Digitising agriculture: what are trends in precision farming and overview of R&I activities

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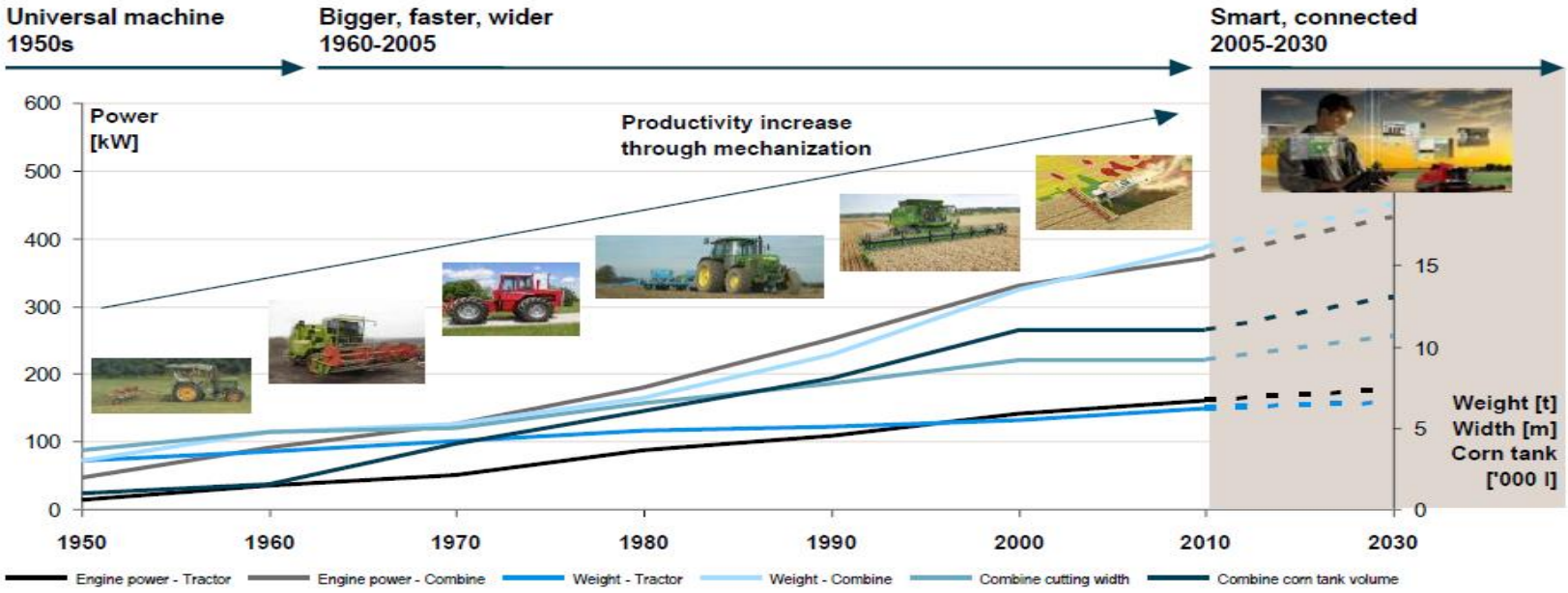
ICT-AGRI era-net

ict-agri.eu

1. History – Precision farming

- Focus on precision farming starts around 1990 (national initiatives, FP 3….)
- SCAR Committee, SCAR foresights
- SCAR working group (CWG) set up in 2006 on ICT and robotics in agriculture
- Cross Thematic ERA-NET (ICT-ENV-AGRI) in 2009

Productivity increase since 1950s



2. ICT-AGRI Consortium overview

ICT-AGRI
18 Partners
15 Countries

→

ICT-AGRI 2
23 Partners
16 Countries

2009 2014 2017

European **R**esearch **A**rea - **NET**work

Information and Communication Technology and Robotics for Sustainable Agriculture

ICT-AGRI-1 2009 – 2014
ICT-AGRI-2 2014 – 2017
ICT-AGRI-3 2019-

Strategic Research Agenda

CHALLENGES → **GOALS** → **SOLUTION DOMAINS**

CHALLENGES
Global food security
Sustainable resource management
Energy consumption
Food quality and safety
Climate change
Social aspects and demands

GOALS
Increase productivity
Reduce waste in the food chain
Optimize fertilizer and pesticide use
Optimize water management
Maintain soil quality
Protect and promote biodiversity
Minimize air pollution
Increase energy efficiency
Ensure food quality and safety
Food traceability and information
Reduce greenhouse gas emissions
Increase animal welfare and health
Less tedious and hazardous work

SOLUTION DOMAINS

- **Plant Production**
  - **Precision Crop Farming**
    - Variable Rate Application (VRA)
    - Controlled Traffic Farming (CTF)
- **Animal Production**
  - **Precision Livestock Farming**
- **Automated Indoor Climate Control**
- **Automated Quality Control**
- **Agricultural Robots**
- **Farm Management and Information System (FMIS)**
- **Farm Management**

Calls for transnational projects

Funded and managed by National Funding Agencies

2010 Integrated ICT and automation for sustainable agriculture (7)

2012 ICT and automation for a greener agriculture (8)

2014 Applications for smart agriculture (with SmartAgriFood) (9)

2015 Enabling Precision Farming (8)

2017 Farm Management Systems for Precision Farming (6)

Call 2017 - Topics

1. **Agricultural research on use of sensor data for decision support**
   Rules and algorithms for the analysis of sensor data and the output of actionable recommendations

2. **Development of applications for Precision Farming**
   Import of data from sensors, rules or algorithms for analysis of data and planning of actions, export to automated machinery

3. **Cases of integration of third-party applications with Farm Management Systems**
   Concrete integration of a third-party application in a Farm Management System.

ICT-AGRI-3 ERA-NET Cofund

- Proposal for “ICT-enabled agri-food systems” in H2020 SC2 Work Programme 2019
- Core challenges of the agrifood sector
  - food and nutrition security
  - climate change and environmental impact
  - social, economic and environmental sustainability.

3.What are we talking about today?

Many new initiatives.

- DG CNCT, DG AGRI, DG RTD
- EIP AGRI
- ESA
- EIT FOOD
- ESIF
- RDP

Future Internet

Sensors

Precision Agriculture

Smart Applications

More for Less

Internet of Things

Agriculture 4.0

Big Data

Drones

Sustainable Intensification

Cloud computing

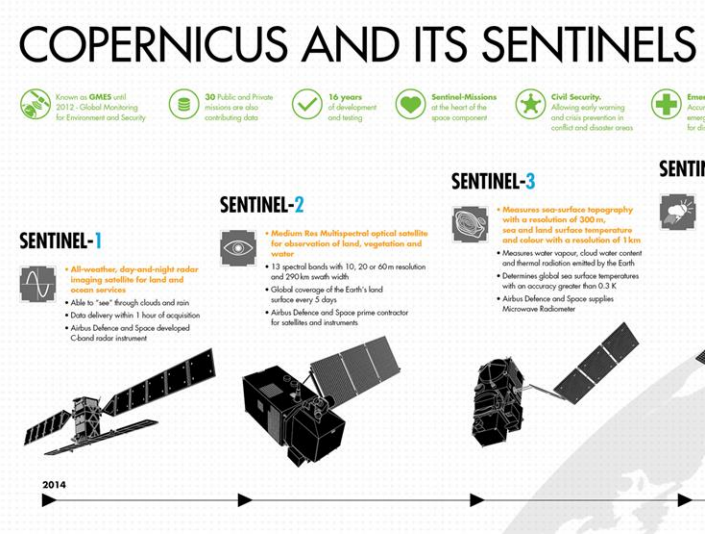
Satellites

4. Trends in Precision Farming

- Trends in hardware
  - Trend 1: More sensors and UAVs (unmanned aerial, vehicles, satellites, planes…)
  - Trend 2: More robotics
  - Trend 3: More network connectivity
- Trends in software
  - Trend 4: Big Data
  - Trend 5: Open/FAIR data
  - Trend 6: Apps everywhere
  - Trend 7: farm to fork integration/standards
- Trends in the ecosystem
  - Trend 8: Explosion of start-ups
  - Trend 9: Consolidation and market dominance

Trend 1: Sensors and UAV

- Precision Agriculture has gone from using GPS (only) as a data source to many sensors:
  - Remote sensing via satellite – Copernicus
  - Proximal sensing on farm machinery, in the ground, on plants
  - Growing use UAVs to complement satellite data, using hyperspectral cameras
- Much more agri machinery with sensors and actuators (up to 80% of new machinery)
- Major drop in prices
- Challenges: Low uptake (e.g. 35% of new spreaders have precision weighing); insufficient use of data standards; difficulty of integration with FMIS

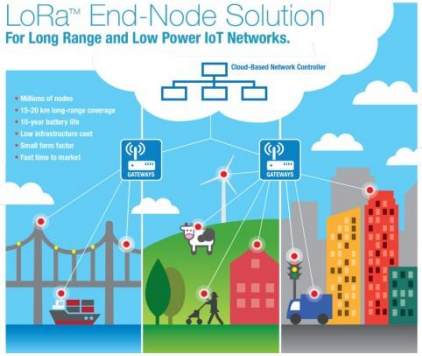


Trend 2: More robotics

- Major focus of PA research is robotics:
  - dairy primarily (e.g. https://www.lely.com/),
  - arable crops (e.g. http://www.handsfreehectare.com/ and https://www.deepfield-robotics.com/en/)
  - horticulture (greenhouses) (e.g. http://www.sweeper-robot.eu/)
- Parallel to development of autonomous cars (different challenges)
- Major area for deep learning (AI) and application of Big Data methods
- Most research occurring outside agrifood (e.g. proximity sensors, image processing etc.)

Trend 3: More network connectivity

- Rural areas (in EC and globally) suffer poor connectivity (only 28% of rural population have broadband): network essential for PA .
- Major support from EC (e.g. Rural Summit 2017)
- Essential for Smart Farming/Internet of Things/Big Data scenarios
- Commercial initiatives – Wide Area Networks for IoT:
  - LoRA
  - Sigfox
  - … challenged by growth of 5G
- Needed for long range monitoring of agricultural land, with low energy consumption



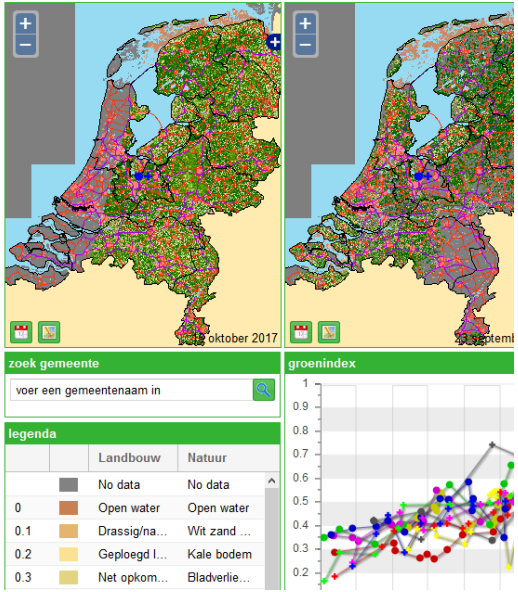
Trend 4: Big Data

- Poster child in US: Climate Corp $1Bn purchase by Monsanto
- In EU, major development is Copernicus Open Data
  - Very very large data sets e.g. ERA5 climate data is 900 Tb (terrabytes)
  - Apps already appearing e.g. evaluation of wine using soil and meteorlogical data (http://www.esa.int/Our_Activities/Observing_the_Earth/Copernicus/Fine_wine_app_wins_top_prize_at_App_Camp)
- PA is a major area for Big Data with growing flow of data from sensors e.g. integration of field map, satellite, drone, seed drilling etc. data may involve 9000 data sets/over 3Gb
- Challenge: need for greater processing power

Trend 5: Open/FAIR Data

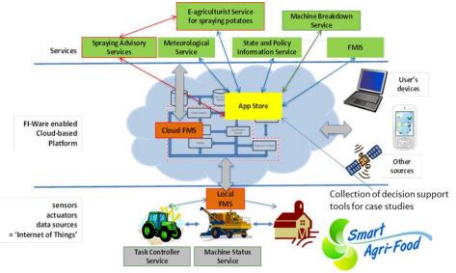
- Making data Open (freely available) or FAIR (easy available/accessible) major development
- Data is new oil/Data is infrastructure
- Types of Open Data for PA:
  - Satellite data (e.g. Copernicus)
  - Soil and Plot data (e.g. http://www.groenmonitor.nl/)
  - Research data sets (crop models)
  - Commercial open data (e.g. Syngenta Good Growth Plan)
- Major international support: GODAN project
- Challenges: Huge variability in acceptance, need to change culture, data governance rules

Groenindex



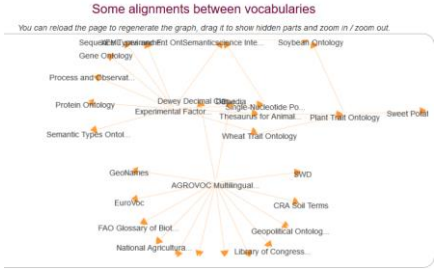
Trend 6: Apps everywhere (FMIS)

- Precision Agriculture dominated by software …
  - Migration from desktop (2000s) to
  - Smartphone and tablet
- Farm Management Information Systems
  - Integrate multiple data sources, multiple services
  - Growing ecosystem of Software as a Service (SaaS)
  - E.g. 365FarmNet, Trible Farm
- Plenty of standalone apps too (e.g. Virtual Vet, Wunderground)
- Challenges: Lack of standards for data integration/interoperability



Trend 7: Development of Data Standards/Farm to Fork

- Many available data standards
  - For agricultural research data: AGROVOC/GACS, cf. http://vest.agrisemantics.org/
  - For on farm PA: ISOBUS for machinery, AgGateway for FMIS
  - For post farm: UN/CEFACT XML, GS1 EPCIS, EFSA, Schema.org
- Major roadblock is lack of data standards for sensors
- The promise of IoT and Big Data depends on greater uptake of data standards



Trend 8: Explosion of start-ups

- As a result of:
  - EC investment in cascading research projects (SmartAgrifood 2, FINISH etc.)
  - Major VC start-up capital
  - Growth of agrifood hackathons (cf. farmhack.nl)
- Many data focussed start ups for all agrifood sectors including PA
- Examples: https://gamaya.com/ (crop monitoring), http://www.agrivi.com/ (farm management), Farmeron (dairy management), Cropti, Agricolus (farm management), http://smartvineyard.com/ (Vineyard Management) …. (cf. https://angel.co/europe/agriculture/jobs to see activity)
- Tendency to consolidation now …, plus major danger of being overwhelmed by US capital (e.g. Fameron)

Trend 9: Consolidation and Market Dominance

- Data and information systems tend to consolidate (network effect, cost efficiencies)
- Major tendencies:
  - consolidation of major ag input players (Syngenta + Chem China, Bayer + Monsanto, Dow + Dupont);
  - consolidation of tech start-ups (Climate Corp bought by Monsanto, Blue River bought by John Deere)
- Sector is very heterogenous nonetheless

5.Conclusion

- **Broadband access** crucial if you shall benefit from PA (new sensors, gps systems in new machines)
- Focus on **competences** as farming becomes high tech (skills higher education)
- **Trust** (Consumers do not trust big food companies. Demand is about more than price, taste, safety and access. Consumer preferences are also about health, sustainabily, local production..)
- **Data ownership / open data.** Different structures in different countries. How can data be used for smart regulation?
- **Many examples of digitalisation has failed.** We must learn from these cases. Think about cybersecurity

5. Conclusion

- Remember that **farming is business** and farmers are economic agents
- **Connect initiatives** in Europe and work smart together (IOF; ESA; ICT-AGRI; EIP; EIT FOOD…..)
- **Connect to countries and initiatives outside Europe** (International Bioeconomy Forum / IBF, Africa…)

ICT-AGRI conference
24 November 2017

http://ict-agri.eu/node/38607

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Thank you for your attention

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