SmartAgriHubs. Connecting the dots to foster the digital transformation of the European agri-food sector – highlighting the Portuguese innovation ecosystem

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1. Digital technologies and business models are dramatically changing the way of farming in Europe

Digital technologies, such as Cloud Computing, Internet of Things, Big Data, Blockchain, Robotics and Artificial Intelligence, enable a transformation into data-driven, intelligent, agile and autonomous farm operations that can be remotely controlled and are seamlessly integrated in the food chain up to the end consumer. Digital Agriculture is generally considered as a key technology to address the grand challenges for agriculture, such as assuring a safe and sustainable provision of quality food, fostering resource efficiency, combating climate change and - lately - to develop the circular economy.

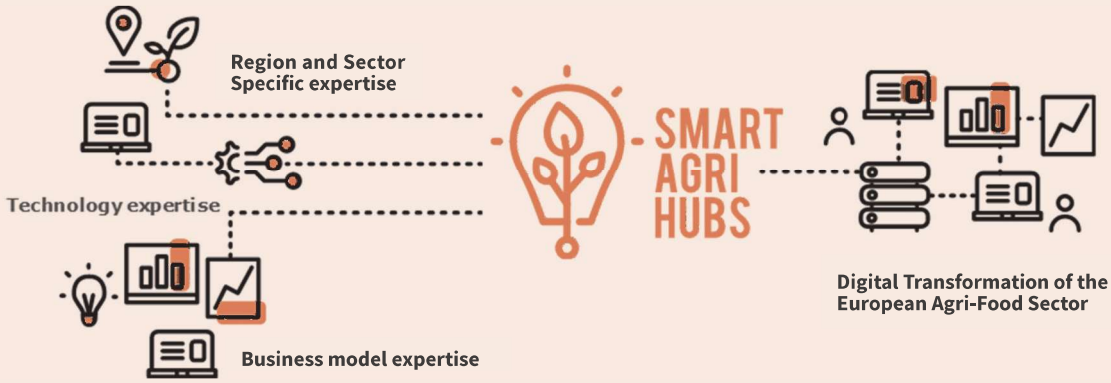
However, sometimes it seems that everybody is busy with Digital Agriculture, except the farmer. Despite the overwhelming interest of tech companies, investors, and policymakers, the adoption rate of Digital Agriculture is still limited. In most EU member states, and Portugal is a good example, there is a consistent but small group of farmers that are frontrunners in this field, which are often seen as role models for other farmers. In fact, the majority of farmers does not yet adopt digital technologies or only invests in proven and tangible technologies such as auto-steering tractors or milking robots.

The current impact of digitization in agriculture is thus way below its true potential. Main reasons for this are the current fragmentation of knowledge and technology expertise in the proximity of farms, and the lack of promising business cases for farmers and business models for the technology providers. At the same time, it should be acknowledged that – unlike other industries – farming is more subject to sector- and region-specific conditions. Another barrier is the fragmentation and misalignment between the various types of public and private funding.

To overcome these challenges the EU H2020 project SmartAgriHubs will build-up a pan-European network of Digital Innovation Hubs (DIHs), fostering a broad digital transformation in the agri-food domain. SmartAgriHubs will leverage, strengthen and connect local DIHs, connected with Competence Centres (CCs). This ecosystem of ecosystems combines the various expertise that is needed to unleash the potential of digital solutions and realize the digital transformation of the agricultural sector in Europe (Figure 1)

A key success factor is that SmartAgriHubs is building on an extensive European network of existing DIHs and CCs. The SmartAgriHubs consortium has brought these DIHs and CCs together, because the core project partners are deeply rooted in the agri-food and ICT community, working on digitizing agriculture already for many years. It started off in the EU's Future Internet program with a platform and market place of digital solutions, powered by the FIWARE foundation (www.fiware.org). There were also several accelerator programs (e.g. SmartAgriFood, FInish, FRACTALS, KATANA), building up a vast network of start-ups, SMEs, service providers, technology experts and end-users. And more recently, this was all leveraged through the Internet of Food and Farm 2020 (IoF2020; www.IoF2020.eu), one of the flagship Internet of Things projects in Europe.

Figure 1 - SmartAgriHubs brings together different expertise for a digital transformation of the European Agri-Food sector



SmartAgriHubs has used the IoF2020 ecosystem as a springboard to unite a unique pan-European ecosystem of DIHs and CCs. SmartAgriHubs also relies very much on the Smart Specialization Strategies (RIS3). Several core partners are part of RIS3 thematic partnerships such as Big Data and Traceability, High-Tech Farming and Smart Sensor Systems 4 Agri-Food. The ambition is to consolidate, extend and strengthen the sustainability of this ecosystem in order to boost the digital transformation of the agri-food sector. This enormous challenge requires an inclusive approach involving every region and all relevant players in Europe.

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2. The main objectives of SmartAgriHubs

The main aim of the SmartAgriHubs project is to consolidate and foster a European-wide network of Digital Innovation Hubs for Agriculture, to enhance the Digital Transformation for Sustainable Farming and Food Production. This overall aim will be achieved by accomplishing the following specific objectives:

1. Build a network of Digital Innovation Hubs, covering all regions in Europe and ensuring a broad coverage in terms of relevant players and technological, business and sector expertise.

2. Support a critical mass of dedicated pan-European "Innovation Experiments" that bring together the farming sector and technology suppliers.

3. Provide structural financial support to third parties through open calls supported by European and regional public and private funds.

4. Ensure the long-term sustainability of the network, including a business plan for the DIHs, to attract investors and address the needs of the farming sector.

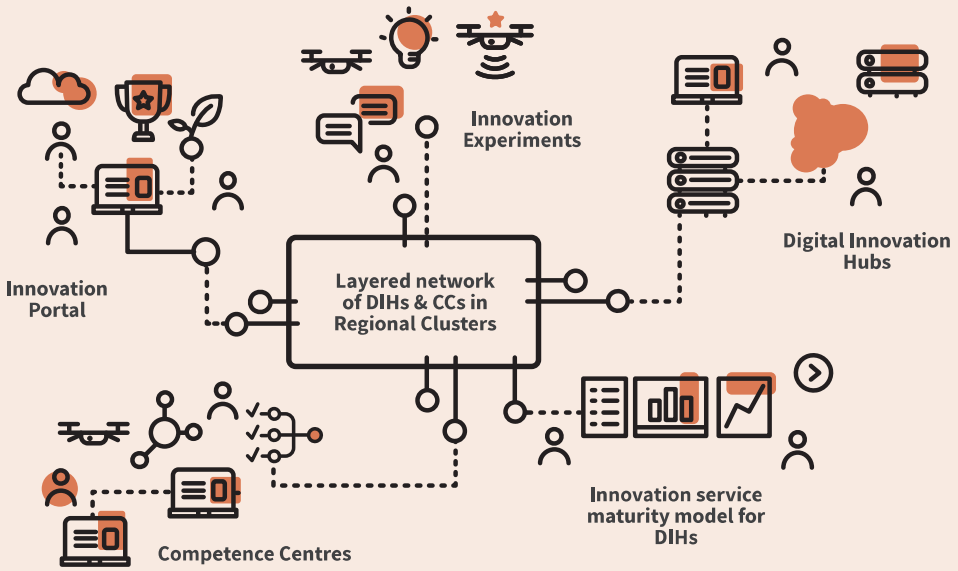
5. Enable and promote the expansion of the DIHs by including new DIHs/CCs in the network and through capacity building measures, ensuring that DIHs reach their full innovation-accelerating potential.

3. New concepts to achieve the digital transformation of agriculture

SmartAgriHubs builds a strong, multi-layered network of agricultural Digital Innovation Hubs (DIHs) and Competence Centres (CCs), to exchange knowledge and create a pan-European market for digital solutions for farming and food production (Figure 2). These will be coordinated by nine European Regional Clusters (RCs) and managed at the European level. As indicated in the figure, the SmartAgriHubs network combines five basic concepts that are based on validated methodologies and models:

(i) Competence Centres (CCs) form the cornerstone for DIHs, where expertise, infrastructures, etc. are available

Figure 2 – The 5 basic concepts to build up a multi-layered pan-European network of DIHs



(ii) Digital Innovation Hubs (DIHs), through which the competences are matched with demands, ideas, funding, etc. and orchestrated and supported by concrete services to translate this interaction into…

(iii) Innovation Experiments (IEs), in which ideas, concepts, prototypes, etc. are further developed, tested and finally introduced into the market.

(iv) Innovation Services Maturity Model (ISSM) will monitor, assess and help the DIHs' innovation services to reach their desired level.

(v) Innovation Portal as a searchable register for knowledge exchange, brokerage, etc.

The next paragraphs will explain in more detail how these building blocks will build up the network.

Competence Centres

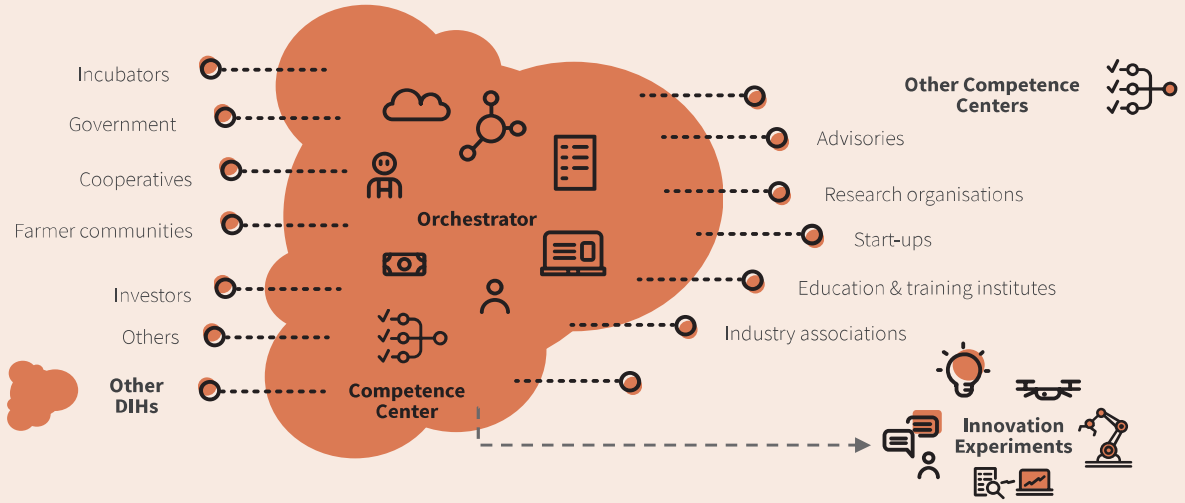
The core of a DIH is formed by one or multiple CCs, which provide advanced technical expertise and facilities (labs, infrastructures, pilot lines for production, etc.). They cooperate within the DIHs with the necessary partners in the innovation chain to support businesses in their digital transformation. This includes the connection to investors, business developers and legal experts, next to the technical expertise. No single competence centre can be excellent in all fields. Hence, it is necessary to build strong links between CCs (within and between hubs), with complementary competences, offering a one-stop-shop for digital transformation. SmartAgriHubs will establish a pan-European network of excellence of digital competence centres associated with DIHs. CCs may be local or external, providing technologies and solutions not available in a certain region. A CC catalogue will also be created to provide easy access to innovative knowledge and technologies and testing and validation infrastructures.

Digital Innovation Hubs

A Digital Innovation Hub refers to an ecosystem through which any business can get access to the latest knowledge, expertise and technology to test and experiment with digital technology relevant to its products, processes, or business models. The DIH also provides the connections with investors, facilitates access to financing and helps to connect users and suppliers of digital solutions across the value chain (Figure 3).

Such an ecosystem will accelerate digital innovation, because it makes the connection between technology, business, and the market. A DIH offers all required innovation services acquiring full representation of the local ecosystem. In SmartAgriHubs the focus is on agricultural

Figura 3 – O Polo de Inovação Digital como o maestro que liga os vários intervenientes



DIHs, although DIHs can also target multiple industries or sectors. At the project's start already 140 DIHs were identified, covering all 28 EU member states. The project will ensure that all DIHs have the capacity to develop and deliver an adequate portfolio of relevant and applicable innovation services for end-users, such as farmers, advisors, SMEs and start-ups (Table 1).

Innovation Experiments

Innovation Experiments (IEs) are conducted through DIHs, enabling access to the latest knowledge, expertise and technology (through CCs) for any business, by testing and experimenting digital innovations relevant to its products, processes or business models. IEs will play a

Table 1 – Categorized services and examples of activities of a Digital Innovation Hub

	Service	Examples of activities
	Community building	Scouting, brokerage, awareness creation, dissemination
	Strategy development	Market intelligence, market assessments, roadmapping
	Ecosystem learning	Workshops, seminars to share knowledge and experience
	Project development	Identification of opportunities, creating consortia, proposal development
	Lobbying	Representing interests at meetings and conferences, organizing country visits
Technology	Technical support on scale-up	Concept validation, prototyping, small series production
Technology	Provision of technology infrastructure	Renting equipment, low-rate commercial production, offering platform technology infrastructure
Technology	Testing and validation	Certification, product demonstration, product qualification
Technology	Strategic RDI	Joint, pre-competitive R&D
Technology	Contract research	Specific R&D, technology concept development, proof of concept
	Incubator/accelerator support	Voice of customer, market assessment, business development, consortia building, offering location
	Access to finance	Financial engineering, connection to funding sources, investment plans
	Skills and education	Courses, workshops, offering technological infrastructure for educational purposes

crucial role in the network expansion of SmartAgriHubs, strengthening the network of DIHs and CCs in numbers and quality of services. Before the beginning of the project, SmartAgriHubs has identified a critical mass of dedicated, pan-European "Flagship Innovation Experiments" (FIEs) through its network of regional cluster leaders. In total 28 IEs were selected, based on criteria such as innovation potential, bringing together end-users or having the capacity to develop/improve DIH services. These FIEs, including two in Portugal, are already under development (Table 2).

Table 2 – Overview of the current Flagship Innovation Experiments [1]

No	Regional Cluster (RC	No	Title	Countries involved	Sector
1	UK & Ireland	1	Farm Sustainability Audit	IE, CH	Livestock
		2	Sustainability tool for remote assessment and management of farmland – STREAM	IE	Livestock
2	Scandinavia	3	Digitising farm machinery produced by SMEs	DK, SE, FI	Arable
		4	Adopting digital technologies by farmers	DK, SE, FI	Livestock
		5	Digital tools and knowhow for valued grain chain	DK, SE, FI	Arable
3	France	6	Co-creation of value and innovations in horticulture - AgriFarmLab	FR	Vegetables
		7	Information system and DSS tool for cereals cultivation - Digi-PILOTE	FR	Arable
		8	Decision support tool for digifarmers - STRATE-GEEK	FR	Arable
4	North West Europe	9	Deep learning and hyperspectral imaging -AI4AGRICULTURE	BE	Vegetables
		10	Smart data use on arable farms – Farmcube	NL, BE, DE	Arable
		11	Pig health assessment based on sensors - SmartPigHealth	DE	Livestock
		12	Improving responsibility in livestock production - DIG-ITfarm	BE, ES, DK	Livestock
		13	Ammonia Emission Monitoring Network –AEMON	BE, NL	Livestock
5	Central Europe	14	Mower-robot for Vineyards	AT	Fruits
		15	Precision Farming on small-scale farms	AT	Arable
6	North East Europe	16	E-services using drones for quantity buyers	PL	Fruits
		17	On-line DSS for optimizing fertilisers - PULS for fertilizers	PL, NL	Vegetables
		18	Autonomous Greenhouses – smart micro farming and smart large-scale production	PL, GB, ES, SI	Vegetables
		19	Bee Monitoring and behaviour prediction	LV	Livestock
		20	Ground Water and Meteo sensors experimentation	LV, CZ, CH	Arable
7	Iberia	21	Sensoring and AI algorithms for early crop disease detection – SAIA	PT, ES	Fruits
		22	Iberian Irrigation Portal	PT, ES	Arable
		23	Data-Intensive Dairy Production	ES	Livestock
8	Italy	24	Implementation of ICT in aquaculture - AquacultuER4.0	IT	Aquaculture
		25	Data driven and precision-based management in vineyards – VINPREC	IT	Fruits
9	South East Europe	26	Digitizing Leafy Vegetables	GR	Vegetables
		27	Animal Identification with IoT	RO	Livestock
		28	Decentralised trust in agri-food supply chain	SI, SRB	Livestock

[1] More information can be obtained at www.smartagrihubs.eu/flagship-innovation-experiments

Innovation Services Maturity Model

The pivotal role of the DIH in the innovation ecosystem is expressed by its added value in advancing and directing innovations by engaging the relevant ecosystem actors and providing innovation services. These services add value to innovation experiments, such as organizing testing and validation. To achieve self-sustainability of DIHs, it is necessary to professionalize these services as if they were a business. To that end, SmartAgriHubs has developed an Innovation Services Maturity Model (ISMM) – inspired by IT capability maturity models – to assess, monitor and improve the DIH's services.

The proposed list of services (presented before in Table 1) represents the core innovation services that a DIH needs in order to be valuable to the ecosystem. The services are typically directed at "users" in innovation projects, but also include services to manage a DIH 'as a business'. A well-functioning DIH is also capable of sourcing from (and adding to) the network of DIHs and CCs.

The Innovation Services Maturity Model (ISMM) helps DIHs to identify areas of attention and allows the community of DIHs to structure and share knowledge more efficiently. The tools will be made available through the SmartAgriHubs Innovation Portal. The list of capabilities is open for adding new ones if desired by the community.

Innovation Portal

The SmartAgriHubs' Innovation Portal is a web-based interactive platform and a key instrument to support the ecosystem building at DIH, regional and pan-European level. The aim of the innovation portal is to:

(i) Support knowledge exchange. For the partners in the DIHs, CCs, RCs and IEs it will serve as an interactive marketplace to exchange results, learnings and best practices.

(ii) Help partners with capacity building. Provide templates, guidelines, how-to documents and trainings in an easy to search library.

(iii) Help partners to find each other. Existing databases, such as the inventory of Digital Innovation Hubs of the Smart Specialisation Platform, will be used as a basis for the address book.

(iv) Inform partners on relevant events with an up-to-date events calendar.

(v) Showcase the project as a whole to a wider audience.

The Innovation Portal will thus play a crucial, central role in building the network of DIHs and the ecosystems around them.

4. A pathway for a digitised future in agriculture

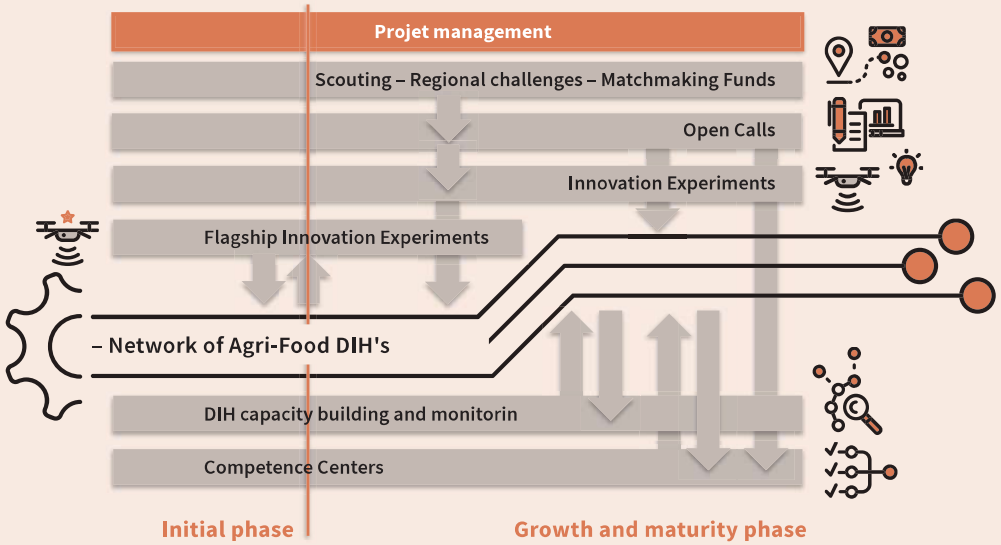
Based on the concepts and building blocks that have been presented, SmartAgriHubs embraces a demand-driven growth methodology in which end-users from the agri-food sector are driving the growth of the DIHs network through Innovation Experiments (IEs). The process does not start off from scratch but build on a large existing network and ecosystem. Table 3 provides the main KPIs that substantiate SmartAgriHubs' growth strategy..

Table 3 – Main Key Performance Indicators (KPIs) for SmartAgriHubs' growth strategy

Key Performance Indicator	Initial value (at the application of the project)	Target value (at the end of the project)
Number of Ag DIHs in Europe	140	400
Number of IEs in the project	28	98
Funding for IEs (public + private)	8 M€	38 M€
Number of CCs involved	42	2000

Figure 4 provides a schematic presentation of the methodology to build the network of DIHs and the SmartAgriHubs ecosystem. In the initial phase, the present set of DIHs, CCs and FIEs will be consolidated, providing lessons, role models, and best practices. This will be used for the next phase, which will identify new IEs, DIHs and CCs, through regional scouting, organizing challenges and searching for additional funds for open calls (to fund more IEs). These open calls will combine different types of funding (public/private, EU/regional structural funds, etc.) depending on the specific context and the needs of IEs. In both phases the DIHs will be monitored and supported, connecting them with CCs, and increasing their maturity level using the ISMM. In this way, a vibrant ecosystem - with the network of agricultural DIHs as a kernel - will be established, which will live after the project.

Figure 4 – SmartAgriHubs approach to build the ecosystem around the network of Ag DIHs



5. Regional Cluster approach – the Iberian Cluster

SmartAgriHubs is using a regional cluster approach, where each cluster represents a group of DIHs and Competence Centres (CCs) within a specific European region. This provides a pan-European coverage and will intensify outreach of technological transformation. The FIEs are also integrated in these 9 regional clusters: UK & Ireland, Scandinavia (Sweden, Norway, Finland, Denmark), France, North West Europe (Germany, Belgium, The Netherlands), Central Europe (Austria, Czech Republic, Swiss, Slovakia, Hungary), North East Europe (Poland, Baltic countries), Iberia (Spain, Portugal), Italy and South-East Europe (Greece, Balkan countries).

The Regional Clusters (RC) will identify and maintain a list of all DIHs in each region and periodically collect basic information for each DIH. Furthermore, they will contact DIHs collecting ideas for monitoring the IEs in the region and monitoring the region for funding schemes that might offer opportunities for leverage the SmartAgriHubs Open Calls.

The Iberian Regional Cluster is coordinated by CAPDER[2], in Spain, and by CONSULAI[3], in Portugal, and aims to bring together different actors from the region's agrifood sector. In this way, the Iberian Regional Cluster will form a network consisting of leading digital innovation organizations, integrated in the Portuguese and Spanish DIHs, that will synergize and, ultimately, create real digital solutions for farmers all around Portugal and Spain. What is more, in line with this regional approach, the Iberian Regional Cluster will bring together DIHs and FIEs in such a way that synergies among the 21 DIHs and the 3 FIEs in Portugal and Spain will arise, also allowing a real and direct transfer of FIEs results to DIHs.

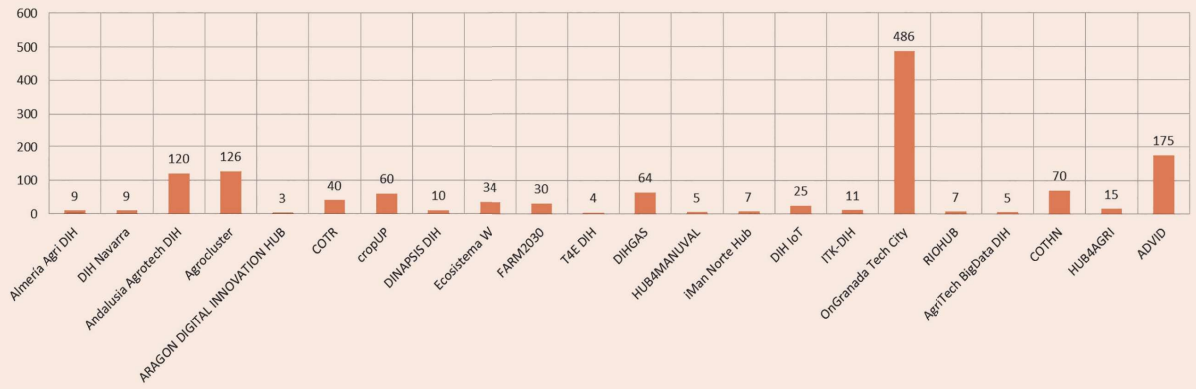
Table 4 – Distribution of DIHs within the Iberian Regional Cluster

Espanha	Andaluzia	4
	Navarra	1
	Aragão	1
	Comunidade Valenciana	2
	Extremadura	2
	Galiza	1
	Castela Leão	1
	La Rioja	1
	Catalunha	1
Total Espanha		**14**
Portugal	Alentejo	2
	Beja	1
	Lisboa	1
	Norte de Portugal	1
	Nacional	1
	Douro	1
Total Portugal		**7**
Total Ibéria		**21**

[2] Consejería de Agricultura, Ganaderia, Pesca y Desarrollo Sostenible - Regional Ministry of Agriculture, Livestock, Fisheries and Sustainable Development of Andalusia

[3] www.consulai.com

Table 5 – Number of actors per DIH in SmartAgriHubs within the Iberian Regional Cluster (1 315)



Also remarkable is the huge number of actors coming from the agrifood sector, both in Portugal and Spain. There are more than 1 300 entities linked to the project through the participation of the DIHs, a number that is expected to increase throughout its development.

Within SmartAgriHubs, Portugal already counts 7 active Digital Innovation Hubs that manage to cover all main agri-food sectors. These DIHs are responsible for some of the country's latest digital solutions, which are being deployed in the field to farmers. By having a well-established network of Competence Centres, end-users, technology developers, and financing partners, these DIHs manage to identify limiting factors, come up with digital solutions and implement them in their respective areas of specialization.

Portugal has two Flagship Innovation Experiments selected for funding in the initial project application. The first is SAIA – Sensoring and AI Algorithms for early detection of crop disease symptoms, a cross-border FIE, that is led by Tekever and co-led by the Spanish company ec2ce, which aims to detect disease symptoms, as well as insects and weeds that limit production for crops such as olives, wine grapes and cork trees. In order to achieve this, SAIA has the support of 8 Iberian DIHs/CCs, as well as 3 other project members. The second FIE focuses on irrigation and water management, and is coordinated by a Spanish company (Hispatec), but has several Portuguese partners involved.

6. Conclusion

Digital technologies enable a transformation into data-driven, intelligent, agile and autonomous farm operations, and are generally considered as a key to address the grand challenges for agriculture. Recent initiatives showed the eagerness of the sector to seize the opportunities offered by ICT and, in particular, data-oriented technologies. However, current available applications are still fragmented and mainly used by a small group of early adopters. Against this background, SmartAgriHubs has the potential to be a real game changer in the adoption of digital solutions by the farming sector.

SmartAgriHubs will leverage, strengthen and connect local DIHs and Competence Centres (CCs) throughout Europe. The project has already put together a large initial network of 140 DIHs, by building on existing projects and ecosystems such as Internet of Food and Farm (IoF2020). The DIHs are aligned within 9 regional clusters, which are led by organizations that are closely related to national or regional digitization initiatives and funds. In Portugal, the regional cluster is led by CONSULAI, an advisory company with more than 1000 clients in the farming sector, and with a long experience in working together with farmers in their innovation processes.

DIHs will be empowered and supported in their development, to be able to carry out high-performance Innovation Experiments (IEs). SmartAgriHubs already identified 28 Flagship Innovation Experiments (FIEs), which are examples of outstanding, innovative and successful technology projects, where ideas, concepts and prototypes are further developed and will be introduced into the market. Two of these FIEs are being developed with Portuguese partners. SmartAgriHubs uses a multi-actor approach based on a vast network of start-ups, SMEs, business and service providers, technology experts and

end-users. End-users from the agri-food sector are at the heart of the project and the driving force of the digital transformation. For many years ahead, SmartAgriHubs will be connecting the dots to unleash the innovation potential for digital transformation of the European agri-food sector.

SmartAgriHubs in numbers

Ecosystem

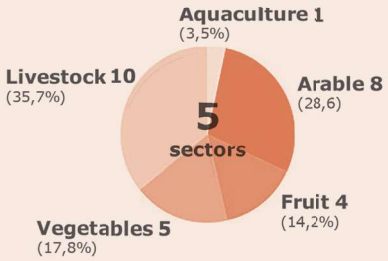
108 Partners
Involved covering all EU
68 partners are SMEs
54% of budget allocated to SMEs

Digital Innovation hubs

140 DIHs in the existing Network covering all **28 Member States**
Regional Approach
9 Regional Clusters
Attract **260 New DIHs**

Flagship innovation experiments

28 FIEs
22 Countries involved
13 Cross-border collaboration FIEs (47%)



Impact

30M additional funding
Mobilized from other sources(public, regional, national and private)
80 new digital solutions
Introduced into the market
2M Farms involved in digitisation

Open Calls

6M Euros distributed through Open Calls
75% Open Call budget to SMEs
70 New Innovation Experiments