The role of ICT for Future Agriculture and the role of Agriculture for Future ICT

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At the start of the 21st Century we are faced with the emerging problem of global food demand and exceeding the Earth’s carrying capacity with the current way of agricultural production. Moreover, the issues of safety, health, quality and sustainability, underpinned by the concept of transparency, have become increasingly important. In many global discussions forums it has been acknowledged that ICT can and will play an important role in meeting these challenges.

Over the past thirty years ICT technologies have been introduced in the agri-food sectors. Important milestones were introduction of computers (1980s), internet, email and mobile phones (1990s), and Global Navigation Satellite Systems (GNSS), wireless communication and social media (last decade). Modern farms make use of one or more of the following ICT: computers with a farm management system to keep track inputs, outputs and economics, weather forecast, early warning and decision support systems for crop management, auto guidance systems for controlled traffic on fields, tractor mounted board computers for steering of sprayers and other machines in a preferred way, and data registration systems to meet legal and chain requirements.

However, the uptake of these solutions has been slow due to a number of important yet unresolved issues. For instance, farmers register a large amount of data. The use of this data is still limited because handling is still far from easy in optimization of crop, farm and chain management. Problems are related with limited standardization, data protection and lack of optimization models. There’s still a large potential in stimulating adoption of current ICT, but future ICT technologies even promise more potential gains. At the same time, it is believed that the agri-food sector itself can also play an important role in the development of future ICT.

Precision Agriculture and modern society could play an important roles in accelerating adoption of ICT technologies. Precision Agriculture requires fast and accurate handling and interpretation of GEO-data. Variation in soil and crop conditions are detected by various sensors and translated into sites specific actions. External data bases have to be consulted. Simple web service should facilitate this decision making. Think of digital diagnosis of crop stress and associated crop care advice. Controlled traffic farming and robotics require robust communication and GNSS networks. Society want sustainable food production. This means that farmers and food chains have to proof with data that their production systems are sustainable and risks are minimized (tracking and tracing). So, farm data will be used outside the farm by various other parties with different objectives (supply chain, food chain, governments, logistics, consumers). Social media allow new ways of promotion and sales of farm products.
The objective of this paper is to present the interactive future development of ICT for the agri-food sector. This will be based on several studies and user panel discussions that were carried out in EU-projects such as SmartAgriFood, AgriXchange, ICT-agri and FutureFarm, including a global view. The following issues will be covered in these projects:

- specific characteristics of the agri-food sector relevant for ICT development;
- future ICT needs from agri-food users' perspective;
- future capabilities of ICT to meet future long and short term needs;
- organization of future ICT development in the agri-food sector through private-public cooperation.

The results will be concluded by setting the agenda points for future ICT development for the agri-food sector and an how these can be achieved. Hereafter a depiction of architecture SmartAgriFood (result of a FP7 project of EU).

Referenties


The role of Information and Communication Technology (ICT) for Agriculture and vice versa

Introductory lecture on the future of agriculture

Sjaak Wolfert (WUR-LEI) & Corne Kempenaar (WUR-PRI)
IWSC, global café, June 19, 2012
Content

- Introduction
- Observations and statistics on ICT in agriculture
  - Opportunities and challenges
- Future scenario’s
- Concluding remarks

- Aim: to stimulate you on developing ideas on future agriculture -> join the world café at 17.10
Turn on your mobile phone

- Multi-tasking is the future?
Some terminology

- Computer use in agriculture
  - Farm Management systems
  - Data registration (inputs, costs, results)
  - Early warning & Decision support systems
  - Board computers

- Internet use in agriculture

- Mobile phones
  - Social media (LinkedIn, Facebook, .....)

- Navigation systems / Robotics
### Weed species and Herbicides (a.i.)

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<tr>
<th>Weed species</th>
<th>Atrazine</th>
<th>Bentazon</th>
<th>Bentazon + Quizalofop</th>
<th>Atrazine + Bentazon + Nicosulfuron</th>
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### Weed stage and Weed sensitivity class

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<th>Weed stage</th>
<th>Very sensitive</th>
<th>Moderate sensitive</th>
<th>Little sensitive</th>
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<td>Seedling</td>
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<td>2 leaves</td>
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<td>4 leaves</td>
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<td>6 leaves</td>
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### Examples of DSS (www.mlhd.nl, ww.gewis.nl)
Current situation on modern farms

Service providers
Government
Suppliers
Customers

Farm process groups

- Finance
- HRM
- Product management
- Quality assurance
Images of (future) precision agriculture
Potato management cycle (Source: Jacob v.d. Borne)
Controlled traffic farming (auto pilot system on tractor and additional machine guidance)

Displays

Steering angle sensor

Hydraulic valve

Navigation Controller

GPS / Galileo / GLONASS, Beidou / GNSS
Agro robots

- Platforms for crop management
Agro Robots – current projects WUR

- Autonomous sprayers
  - Strawberry
  - Orchards
- Autonomous weed robot ‘Ruud’
Ground sensors used in crop protection
Related developments in other domain

- Weed control on pavements
- Registration, planning, weather criterion compliance are mandatory
Challenge

- How do we handle the massive amount of available (sensor) data and use them in a clever way
  - Need of intelligence
- Easy exchange of data between sensors, FMS and external services
- Standardisation
  - ISOBUS (ISO 11783)
State of the art use satellites in PA

- Many satellites around the world support PA with
  - References forpositing systems
  - Qualitative and quantitative crop information
- National satellite database (2012-2015)
- Satellite sensors provide data for
  - Land use monitoring
  - Crop and yield monitoring
  - Optimization of crop management
Variable rate application of pesticides

- Case of potato haulm killing
Ground sensor - VRA (MLHD PHK) 2005

Reglone

Minimum effective dose (l/ha)

Reflection parameter CropScan

Legenda
- Meepunten
Interpolatie
Dosering (l/ha)
- 1.50 - 1.75
- 1.76 - 2
- 2.01 - 2.25
- 2.26 - 2.5
- 2.51 - 2.75
- 2.76 - 3.00
Use of remote satellite images in potato haulm killing

WDVI map on FMS

Dosing map

Spray task map
Figure x. Worldview-2 image, 15-08-2011, Flevoland. Test parcel for variable rate application in yellow outline (above). WDVI image of test parcel (lower-left). Reglone dose instruction map (lower-right)
Spray map PHK using UAV biomass map and PHK-algorithm Reglone (sept 2011)
Standardisation issue
VRA soil herbicides

Lutum map made with gamma radiation sensor -> spray map on akkerweb
Data infrastructure

- Internet platform for agriculture
  - On farm communication
  - Between FMS and machines v.v.
  - Communication within food chain
  - Apps
  - Standardisation
Internet Platform Akkerweb
Smart Agri Food (SAF) project

- EU FP7 project in ICT domain
- Some schemes for future internet in agriculture
- Coordinator is Sjaak Wolfert
SAF small scale pilot architecture

External Services

Centralized Cloud of Core Platform

Farmer’s devices

Data Sources Farmer’s Greenhouse

Wireless rural areas

state’s policies and information service

FMIS

1 Gbps

EFMIS

“Public” Repository and Registry

8 Mbps

LT MSS

LFSS

FMIS: Farm Management System
EFMIS: Extended FMIS
LTMSS: Local Tractor Mgmt Subsystem
LFSS: Local Farm Mgmt Subsystem
FI-PPP Architecture for SAF (long term)

Future Network Technologies

- Cloud server Farm
- Self Management
- Social
- Security
- Trust
- Privacy
- Storage
- Resilience

Support functions for Mass data storage, processing and decision making

Function split with FI network for better security and efficiency

- Local Food Industry Nets
- Local Farmer Nets
- Local Logistics Nets
- Local Merchandiser Nets
- External Services (weather, ..)
- Government Authorities Net

IO-PPP Architecture for SAF (long term)
SAF small scale pilot (1/2)
Summary of smart Agri Food (SAF) project

- Exchange of data within food chain
  - Representation of reality
  - Connectivity
  - Intelligence (content underestimated)
  - Integration
    - Precision Ag, logistics, E-commerce, regulations, food chain network
Conclusion: ICT will play a crucial role in shaping future agriculture

- Intelligence at farm level
  - Excess to databases
    - E.g. nat. satellite data base
    - Open sources and ‘ask your neighbour’
  - Diagnosis, advice
  - PA, Logistics, E-commerce, regulations

- Communication within food chains
  - Tracking and tracing

- Autonomous vehicles/robotics
End of presentation

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