ICT-AGRI: main achievements and future perspectives

Jürgen Vangeyte\textsuperscript{a}, Koen Mertens\textsuperscript{a}, Iver Thyser\textsuperscript{b}, Markus Lötscher\textsuperscript{c}, Martin Holpp\textsuperscript{d}, Raymond Kelly\textsuperscript{e}, Reamonn Fealy\textsuperscript{e}, Dominique Didelot\textsuperscript{f}, Jan Erpenbach\textsuperscript{g}, Annett Latsch\textsuperscript{c}, Bert Beck\textsuperscript{a}

\textsuperscript{a} Institute for Agricultural and Fisheries Research (ILVO), Technology and Food Science Unit, Agricultural engineering, Burg. van Gansberghelaan 115 bus 1, 9820 Merelbeke, Belgium

\textsuperscript{b} Danish Agency for Science, Technology and Innovation, Bredgrade 40, 1260 Copenhagen, Denmark

\textsuperscript{c} Federal Office for Agriculture - Bundesamt für Landwirtschaft, Mattenhofstrasse 5, 3003 Berne, Switzerland

\textsuperscript{d} Agroscope - ART-Agricultural System Engineering Tänikon 1, Ettenhausen, Switzerland

\textsuperscript{e} Agriculture and Food Development Authority (Teagasc), Oak Park, Carlow, Ireland

\textsuperscript{f} Institut National de Recherche en Sciences et Technologies pour l’Environnement et l’Agriculture (Irstea)- Centre de Clermont-Ferrand, 9 avenue Blaise Pascal, CS 20085 63178 Aubière, France

\textsuperscript{g} Federal Agency for Agriculture and Food Deichmanns Aue 29, 53179 Bonn, Germany

\* jurgen.vangeyte@ilvo.vlaanderen.be

Abstract

Producing more food from the same amount of land while reducing the environmental impact requires an intensification of agricultural production systems. The concept of sustainable and ecological intensification aims to increase yield with fewer inputs. This calls for a set of multifaceted measures and developments that complement and interact with one other. The 3rd SCAR Foresight Report suggests three innovation pathways: consumer-driven, technology-driven and organization-driven. Information and communication technology (ICT), robotics and automation can contribute in different ways to all of these pathways. To strengthen and coordinate the European research in ICT and Robotics in Agriculture and Related Environmental Issues the European Research Area-network ICT-AGRI was launched in April 2009. This cross-thematic ERA-Net, spanning three FP7 themes: “agriculture and food supply”, “environment and climate” and “information and communication technology project”, ends in February 2015 and its main achievements and future perspective are presented in this paper. In 2010 and 2012 two transnational joint calls were successfully launched. Both calls were using a virtual pot with a minimum of three participating countries, meaning that the different national partners were funded by their own national funding agencies. Fifteen research projects were selected. The outcomes of the seven projects with a duration of 2 years, funded in the first call, were presented at the EFITA Conference in Torino in June 2013. In the Strategic Research Agenda (SRA) future challenges for European agriculture were identified. Each of these challenges were connected to specific objectives and solution domains based on ICT and robotic technologies, as they apply to primary agriculture. Further research and innovation requirements were listed and a vision for ICT and robotics in agriculture was presented. Finally three commendations for SRA implementation were formulated: (1) developing ideas from different areas of academic expertise to arrive at innovative solutions, (2) achieving maximum profit by combining stakeholder expertise and (3) investing in compatible systems
in order to utilize the full potential of the technology. A third achievement is the Meta Knowledge Base (MKB), an online R&D network with more than 1000 users, for information on relevant ICT-AGRI activities. It includes address and contact information, descriptions of ICT-AGRI-related expertise, facilities and priorities as well as the online submission system for the call management. The MKB allows one to find partners for the establishment of ICT-AGRI consortia. The MKB contributes to a joint pool of knowledge on ICT. Finally PPP (Public Private Partnerships)-Initiatives were also supported by the project to mobilize relevant actors in the field, aiming to involve companies in bringing products to the markets and to speed up the innovation process. To further support the implementation of the SRA in future a follow-up project ICT-AGRI 2 will start in 2015. Three annual calls cycles with different call models will be organized.

Keywords: ICT-AGRI, ERA-Net, robotics, automation

1 Introduction

According to the statistical and economic information on rural development in the EU (EC 2011a), the primary sector (agriculture, forestry and fishery) in the EU-27 generated EUR 169 billion in 2009. In 2010, the EU-27 accounted for approximately 12 million farms and 170 million ha of utilized agricultural area (UAA). Between 2003 and 2010, the average annual rate of decline in the number of farms was about 3%, while ha of UAA remained fairly stable. Consequently, the average size of farms increased in many European countries. The composition of production factors has evolved towards more machinery and fewer workers. There has been a noticeable increase in mechanization: for example, in the EU-15 the share of farms owning a tractor increased from 44% to 56% and the average number of tractors per farm with machinery increased from 1.7 to 1.9 between 1995 and 2005.

The labour productivity of agriculture in the EU-27 grew at an average annual rate of 3.4% between 2002–2004 and 2007–2009. Gross fixed capital formation (GFCF) is a key element for future competitiveness, measuring how much of the value-added is invested rather than consumed. From 2005 to 2008, the GFCF of agriculture in the EU-27 grew at an average annual rate of 4.3%. Despite this, the average figures given above do not reflect the significant disparities between member states and regions.

A strong agricultural sector is vital for both the EU food industry and global food security. Owing to their leading role in the agricultural engineering sector, Europe and the Associated Countries harbour a huge potential for producing safe, high quality food for a continuously growing market. However, pressure on European agriculture and on agricultural income in particular is expected to continue as farmers face more risks, a slowdown in productivity, and a margin squeeze due to rising input prices (COM2011 627).

Many other countries in the world are able to produce food more cheaply. A cutback of subsidies on both the European and national levels is imminent. The legal and administrative requirements for environmentally friendly land use and animal friendly livestock production systems continue to increase. Meanwhile, we face new challenges such as climate change, the protection of biodiversity (Le Foll, 2010), producing food for a growing world population, and future natural resource scarcities.

To strengthen and coordinate the European research in ICT and Robotics in Agriculture and Related Environmental Issues the European Research Area-network ICT-AGRI was launched in April 2009. This cross-thematic ERA-Net, spanning three FP7 themes: “agriculture and food supply”, “environment and climate” and “information and communication technology project”, ends in February 2015 and its main achievements and future perspective are presented in this paper.
2 Methodology

Producing more food from the same amount of land while reducing the environmental impact requires an intensification of production systems. The concept of sustainable or ecological intensification aims to increase yield with fewer inputs and adverse consequences. This calls for a set of multifaceted measures and developments that complement and interact with one other. SCAR Foresight Report suggests three innovation pathways: consumer-driven, technology-driven, and organizational-driven (SCAR 2011). Information and communication technology (ICT), robotics and automation can contribute in different ways to all of these pathways.

2.1 Implementation of an ERA-Net

The key concerns of the ICT-AGRI ERA-Net are to strengthen the international competitiveness of European farmers and to reduce the negative impact of agricultural production on the environment. Furthermore, ICT-AGRI aims to facilitate the use of information and communication technologies by farmers, as a way of meeting future challenges.

2.2 Web based research mapping and analysis

As the relevant knowledge within the ICT-AGRI research area is quite disperse and it is often time-consuming to search for knowledge and difficult to assess whether all relevant knowledge has been found a structured framework for mapping and analysing all relevant knowledge within the ICT-AGRI research area was developed. This framework became the basis of the Meta Knowledge Base (MKB): a tool for gathering knowledge and mapping research, expertise and facilities. This is described in detail in Mertens et al. (2012).

2.3 Meeting challenges through ICT and automation: the strategic research agenda

From April to June 2011, an online consultation was conducted with the dual aim of identifying solutions for ICT and automation applications with the highest potential for meeting the challenges facing European agriculture, and determining research and innovation (R&I) requirements. The online consultation was designed as a real-time Delphi survey, so participants could see the R&I voting results and the comments of the other responders. Around 180 participants from 21 countries voted and commented. They were given the opportunity to modify the descriptions of the solution domains and components. They also had the option of creating and commenting on additional solution domains, all of which turned out to be subcases of the more-narrowly-defined ICT-AGRI solution domains. The participants’ ideas were therefore incorporated into the solution domains defined by ICT-AGRI.

The solution domains were designed to cover nearly all of the contributions of ICT and robotics to primary agricultural production and to the agriculture related environment. The basis for the concept of solution domains was a review of current technologies used in plant and animal production and farm management.

Evaluation of the solution domains included the assessment of R&I needs for six different solution components. These components described the requirements for making a solution domain work at farm level.
2.4 Call organization for transnational research

Until now three calls were organized. A first call in 2010 had a system approach and aimed at the integration of ICT, automation and robotics at farm level. For the second call in 2012 the focus was on Sensor Technique and Research & Innovation for a Greener Agriculture. At the moment a third call is in preparation. This will be a joint call with SmartAgriFood 2 project (www.smartagrifood.eu) and will be launched in September. The topic is not yet determined.

2.5 Public private partnerships (PPPs)

As mentioned previously, new developments in ICT and robotics in agriculture are recognized as having great potential to ease the transition to a more sustainable agriculture. Progress in the implementation and use of these promising technologies at farm level requires the development of solutions in which hardware (e.g. machines, sensors, computers) and software together support manageable and profitable use by farmers. Only those technological solutions providing a clearly observable economic advantage are marketable, and industry sees to the development of these commercial products. This calls for interdisciplinary R&D, as well as cooperation between research, industry, providers and farmers in the form of Public Private Partnerships (PPPs).

3 Results and discussion

3.1 Implementation of an ERA-Net

The EU's ‘Europe 2020’ Strategy (EC 2010a, follow-up programme of the Lisbon Strategy) underscores the fact that ICT has now become one of the most vital of the enabling technologies. ICT-related development and innovation is responsible for approximately half of the productivity growth in modern economies. The potential gains from coordinated ICT-related research and development within the fields of knowledge based bio-production will represent a major step forward in one of the most important sectors of the European economy. The enabling technology ICT drives improved efficiency and better products across the private and public sectors. It has a strong potential to contribute to growth and jobs through innovation and investments in the knowledge based bio-economy built by Europe to protect European standards of living and sustainable development. In order to achieve the ‘Europe 2020’ objectives, coordination of the ICT-related research strategies of the private and public sectors in Europe must be further developed. The ICT-AGRI ERA-Net supports the EU’s ‘Europe 2020’ strategy by contributing to better coordination, competitiveness and industrial development within the agri-food sector.

3.2 Finding partners for cooperation: Meta Knowledge Base

Given the many institutes, organizations and enterprises possessing substantial knowledge in the ICT-AGRI sphere, there is significant potential in mobilizing research and innovation efforts in ICT and robotic technology within the EU. A helpful tool for cooperation in European research initiatives is the Meta Knowledge Base (MKB), developed by ICT-AGRI. An information platform with technical and social content, the MKB is a structured framework for mapping and analyzing all relevant knowledge within ICT and robotics in agriculture, as well as a central internet based resource for researchers, developers and users. This tool stimulates cooperation and coordination of R&D through user-driven initiatives and activities, leading to the pooling of fragmented human and financial resources. In this way, both the efficiency and the effectiveness of Europe’s research efforts can be improved. The database currently comprises 1000 registered users, over 200 organizations, and almost 200 research postings related to ICT and automation in agriculture. All postings are
classified by keywords and associated with the solution domains identified by the ICT-AGRI ERA-Net.

3.3 Meeting challenges through ICT and automation: the strategic research agenda

There are many areas where innovative ICT and robotic applications from the different solution domains can help pave the way towards agricultural production systems that are more sustainable and efficient. ICT-AGRI has identified six main challenges for agriculture in the coming decades, and outlined key goals for meeting these challenges (Fig. 3.1). The goals are placed in the context of solution domains for both plant and animal production and farm management. The basis for the concept design was a review of current technologies used in plant and animal production as well as farm management.

The solution domains of Precision crop farming, Precision livestock farming, Automated indoor climate control, Automated quality control, Agricultural robots, and FMIS were designed to cover nearly all of the contributions of ICT and robotics to primary agricultural production and to the agriculture related environment. More detailed descriptions of the solution domains are given the strategic research agenda.

![Fig. 3.1 Challenges, goals and solution domains for a sustainable European agriculture as identified by the ERA-Net ICT-AGRI](image)

3.4 Calls for transnational research

ICT-AGRI has launched transnational research calls based on funds from participating countries. The calls have enabled collaborative projects based on complementarities and the sharing of expertise within ICT and robotics in agriculture. The aim has been to pool fragmented human and financial resources in order to improve both the efficiency and the effectiveness of Europe's research efforts.

For the first call projects were expected to apply a systems approach addressing farm-level integration of information technology, communication technology, automation and robotics,
and were expected to fall into one of two categories: (1) a broad based approach combining existing or new software and hardware products to demonstrate a system meeting important challenges within a specific application area; (2) a narrow based approach focusing on specific elements of vital importance for the functioning of integrated systems.

For the second call the overall objective of the second call was to foster progress by means of ICT and automation in agriculture in the sustainable use of natural resources, the reduction of agriculture’s environmental footprints, and climate change mitigation, while safeguarding the agricultural economy, good working conditions, and food supply, quality, and security, as well as animal welfare. The call topics referred to five issues essential for the improved use of ICT and automation in agriculture: (1) Open farm management systems; (2) Enabling framing based on ICT and robotic machines; (3) Knowledge and solution transfer; (4) ICT and automation-based interactions between farmers and public services; and (5) Retrieval of agricultural knowledge based on empirical data in farm management systems.

3.5 Public private partnerships (PPPs)

The ICT-AGRI/PPP action aims to encourage PPP by creating consortia of concerned actors, in order to facilitate product innovation on a specific challenge. One definition of innovation is the process of going “from an idea to a concrete product”. All the bricks and links playing a part in this process constitute the ‘value chain’. The ‘value chain’ analysis will provide the following: (1) A comprehensive overview of all components and actions needed to build the product and bring it to market; (2) A comprehensive list of all actors concerned at each link (e.g. developers, disseminators, research actors); (3) The opportunity for all actors to work together to deal with questions, subjects or difficulties that must be resolved in order to reach the final aim; and (4) Benefit from possible complementarities between countries. Concrete products directly related to the market must be defined and validated in order to attract private actors to the PPP process.

4 Conclusions and future work

The main goals of the ERA-Net ICT-AGRI were pooling the European research knowledge on ICT and robotics in agriculture, proposing future research directions and increasing European research cooperation, to avoid double work and to allow specialization. These goals were obtain the four main achievement: the development of the Meta Knowledge Base, the publication of the Strategic Research Agenda, the support of PPP- initiatives and the organization of Research calls. In future the follow-up project: ICT-AGRI 2 will expand the Meta Knowledge Base and Update the Strategic Research Agenda to further increase European research cooperation. In three annual repeat Action plan for implementation of the Strategic Research Agenda will be developed. Therefore three calls will be launched each year. The first call is expected in the beginning of 2015.

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6 References


