Economic, environmental and social challenges

Area 1	–	SPA Overview
Lesson 1	–	Introduction to SPA
Sequence ID	–	5

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DAGRI
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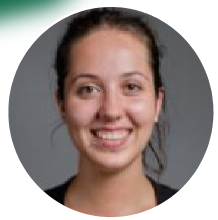

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A1.L1.T5 Economic, environmental and social challenges:

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Overview

The new paradigm of digitalization, connectivity and Precision Agriculture is a great opportunity to improve on work efficiency and profitability, social evolution in new jobs, and a new way of working, resources, and environment care. But widespread adoption requires time using new machines, devices, systems and procedures. The different degrees of complexity of economic and environmental advantages are already defined in an important document of the European Parliament (STOA 2016 and 2017), e.g. the first step of PA adoption saves time and 15-20% of fuel, new conservative operations reduce soil erosion up to 15 times, and more complex steps can reach a saving of up to 70% of chemicals for pest control.

However, problems arise with education and training, investment costs, and the rapidly increasing complexity of the technologies of today.

1. Difficulties in PA High Tech adoption

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- Several surveys over the last years have identified the following obstacles to high technology acquisition for Precision Farming:
  - 25% think that Fell Equipment is too complex
  - 40% think there is too much incompatibility
  - 50% think that equipment changes too quickly
  - 25% don’t think they can make money on PA

https://farmsmartconference.files.wordpress.com/2013/11/1agriculture_feature_budzynski.pdf

2. General Benefits of PA High Tech adoption

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How does precision agriculture influence policies?		
Policy issue	**Description**	**Effect on policy objective***
Competitiveness of EU farming	Farm holdings will apply PA technologies to produce 'more with less', increasing the competitiveness of farm holdings and agri-food chains. Large farms will benefit the most.	+
Farm holding size and number	Farm size will increase because of the required investments in PA technologies and know how. The number of farms will go down, which is the current trend already.	=
Jobs on farms in primary production	The number of jobs on farm holdings will decrease due to the implementation of PA technologies, especially on farms where still a lot of work is done by low skilled workforces.	-
Skilled workforces	PA requires more farmers skilled in (ICT) and a mature services industry.	+
Business development in agri-food chains	PA offers many opportunities for service industry (sensor industry, ICT, IoT, machine companies) and food companies (processors, logistics, retail) when the PA market grows.	++
Multi-functional agriculture	Farm holdings will focus more on farming when they invest in PA technologies and know how.	= /-
Demographic and rural development	PA may slow down or stop the trend of people leaving rural areas in the EU for better life in cities because it creates new business opportunities and work for highly skilled persons.	+
Food security	Sensor based monitoring systems and Decision Support Systems (DSS) will provide farmers and stakeholders with better information and early warning on the status of crops and animals and improve yield forecasts.	++
Food safety	Sensor based monitoring systems and DSS plus track and trace systems will provide farmers, processors and other stakeholders with better information and early warning on quality of food products.	++
Transparency of agri-food chains	See food safety.	++
Sustainable production	PA technologies allow the production of 'more with less'. The use of natural resources, agrochemicals, anti-biotics and energy will be reduced to the benefit of both farmers and the environment, thus in turn society.	++
Climate change and action	See sustainable production and Food security. Farmers and stakeholders can detect effects of climate change on agricultural production in an earlier stage and take action.	+

**++ and + are positive, = is neutral or unknown, - and -- are negative effects*

Tab.1: How does precision agriculture influence policies?

http://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892_EN.pdf

3. Environmental sustainability in PA High Tech adoption

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Tab.2: Expected environmental gains from main PA processes and techniques

http://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892_EN.pdf

Process	Technique	Expected environmental gains
Timeliness of working under favourable weather conditions	Automatic machine guidance with GPS	Reduction in soil compaction Reduce carbon footprint (10 % reduced fuel consumption in field operations)
Leave permanent vegetation on key location and at field borders	Automatic guidance and contour cultivation on hilly terrain	Reduction of erosion (from 17T/ha.y to 1 T/ha.y and perhaps lower) Reduction of runoff of surface water and fertilisers Reduced flood risk
Reduce or slow down water flow between potato/vegetable ridges to slow water	- Micro-dams or micro-reservoirs made between ridges ("tied ridges") - Ridges along field contours	Reduced sediment runoff Reduced fertiliser runoff
Keep fertilisers and pesticides at recommended distances from water ways	- Automatic guidance based on geographic information - Section control of sprayers and fertiliser distribution	Avoidance/elimination of direct contamination of river water
Avoid overlap of pesticide and fertiliser application	Section control of sprayers and fertiliser distribution	Reduce/avoid excessive chemical input in soil and risk of water pollution
Variable rate manure application	On-the-go manure composition sensing Depth of injection adjustment	Reduced ground water pollution Reduced ammonia emissions into the air

3. Environmental and Economical sustain in PA High Tech adoption

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(Cont.)
Tab.2: Expected environmental gains from main PA processes and techniques

http://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892_EN.pdf

Process	Technique	Expected environmental gains
Precision irrigation	Soil texture map	Avoidance of excessive water use or water logging Reduction of fresh water use
Patch herbicide spraying in field crops	Weed detection (on line/weed maps)	Reduction of herbicide use with map-based approach (in winter cereals by 6–81% for herbicides against broad leaved weeds and 20–79% for grass weed herbicides) Reduction of 15.2–17.5% in the area applied to each field was achieved with map-based automatic boom section control versus no boom section control
Early and localised pest or disease treatment	Disease detection: - Multisensor optical detection - Airborne spores detection - Volatile sensors	Reduction of pesticide use with correct detection and good decision model (84.5% savings in pesticides possible)
Orchard and vineyard precision spraying	- Tree size and architecture detection - Precision IPM	Reduction in pesticide use of up to 20 – 30 % Reduction of sprayed area of 50-80%
Variable rate nitrogen fertiliser application according to crop requirements and weather conditions	Crop vegetation index based on optical sensors Soil nutrient maps	Improvement of nitrogen use efficiency Reduction of residual Nitrogen in soils by 30 to 50 %
Variable rate phosphorus fertiliser application according to crop requirements and weather conditions	Crop vegetation index Soil nutrient maps	Improvement of phosphorus recovery of 25 %
Crop biomass estimation	Crop vegetation index	Adjust the fungicide dose according to crop biomass
Mycotoxin reduction	Crop vegetation index and fungal disease risk	Optimisation of fertiliser dose and fungicide use on the basis of higher disease risk in areas with high crop density

4. Evident achievements in practice

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Tillage Crops	Up to 15% less time and fuel consumption. GHGs emissions with Automatic Guidance	First levels in adoption High Tech for PA generally adopted by farmers. Technologies mature and not so expensive. Advantages recognized
Vineyard / Orchard	Up to 70% saving in crop protection chemical use with DSS and automation in Variable Rate Technology (VRT)	Wide adoption in DSS for Risk control (Climate and Pests), wide interest for VRT in spraying and especially in fertilizing
All crops	Safeguard soil fertility (15 times less erosion, etc.,) and biocoenosis with cover crops and reducing compaction	Wide attention in High Value Chain Farming systems. Use of light equipment and proper tires / vehicles / practices. General recognition of the relation between soil health and quality of products
Forage production	Up to 30% higher price for forage produced with BAP, PA High Tech, and traceability	Padana Cheese Factory recognise more product and quality in milk for which are used traced and well produced forages

http://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892_EN.pdf

5. Social innovation with PA High Tech adoption

- **Taking the principles of Internet of Things (IoT) pilot sustainability into account:**
  - integration of environmental, social, human and economic goals in policies and activities related to the IoT pilot;
  - open platforms and architectures, interoperability, scalability and potential for replication
  - addressing transparency and systemically the risk, uncertainty and irreversibility
  - appropriate valuation, appreciation and restoration of the environment
  - opportunity and community participation / sustainable community
  - ensuring legacy and future technologies integration
  - commitment to best practices and methodologies
  - no net loss of human capital or natural resources
  - global alignment and integration
  - continuous improvement
  - good governance
  - financial viable

http://www3.weforum.org/docs/IoTGuidelinesforSustainability.pdf

5. Social innovation with PA High Tech adoption

- **SPA Sustainable Precision Agriculture has the potential to change the vision and scenery in the rural system and in the related areas. With the implementation of the IoT, urban and rural territorial activities will be joined in a common value chain.**
  - Farmers will join the local ecosystem (providers, services, consultants, educational system, governance) in a Common Value Chain
  - Agro-electronics, agro-informatics, and agro-statistics will grow to support farmers / entrepreneurs and farming operators

5. Social innovation with PA High Tech adoption

Technological expertise *(relevant in all scenarios)*	**Legislative expertise** *(relevant in all scenarios)*	**Local community leadership** *(relevant in all scenarios but scenario 1)*
• Work with robots/automation technology • Work with data/data skills (data science) • Choose right technologies or solutions • Low waste production • Diverse high-tech production skills	• Understanding legislation • Knowledge of the laws/anticipating changes • Dealing with bureaucracy • 'Diplomacy' and 'people skills' in working with institutions	• Knowledge of regional potential and regional growth • Insight into local needs • Communication • People management/'people skills' • Sense of solidarity with and responsibility for the community

Tab.3: Clusters of skills relevant to the three key areas of expertise

http://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892_EN.pdf

Further Reading

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❖ STOA-EPRS (2017). Precision Agriculture in Europe. Legal, social and ethical considerations. ISBN 978-92-846-1662-6, doi 10.2861/278. November 2017.
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