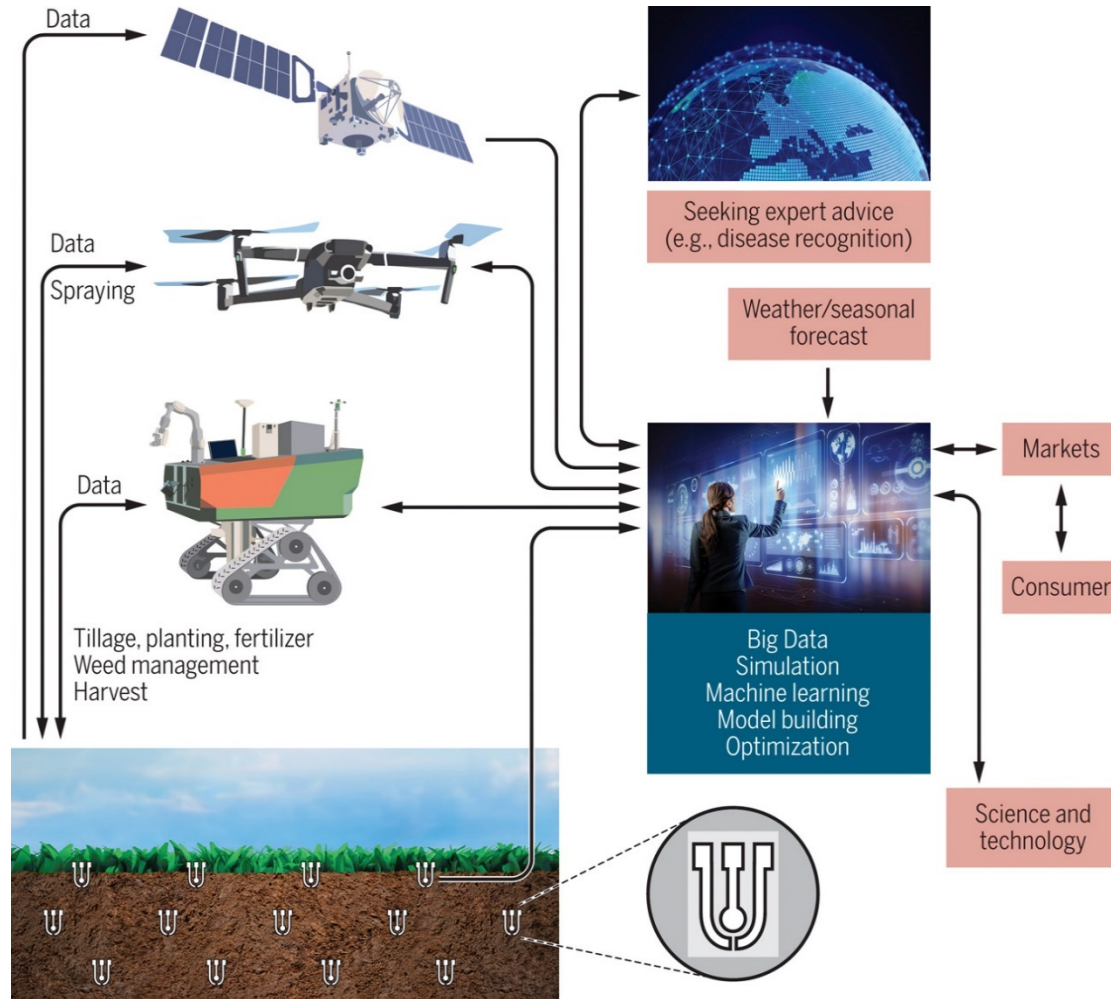
Agriculture & population growth



World Bank 2016, Bourguignon and Morrisson 2002



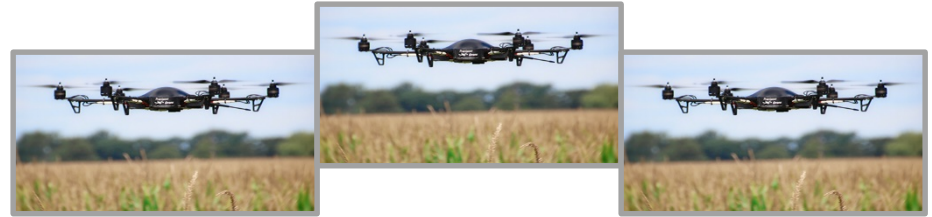
Future farms without farmers ?



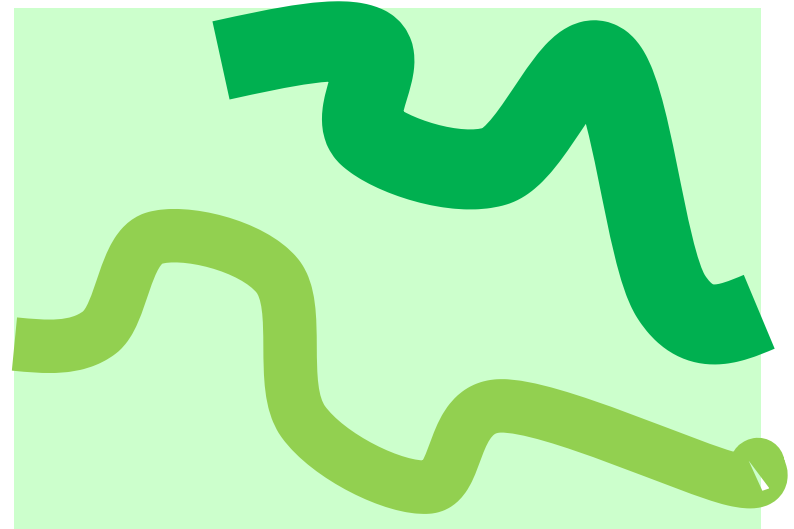
Asseng & Asche, Science Robotics 2019

- 1. Increased productivity**
 - a) Economy of scale less important**

Economy of scale less important



Economy of scale less important



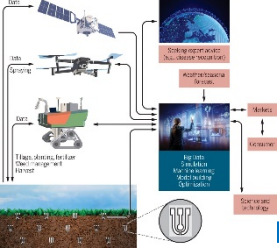
- 1. Increased productivity**
 - a) Economy of scale less important
 - b) Reduced labor
 - c) Reduced inputs & higher yields through optimization

- 2. Reduced environmental impact**
 - a) Reduced soil compaction
 - b) Reduced pesticides
 - c) Reduced fertilizer
 - d) Opportunities for re-arranging fields

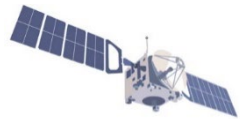
- 3. Traceability of food**
 - a) Early warning systems

- 4. New opportunities in R & D (new jobs)**

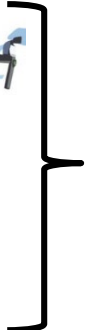
Needed expertise



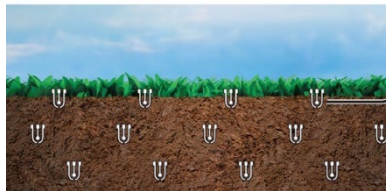
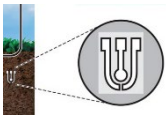
Remote sensing



Picture recognition
Autonomous acting

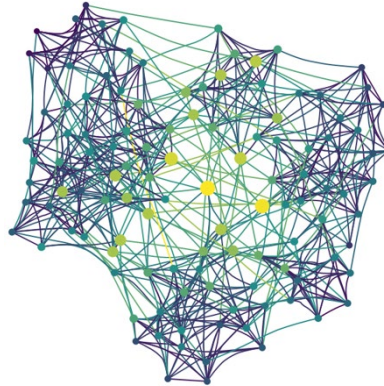


Sensor technique



Crop physiology
Crop nutrition
Plant disease epidemiology
Agronomy/farmer
Soil science

Computer networks



Data management
Data storage
Big data processing
Machine learning
Crop simulation
Optimization

Weather/season forecasting
Web interface
Market/economics
Law
Social science/policy

Weather/seasonal forecast



Seeking expert advice
(e.g., disease recognition)



Markets

Consumer

- 1. Technology revolution in agriculture**
- 2. Less traditional farmer**
- 3. New challenges/opportunities in digital ag.**

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