

D3.6. Smart-AKIS recommendations and fact-sheets



smartAKIS
Smart Farming Thematic Network



Document Summary

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Abstract

This deliverable proposes a number of recommendations drawn by Smart-AKIS Network as a result of the 2 years and a half project implementation. Recommendations are extracted from the whole of activities and processes carried out during the project, described in the document, into 3 domains: 1) Enhancing innovation-driven agricultural research within the EIP-AGRI ecosystem; 2) Future Research in Smart Farming; and 3) Mainstreaming Smart Farming. Main recommendations are also summed up in Factsheets, to be used with dissemination purposes.

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1. Introduction

Smart-AKIS is a Thematic Network funded by the European Commission in the frame of the Horizon 2020 programme for Research and Innovation. The project's overall objective is to close the research and innovation divide in the field of Smart Farming. Running for 30 months, Smart-AKIS is fostering the effective exchange between research, industry, extension and the farming community so that direct applicable research and commercial solutions are widely disseminated and grassroots level needs and innovative ideas thoroughly captured.

Smart-AKIS follows the EIP-Agri “multi-actor approach”, implementing an interactive innovation model, for engaging with different stakeholders within and outside the project at regional, national and European level. Through its different activities, the project has gathered insights on the barriers and incentives for the adoption of Smart Farming Technologies (SFT) as well as on the needs from end-users and other stakeholders in the value chain, such as researchers, industry and advisors.

These findings, together with other project's outcomes, such as the trends on SFT research and industry solutions, have allowed the consortium to produce a set of recommendations for closing the research and innovation divide in the field of SFT in Europe, which are presented in this Deliverable. Being one of the central outcomes of Smart-AKIS, the recommendations have also been drafted in the form of fact-sheets, easily readable documents for wide dissemination among end-users and stakeholders in the value chain.

The Deliverable is divided into four Chapters:

- **Chapter 1** makes an introduction to the goals and content of the deliverable.
- **Chapter 2** describes the process followed at the overall project level to gain the necessary insights and information for issuing the recommendations. This chapter also presents the background for the choice of fact-sheets template for the wide dissemination of the recommendations.
- **Chapter 3** presents the recommendations of Smart AKIS on three different areas: a) Enhancing innovation-driven agricultural research within the EIP-AGRI ecosystem, b) Future research on Smart Farming and c) Recommendations for mainstreaming Smart Farming.
- **Chapter 4** sums up the main recommendations for mainstreaming Smart Farming in Europe into Factsheets, easy to read and understand summaries for dissemination purposes.

2. Process

2.1. Methodology for the integration of results

Smart-AKIS follows the EIP-Agri “multi-actor approach”, implementing an interactive innovation model, for engaging with different stakeholders within and outside the project. The project has implemented a bottom-up approach, integrating information gathered at the European level with the findings and insights gathered through surveys and workshops at the grassroots level in the project’s seven Regional Innovation Hubs. Figure 2.1 presents the project results that have been taken into consideration for the production of the recommendations, showing both the results obtained as a result of activities at the European level as well as at the grassroots level in the seven Regional Innovation Hubs.

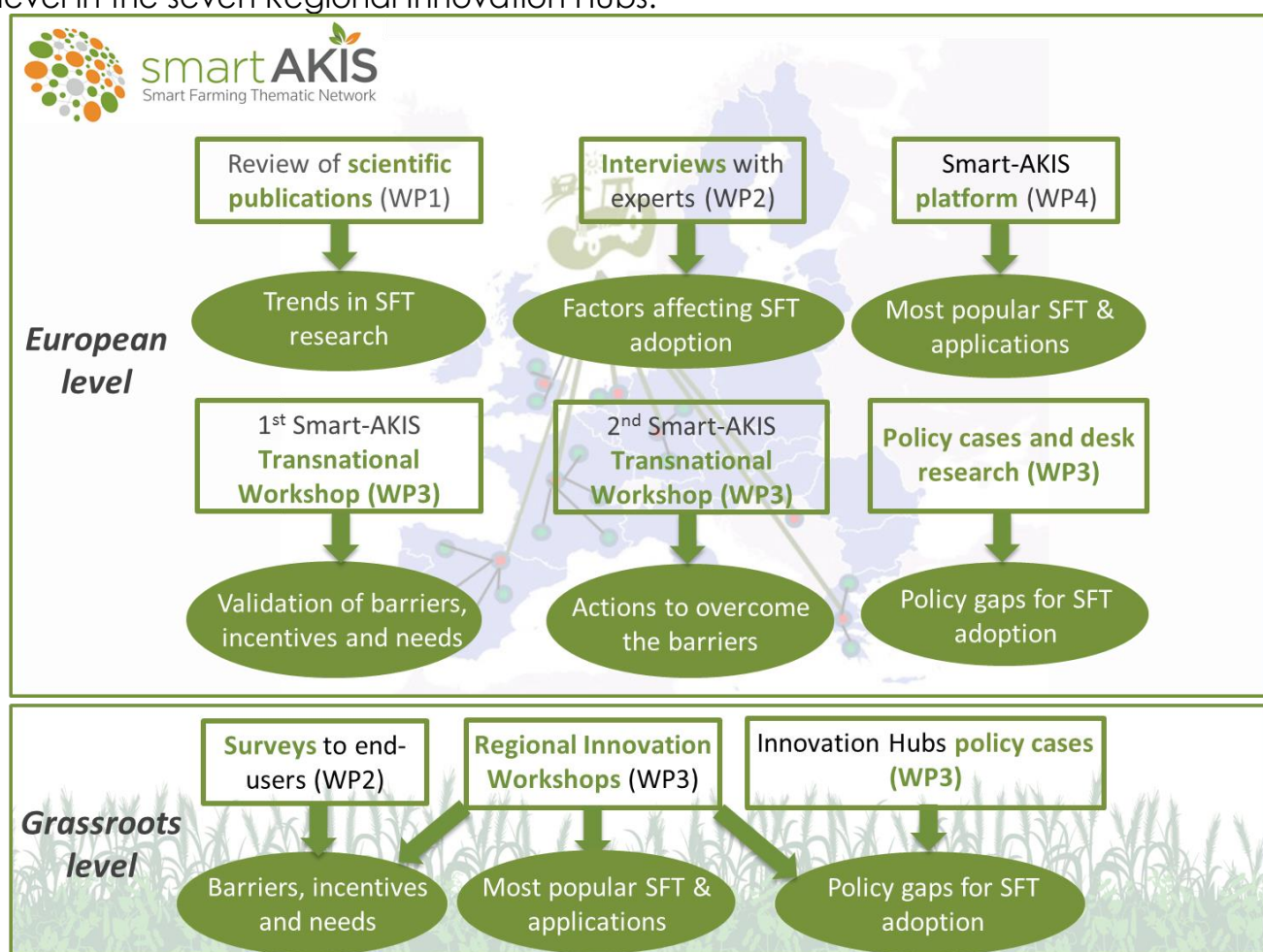


Figure 2.1. Project results that have been taken into consideration for the production of the recommendations. Above, results of activities conducted at the European level. Below, results of activities at the grassroots level. Boxes represent activities and green bubbles represent project results.

The wealth of information gathered in the project’s Deliverables has been thoroughly analysed and integrated in order to produce a set of recommendations for fostering

the adoption of SFT in Europe, which are presented in Chapter 3 of this Deliverable. The policy briefs produced on the basis of these outcomes and the policy gaps identified at the grassroots and European level are presented in Deliverable 3.7. Figure 2.2 shows the flow of integration of project results leading to the production of the recommendations and policy briefs.

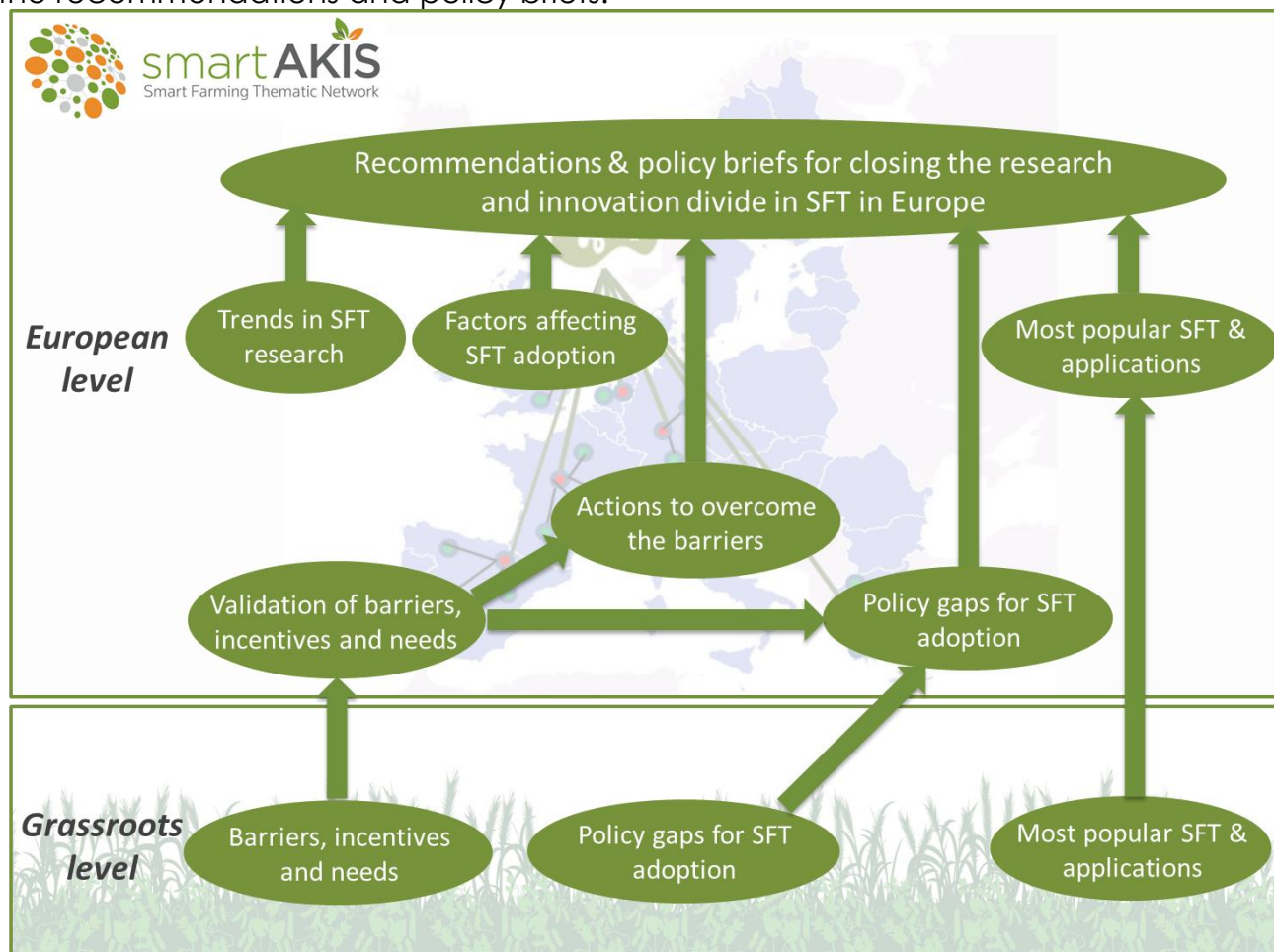


Figure 2.2. Flow of integration of project results leading to the production of the recommendations and policy briefs. Above, results at the European level. Below, results at the grassroots level.

The present Chapter explains the process followed for integrating the different project deliverables and outcomes for the production of the recommendations. For details on the methodology used by the different partners to produce the individual outcomes and results, the reader is referred to the individual Deliverables. For details on the methodology used for the identification of the policy gaps and the production of the policy briefs, the reader is referred to Deliverable 3.7.

The following sections present in detail the project's outcomes that have been taken into account for the production of the recommendations.

2.2. Trends in Smart Farming Technologies

A systematic review was conducted in WP1 in order to get insights in current SFT development both with regards to research results but also in relation to products and services already in the market. Scientific journals, EU-funded projects (H2020, FP7 and ICT-AGRI), national projects and marketed products were researched, making a clear distinction between SFTs from scientific articles, scientific projects and marketed products.

Scientific articles were sought with the use of several reference databases, such as Scopus, Web of Science, CAB Abstracts, Agricola and Agris, whereas for EU-projects, the CORDIS database was used. SFT products on the market were researched through a careful selection on relevant market stakeholders involved in the development of SFTs, which were afterwards approached for a survey on their SFT products or services.

A total amount of 718 scientific articles and 201 research projects were finally selected under the category “SFT research results”, whereas the survey to industrial players allowed for describing a total of 164 SFT products and services available on the market. These results were made available EU-wide in the form of “Technology cards” through the Smart-AKIS platform (<https://smart-akis.com/SFCPPortal/#/app-h/dashboard>). The review of research results and market products allowed identifying trends in relation to the most popular types of SFT, field operations, target users, effects of SFT application and farm size. For details of the methodology used and the results obtained the reader is referred to D1.2 and D1.3 and their updates (D1.4, D1.5 and D1.6).

Information of the trends regarding SFT research results and market products has been taken into account for the definition of the **Recommendations regarding Future research in Smart Farming** in section 3.2 of this report.

2.3. Factors affecting SFT adoption

WP2 identified socio-demographic, economic, political and societal factors that foster and/or hinder the innovation, adoption and diffusion processes of SFT. In total, 22 experts belonging to three different actor groups (research, industry, practice) in 9 countries (Denmark, France, Germany, Greece, Italy, the Netherlands, Serbia, Spain) were interviewed. The interviewees were selected for their comprehensive expertise on influencing factors along the chain of innovation development, adoption and dissemination in the European context.

Experts identified multiple additional aspects affecting the speed and direction of innovation implementation and development. Major dynamics mentioned are relating to economic and political strategies varying noteworthy throughout Europe. Differences were mainly perceived between North-Western and South-Eastern Europe also reflected by societal demands and interests. The role of the European

Union and its political decisions were considered essential for the future development of sustainable agriculture as supported by SFT. Most experts' opinions correspond on the increasing importance of SFT and their likely adoption by more and more farmers. For details of the methodology used and the results obtained the reader is referred to D2.3.

Information on the factors affecting SFT adoption has been taken into account for the definition of the **Recommendations for Mainstreaming SFT** in section 3.3 of this report.

2.4. Barriers, incentives and needs

Insights on the barriers, incentives and needs related to SFT adoption were collected through a survey conducted in the frame of WP2. A total number of 271 farmers were surveyed in France, Germany, Greece, Spain, Serbia, the Netherlands, and the UK in order to understand their technological needs and interests regarding SFT. Farmers were selected according to their cropping system (arable crops, open field vegetables, tree fruits, and vineyards) and farm size class (<2, 2-10, 11-50, 51-100, 101-200, 201-500, >500 ha). Information related to perceptions of farming challenges, SFT potential, information sources for farmers, and adoption was gathered in order to obtain insights to subjective perceptions of SFT, how they may help overcome challenges in agriculture, information sources that are important for farmers, and how some of the patterns differ between adopters and non-adopters.

While farmers' perception of challenges in agriculture was shaped largely by country-specific contexts, there was an overarching tendency amongst farmers to be uncertain about the ability of SFT to help overcome those challenges. Interests and needs of farmers varied somewhat according to cropping system and farm size, but there was little difference between adopters and non-adopters. Farmers across countries and cropping systems indicate that they need more access to information about SFT, and that existing SFT is too costly and not compatible enough with other machinery. For details of the methodology used and the results obtained the reader is referred to D2.2.

The barriers, incentives and users' needs related to SFT and identified in this WP2 survey were validated and complemented with new findings gathered in the first two rounds of Regional Innovation Workshops (RIWs) held by Regional Innovation Hub partners in the frame of WP3. The information was analysed, removing regional biases and particular cases in order to favour the EU wide perspective and have as broad a starting point as possible for the discussions. The outcomes of this preliminary analysis were presented to the Smart-AKIS consortium and the high-level experts of the project's External Advisory Board at the 1st Smart-AKIS Transnational Workshop held in Pamplona (Spain) in November 2017. The Workshop allowed for further validating the findings related to the barriers, incentives and needs around SFT as well as to start defining strategies and actions to overcome the main barriers. Thanks to the feedback obtained during this workshop, barriers were grouped in four main

groups, namely economic, technical/technological, barriers related to agricultural data and barriers faced by advisory services. For details of the methodology used and the results obtained the reader is referred to D3.2, D3.3 and D3.4.

The information regarding the barriers and the incentives was used as the basis for the 2nd Smart-AKIS Transnational Workshop. The information regarding research needs has been taken into account for the definition of the **Recommendations regarding Future research in Smart Farming** in section 3.2 of this report.

2.5. Actions to overcome the barriers

The 2nd Smart-AKIS Transnational Workshop held in Serbia on March 2018 in the frame of WP3 allowed Smart-AKIS to take a step forward in the definition of strategies and actions to overcome the barriers to the adoption of SFT in Europe. A participatory session was held both with project partners and external stakeholders from the seven Regional Innovation Hubs, in which actions and strategies to overcome the main barriers were suggested. For details of the methodology used and the results obtained the reader is referred to D3.5.

The actions to overcome the barriers suggested by the Smart-AKIS partnership and external experts of the Advisory Board were jointly analysed with the contributions of stakeholders in the 2nd Transnational Workshop, and they have all been taken into account for the definition of the **Recommendations for Mainstreaming SFT** in section 3.3 of this report, as well as for the definition of the policy gaps and briefs (deliverable D3.7).

2.6. Most popular SFT and applications

The RIWs held by Regional Innovation Hub partners in the frame of WP3 were the venue where the most suitable SFTs for the particular region or country were presented to end-users. The SFTs presented in each Regional Innovation Hub are shown in section 3.4 of Deliverable 3.3. Upon presentation at RIWs of the most suitable SFTs end-users were able to: i) give feedback to the SFT providers in order to facilitate their innovations to reach the market, ii) provide inputs to researchers for the definition of commercialization strategies for SFT not yet available on the market, iii) generate innovative uses for available SFT solutions and iv) foster the development of new or evolved SFT solutions taking into consideration grassroots level ideas and farmers' needs. RIWs allowed Regional Innovation Hub partners to identify which were the most popular SFT solutions in their Hubs as well as which SFTs are to be most demanded by end-users in the near future.

The Smart-AKIS platform (<https://smart-akis.com/SFCPPortal/#/app-h/technologies>) is the main tool for the dissemination of available SFT solutions, ranging from scientific papers and research results to products and services already on the market. SFT solutions are presented in a user-friendly manner in the form of "technology cards", showing SFT key features such as cropping system, crop type and field area in which

it can be used, type of SFT and effects (fertilization, harvest, pest and disease control, etc.). It also provides information on potential yield and/or quality increase, production costs decrease and environmental impact reduction derived from its use. The platform has now over 500 registered users. WP4 leader designed a battery of Key Performance Indicators (KPIs) to monitor the interaction of registered users with the platform. Some of the KPIs that are being monitored are the following: top 25 searched words, top 25 SFT viewed, top 25 SFT assessed, ranking of cropping systems and crop type searched, ranking of total area cultivated searched, ranking of SFT type searched, ranking of SFT with the effects on searched, ranking of TRL searched. KPIs are monitored by category of end-user, country of origin and type of SFT so that broken-down information can be extracted. The monitoring of these KPIs allows getting valuable insights on the interest of end-users on the particular SFTs on the platform.

The information gathered at the RIWs as well as the platform's KPIs have been taken into account for the definition of the **Recommendations for Mainstreaming SFT** in section 3.3 of this report.

2.7. Other findings

The interactive innovation model followed by Smart-AKIS has also allowed getting some insights into the functioning of the multi-actor approach and the role of Thematic Networks for closing the innovation divide in European agriculture. This relates to the methodology followed in the RIWs, the evaluation of the RIWs by participants as well as the subjective perceptions of Hub partners regarding what worked and what not in the multi-actor process. These insights are presented in detail in D3.3 and have been the basis for the definition of the **Recommendations for Enhancing innovation-driven agricultural research in Europe** in section 3.1 of this report.

3. Recommendations

3.1. Enhancing innovation-driven agricultural research within the EIP-AGRI ecosystem

The innovation process carried out in Smart AKIS has provided evidence that the **multi-actor interactive and collaborative approach** promoted by the General Directorate for Agriculture of the European Commission and the EIP-AGRI is a suitable approach for promoting innovation-driven research in agriculture through the Thematic Networks such as Smart-AKIS.

Bringing together all actors in the agricultural value chain allows identifying measures to overcome the barriers that hinder the adoption of research results by practitioners and it facilitates capturing grassroots level ideas for current and future research. Furthermore, in the particular case of Smart Farming Technologies, the multi-actor approach is a valuable tool for the development of innovation-driven business models for fully tapping the potential of these technologies.

Despite the multi-actor approach was implemented as a suitable tool for involving farmers and other end-users (cooperatives, irrigation communities, etc.) in exchanges with the industry, research and advisors, it could be noticed that farmers systematically participated to a lower extent than other actors in the project's workshops and events. This clearly gives room for improvement in terms of practitioners' engagement for fostering and mainstreaming real innovation-driven agricultural research across Europe.

The present section proposes a number of recommendations for enhancing innovation-driven agricultural research, considering the reflections of the smart farming community, as gathered in Smart-AKIS.

The multi-actor approach and its performance within the [EIP-AGRI](#) ecosystem

- Increase **farmers' participation** in the multi-actor approach through the development of **hands-on demonstrations** in the frame of Thematic Networks and multi-actor projects: field visits, cross-visits, set-up of demo-farms, etc., thus mixing different types of approaches for engaging with them: online and digital tools, but also direct contacts and peer-to-peer demonstration activities.
- Increase **farmers' direct participation** in projects following a multi-actor approach, such as for Thematic Networks, through mechanisms that facilitate their access to the funding (e.g. foreseen a pre-harvesting phase for the submission of proposals, as ongoing in the [IoF2020](#) large scale project Open Call; keeping some budget for funding the proposals' preparation, as proposed during the Thematic Networks Coordination meeting¹).

¹ Meeting called by DG AGRI and held in Brussels on March 9, 2018.

- Request Thematic Networks and multi-actor projects to organize multi-actor events and workshops for increasing knowledge exchange and cross-fertilisation among actors and stakeholders, tailoring these events to the needs of end-users for encouraging their participation.
- Reinforce the **key intermediary role of advisory services, and other interface and intermediary bodies acting as facilitators and brokers** for cooperation and innovation, as promoted by [SCAR AKIS Strategic Working Group](#)², building bridges between the needs, solutions, expectations and languages of research, industry and the farmer community, particularly in remote rural areas, between the internet connection is still lacking.
- Support **dissemination actions carried out by advisory services** as they are ultimately the closest actors to the farming community and can thus better transfer the panoply of practical information compiled by Thematic Networks and other multi-actor projects.
- Create **small networks of end-users at the local and regional AKIS scale**, interested in the particular research results and solutions of the Thematic Networks and multi-actor projects. These networks could be further supported by involving different actors, such as technology specialists, public organisations, technology centres, universities and public authorities (local, regional) that can provide impartial information.
- Encourage the integration of **training activities** in terms of “facilitation” and “soft skills” in Thematic Networks and multi-actor projects and make the material available on the EIP-AGRI platform, as remarked by SCAR AKIS Strategic Working Group³.
- Avoid the duplication of platforms in the different Thematic Networks funded, facilitating the **integration of solutions in common platform(s)** easier to be reached by practitioners and maintained over the time, after the project(s) end.
- Encourage the **translation** of the relevant dissemination materials (targeting, in particular, farmers) contained in such joint platform(s) in the different EU languages (e.g. through the intermediation of advisory services, or through a service offered by the EIP-AGRI service point, etc.).

Further structuring the EIP-AGRI ecosystem

- Promote the further **coordination of Thematic Networks**, among them but also with other multi-actor projects that focus on cross-cutting issues, especially those

² SWG SCAR-AKIS Policy Brief on the Future of Advisory Services. 2017.

³ SWG SCAR-AKIS Policy Brief on New approaches on Agricultural Education Systems. 2017.

focusing on demonstration farms, peer-to-peer exchanges, advisory services, AKIS, etc. ([PLAID](#), NEFERTITI, [AgriLink](#), etc.).

- Set up permanent exchange mechanisms and channels among **Thematic Networks, the SCAR AKIS Strategic Working Group, DG Agri and EIP-AGRI Service-Point**, where EIP-AGRI Service Point can play the pivotal role for the upstream and downstream flowing of information between Thematic Networks and SCAR AKIS Strategic Work Groups.
- Evolve the EIP-AGRI platform as a **one-stop shop knowledge platform** for delivering to practitioners the wealth of practical information gathered from Operational Groups and Thematic Networks, thus avoiding the duplication of platforms.
- Keep and increase the budget devoted in Rural Development Programmes (RDPs) funded by EARDF for the **creation and support of Operational Groups** and further promote the inclusion of funding for cross-border Operational Groups.
- Create a **new funding measure** (under EARDF 2nd Pillar or Horizon Europe), for cross-border Operational Groups, as mini-projects for co-creation, joint development and demonstration, with reduced red tape for farmers and advisors. A **challenge-based approach could be implemented**, mirroring the mission driven strategy proposed for new Horizon Europe programme, but in leaner and smaller multi-actor collaboration projects, oriented to transfer, adoption and absorption of technologies.
- Empower **National Rural Networks (NRN)** and **National Contact Points (NCP)** as focal points of EIP-AGRI for the further coordination of the ecosystems at national and regional level, strengthening the links between Operational Groups and Thematic Networks, and clarifying the links between the EIP-AGRI platform and the **European Network for Rural Development** ([ENRD](#)) database.

Synergies between programmes

- Facilitate synergies between the EIP-AGRI funding scheme (H2020, EARDF) and **European Territorial Cooperation (INTERREG) funds**, to increase territorial and cross-border cooperation and knowledge flows. Raise awareness among programme officers about the synergies among funding programmes.
- Disseminate a **mapping** of available funds and programmes considering farmers point of view in relation to their position all along the **research, innovation and market uptake of smart farming technologies value chain**.
- Simplify access to R&D and innovation funding through **reducing/removing red tape** for access to funding and reporting.

- Promote the further inclusion of **innovative financial instruments** within the next generation of Rural Development Programmes funded by EARDF, in order to increase the access to funding opportunities for the development of innovation-driven products and services.
- Create links with other programmes such as **Erasmus+**, for the mainstreaming of the end-user information into current and future education and training curricula.
- Close the gap between **agricultural research and rural development**, more so for the promotion of digital transformation and rural renaissance. Closer links should be established between the EIP-AGRI and ENRD in order to fully deploy the **Smart Villages Act** and benefit the whole farmers' and rural development communities.
- Promote a **Smallholders Farmers Act** at EU level mirroring the Smaller Business Act initiative for SMEs, with the goals of easing or reducing the regulatory burden within REFIT Commission's Regulatory Fitness and Performance (REFIT) programme, the red tape linked to CAP direct aid, the participation in agricultural research projects at different programmes, and access to financial instruments. This **overarching framework** might influence all programmes affecting agricultural research.

3.2. Future research in Smart Farming

The analysis of the collected research and commercial SFTs performed in the frame of the project revealed a number of knowledge gaps in Smart Farming research at the overall European level. At the grassroots level, participants in the RIWs were also asked to express their research needs related to the SFTs categories addressed in the project, namely: sensors, imagery, VRA and autonomous systems, Decision Support Tools and the integration of different SFTs. The present section suggests a number of research topics for future research in Smart Farming, which could be the subject of R&D&I projects, spanning different:

- **Technology Readiness Level:** from basic research to innovation projects, demonstration initiatives, applied research studies, market uptake projects, etc.
- **Geographical scope:** a combination of EU, national and regional initiatives can address the wide scope of subjects and challenges presented. Information, communication, coordination and transfer are key cross-cutting activities supporting the achievement of these challenges.
- **Funding sources:** the synergistic use of public and private funds is necessary for addressing the research challenges in an optimized manner. Operational Groups funded under EARDF can support co-development, applied research and demonstration initiatives, while Horizon 2020 can support Thematic Networks with dissemination of practical knowledge and other measures from EAGF can support market uptake of brand new technologies. Living Labs and Digital innovation Hubs can bring together the industry and end-users on joint new developments.

General recommendations for future research

- Close the **knowledge gap** between measuring the status of crop and soils on the one hand, and using that information to make practical decisions in farming on the other hand. The majority of academic research on SFTs focuses on monitoring and mapping of crops and soils whereas commercial SFTs focuses on actuation as well as on monitoring and mapping, in all likelihood because end-users demand solutions which can be put into practice.
- Provide the required knowledge in the measuring tools to be applied for **different cropping systems**.
- Support research on **reactive technologies**, such as variable rate pesticides, variable rate fertilizers (especially for P and K), as well as variable rate seeding and tillage.
- Develop robots for niche markets in both research and commercial products, as an area that is expected to attract a lot of attention in the near future. Robots have the enormous potential to drastically decrease pesticide use by mechanically removing weeds or by only spraying pesticide on weeds instead of over the complete field. Spraying drift can be reduced and environmental impact decreased.
- Foster research on **SFTs directly improving sustainability** (e.g. biodiversity, soil compaction) in contrast to the majority of commercially available SFTs that lead to higher productivity and profitability, sometimes with reduced emissions as a side-effect.
- Mainstream SFTs, targeting also smaller farms and not only larger farms. Commercially available SFTs often target larger farms, while SFTs investigated in applied research projects are applicable both on smaller and larger farms.
- Develop **technical solutions** and, equally importantly, mechanisms for stakeholders to **collaborate effectively** in all issues related to **data** collection, standardisation, analysis, quality and applicability, and more broadly, all issues related to data management, such as ownership, transfer, sharing, security, privacy and exploitation. We are convinced that many opportunities to increase the profitability and sustainability of farming remain unrealized at present because of data-related issues.

Recommendations for future research on sensors

Future research on sensors should focus on the development of affordable sensors for:

- ✓ Measurement of the soil properties used in Decision Support Systems irrespective of the type of soil (sandy, loamy, etc.).
- ✓ Measurement of soil thermal & moisture content for effective irrigation.
- ✓ Crop protection and crop status in general (yield potential, growth rates, stress...).
- ✓ Other applications: underground measurement/exploration of roots, tubers, etc.

Recommendations for future research on imagery

The spectrum of cameras should be improved and new indexes should be developed for more specific information on:

- ✓ Assessment of ripening of edible products and quality of fruit (including grapes).
- ✓ Early disease detection for targeted chemical application.
- ✓ Weed recognition in arable crops.
- ✓ Correlation of crop imaging with soil features.
- ✓ Wildlife and nature interactions: active bird scaring, census of deer and rabbits, badger trails on livestock farms, 3D maps for flood volume areas, etc.

Recommendations for future research on VRA and autonomous systems

Future research on VRA and autonomous systems should focus on:

- ✓ Development of cheap precision inclination sensors that measure the incline or tilt angle to improve the autonomous GPS positioning.
- ✓ Development of spatial application by GPS maps (drones and SAT) considering NDVI index for spraying.
- ✓ Development of more flexible switch between nozzle types considering spatial application in the field.
- ✓ Development of Variable Rate Fertilisation with biological-based fertilisers.
- ✓ Implementation of a holistic approach to Variable Rate Irrigation from water drilling to application.

- ✓ Use of drones for crop protection purposes (spraying).
- ✓ Development of autonomous robotic systems for weed control and selective harvesting.

Recommendations for future research on Decision Support Tools

Future research on Decision Support Tools (DST) should focus on:

- ✓ Improvement on the automated translation of images and data into operational and actionable information for decision making.
- ✓ Development of Artificial intelligence and auto learning in different devices and implements for capturing information (data or images).
- ✓ Development of better localised and timelier weather forecast systems.
- ✓ Develop models based on imagery and sensors for a variety of applications: soil moisture for a more effective irrigation, yield potential and forecast models combining fertilization processes, pest and disease forecast modelling and mapping, soil characterisation/zoning in vineyards, early detection of pests for crop protection, link soil microbiology maps to yield maps.

Recommendations for future research on Smart Farming systems integration

Future research for the integration of different Smart Farming systems should focus on:

- ✓ Development of integrated and autonomous systems that aid in-field operations and data analysis, combining for example early disease detection sensors with on-machine response systems.
- ✓ Develop GPS location management systems for harvest easing traceability.
- ✓ Implement a system-based approach: consideration of the whole technology-plant-soil system against one-shot solutions (fertilization/treatment based on individual symptoms).
- ✓ Foster the implementation of Data Hubs for farmers to share market relevant information (e.g. on prices for farm inputs, like US' Farmers Business Network) and combining compulsory information collected from governments' monitoring systems.
- ✓ Integrate traceability and consumers requests.

- ✓ Develop alternative means of communication to internet connection for sensors and IoT systems.

3.3. Mainstreaming Smart Farming

Smart AKIS has grouped the recommendations for mainstreaming Smart Farming into four blocks, addressing the main barriers assessed for smart farming adoption in Europe. The specific recommendations are issued addressing different stakeholders.

BLOCK1: VALUE FOR MONEY
1. Demonstrate smart farming's benefits
2. Improve smart farming funding
3. Innovate on business models
BLOCK 2. THE 3 CS PROBLEM: CONNECTIVITY, COMPLEXITY & COMPATIBILITY
4. Ensure rural broadband connectivity
5. Develop user friendly solutions
6. Promote interoperability standards
BLOCK 3. AGRICULTURAL DATA FUELING GROWTH
7. Promote a transparent framework for agricultural data
8. Spur growth from agricultural data
BLOCK 4. SMART FARMING SUPPORT STRATEGIES
9. Mainstream smart farming into education & training
10. Strengthen the AKIS role for the digital era

Block 1. Value for money

Under this block, the economic barriers and incentives related to the use of SFT are considered. The pervasive idea that the value for money of such investments is uncertain or questionable remains the main challenge.

R1. Demonstrate smart farming's benefits

High investment costs linked to the set up and running of SFTs remains one of the largest barriers for their widest adoption. Furthermore, farmers and advisors share the perception that the **value for money** is uncertain on regards to many SFTs. Few technologies, such as GPS have become the new normal, being widely adopted by the farmer community without any contestation about their economic benefits.

Farmers and advisors demand more **empirical based evidence** about the economic benefits of using such technologies in yield performance and on a more efficient use of inputs. For such evidence to be successful in engaging farmers the community would welcome in-field evidence and demonstration of results coming from

impartial and non-commercially biased actors, such as public advisors, applied research or certification bodies.

The perception about the usefulness for farmers of Smart Farming Technologies is almost exclusively based on the economic performance of the farm, overlooking other relevant aspects such as the **environmental impact** that the use of such technologies can bring into the fold, or the impact on the work conditions for farm workers.

Recommendations for Policy-Makers

Public authorities and or bodies are called to play a role on the impartial assessment of Smart Farming Technologies, through different approaches:

- Create an **independent institute or organization**, a public neutral body or an applied research organization, for conducting benchmarking studies of SFTs, including cost/benefit analysis calculations. Experiences in place include the role of [Institut Français du Vin et de la Vigne](#) (IFV), which will be the official French body for certification of sprayers for vineyards.
- Develop and deploy easy to understand and use **databases, repositories and resources**, with audio-visual materials (videos, games, etc.), field testimonials, etc. about Smart Farming use and benefits, following the model of online platforms such as the Smart AKIS Platform.
- Support **demand-side policies** with stricter environmental and food safety regulations, as an opportunity for an increased adoption of SFTs, as these technologies will ease regulatory compliance: nutrient inputs, water and carbon footprint, systemic approach to food traceability following increasing social demands for more sophisticated and safer food market, etc. This might prove an additional added value for Smart Farming adoption besides the pure economic one.

Recommendations for Farmers and Advisors

- Develop **Decision Support Tools and services** provided by advisors and agronomists in order to support investments decisions based upon performance, as well as for accompanying users in the setup and maximum use of purchased equipment and technologies.
- Implement **feedback systems** to collect and share information on the economic profitability of new technologies.
- Disseminate and **demonstrate successful business cases** as good practices at the farm level providing information on cost-benefit following existing cases, testimonials by early adopters on the use of SFT, peer-to-peer exchanges and

benefit analysis, and training and demonstration of SFT on demo farms, such as [Bayer](#) digital farming demonstration farms in Belgium and Germany, [Digifermes](#) demonstration farms in France and [Digital Farm](#) in Serbia.

- Promote **farm clusters or communities for data collection**, allowing for trials and demos with field-scale and long-term experiments for benchmarking of data between farms.

Recommendations for Industry & Research

- Conduct **independent and neutral research** as well as the **demonstration** of SFT solutions with a wide variety of farmers and advisors covering a variety of soils and crops. Farmers demand “ground truth evaluation” based on objective and provable data so that they could gain confidence on SFTs capabilities.
- Improve the **marketing and communication** efforts by industry, bridging the gap in terms of language, culture and expectations with the farmer and advisor community, using more pedagogically sound and interactive communication tools. A wider dissemination and multiplication of existing initiatives with practical demonstration purposes, such as digital Demonstration Farms and Fairs ([Demoagro](#), [Les Culturelles](#), etc) is encouraged for engaging farmers and end-users.

R2. Improve smart farming funding

Funding Smart Farming investments remains a challenge in terms of available subsidies and financial instruments specifically tailored for investments in these technologies that entail a higher risk than other well-established machinery and equipment purchase or leasing.

Recommendations for Policy-Makers

- **Make grants programmes simpler and smarter.** Make application procedures easy to understand, including eligibility criteria. Reduce the red tape involved in the application of public grants programmes, such as those programmed under Rural Development Programmes (RDPs), allowing to invest on Smart Farming equipment and services, making use of the automation capture of data by smart farming technologies linked to sensors, satellite imagery, etc.
- **Boost innovation in the funding landscape**, following 2 directions:
 - ✓ A better synergy of instruments within the existing funding framework at EU and national levels: EARDF, ERDF, financial instruments ([FI-COMPASS](#)), Innovative Public Procurement schemes, etc. A **mapping of available funding sources and programmes aiming at the different stages** of the Research & Innovation continuum to the market uptake support, could allow identifying gaps, duplicities, and complementarities.

- ✓ Develop innovative financial and funding instruments specific for investments in SFTs, such as tax deduction bonus, financial technology loans or grants programmes allowing for soft investments on external services support and the development or access to data platforms or databases.
- Turn the **Common Agricultural Policy (EARDF and EAGF) into an opportunity**. CAP is considered as the biggest opportunity to make EU's Agriculture smarter and greener. This demands to follow a holistic approach on the planning of previous and new measures, considering at all times these principles: **1) promoting solutions that are farmers-centred and that reward farmers**; 2) simplicity in the aid programmes management; 3) making the utmost use of Smart Farming Technologies and IT capabilities and 4) with ultimate goal of greening or increasing the achievement of environmental impact goals of EU Agriculture **whilst maintaining it competitive**. An Agricultural Sustainable Productivity Bonus (ASPB) scheme in new CAP as proposed by CEMA's contribution to the debate on the CAP's future⁴ fits this approach. In this sense, it is considered that "Digitalisation is a means, not a goal".

R3. Innovate on business models

The **Smart Farming and Digital Agriculture** field is a relatively new business sector, with a strong link to the so-called Digital Economy, where new, innovative and disruptive **business models** are tested in the market. There is no set up business models for the smart farming market, where different models co-exist promoted by multinational agricultural equipment and solutions providers and fledgling start-ups alike.

Recommendations for Industry & Research

- Increase **transparency and fair contracting** schemes by agricultural industry and retailers, as a means to build trust and fully exploit the possibility of the agricultural data economy potential. In this regards the recent **EU Code of Conduct on agricultural data sharing by contractual agreement**⁵, endorsed by the industry and the farmers community is highly lauded as a necessary step in that direction. The Code of Conduct should be widely disseminated by the different actors involved in order to reach its full potential.
- **Foster collaboration among industry players**, beyond interoperability and standardisation prerequisites. Farmers might be willing to reduce the number of solution providers and rather head to agricultural services aggregators or consultants, who are able to mix the solutions and technologies from different providers for the delivery of single and tailored services. Smart Farming as a Service might be so confirmed as a market trend in upcoming years.

⁴ http://cema-agri.org/sites/default/files/publications/CEMA_CAP%20position%20paper%202017.pdf

⁵ http://cema-agri.org/sites/default/files/publications/EU_Code_2018_web_version.pdf

- **Assess servitization as a fitting model for end-users.** Servitization will probably go hand-in-hand with further platform services provided by multinational or grouping of companies. Innovation on business models and on price modelling schemes might ease farmers' buy-up of such services, such as free-of-charge SFT try out periods for users, pay as you use services, etc.
- Call industry players to acknowledge and **give value to farmers' knowledge, expertise and data** shared with companies for the development of new technologies, services and solutions through fair collaboration agreements as proposed by the EU Code of Conduct on agricultural data sharing. By setting up clear contractual agreements, trust and buy up of smart farming services could be fostered.

Recommendations for Farmers and Advisors

- Support **collaborative investment schemes**, following the Collaborative Economy paradigm (such as French CUMA, other type of cooperatives sharing equipment, machinery or processes, **and/or local SFT knowledge centres owned/controlled by farmers**) allowing **collaborative investment** decisions by farmers and advisors, sharing risks and investment costs and maximizing the use of the technologies following the collaborative exploitation of generated information and data.

Block 2. The 3 Cs problem

Under this block, technical and technological barriers are addressed. Among them, the so-called 3 Cs problem can be highlighted, referred to Connectivity, Complexity and Compatibility issues. Overcoming these barriers is a cornerstone for the widest adoption of Smart Farming Technologies, where policy-makers and industry players are the ones called to act considering end-users perceptions and needs.

R4. Ensure rural broadband connectivity

Connectivity: Smart Farming Technologies are heavily dependent on a steady and high quality access to internet connection considering the number of communication nodes (sensors equipment, laptops, tablets, vehicles, etc.) and the big data managed, stored and exploited. In spite of current public and private investments on the delivery of broad-band connectivity to EU rural areas, there is still ample room for improvement.

Recommendations for Policy-Makers

- Increase **public investments or public-private partnerships** such as the [Connecting Europe Facility \(CEF\)](#), the Investment Plan for Europe, ESIF and ERDF, ensuring broadband connectivity all over EU rural and agricultural areas are encouraged for full deployment of smart farming technologies.

- **Promote alternative solutions**, such as for the use of a combination of wired (fibre cable) and wireless solutions to extend the range of connectivity in remote areas.
- A crosscheck of national initiatives for rural connectivity must be coordinated and **harmonization** must be sought as much as possible to minimize the number of technologies to be used.

Recommendations for Research

- Increase **research on wireless technologies** of communication data in rural areas, and offline operability, such as LoRa/LoRAWAN technology for long range, low power wireless communication platforms, Sigfox or Neul, using different radio bands.

R5. Develop user-friendly solutions

Complexity: Farmers and advisors report the complexity in the set-up, running and maintenance of smart farming solutions as a relevant hindrance. Usability of equipment and platforms can be improved for starters. The current deployment of a given commercial solution into a real-life farm setting turns out many times as a time-consuming and discouraging exercise, where many unforeseen technical problems and glitches come up leading to tinkering efforts by farmers and retailers alike.

Recommendations for Industry & Research

- Adopt **User Experience (UX) tools** in the definition and design of the interfaces of new solutions and platforms, putting the simplicity and usability by the end-user at the forefront.
- Make easier the translation of raw data into intelligence. A support on the decision-making by farmers and advisors is the final goal of many smart farming solutions. **Turning data into intelligence** is the key, which leads to the necessary display of data and information into actionable and easy to understand pieces of intelligence supporting the farmers' decisions. Ultimately, Smart Farming Technologies are another tool, not an end in themselves, supporting farmers in the agricultural process, based upon the agronomist science principles and knowledge.
- Promote **Plug & Play** approaches in the industrial design of new pieces of equipment, machinery, sensors and networks, easing the set-up and deployment of new solutions, as well as the **capacity to upgrade/replace** existing components and machinery with new solutions and capabilities, ensuring the compatibility between old and newer equipment and systems.

- **Improve the existing training and tutorial tools and platforms** allowing training users in the set up and running of new equipment and solutions. A **better** combination of interactive and digital tools should be made available training podcasts, infographics, the use of digital screens, short video clips.
- Improve communication on the engagement activities carried out by the industry with farmers and advisers in the **testing of new solutions** before going to market on a wide range of farms with different production types, crops, topography, spatial variability, etc, allowing adapting the solutions at the biggest number of real life settings possible.

R6. Promote interoperability standards

Compatibility: One of the fiercest demands of users is the improvement on the compatibility and interoperability of solutions and data systems. Farmers demand advances in digital communication standards leading to a leaner integration of different technologies and solutions into existing equipment, machinery and sensors with farm management systems in the farm. Nonetheless, the integration of sophisticated equipment and solutions with older equipment might also lead to incompatibility dead-ends, only surmountable by equipment replacement strategies.

Recommendations for Industry & Research

- Increase the **visibility and outreach of standardisation** initiatives within the industry, promoted by the [Agricultural Industry Electronics Foundation \(AEF\)](#) and [AgGateway Global Network](#) for the standards for smart, interoperable farm machines, in the fields of Farm Management Information Systems (FMIS, wireless in-field communication, high-speed ISOBUS, electric drives and camera systems). The back up by policy-makers and authorities of such industry-led initiatives can only increase their outreach and social endorsement.
- Increase the **accuracy and reliability of data**. Standards should be developed for interoperability and compatibility allowing exploiting data from different sources and equipment, allowing for translation of data into actionable intelligence.

Block 3. Agricultural data fueling growth

Agricultural data arises as one of the main hot topics in the new agricultural digital economy, in terms of privacy, protection, data attribution or ownership, ownership, usability, storage, security, sharing and exploitation.

Even though coined as the biggest driver for productivity gains, challenges remain in terms of regulation and the rights of farmers in this field, which seem to have resulted in transparency and trust issues between the farmer and advisor community and the

industry. Recommendations in this field are addressed mainly to the industry and oriented to make the rules clearer and more widespread, empowering farmers on more balanced sharing schemes that could spur new business opportunities and the delivery of better agricultural services.

R7. Promote a transparent framework for agricultural data

Farmers' personal data is fully protected by the General Data Protection regulation, while equipment data is also protected by the industrial providers. Agricultural Data, defined as that related to the agricultural production, including farm data and all types of data generated within the farming process is legally owned by the farmer or data originator, who can decide to share it or not with providers, advisors or researchers.

Yet, in real practice, farmers are seldom aware about applicable rights, and controversy arises when farmers' primary data is computed or aggregated with other farmers' data. There is a need to assure people that it is safe to release their data to different instances. To that end, the building of trust between farmers, agricultural retailers and operators should be encouraged, through transparency and information on where the data is stored and how it is used, by the means of fair and easy to understand agreements. In this capacity, the acknowledgment and valuation of the data willingly shared by farmers in the development of new products could be an incentive.

The delivery of a more transparent framework to agricultural data management allows for two approaches. A hard approach, following regulation by public authorities at EC and national levels, and a soft approach, based upon the self-regulation efforts by the industry and end-users.

In this field, a recent development is highly welcomed: the [EU Code of Conduct on agricultural data sharing by contractual agreement](#) promoted by a coalition of industry and farmer community representatives, including [CEMA](#), [COPA-COGECA](#), [CEETAR](#) and [CEJA](#) among others and the support and assistance from the European Commission. It proposes guidelines for the management of agreements between farmers and providers in the field of data attribution or ownership, data access, control and portability, data protection and transparency, data privacy and security and liability and intellectual rights.

Recommendations for Industry

- **Boost dissemination** of the newly agreed EU Code of Conduct between company members from the signatories' industries association. Furthermore, the operationalisation of the guidelines through **contractual agreements templates or models** could also represent a step forward in the trust building between the industry and farmer communities.

- Increase the **transparency** in the contractual agreements between farmers and industry providers is encouraged as a good practice, with easy to understand regulation of all aspects related to data management and the potential use given to the shared data for commercial or R&I purposes.
- Improve the quality of gathered data. Good calibration of machinery and automatic transfer of data from machinery to data management tools are a must for ensuring quality of data captured. Further **research and self-regulation** is proposed in order to ensure the **data accuracy, safety and security**, increasing the reliability of the data based new services and solutions and the trust of farmers reducing any kind of potential data misuse.

R8. Spur growth from agricultural data

Recommendations for Farmers and Advisors

- **Empower farmers in the data economy**, by means of wide campaigns for **awareness raising, dissemination and training** of farmers and advisors on the newly agreed EU Code of Conduct. Besides the rights and contract models and guidelines, a specific focus should be put on the valorisation of data sharing models where farmers can grasp how to **extract value from their data** and the benefits of sharing it:
 - ✓ Data-based traceability of products can support demonstration of quality and final higher price on the market.
 - ✓ Models promoting economic return for farmers willing to share their data with the industry for the development of new products and services (Farm Mobile Model in the US).
 - ✓ Use of collective data platforms for sharing and analysing data in production groups such as CUMA, cooperatives, regional advisory agencies for the development of early warning systems centralized by advisors.

Recommendations for policy-makers

- Promote **Agricultural Open Data** policies, for disclosing and **making available public** and **anonymised agricultural data coming up from existing regulatory requirements**, compliance and certification processes, and public national or regional Earth Observation Systems based tools and platforms.
- Support the development of **public-private agricultural data platforms**, allowing for the build-up of ecosystems for the start-up of new services and businesses opportunities, following open innovation ecosystems, such as Living Lab based upon data and Hackathons, like the ones promoted by [API-AGRO](#) agricultural data platform in France.

Recommendations for Industry

- Build further **bridges between the IT and the Agtech entrepreneur and innovation** support ecosystems, allowing for the cross-fertilisation of technologies, needs and solutions in the framework of open innovation ecosystems, as the [Digital Innovation Hubs](#) promoted by the European Commission, bringing into the fold end-users, farmers and advisors alike.
- Benefit from the capacities of **Artificial Intelligence**, for the delivery of Decision Support Tools built upon agricultural data and Artificial Intelligence, by means of combining AgData interpretation and agronomic knowledge to produce recommendations and decision support intelligence.
- Support and self-regulate, if necessary, the emergence of new expert support services emerging in the field of data management in the new Data Economy, such as **legal experts in Data Management** that might act as neutral trusted moderators between data producers (farmers) and data users (industry).

Recommendations for Research

- Increase research in the field of **data accuracy, reliance and usability**. Research on which data are really useful for farmers' decision is the first step for the delivery of useful and relevant smart farming solutions by the industry.
- Embrace the **Open Data Research principles** widely at all levels of the Education, Training and Research ecosystem, by the dissemination and sharing of public available data resulting from research. Further dissemination and support is encouraged for initiatives in this field such as Global Open Data for Agriculture and Nutrition initiative ([GODAN](#)) and the [Ag Data Alliance](#), also tackling the ethical management of agricultural data.
- Promote with the support of public authorities a new stable **EU research infrastructure in digital agriculture**, as done in other research areas in the Food and Agriculture research field, such as aquaculture, plant phenomics and food security.

Block 4. Smart Farming support strategies

Under this block, recommendations are issued aiming at supporting farmers in the transition towards a smarter and greener EU Agriculture. Education, Training and Lifelong learning as well the strengthening of the role of Agricultural Knowledge and Innovation Systems (AKIS), mostly advisory services in the new landscape are the main strategies foreseen in order to enable farmers to fully benefit from the new smart farming paradigm shift.

R9. Mainstream Smart Farming into Education & Training

The unrelenting pace of innovation in Smart Farming Technologies makes it difficult to keep abreast on latest tech developments and innovation for farmers and advisors. The specialised and mass media are the main information sources about the latest developments in the field; however, end-users and advisors demand more and more access to information and training on the latest technologies, looking for evidence about the benefits resulting from their application.

The new generation of farmers are native digitals and demand new approaches on the usability and impact of Smart Farming Technologies. Younger generations can be attracted to the farming practice as they perceive farming as a more techie job thanks to Smart Farming Technologies.

Even though well-established technologies have already been integrated into Education and Training curricula and into the practical knowledge of advisors, acceleration on such mainstreaming efforts will become a necessity in future years, when some novel Smart Farming Technologies will become mature and widely adopted and other technologies will emerge and pose new challenges.

Thus, an ongoing review of current curricula at all educational levels (higher education, vocational training and lifelong learning is encouraged in order to keep abreast with current and future farmers and agronomists demands.

Recommendations for Policy-Makers

- Keep **updating agricultural studies curricula** in University and Schools, as well as in the Lifelong Learning offer aimed at advisors and agronomists, mainstreaming well-established and upcoming smart farming technologies.
- Mainstream into European projects, such as Thematic Networks and **other multi-actor projects**, an **Education & Training strand**, including training in their work plans in order to maximize their impact and facilitate the knowledge transfer.

Recommendations for Farmers and Advisors

- Support all training and educational efforts with the **latest digital and social media capabilities** (videos, podcasts, Augmented Reality, Facebook, Twitter, serious games, etc) in order to keep abreast of the ongoing technology developments in the market and disseminate them towards end-users.
- Set up **"train the trainers"** approaches for Advisors, training advisors on the practical knowledge, use and cost-benefit of Smart Farming technologies, conducting "ground truthing" to validate assessed technologies in the field.

- Follow the **Agronomy First principle** when integrating smart farming technologies into training and information, upon which Smart Farming technologies assessment has to take place against the agronomic benefits provided by a given technology.

R10. Strengthen the AKIS role for the digital era

Agricultural Knowledge and Innovation Systems (AKIS) remain the open innovation ecosystem where Smart Farming adoption and mainstream is to take place following a multi-actor approach. Encompassing and revamping the roles of Agricultural Knowledge and Innovation Systems (AKIS) actors is therefore necessary, looking for new avenues, tools and approaches for the delivery of more effective support services for Smart Farming adoption. Recommendations are addressed to all AKIS actors, but two main issues are considered to be central, in relation to the industry and advisory approaches to digital agriculture:

Role of Advisors

The broad offer of available technologies and the speed of innovations make it difficult for advisors to keep abreast of SFTs and provide sound advice to farmers. Against this backdrop, two potential approaches need to be considered:

- Intermediation: advisors may start playing a facilitator role, connecting users with experts from industry, applied research, agricultural contractors and other actors (i.e. CUMAs) and bringing together adopters and non-adopters for the assessment and transfer of technologies. Under this approach, advisors are seen as third party experts, carrying out comparative tests of similar SFTs. Under these new collaboration models, advisors would still play a key role as trustworthy and independent bodies close to end-users, capable of interpreting agricultural data and providing individualized advice on the most relevant technologies to use for improving farm management decisions. Advisors may also play a role in supporting farmers understand their position in a digital economy, especially with regards to data management.
- Specialisation: advisors might also follow a specialization approach, either by technologies applicable to different cultivation processes, or by areas of expertise (crop protection, smart irrigation, etc), allowing for advisors to gain practical knowledge on narrower and more specific knowledge fields and provide accurate information and advice to farmers.

It is not up to Smart-AKIS to opt for one approach over the other, so both are encouraged to be tested and evaluated in the myriad of advisory services ecosystems all over Europe.

Smart Farming for All

Smart Farming adoption faces social and cultural resistances linked to lack of digital skills, avoidance of high tech solutions and resistance to change. Nonetheless,

democratisation of Smart Farming is a wilful aspiration, as we consider that Smart Farming can benefit all kind of farmers irrespective of their digital savviness, farm size or risk and change aversion. Not all farmers can be early adopters, but all of them can benefit from different SFTs, even smallholders, for which tailored demonstration activities could be organized leading to an update or scale-down of available technologies to their context.

Industry is therefore encouraged to address all farmers as potential users of technologies, and instead of only targeting early adopters or advanced users, marketing should target all farmers, and later on the willingness and absorption capacity of end-users will narrow down the adopters.

Recommendations for Farmers & Advisors

- Promote **outdoors fairs and field demonstrations** of SFTs through Field Days and Demonstration Farms, jointly with industry, for the benefit of advisors and farmers. Demonstrations is deemed a key factor for adoption: demonstration farms, peer groups, farmers groups, etc. are efficient approaches for users to see upstream and downstream implications, costs and usability of Smart Farming technologies.
- Develop **collaborative tools among farmers and advisors for the joint assessment of SFTs**, mediated by Advisors' independent role, allowing the dissemination of technical and economical transparent information to farmers. For instance, the promotion of farm clusters for data collection, trials and demos with field-scale and long-term experiments allowing for benchmarking of data between farms is encouraged.
- Support the decision making process of the farmer on regards to the purchase of new technologies, based upon **quality checklists** of technologies, with the criteria that farmers should have in mind when assessing the available commercial offer for such technology.

Recommendations for Industry & Research

- Broaden up **the participation of start-ups, applied research institutes and the industry in multi-actor collaboration** initiatives, such as Operational Groups or Demonstration Farms, contributing thus to the adaptation of available smart farming technologies to farmers' real needs, especially those of small-holders.
- **Formulate applied research results** in easily to understand language and making visible the potential benefits of the newly developed or tested technologies, facilitating thus the take-up of information by advisors.

4. Annex: Fact-sheets

The following 14 fact-sheets sum up main recommendations drawn:

- 1 Introduction Fact-sheet with the overall presentation of the recommendations and fact-sheets
- 1 fact-sheet with recommendations for enhancing innovation-driven agricultural research within the EIP-AGRI ecosystem.
- 1 fact-sheet with recommendations about future research in Smart Farming.
- 1 fact-sheet describing the 10 general recommendations for mainstreaming Smart Farming.
- 10 fact-sheets with specific recommendations for each of the 10 general recommendations.

The Fact-sheets are designed as briefs that provide an overview and key highlights from the recommendations and can be used for dissemination purposes.

In the Fact-sheets, the following icons are used in order to indicate the target group of each of the recommendations:



Farmers



Industry



Research



**Advisors/
Innovation
Brokers**



Policy-makers

Smart-AKIS Recommendations for Mainstreaming Smart Farming in Europe

Why?

Response to the global food challenge of feeding more than 9 billion people in 2050 and the sustainability and competitiveness challenges of the European agricultural sector, demands a wider adoption of Smart Farming Technologies allowing for a more sustainable, resource efficient and more productive EU agriculture.

Adoption of Smart Farming technologies allows for increases in the sustainability, resource efficiency and yield of agricultural production. However, a number of technological, social, regulatory and economic factors have hindered the widespread adoption of these technologies, both in large but also in small and medium scale farms.

Who?

Smart-AKIS is the Thematic Network focusing on Smart Farming running from 2016 to 2018. During this time, Smart-AKIS has researched farmers' interests and needs vis a vis Smart Farming, has disseminated Smart Farming technologies through an online platform, and has animated more than 900 stakeholders in 7 EU countries for the generation of multi-actor collaboration projects. You can read the Network's activity in www.smart-akis.com.

This has allowed us to pool together a wealth of information and insights, leading to a number of recommendations for increasing the adoption of Smart Farming in Europe.

What?

Recommendations are drawn in three domains :

- Enhancing innovation-driven agricultural research within the EIP-AGRI ecosystem.
- Future research in Smart Farming.
- Recommendations for Mainstreaming Smart Farming, addressing potential solutions to overcome technical economic and social barriers identified.

Following a multi-actor approach, the recommendations target different groups displayed with the following icons:



Farmers



Industry



Research



Advisors/
Innovation Brokers



Policy-makers

How?

The whole set of Recommendations are described in a publication available in Smart-AKIS website. The Fact-sheets sum up recommendations with dissemination purposes. All in all, you will find 14 Fact-sheets, including this introductory one.

Enhancing innovation-driven agricultural research

Facilitating the multi-actor approach



- Increase **FARMERS' DIRECT PARTICIPATION** as partners in projects facilitating their access to funding, such as budgets for project proposal preparation.
- Facilitate the participation of farmers in Networks and projects by hands-on **DEMONSTRATIONS**: field visits, cross-visits, demonstration farms and small networks of end-users, at the local and regional AKIS scale.
- Reinforce the key intermediary role of **ADVISORY SERVICES**, and other interface and intermediary bodies acting as facilitators and brokers for cooperation and innovation.
- Encourage the integration of **TRAINING** activities aimed at farmers in Networks and projects.

Structuring the EIP-AGRI ecosystem



- Promote the further **COORDINATION** of Thematic Networks, among them but also with other multi-actor projects that focus on cross-cutting issues, especially those focusing on demonstration farms, peer-to-peer exchanges, advisory services, AKIS, etc.
- Set up permanent **EXCHANGE MECHANISMS AND CHANNELS** among Thematic Networks, the SCAR AKIS Strategic Working Group, DG Agri and EIP-AGRI Service-Point, where EIP-AGRI Service Point can play a central role in the diffusion of information.
- Evolve the **EIP-AGRI PLATFORM** as a one-stop shop knowledge platform, avoiding the duplication of platforms by Networks and projects.
- Increase the budget devoted in Rural Development Programmes (RDPs) for **OPERATIONAL GROUPS** and further promote the inclusion of funding for cross-border Operational Groups.
- Create a new funding measures (under EARDF 2nd Pillar or Horizon Europe), for **CROSS-BORDER OPERATIONAL GROUPS**, as mini-projects for co-creation, joint development and demonstration, with reduced red tape for farmers and advisors following challenge-based approaches.
- Empower National Rural Networks (NRN) and National Contact Points (NCP) as **FOCAL POINTS** of EIP-AGRI at national level, for the further coordination of the ecosystem.

Promoting synergies between EU programmes



- Disseminate a **MAPPING OF AVAILABLE FUNDS/PROGRAMMES** from farmers' point of view.
- Facilitate **SYNERGIES** between EIP-AGRI funding scheme (H2020, EARDF), European Territorial Cooperation (INTERREG) and Erasmus+ programme.
- Simplify access to R&I funding through **REDUCING/REMOVING RED TAPE**.
- Promote the further inclusion of innovative **FINANCIAL INSTRUMENTS**.
- Close the gap between agricultural research and rural development by closer links between the **EIP-AGRI AND EUROPEAN NETWORK FOR RURAL DEVELOPMENT (ENRD)** in order to fully deploy the Smart Villages Act.

Future research in Smart Farming

Overall recommendations for future research



- Close the knowledge gap between measuring the status of crop and soils for users to make **PRACTICAL DECISIONS** in farming.
- Update/Tailor measuring tools to be applied for **DIFFERENT CROPPING SYSTEMS**.
- Support research on **REACTIVE TECHNOLOGIES**: Variable Rate fertilization, pesticide, seeding and tillage.
- Develop **ROBOTS** for weeding, precision spraying and selective harvesting.
- Foster research on technologies directly improving **SUSTAINABILITY**: e.g. biodiversity, soil compaction.
- Develop and mainstream technologies suitable for **SMALL FARMS**.
- Develop technical solutions and mechanisms for stakeholders to collaborate in all issues related to **DATA COLLECTION, STANDARDIZATION AND MANAGEMENT**.

Specific topics for future research



New affordable Sensors for:

- Measurement of the soil properties used in Decision Support.
- Measurement of soil thermal & moisture content for effective irrigation.
- Crop protection and crop status in general (yield potential, growth rates, stress...).
- Other applications: underground measurement, exploration of roots, tubers, precision inclination sensors for autonomous GPS positioning.

Imagery: New cameras and indexes for:

- Assessment of ripening of edible products and quality of fruit.
- Early disease detection for targeted chemical application.
- Weed recognition in arable crops.
- Correlation of crop imaging with soil features.
- Wildlife and nature interactions: active bird scaring, census of deer and rabbits, flood areas, etc.

VRA and autonomous systems

- Maps considering NDVI index for spraying.
- More flexible switch between nozzle types considering spatial application.
- Variable Rate Fertilisation with biological-based fertilisers.
- Drones for crop protection and robots for weed control and selective harvesting.

Smart Farming systems integration

- Integrated and autonomous systems that aid in-field operations and data analysis
- GPS location management systems for harvest easing traceability.
- Implement a system-based approach: consideration of the whole technology-plant-soil system.
- Integration of traceability and consumers requests.

Decision Support Tools

- Improvement on the automated translation of images and data into operational and actionable information for decision making.
- Development of Artificial Intelligence and auto learning in devices for capturing information-
- Better localised and timelier weather forecast systems.
- Models based on imagery and sensors for effective irrigation, yield potential and forecast models.

Mainstreaming Smart Farming

Overview	
<p>Smart-AKIS has grouped the recommendations for mainstreaming Smart Farming into four blocks, addressing the main barriers of an economic, technical, cultural and social nature, linked to the Smart Farming adoption in Europe:</p> <ul style="list-style-type: none"> ○ Block 1: Value for Money of Smart Farming Technologies. ○ Block 2: The 3 Cs problem: connectivity, complexity & compatibility. ○ Block 3: Agricultural Data. ○ Block 4: Smart Farming support strategies. <p>All in all, 10 general recommendations are made for the 4 blocks. Each of them is broken down in turn into specific recommendations aimed at different target groups.</p>	
Recommendations	
Block 1: Value for money	R1. Demonstrate Smart Farming's benefits
	R2. Improve Smart Farming funding
	R3. Innovate on business models
Block 2: The 3 Cs problem: connectivity, complexity & compatibility	R4. Ensure rural broadband connectivity
	R5. Develop user friendly solutions
	R6. Promote interoperability standards
Block 3: Agricultural Data fueling growth	R7. Promote a transparent framework for agricultural data
	R8. Spur growth from agricultural data
Block 4: Smart Farming support strategies	R9. Mainstream Smart Farming into Education & Training
	R10. Strengthen the AKIS role for the digital era



Farmers



Industry



Research



Advisors/
Innovation Brokers



Policy-makers

“Ultimately, Smart Farming Technologies are another tool, not an end in themselves, supporting farmers in the agricultural process, based upon the agronomist science principles and knowledge.”

Mainstreaming Smart Farming:

B1.R1.Demonstrate Smart Farming's benefits

Why?

High **INVESTMENT COSTS** remains one of the largest barriers for the widest adoption of Smart Farming. There is a perception that the value for money is uncertain. Farmers and advisors demand **EMPIRICAL BASED EVIDENCE** about the economic benefits in yield performance and on a more efficient use of inputs by the means of in-field evidence and demonstration from impartial actors.

The perception about the usefulness for farmers of Smart Farming technologies is almost exclusively based on the economic performance, overlooking the **ENVIRONMENTAL IMPACT** or the improvement of **WORK CONDITIONS**.

Recommendations



- Promote **INDEPENDENT ORGANIZATIONS** for conducting benchmarking studies of Smart Farming technologies, including cost/benefit analysis calculations.
- Disseminate easy to understand and use **DATABASES, REPOSITORIES AND RESOURCES**, with audio-visual materials and practical information about Smart Farming uses and benefits.
- Support **DEMAND-SIDE POLICIES WITH STRICTER ENVIRONMENTAL AND FOOD SAFETY REGULATIONS**, as Smart Farming technologies will ease regulatory compliance.

Recommendations



- Develop **DECISION SUPPORT TOOLS** and services by advisors and agronomists in order to support investment decisions based upon performance, as well as for accompanying users in the setup and maximum use of purchased equipment. Implement feedback systems to collect and **SHARE INFORMATION ON THE ECONOMIC PROFITABILITY** of new technologies.
- Disseminate and demonstrate **SUCCESSFUL BUSINESS CASES** as good practices at the farm level by testimonials from early adopters, peer-to-peer exchanges and demonstration.
- Promote **FARM CLUSTERS OR COMMUNITIES FOR DATA COLLECTION**, allowing for trials and demos with field-scale and long-term experiments for benchmarking of data between farms.

Recommendations



- Conduct independent and neutral research as well as the demonstration of solutions with a wide **NUMBER OF FARMERS AND ADVISORS** covering a variety of soils and crops.
- Improve the **MARKETING AND COMMUNICATION EFFORTS** by industry, bridging the gap in terms of language, culture and expectations with the farmer and advisor community, using more pedagogically sound and interactive communication tools.

How?

- The [Smart-AKIS Platform](#) model looks efficient to outreach and disseminate practical information for end-users.
- Independent organizations such as [Institut Français du Vin et de la Vigne \(IFV\)](#), which will be the official French body for certification of sprayers for vineyards, can be encouraged.
- Demonstration is key in the digital field, such as [Bayer](#) digital farming demonstration farms in Belgium and Germany, [Digifermes](#) demonstration farms in France and [Digital Farm](#) in Serbia.

Mainstreaming Smart Farming:

B1.R2. Improve Smart Farming funding

Why?

Funding Smart Farming investments remains a challenge in terms of available subsidies and financial instruments specifically tailored for investments in these technologies that entail a **HIGHER RISK** than other well-established machinery and equipment purchase or leasing.

Recommendations



- Make grants programmes **SIMPLER AND SMARTER**. Make application procedures easy to understand, reduce the red tape involved and make use of the automation of data captured by Smart Farming technologies linked to sensors, satellite imagery, etc in the application and reporting of grants.
- A better **SYNERGY OF INSTRUMENTS** within the existing funding framework at EU and national levels: EARDF, ERDF, financial instruments (FI-COMPASS), Innovative Public Procurement schemes, etc. A mapping of available funding sources and programmes aiming at the different stages of the R&I continuum to the market uptake support, could allow identifying gaps, duplicities, and complementarities.
- Develop **INNOVATIVE FINANCIAL AND FUNDING INSTRUMENTS** specific for investments in Smart Farming, such as tax deduction bonus, financial technology loans or grants programmes allowing for soft investments on external services support and the development or access to data platforms or databases.
- Turn the **COMMON AGRICULTURAL POLICY** (CAP) into an opportunity. CAP is considered as the biggest opportunity to make EU's Agriculture **SMARTER AND GREENER**. This demands to follow a holistic approach on the planning of measures, considering these principles:
 1. Promotion of solutions that are farmers-centred and that reward farmers;
 2. Simplicity in the aid programmes management;
 3. Making the upmost use of Smart Farming Technologies and IT capabilities and
 4. Ultimate goal of greening or increasing the achievement of environmental impact goals of EU Agriculture whilst maintaining it competitive.

How?

- [RECAP](#) project aims to develop an improved remote monitoring of CAP obligations and to supplement the in-field inspections procedures eliminating several of the burdens linked to the Cross Compliance Scheme. RECAP also offers farmers a tool supporting them to comply with regulations imposed by the CAP, providing personalised information for simplifying the interpretation of complex regulations, and early alerts on potential non-conformities.

Mainstreaming Smart Farming:

B1.R3. Innovate on business models

Why?

The Smart Farming and Digital Agriculture field is a relatively new business sector, with a strong link to the so-called Digital Economy, where new, innovative and disruptive **BUSINESS MODELS** are tested in the market. There is no set up business models for the Smart Farming market, where different models co-exist promoted by multinational agricultural equipment and solutions providers and fledgling start-ups alike.



Recommendations



- Increase **TRANSPARENCY AND FAIR CONTRACTING SCHEMES** by agricultural industry and retailers, as a means to build trust and fully exploit the possibility of the agricultural data economy potential.
- Foster collaboration among industry players, beyond interoperability and standardisation prerequisites for the delivery of joint services. **AGRICULTURAL SERVICES AGGREGATORS** or consultants, mixing the solutions and technologies from different providers for the delivery of single and tailored services.
- Assess servitization as a fitting model for end-users through the means of further platform services provided by multinational or grouping of companies. **SMART FARMING AS A SERVICE** might be confirmed as a market trend.
- Increase innovation on **BUSINESS MODELS AND ON PRICE MODELLING** schemes might ease farmers' buy-up of such services, such as free-of-charge try out periods for users, pay as you use services, etc.
- Acknowledge and **GIVE VALUE TO FARMERS' KNOWLEDGE**, expertise and data shared with companies for the development of new technologies, services and solutions through fair collaboration agreements.

Recommendations



- Support **COLLABORATIVE INVESTMENT SCHEMES**, following the Collaborative Economy paradigm, allowing collaborative investment decisions by farmers and advisors, sharing risks and investment costs and maximizing the use of the technologies.

How?

- Transparency and fair contracting schemes have taken a big step forward thanks to the recent [EU Code of Conduct on agricultural data sharing by contractual agreement](#) , endorsed by the industry and the farmers community, highly lauded as a necessary step in that direction. The Code of Conduct should be widely disseminated by the different actors involved in order to reach its full potential.
- There are successful collaborative investments methods already established in Europe, that might be used for adoption of Smart Farming technologies, such as the French [CUMA](#), or other type of cooperatives sharing equipment, machinery or processes, and/or local knowledge centres owned/controlled by farmers.

Mainstreaming Smart Farming:

B2.R4. Ensure rural broadband connectivity

Why?

The so-called 3 Cs problem is referred to Connectivity, Complexity and Compatibility issues. Overcoming these barriers is a cornerstone for the widest adoption of Smart Farming technologies, where policy-makers and industry players are the ones called to act considering end-users perceptions and needs.

CONNECTIVITY: Smart Farming technologies are heavily dependent on a steady and high quality access to internet connection considering the number of communication nodes (sensors equipment, laptops, tablets, vehicles, etc.) and the Big Data managed, stored and exploited. In spite of current public and private investments on the delivery of broadband connectivity to EU rural areas, there is still ample room for improvement.

Recommendations



- Increase **PUBLIC INVESTMENTS OR PUBLIC-PRIVATE PARTNERSHIPS**, ensuring broadband connectivity all over EU rural and agricultural areas.
- Promote **ALTERNATIVE SOLUTIONS**, such as for the use of a combination of wired (fibre cable) and wireless solutions to extend the range of connectivity in remote areas.
- A **CROSSCHECK OF NATIONAL INITIATIVES FOR RURAL CONNECTIVITY** must be coordinated and harmonization must be sought as much as possible to minimize the number of technologies to be used.

Recommendations



- Increase research on **WIRELESS TECHNOLOGIES** of communication data in rural areas, and offline operability, such as LoRa/LoRAWAN technology for long range, low power wireless communication platforms, Sigfox or Neul, using different radio bands.

How?

- [Connecting Europe Facility](#) (CEF), the [Investment Plan for Europe](#), ESIF and ERDF have allowed relevant investments ensuring rural broadband connectivity, by the pooling of EU and national resources and private funds.

Mainstreaming Smart Farming:

B2.R5. Develop user-friendly solutions

Why?

COMPLEXITY: Farmers and advisors report the complexity in the set-up, running and maintenance of Smart Farming solutions as a relevant hindrance. Usability of equipment and platforms can be improved for starters.

The current deployment of a given commercial solution into a real-life farm setting turns out many times as a time-consuming and discouraging exercise, where many unforeseen technical problems and glitches come up leading to tinkering efforts by farmers and retailers alike.

Recommendations



- Adopt **USER EXPERIENCE (UX)** tools in the definition and design of the interfaces of new solutions and platforms, putting the simplicity and usability by the end-user at the forefront.
- Make easier the **TRANSLATION OF RAW DATA INTO INTELLIGENCE**. A support on the decision-making by farmers and advisors is the final goal of many smart farming solutions. Turning data into intelligence is the key, which leads to the necessary display of data and information into actionable and easy to understand pieces of intelligence supporting the farmers' decisions. Ultimately, Smart Farming Technologies are another tool, not an end in themselves, supporting farmers in the agricultural process, based upon the agronomist science principles and knowledge.
- Promote **PLUG & PLAY** approaches in the industrial design of new pieces of equipment, machinery, sensors and networks, easing the set-up and deployment of new solutions, as well as the capacity to upgrade/replace existing components and machinery with new solutions, ensuring the compatibility between old and newer equipment and systems.
- Improve the existing **TRAINING AND TUTORIAL TOOLS** and platforms allowing training users in the set up and running of new equipment and solutions. A better combination of interactive and digital tools should be made available through training podcasts, infographics, the use of digital screens, short video clips, etc.
- Improve communication on the engagement activities carried out by the industry with farmers and advisers in the **TESTING OF NEW SOLUTIONS** before going to market on a wide range of farms with different production types, crops, topography, spatial variability, etc, allowing adapting the solutions at the biggest number of real life settings possible.

How?

- Usability is key for adopting of new technologies by farmers. The use of tutorials, videos and other interactive and audiovisual materials can help farmers grasping use of new programmes, platforms and equipment. New training models can be encouraged, such as serious gaming methods. The upcoming [GATES game](#) will be the first ever serious game developed having in mind the Smart Farming training needs for farmers, students, advisors and retailers.

Mainstreaming Smart Farming:

B2.R6. Promote interoperability standards

Why?

COMPATIBILITY: One of the fiercest demands of users is the improvement on the compatibility and interoperability of solutions and data systems. Farmers demand advances in digital communication standards leading to a leaner integration of different technologies and solutions into existing equipment, machinery and sensors with farm management systems in the farm.

Nonetheless, the integration of sophisticated equipment and solutions with older equipment might also lead to incompatibility dead-ends, only surmountable by equipment replacement strategies.

Recommendations



- o Increase the visibility and outreach of **STANDARDISATION INITIATIVES** within the industry. The back up by policy-makers and authorities of such industry-led initiatives can only increase their outreach and social endorsement.
- o Increase the **ACCURACY AND RELIABILITY OF DATA**. Standards should be developed for interoperability and compatibility allowing exploiting data from different sources and equipment, allowing for translation of data into actionable intelligence.

How?

- Further dissemination is called for the initiative promoted by the [Agricultural Industry Electronics Foundation](#) (AEF) and [AgGateway Global Network](#) for the [standards for smart, interoperable farm machines](#), in the fields of Farm Management Information Systems (FMIS, wireless in-field communication, high-speed ISOBUS, electric drives and camera systems). AEF has joined forces with AgGateway to make the standard for data exchange future-proof and adapt it to the needs of Digital Farming. Both AEF and AgGateway are active in developing sector-specific standards and guidelines; the value of their cooperation lies in pooling different areas of expertise and knowledge, allowing covering the entire landscape of Digital Farming.

Mainstreaming Smart Farming:

B3.R7. A transparent framework for agricultural data

Why?

Agricultural Data arises as one of the main hot topics in the new agricultural digital economy, in terms of privacy, protection, data attribution or ownership, ownership, usability, storage, security, sharing and exploitation. Even though coined as the biggest driver for productivity gains, challenges remain in terms of **REGULATION AND THE RIGHTS OF FARMERS** in this field, which seem to have resulted in transparency and trust issues between the farmer and advisor community and the industry.

Farmers' personal data is fully protected by the General Data Protection regulation, while equipment data is also protected by the industrial providers. Agricultural Data, defined as that related to the agricultural production, including farm data and all types of data generated within the farming process is legally owned by the farmer or data originator, who can decide to share it or not with providers, advisors or researchers.

Yet, in real practice, farmers are seldom aware about applicable rights, and controversy arises when farmers' primary data is computed or aggregated with other farmers' data. There is a need to assure people that it is safe to release their data to different instances. To that end, the **BUILDING OF TRUST BETWEEN FARMERS, AGRICULTURAL RETAILERS AND OPERATORS** should be encouraged, through a transparent framework and rules.

Recommendations



- Boost dissemination of the newly **AGREED EU CODE OF CONDUCT** between company members from the signatories' industries association. Furthermore, the operationalisation of the guidelines through contractual agreements templates or models could also represent a step forward in the trust building between the industry and farmer communities.
- Increase the **TRANSPARENCY IN THE CONTRACTUAL AGREEMENTS** between farmers and industry providers is encouraged as a good practice, with easy to understand regulation of all aspects related to data management and the potential use given to the shared data for commercial or R&I purposes.
- Improve the **QUALITY OF GATHERED DATA**. Good calibration of machinery and automatic transfer of data from machinery to data management tools are a must for ensuring quality of data captured. Further research and self-regulation is proposed in order to ensure the data accuracy, safety and security, increasing the reliability of the data based new services and solutions and the trust of farmers reducing any kind of potential data misuse.

How?

- The [EU Code of Conduct on agricultural data sharing by contractual agreement](#) promoted by a coalition of industry and farmer community representatives, including [CEMA](#), [COPA-COGECA](#), [CEETAR](#) and [CEJA](#) among others and the support and assistance from the European Commission. It proposes guidelines for the management of agreements between farmers and providers in the field of data attribution or ownership, data access, control and portability, data protection and transparency, data privacy and security and liability and intellectual rights.

Mainstreaming Smart Farming:

B4.R8. Spur growth from agricultural data

Why?

Management and exploitation of agricultural data can lead to a boost of productivity in farms and to further innovation and refinement of smart farming technologies. This demands, though, the acknowledgment of the farmer and advisor community as owners of such data and their **EMPOWERMENT IN THE DATA ECONOMY**, leading to the emergence of new data sharing models where farmers can grasp how to extract value from their data and the benefits of sharing it.

Recommendations



- Promote **AGRICULTURAL OPEN DATA** policies, for disclosing and making available public and anonymised agricultural data.
- Support the development of public-private **AGRICULTURAL DATA PLATFORMS**, allowing for ecosystems for the start-up of new services, following open innovation ecosystems.

Recommendations



- Further awareness raising, dissemination and training of farmers and advisors on the **EU CODE OF CONDUCT**, including new data sharing models like for instance models providing economic return for farmers willing to share their data with the industry or models based upon the use of collective data platforms for sharing and analysing data in CUMA, cooperatives or advisory agencies for the development of early warning systems.

Recommendations



- Build further bridges between the **IT AND THE AGTECH** entrepreneur and innovation support ecosystems in the framework of open innovation ecosystems.
- Benefit from the capacities of **ARTIFICIAL INTELLIGENCE (AI)**, for the delivery of Decision Support Tools, by means of combining AgData interpretation and agronomic knowledge to produce recommendations and decision support intelligence.
- Support and self-regulate, if necessary, the emergence of new expert support services in the new Data Economy, such as **LEGAL EXPERTS IN DATA MANAGEMENT**.

Recommendations



- Embrace the **OPEN DATA RESEARCH** principles widely at all levels of the Education, Training and Research ecosystem, by the sharing of public available data resulting from research.
- Promote a new stable EU **RESEARCH INFRASTRUCTURE IN DIGITAL AGRICULTURE**, as done in other research areas in the Food and Agriculture research field.

How?

- [API-AGRO](#) agricultural data platform in France is a public-private initiative, setting up an open platform of agricultural data for the delivery of new services.
- [Digital Innovation Hubs](#) promoted by the European Commission, bring into the fold end-users, farmers and advisors alike from the IT, and Agricultural field.
- Further dissemination is encouraged for initiatives such as Global Open Data for Agriculture and Nutrition initiative ([GODAN](#)) and the [Ag Data Alliance](#).

Mainstreaming Smart Farming:

B4.R9. Mainstream Smart Farming into Education & Training

Why?

The unrelenting pace of innovation in Smart Farming Technologies makes it difficult to keep abreast on latest tech developments and innovation for farmers and advisors. The specialised and mass media are the main information sources about the latest developments in the field; however, end-users and advisors demand more and more access to information and training on the latest technologies, looking for evidence about the benefits resulting from their application.

Even though well-established technologies have already been integrated into Education and Training curricula and into the practical knowledge of advisors, acceleration on such mainstreaming efforts will become a necessity in future years, when some novel Smart Farming Technologies will become mature and widely adopted and other technologies will emerge and pose new challenges. Thus, an ongoing review of current curricula at all educational levels (higher education, vocational training and lifelong learning is encouraged in order to keep abreast with current and future farmers and agronomists demands.

Recommendations



- o Keep **UPDATING AGRICULTURAL STUDIES CURRICULA** in University and Schools, as well as in the Lifelong Learning offer aimed at advisors and agronomists, mainstreaming well-established and upcoming smart farming technologies.
- o Mainstream into **EUROPEAN PROJECTS**, such as Thematic Networks and other multi-actor projects, an **EDUCATION & TRAINING STRAND**, in order to maximize their impact and facilitate the knowledge transfer.

Recommendations



- o Support all training and educational efforts with the latest **DIGITAL AND SOCIAL MEDIA CAPABILITIES** (videos, podcasts, Augmented Reality, Facebook, Twitter, serious games, etc) in order to disseminate the ongoing technology developments in the market
- o Set up "**TRAIN THE TRAINERS**" approaches for Advisors, training advisors on the practical knowledge, use and cost-benefit of Smart Farming technologies
- o Follow the **AGRONOMY FIRST PRINCIPLE** when integrating Smart Farming technologies into training and information, upon which technologies assessment has to take place against the agronomic benefits provided by a given technology.

How?

- Public and private advisory services such as [Teagasc](#) and [Delphy](#) follow train the trainers approaches in order to ensure that all advisors get a minimum set of smart farming technology skills for advising the farmer community, backed up by specialized knowledge in the back-end of their services.

Mainstreaming Smart Farming:

B5.R10. Strengthen the AKIS role for the digital era

Why?

AGRICULTURAL KNOWLEDGE AND INNOVATION SYSTEMS (AKIS) remain the open innovation ecosystem where Smart Farming mainstream is to take place following a multi-actor approach. Encompassing and revamping the roles of AKIS is necessary, looking for new avenues, tools and approaches for the delivery of more effective support services for Smart Farming adoption.

Recommendations



- Assess and experiment on the **ROLE FOR ADVISORS** vis a vis Smart Farming adoption:
 - **FACILITATORS:** Advisors might play a facilitator role, connecting users with experts from industry, applied research, agricultural contractors and other actors, bringing together adopters and non-adopters for the assessment and transfer of technologies. Under this approach, advisors are seen as third party experts, carrying out comparative tests of similar technologies.
 - **SPECIALISTS:** Advisors might also follow a specialization approach, either by technologies applicable to different cultivation processes, or by areas of expertise (crop protection, smart irrigation, etc), allowing for advisors to gain practical knowledge on narrower and more specific knowledge fields.
- Promote **FIELD DEMONSTRATIONS**, jointly with industry, for the benefit of advisors and farmers: outdoor fairs, demonstration farms, field days, peer groups, etc. are efficient approaches for users to see implications, costs and usability of Smart Farming.
- Develop **COLLABORATIVE TOOLS** among farmers and advisors for the joint assessment of technologies, mediated by Advisors' independent role, allowing the dissemination of technical and economical transparent information to farmers.
- Support the decision making process of the farmer for the purchase of new technologies, based upon **QUALITY CHECKLISTS**, with the criteria that farmers should have in mind when assessing the available commercial offers.

Recommendations



- **SMART FARMING FOR ALL:** Industry is encouraged to address all farmers as potential users of technologies. Democratization of Smart Farming is a willful aspiration, as we consider that Smart Farming can benefit all kind of farmers irrespective of their digital savviness, farm size or risk and change aversion.
- Broaden up the participation of start-ups, applied research institutes and industry in **MULTI-ACTOR INITIATIVES**, such as Operational Groups or Demonstration Farms, contributing thus to the adaptation of technologies to farmers' real needs, especially those of small-holders.
- Formulate **APPLIED RESEARCH RESULTS IN EASILY TO UNDERSTAND LANGUAGE**, making visible the potential benefits of new technologies, facilitating the uptake of information by advisors.

How?

- [NEFERTITI](#) is a Horizon 2020 project that establishes 10 interactive thematic networks and bring together regional clusters (hubs) of demonstration farms and the involved actors, specially advisory services in 17 countries. NEFERTITI focuses on creating added value from the exchange of knowledge, in order to boost innovation uptake and peer to peer learning.



smart **AKIS**
Smart Farming Thematic Network



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