



Overview of topics and questions to be addressed by the FG Mainstreaming Precision Farming

STARTING PAPER for FG meeting held on 3 and 4 June 2014
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Content

1. Introduction	p. 3
2. Factors influencing implementation of precision farming	p. 4
2.1 Stakeholders	p. 4
2.2 Farm types	p. 4
2.3 Data sources and types	p. 5
2.4 Data infrastructures and standardization	p. 6
2.5 Relevance for in agri-food chains	p. 7
3. Tasks of the focus group	p. 8
4. Reference list	p. 9
Appendices	

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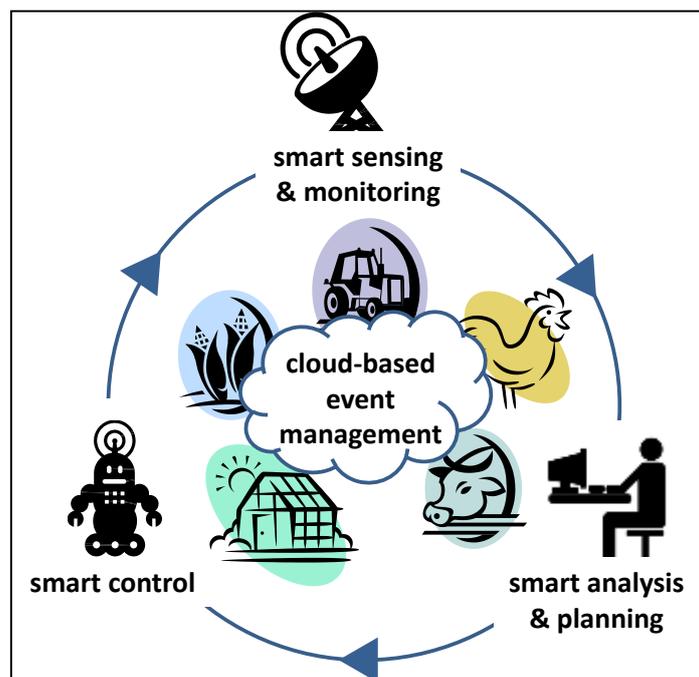
1. Introduction

Precision farming (PF) is an innovation in agriculture allowing the right treatment of crops and livestock at the right time and smallest scale possible (up to treatment of individual plants or animals). It requires a seamless integration of different technologies and intelligence (data, decision algorithms, software). Optimization of treatments at the lowest scale possible will improve yields and resource efficiency in agri-food chains, so reducing the agricultural footprint. More and more, PF will become the 'licence to produce' for farmers in the EU.

Technology conditional for practising PF has become available to farmers during the last decades, such as Farm Management Information Systems (FMIS) and Global Navigation Satellite Systems (GNSS) and various sensors. They pave the way for implementation of PF as a farming concept. A FMIS is a system for collecting, processing, storing and disseminating of data in the form of information needed to manage the farm. GNSS allows to link data to specific geographical coordinates (geo-referencing) and this can be combined with auto-guidance of machines. We can call this technology development stage Precision Farming 1.0 (PF 1.0). A survey in the Netherlands showed that 65% of the arable farmers used in 2013 GNSS technology in crop management. However, optimized treatment of crops and livestock at the lowest scale possible (see the definition of PF), is still in its infancy when looking at farming practices today. We can call this desired stage Precision Farming 2.0 (PF 2.0), or Smart Farming. The figure shown (source:

Wolfert/SmartAgriFood2) summarizes the sense-model-act cycle typical for PF 2.0. Key elements are sensing of conditions, analysis & decision making, and actuation/implementation.

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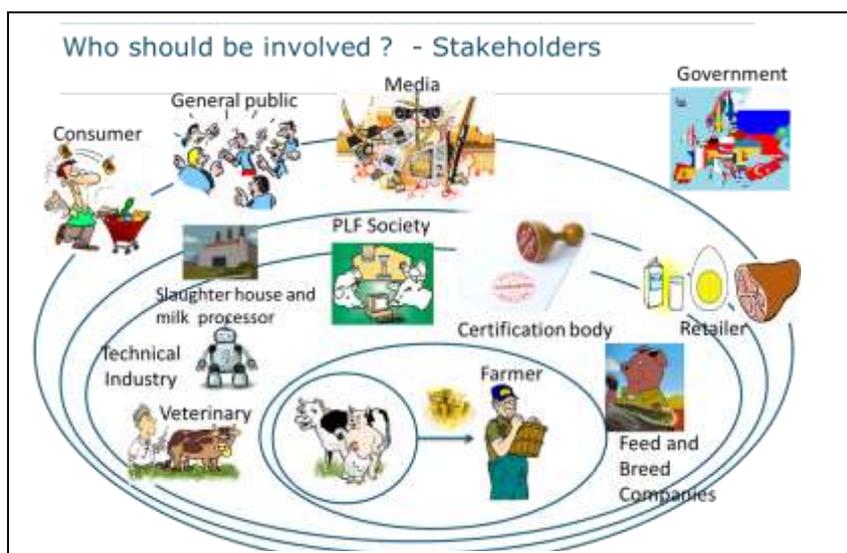


The purpose of this starting paper is to serve as an input to the first meeting of the European Innovation Partnership (EIP) Focus group (FG) on Mainstreaming Precision Farming (MPF), whose first task is to discuss and advise on how to organise data capture and processing for implementation of PF on small and large farms in the EU, by identifying problems, constraints and opportunities, and by proposing solutions and priorities (specific questions for the FG are shown in chapter 3).

2. Factors influencing development and implementation of precision farming

2.1. Stakeholders

PF has a wide range of stakeholders, as shown in the figure below for precision livestock farming (source: Livestock Research of Wageningen UR). Main (direct and indirect) stakeholders of PF include farmers associations, farm input suppliers (e.g. machines, agro-chemicals, farm advisers), agri-food processing chains, retailers, consumers, ICT companies, researchers, policy makers (land use, food security, economic development, environment, communication), governments and non-governmental organisations. These stakeholders are involved at different levels with different roles and interests. Although, co-operation between two or more categories exists in development of PF technology, major break-through in PF 2.0 and its adoption by the agri-food chains in the EU are yet to be made.

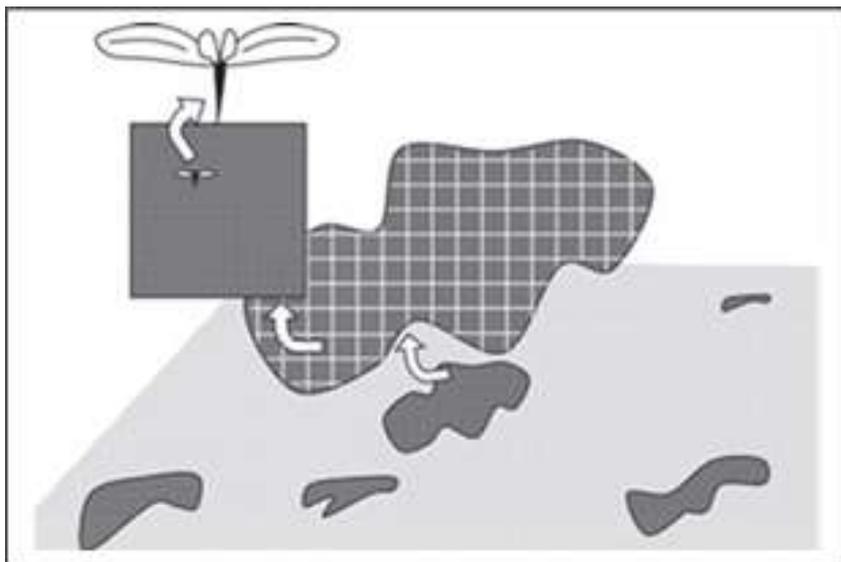


2.2. Farm types

Within the EU, several agricultural sectors and farm types can be distinguished. The plant production sector can be divided in production of protected crops (open field production) and unprotected crops (greenhouse production). And unprotected crops can be divided in on one hand the more traditional arable crops, and on the other hand the more diverse horticultural crops, including viticulture, orchards and ornamentals. The livestock sector is possibly as diverse as the plant production sector, with dominant farm types such as cow, pig and poultry farms. Some information on implementation by the farms of PF is available. E.g., ca. 600.000 ha of winter wheat in France was monitored with satellites. Cows on modern farms often carry sensors that provide data on their activity and needs. The use of GNSS

technologies by arable farms increased from 10 – 65 % between 2007 and 2013. Farm size has an effect on adoption of the technology. Arable farms with more than 100 ha in the Netherlands almost all have adopted GNSS technology, while only 20 % did so when the farms were smaller than 30 ha. For use of FMIS, see chapter 2.4.

Broad adoption of PF 2.0 is still to be achieved. The 'lowest scale possible' (see definition of PF) needs to be defined per farm type when considering implementation of PF 2.0. Of course, the opportunities depend on total farm size (ha or number of livestock). For arable farming, the scale of precision should preferably be less than 10 m², but could already be economical at a resolution of 100 m² for large arable farms. The Figure below shows the different integration levels at which PF can be done on arable fields (source: Weed Research/Christensen et al., 2009). For livestock farming, the lowest scale possible is optimization of treatment of individual animals. Our recommendations should be to the benefit of both small and large scale farms in EU.



2.3 Data types and sources

PF cannot be practiced without a vast amount of digital farm information (data), environmental conditions and references. Historic, actual and predicted crop and livestock data have to be available to start deliberate planning of activities. Growth and development, specific properties and positions of plants and animals need to be measured. Farmers can use satellite data to get accurate spatial information on soils and crops, and positions of fields, animals and machines, and to guide autonomous vehicles. In addition, a wide range of nearby sensors to capture soil, crop, climate and animal data is available. Data on weather, climate, economics, product information and specification, machine settings, etc., from external computers improve the planning and allow benchmarking. Service companies, farm advisors,

laboratories, etc. can add additional knowledge and value to the data. The recommendations we make should cover all relevant data sources and types in PF.

Several countries have an open data policy. These policies will affect implementation rate of PF. On one hand, PF will benefit from easy access to open data sources. Quality and maintenance of the data is then conditional. On the other hand, farmers will be reluctant to opening up their data to parties they do not know or trust. An important role lies with food processing companies, who can define delivery conditions and use the data to optimize the chain and communication with retailers and consumers. In that way, reduction of agricultural footprint by PF can be communicated. Other benefits of open data policy is easy access to big data to do data mining.

2.4 Data infra-structures and standardization

A data infrastructure has to be available to collect, store, visualize, analyse and use the vast amount of data. The FMIS will have a central position in the infrastructure. From there, connections and data exchange are possible with computers of service providers (e.g. satellite data), farm consultants, laboratories, contractors, machine implements, agri-food processing chains, certifying organisations, governments, accountants, etc. Fast ICT developments on satellite sensor data availability, bio-sensors and bio-informatics, Internet of Things, Cloud computing, Smart phones, Implement guidance software, Social media, Open data, Big data analysis will be, more or less, part of the infrastructure. During the first FG meeting, we will e.g. identify different systems for data handling and describe constraints and opportunities.

Farmers have to have a FMIS to capture, use and exchange data for PF and other tasks. Not all farmers in the EU have a FMIS. Reasons for this are education level farmers, and costs and labour input in relation to the benefit. Use of FMIS differs per sector and country. A recent study in the Netherlands showed that 30 % of the arable farmers use a FMIS. A first analysis of the survey among the experts of the FG indicate that the use of FMIS is higher in livestock farming than in arable farming. In some countries and sectors, the use of FMIS on farms is less than 10% while in other sectors and countries the use is more than 70%. The use of FMIS should increase to make FMIS a starting point in the data-infrastructure for precision farming. The strategic agenda of ERA NET ICT AGRI concludes the FMIS is the backbone of PF.

One of the reasons why PF adoption is slow, is compatibility problems between hard- and software of different suppliers of PF sensors, data and implements. Although the ISOBUS system has become a standardized communication system between tractors and implements, and agroXML a standardized language for data exchange, not all technologies on the market comply with these standards. This results in problems with visualizing sensor data on FMIS, making of task maps, implement control and

machine to machine communication. The Dutch R&D program on Precision Farming 2009-2013 showed that several innovator farmers have problems with task map based variable rate application because of incompatibility problems. A more recent study at CAH Vilentum confirmed this problem. Students could only get a VRA task map sprayed in one out of nine sprayers selected.

2.5 Benefits of PF

Farmers will benefit from PF technologies in many ways. In general, the benefits come from optimization of inputs and yields. Savings on fuel and more efficient use of water, fertilizer and pesticides are mentioned for arable farming. Gaps and overlaps in field work are minimized. Improved logistics, clear insight in business processes and administration and more pleasure are also mentioned by farmers that apply PF. Society also benefits because of less use and emission of more sustainable production methods.

Farm management data, conditional for PF, are not only needed to make economic management decisions on a farm at the lowest scale possible. They also have a value in in agri-food chains, see Figure below (source: FiSpace/Wolfert et al., 2012). They are sometimes mandatory from a legal point of view, e.g. in situations where farmers have to provide to authorities statistics on their production methods, to show they meet Good Agricultural Practice (GAP) criteria. When they comply with criteria, they obtain licences to produce or specific subsidies. In other situations, data are asked for by food-processing companies. E.g., in some food-processing chains, processors demand specific farm management and product data to be able to demonstrate sustainable production and to track and trace on important features of their products.



Future Internet will facilitate:

- ... seamless B2B Collaboration (information exchange, communication, coordination of activities)
- ... rapid & easy development of customized solutions at minimal costs
- ... quick formation & evolution of open business networks

3. Tasks of the Focus group

The Focus group is expected to provide answers and recommendations by doing an analysis on constraints and opportunities of the required data infrastructure for PF, and to list Good Practices. They should take into account the Strategic Research Agenda of ERA NET ICT AGRI, asking for innovative approaches, stakeholder cooperation, solving of incompatibility issues and innovation platforms. Six specific questions are to be answered by the FG, to the request of DG AGRI, are given hereafter. The bullet comment line gives some clarification on the approach per question.

1. Identify and assess the different systems and use of data handling in precision arable farming and precision livestock farming.
 - FG Experts are invited to mention any relevant system or data infrastructure for PF they are aware of, including owners and stakeholders.
2. Identify and assess where compatibility issues need to be resolved as well as potential solutions;
 - FG experts are invited to sum up constraints within existing PF data infrastructures, and to propose solutions.
3. Identify existing or potential solutions to processing large volumes of data from different types of precision farming sensors as well as existing or potential solutions to integrating these data into user-friendly farm management support systems;
 - Experts are invited to come up with solutions and suggestions.
4. Identify existing or potential solutions to integrating precision farming systems into small and medium-sized holdings;
 - PF is often referred to as a technology for large farms. Experts are invited to come up with suggestions how small and medium-size farms can also benefit from PF.
5. Identify EU, national and private initiatives and key players/ organisations;
 - Results of the survey will be discussed during the FG meeting.
6. Identify fail factors that limit the use of the identified techniques/systems by farmers and summarize how to address these factors as well as explore the role of innovation and knowledge transfer in addressing these fail factors.
 - This will be part of the discussion on day 2 of the FG meeting.

The FG will meet on 3 and 4 June 2014 for the first time, to complete the identification of problems hampering implementation of PF, constraints and opportunities, and by proposing solutions and priorities. Problems often mentioned in related to PF are poor standardization hampering data exchange, limited education of farmers in the field of PF technology, unclear costs and benefits, and lack of robust software that translates sensor data in added value for the farmer.

After that FG meeting, mini-papers on topics could be made to better understand remaining questions. A final document with answers and recommendations will be delivered to DG AGRI early 2015.

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Appendices

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