

Feeding future generations

How finance can boost
innovation in agri-food



European
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Prepared for:
The European Commission

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Forewords

Vice President Andrew McDowell

European Investment Bank

The agri-food sector concerns all of us. It is linked to many UN Sustainable Development Goals, such as hunger and nutrition, climate change, biodiversity, and jobs and economic growth. The strength of the local agri-food sector also heavily influences the socio-economic fabric of many towns and communities.

Powered by the European Fund for Strategic Investments and InnovFin, the EIB provided over €32 billion in financing to agriculture and the bioeconomy from 2014 to 2018. In view of the environmental, economic and societal value of these sectors, we must make more ambitious investments in agricultural innovation to meet future demands.

I congratulate the European Commission and the European Investment Bank's Advisory Services for developing this study. I welcome its findings and recommendations. The study highlights the need for more and better-tailored finance, and for a new focus on innovation across the sector to fully exploit the opportunities and ensure there is enough food for growing populations while safeguarding our planet. It also makes it clear that we urgently need to address slow growth, fragmentation, risk aversion, low levels of innovation spending and the limited uptake of new technologies.

The report provides a clear basis for more EU support to mobilise funding, mainly for innovative companies in the European agri-food sector. Not only do we have to focus on innovation in the sector, but we also need to innovate in the way we finance the sector. Promising developments like crowdfunding, mini-bonds and advanced risk sharing can offer more financing to innovators and farmers.

The report complements the Bank's *fi-compass* platform activities for the agricultural sector. This platform aims to understand the structure of the EU financial markets and understand agricultural enterprises and farmers' needs in terms of finance. In this context, we recently announced a new EIB lending facility with the Directorate-General for Agriculture and Rural Development to support the agriculture and bioeconomy sector, including a package for young farmers. We believe that the current study will further enhance the existing support measures in the sector and contribute to new ones.

With the European Commission's excellent support, the EIB is committed to mobilising technical expertise and financial firepower to help boost innovation in agriculture. We owe it to future generations!

Director-General Jean-Eric Paquet

European Commission, DG Research and Innovation

Our current food system is not fit for the future. Many farm practices are not sustainable, a lot of the food we eat – and the huge amounts we waste – is not healthy for us or for our planet. Scientists and European Union citizens urge us to transform our food system towards sustainability and guarantee food security and health for the next generations, to remain competitive, support the jobs of the millions of Europeans making a living along the food system and to sustain Europe's rich and diverse food culture.

Research and innovation are key drivers of the transition to a future-proof, sustainable, healthy, resilient, climate-neutral, and inclusive food system, as promoted through the European Commission's FOOD 2030 initiative. This is why the European Commission proposed to spend €10 billion in its next Research Framework Programme – Horizon Europe – on **food, bioeconomy, natural resources, agriculture and environment**. This will deliver breakthroughs and new opportunities for the actors in our food system, and for society as a whole.

Developing research, innovation and potential solutions in itself is not enough. We have to make sure that they reach the market, realise the social and ecological innovations in practice, and that the possibilities and the capacities of farmers and small and medium-size enterprises (SMEs) to innovate and take risks are enhanced. Strengthening synergies of Horizon Europe with other Union Programmes such as the Common Agricultural Policy, European Regional and Development Funds or the instruments of the European Institute of Innovation and Technology (in particular the Knowledge and Innovation Communities on Climate and Food) will play a major role in strengthening the support for these actors in the years to come. The European Innovation Council pilot also provides opportunities for SMEs and start-ups developing innovations in the food system, be it digital technologies, new proteins or production methods.

Financing beyond the start-up phase will have a strong role in creating the new players that will drive a sustainable food system. In order to support European agri-food innovators, we need to identify potential financing gaps, challenges and constraints that farmers and SMEs face when accessing funding for their projects and we need to explore the best ways to address these barriers.

Therefore, I welcome this timely study from the European Investment Bank and its recommendations. It sets out concrete ideas, including more tailored and creative approaches, for improving access to finance and for mobilising private capital for innovators wishing to scale-up their business across Europe's food systems. The European Commission shall consider these recommendations, especially when designing the financial instruments for the next multiannual financial framework. I thank the European Investment Bank for this insight and look forward to exploring these ideas.

Executive Summary

A new approach to food production

To make sure our production of food is prepared for the future, we need more innovation in the agri-food sector and we must reap the full potential of existing and new technologies. As this study will explain, we also need creative and ambitious financing on various levels.

Agri-food and the UN Sustainable Development Goals

The agri-food sector contributes significantly to the UN Sustainable Development Goals. Many of these goals are directly connected to the agri-food value chain, such as hunger, nutrition, global partnerships, jobs and economic growth. To nourish the 815 million people who are hungry around the world and the 2 billion extra people expected to be undernourished by 2050, investments in agriculture and food production are crucial. Such investments will increase productivity and create more sustainable food production systems.

The timetable for the UN goals, known as the Sustainable Development Goals (SDGs), is similar to the timeline for the European Commission's FOOD 2030 initiative, which emphasises the importance of research to create more sustainable, circular, inclusive, competitive and healthy food systems. The initiative calls for a better approach to innovation that deploys solutions for key issues such as food waste, which equals 20% of EU production. The initiative also calls for coherent policy actions that go beyond funding for research and development.

Figure 1: Contribution of the agri-food sector to the UN SDGs



Complex challenges

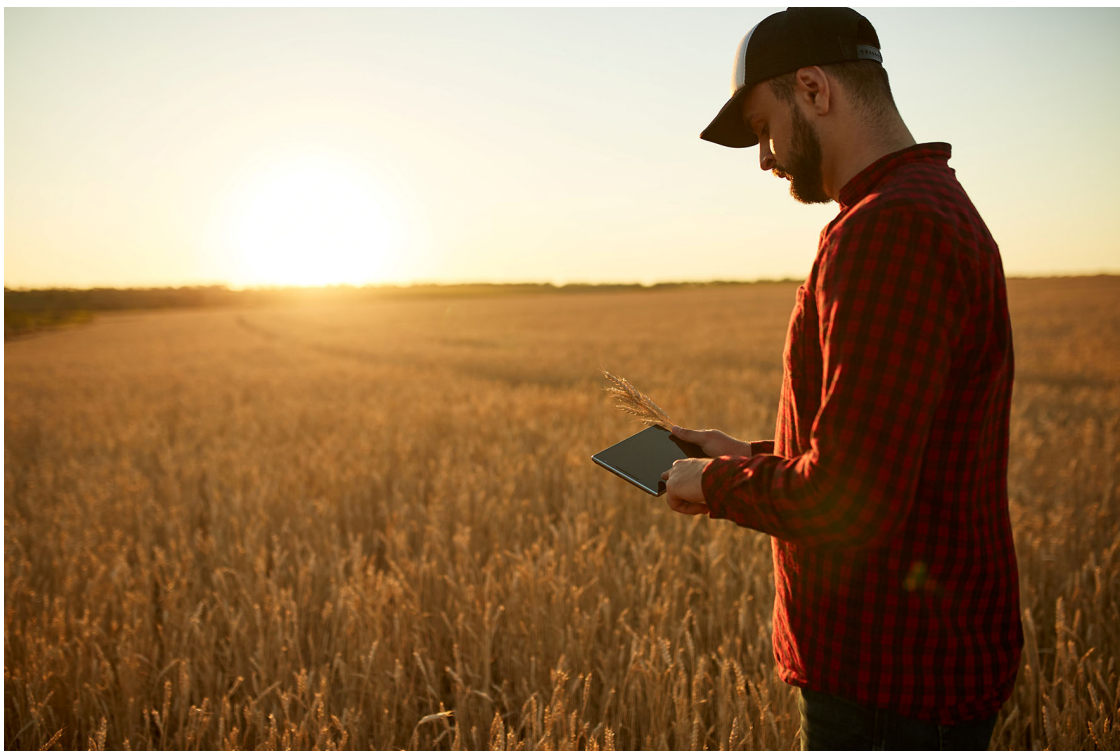
The agri-food sector is a strategic part of the European economy, but it faces many complex challenges. The sector's revenues of about €1.45 trillion are equal to 9% of the EU's gross domestic product and represent over 15% of Europe's manufacturing industry. Over 15 million people in the EU have agri-food jobs. The sector is a key driver of employment, particularly in peripheral or structurally disadvantaged regions of Europe. The EU is the world's largest exporter of agri-food products, amounting to over 17% of the EU's exports and generating a trade surplus of almost €30 billion.

However, the European agri-food sector is facing challenges regarding growth, fragmentation, low innovation spending and the slow uptake of new technologies. In addition, there are the bigger societal challenges like demographic growth, competition for resources and climate change. At an average annual growth rate of 0.7% over the period of 2008-2017, total sales of the European food and drink sector have underperformed the growth rates in the US (1.6%) and China (10.8%). More than 99% of the companies in the sector are small businesses, which makes it hard to realise economies of scale, to be competitive on the global agri-food market and to take advantage of innovations.

Low participation in innovation

The sector's total annual private investment R&D of €3 billion is significantly lower than that of other key areas of the European economy, like the health sector, at €41 billion, or the information technology sector, at €34.3 billion. Less than 50% of all agri-food companies in the EU undertook innovation activities over the past three years, while only 9% innovated in core areas such as technology, products and processes. Demand for food is projected to increase by 98% by 2050, while the situation of available arable land and other natural resources is expected to remain unchanged or even deteriorate – creating a big demand for innovation across the entire food system. There is a lot of potential in the sector for invention by using a new set of digitalisation-driven technologies in areas such as precision farming, sustainable packaging and blockchain-based food tracing.

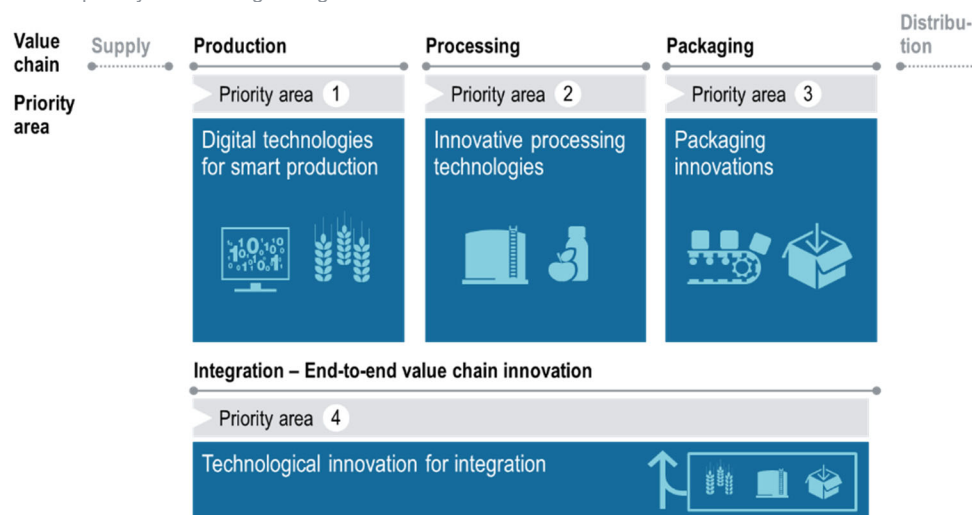
Innovation in the agri-food value chain is hard. Businesses in the agri-food sector are interdependent and generally compete more on price than on quality, innovation or environmental impact. Price competition, in combination with low margins and long payback periods, limits the appetite and possibilities for innovation and risk-taking. This also reduces the financing of agri-food innovation.



A study on R&D and innovation financing

The main objective of this study is to explore the financing practices of R&D and innovation in the European agri-food sector. The sector comprises agricultural production, food processing and food packaging. We want to identify areas where there is not enough financing and explore how better government policy can address these gaps. The study focused on four groups of high-impact innovations (as illustrated below).

Figure 2: Selected priority areas along the agri-food value chain



- Digital technologies for smart production can make agri-food production more efficient and sustainable by reducing the use of fertilisers and chemicals to protect crops.
- Innovative processing technologies are important for adapting to changing consumer demands and enhancing the efficiency of food manufacturing.
- Packaging innovations can reduce waste with biodegradable materials and new contact materials that increase the shelf life of food.
- Technological innovation for integration can optimise the use of resources and improve transparency by linking data from different segments along the agri-food value chain.

VOICES FROM THE SECTOR

"For our business, seasonality in terms of harvest cycles and consumer demand is a major factor. Our customers have to pay for our services early in the season, but mostly generate profit only at the end of the season." – CEO of a company offering digital technologies for integration along the value chain

"Farmers are quite conservative. In our experience, they do not invest much per year and are quite risk-averse. Hence, it is key to convince the farmer of the added value. Furthermore, data handling is crucial." – CEO of an innovative agri-tech company

"Digitalisation can increase consumer trust by ensuring transparency along the whole agri-food value chain." – Founder of a company developing innovative technologies for food processing

The study involved 40 interviews with agri-food innovators, technology-driven start-ups, innovative small businesses, and mid-cap or established innovators. We also interviewed 20 agri-food financiers from commercial and public banks, and from the fields of private equity and corporate venture capital. About 50 national and international good practices were screened and two workshops took place with sector experts, intermediaries (federations, research centres) and policy makers.

Ten key findings

Demand for new financing tools in the agri-food sector has steadily increased since the reform of the EU Common Agricultural Policy in 2013 and the shift towards the abolition of production and market support mechanisms. Institutions such as the European Investment Bank already offer a wide range of financial instruments to the sector, including loans, equity products, advisory services for national and regional governments, and guarantees.

The study confirmed the broader rationale behind these instruments, showing that there are barriers and opportunities. However, the study also highlights the need for more tailored and creative approaches to financing for the development and uptake of exciting new (e.g. digital) technologies. As the EU debates its next long-term budget, known as the Multiannual Financial Framework, the study's insights are timely.

The key messages of this study are:

- 1) The agri-food sector is predominantly risk-averse and cautious
- 2) There is a lot of potential for digital, data-driven solutions
- 3) Financing is complex and dominated by specialised investors and financiers

Here are the 10 key findings of the study:

Key finding		In detail
A predominantly risk-averse and cautious sector		
1	Risk-averse and cautious segment of the European economy	<ul style="list-style-type: none"> • This is mainly driven by consumer demand for safe and attractive food products, but also economic parameters like high cash flow cyclicality (resulting from long harvest cycles, seasonality and market volatility) and strong price competition • Prudence towards innovation and slow innovation uptake in the agri-food sector is not caused by scepticism, but appears to be a rational phenomenon related to the specific market characteristics
2	There is a significant "barrier" preventing most agri-food producers from adopting new technologies	<ul style="list-style-type: none"> • About 75% of the agri-food innovation developers interviewed agreed that the European agri-food sector is conservative in the uptake of new technologies • High reliance on tried-and-tested practices and little professional exposure to IT-based innovation (generational issue) • Innovation is typically incremental rather than transformational
Digital, data-driven solutions have strong potential for disruptive innovation in the agri-food sector		
3	Digitalisation, consumer health and sustainability are key drivers	<ul style="list-style-type: none"> • Digital, data-driven solutions like big data applications and data analytics, drones, robotics and automation have strong disruptive potential in agri-food production • Potential to transform food systems, strengthen cooperation along the value chain, lower costs to scale and accelerate innovation, and increase sustainability
4	Innovation is most intensively driven by highly agile, small agri-food innovation developers	<ul style="list-style-type: none"> • About 67% of the agri-food innovators interviewed during the study that develop data-driven innovations have revenues below €1 million • Larger, well-capitalised industry players tend to take up these innovations through open, collaborative platforms and other knowledge-transfer approaches, like field labs, innovation hubs and other open innovation activities

5	Also in food processing and packaging, incremental innovation is prominent	<ul style="list-style-type: none"> • Development and production of new food ingredients is a promising and growing subsector • In packaging, bio-based and biodegradable materials are a key area of innovation activity • Both sectors are highly driven by cost and heavily asset-based, with a reluctance to invest in disruptive innovation
6	Data-driven technologies and services are key innovations for integration along the value chain	<ul style="list-style-type: none"> • Technologies like blockchain-based smart monitoring systems aim at increasing supply chain transparency by allowing the product to be traced back to the specific farm • Importance of fair rules on data ownership and data protection in order to encourage data-sharing
Fragmented and complex funding landscape dominated by specialised investors and financiers		
7	The European funding landscape is fragmented and highly complex	<ul style="list-style-type: none"> • A wide range of financing instruments is available at European, national and regional levels; applicants need to meet widely differing conditions • Small-scale post-start-up agri-food innovators mostly have trouble navigating Europe's multilevel financing and funding landscape • Market participants stress that supply does not meet the market's demand in an effective way. To match US agri-food financing, over €20 billion of additional financial investments per year would be needed
8	Importance of specialisation and sector experience; only few equity investors have so far entered the market	<ul style="list-style-type: none"> • Lenders and investors in the agri-food market need to be highly knowledgeable of the sector and must be able to provide "patient capital" • Margins in agri-food production and processing are typically low and innovation cycles are long (below average ROI/EBITDA margins) • The average holding period of a venture capital fund in the agri-food sector is about nine years, while the overall market average is six years
9	Finance needs to go hand in hand with knowledge	<ul style="list-style-type: none"> • Small-scale innovators in the agri-food sector are primarily looking for "intelligent money" from equity investors, especially in the early stages • They are specifically looking for investors with industry knowledge and relevant networks – only a few of which are active in Europe
10	Obtaining finance for growth is a key challenge	<ul style="list-style-type: none"> • The most frequently mentioned reason that finance was not obtained was an unclear or unproven business model. Other reasons were poor commercial outlook, limited financial track record and regulatory uncertainty • A visible financing gap exists regarding the scale-up of smaller agri-food innovators that earn €250,000 to €5 million per year • The agri-food innovators that reported difficulties in accessing finance were looking for loans of €250,000 to €1.5 million

CASE STUDY: AGRIVI – FARM MANAGEMENT SOFTWARE

- Founded in 2013 in Croatia as a Europe-based farming software company employing big data algorithms for farm management
- Team of agricultural experts and software engineers with farming background and a staff of about 32
- Financing of the company is ensured by private angel investors and Southern Central Ventures
- Customers are farmers of all scales in 150 countries
- Honoured by Barclays as a top 10 high-growth company in UK

Agrivi says, "Our software lets you plan, monitor and analyse all activities on your farm easily. Tillage, planting, spraying, fertilisation, irrigation, harvesting and all other activities are managed with a few clicks." Agrivi employs big data algorithms to analyse and visualise farm data in a farmer-friendly manner. This means that elements like graphics or tables are developed from a farmer's perspective. In the area of existing farm management software, Agrivi is one of the few providers that are transparent about data ownership. Farmers decide for themselves on the distribution of their data.

Agrivi's software builds on existing farm data, which can either be supported manually by the farmer or collected through existing farm sensors. In the case of field treatments, the software compares the farmer's current situation (soil fertility, weather forecast, etc.) with similar situations in the past and recommends the input combination that will achieve the best yield overall. This way, a large and constantly growing data pool analysed by big data algorithms enables Agrivi to



Five recommendations

The study makes five recommendations aimed at improving access to finance for innovative agri-food companies. Three recommendations address access to finance, and two focus on the broader environment.

VOICES FROM THE SECTOR

"In the agri-business, you can forget about the revenue in the business plan: the price depends on global markets and the quantity on the weather. What you can look at is the margin. Except if you have a company that sells branded products." – Head of debt financing of a large cooperative bank

"You need to be patient if you want to invest in the agri-food sector. Being a successful investor in agri-food is more difficult than in other sectors." – Managing Director of a venture capital fund

The recommendations are:

ACCESS TO FINANCE

STRENGTHEN CROWDFUNDING TO FINANCE AGRI-FOOD INNOVATIONS

- 1 Development of new and/or strengthening of existing crowd lending platforms (crowdfunding) dedicated to the financing of agri-food innovators

FACILITATE ACCESS TO RISK BEARING/PATIENT CAPITAL FOR INNOVATORS

- 2 Enable the issuance and securitisation of mini-bonds to share risks and unlock investments for the adoption of agri-food innovations

EXPLORE THE DEVELOPMENT OF A DEDICATED RISK-SHARING FINANCIAL INSTRUMENT

- 3 Further explore the development of a purpose-driven (risk-sharing) financial instrument dedicated to digital/data-driven agri-food innovators

SOFT MEASURES TO CATALYSE INNOVATION

SUPPORT THE ECOSYSTEM ON DIGITAL TRANSFORMATION

- 4 Empower Digital Innovation Hubs (DIH) to further prioritise their support activities for the digitalisation along the agri-food value chain

SUPPORT THE RAMP-UP OF TECHNOLOGIES/INNOVATIONS

- 5 Support the broader rollout of field labs to increase the take-up/scale-up of promising technologies/innovations

Recommendation 1: Further develop and strengthen crowd-lending platforms (crowdfunding) dedicated to agri-food innovators

Agri-food is more than a strategically important economic sector. It is also crucial for society, because it provides affordable and sustainable nutrition for the population. An increasingly growing part of society, especially the young, are willing to pay more for sustainable food. This is important, as the sector is extremely sensitive to price changes.

Crowdfunding can give more financing to smaller agri-food innovators and it can connect consumers to small agri-food businesses. This type of funding has gained significant popularity in recent years, especially in the US (AgFunder or Barnraiser), and European platforms are starting to emerge (MiiMOSA, CONDA or platforms like Lendix). The agri-food sector can be suitable for crowdfunding, as the connection between the investor and the company (i.e. the agri-food innovator and its product) can be fairly close, geographically and conceptually. This type of funding could be supported by blockchain technology, offering transparency and a direct connection between the investor and the small business. Furthermore, the results of the investment is likely to be obvious and tangible. For example, a company developing sustainable packaging sold at local supermarkets or at regional farmers' markets, where investors live and shop, offers a direct connection between the investment and the investor.

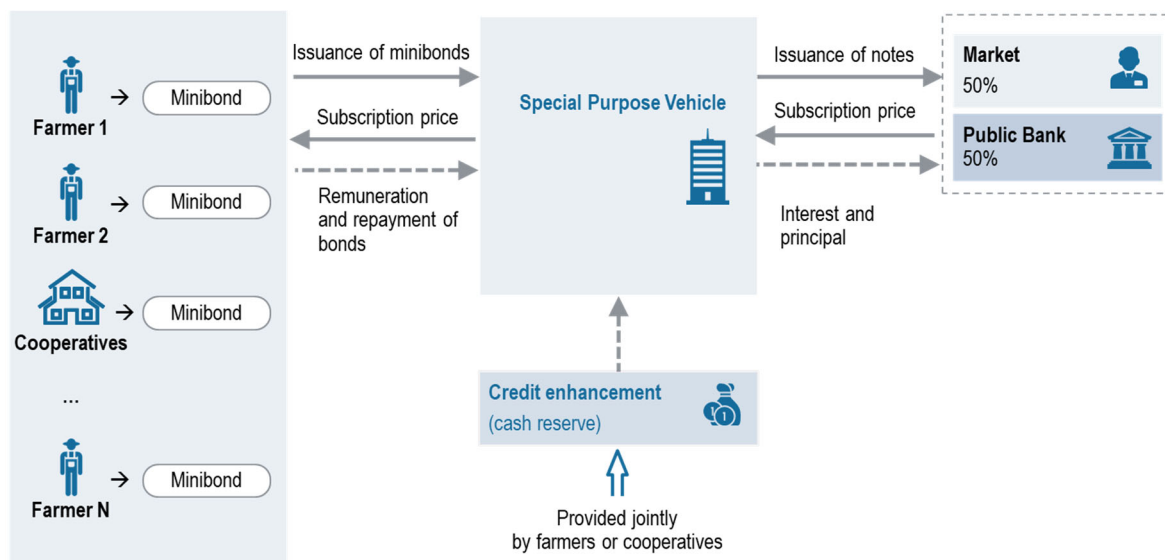
The financing gap for small-scale agri-food innovators, especially in smart technologies, will not be filled by the market alone. This suggests that there is space for public financial institutions. Also, the investors in sustainable investments usually expect lower returns than venture capitalists. Using equity offerings on a crowdfunding platform, which would let the public invest in small businesses, will bring more capital to agri-food innovators. In addition to partially addressing the financing gap, crowdfunding for agri-food would raise awareness of the importance of the sector, create a direct local link with society and have a positive effect on the Bank's decision to finance agri-food projects, due to the equity contribution to the small businesses' capital.

We should explore the potential for equity crowdfunding platforms to help agri-food innovations, while enhancing the role of public financial institutions such as national promotional banks or the EIB Group. The establishment of pilot projects in innovation hotspots in the European agri-food sector could be a good first step. This could start via established platforms such as Oneplanetcrowd in the Netherlands, a crowdfunding platform that focuses on sustainable investments. In 2017, the EIB Group, through the European Investment Fund, joined with the European-based Lendix platform to increase crowd-lending for businesses via a joint investment fund backed to the tune of €18.5 million. Similar platforms relevant to agri-food could benefit from this type of support and provide even more investment to the sector.

Recommendation 2: Enable the issuance of mini-bonds to share risks and unlock investment in agri-food innovations

The uptake of innovations as well as investment in innovations are slow, mainly due to the financial risks that farmers and small businesses face. The financiers, including commercial banks, are not willing to accept this risk. This prevents many farmers and small businesses in agri-food processing and packaging from adopting smart technologies. The issuance of mini-bonds at regional, national and European levels could address this barrier. Such a risk-sharing structure would provide farmers and small businesses with extra money to invest in innovation and let them share the risk with other farmers and businesses, for example through the involvement of cooperatives (see illustration below).

Figure 3: Illustration of financial structure based on the issuance of mini-bonds



In 2012 and 2013, Italy introduced legislation to facilitate the issuance of mini-bonds for small companies not listed on the stock market (those with more than 10 employees and sales of more than €2 million) as a response to the sovereign debt crisis. With the support of an advisor, small and medium-sized companies issued mini-bonds, which provided investment opportunities for concrete projects. In 2016, the Italian cooperative Faro Società Cooperativa Agricola issued mini-bonds, showing their ability to attract finance in the agri-food sector. Similar mini-bond markets exist in the UK, France, Spain, Germany and Norway. Once the legal framework and trading systems are in place, innovative securitisation structures can be designed. A structure that demonstrates the functionality was developed, together with the EIB, by eight Italian water utilities in the Veneto Region in 2014 (Viveracqua). This structure uses mini-bonds in combination with the well-established Italian securitisation legal framework to finance medium and small-sized water companies that have trouble getting long-term loans because of their risk profile. This was the first case of self-financing by medium-sized enterprises in the capital markets through securitisation – without using a bank as an intermediary.

A similar instrument could be used by European farmers, cooperatives and small agri-food businesses. It would enable farmers and agri-food businesses to invest in innovations by raising money through mini-bonds issued on a cross-collateralised basis. This would then enable a larger loan, possibly supported by a credit enhancement instrument. The farmers and businesses would have a better credit standing due to risk diversification and the credit enhancement facility.

Recommendation 3: Explore the development of risk-sharing financial instruments dedicated to digital, data-driven agri-food innovators

The market analysis shows that smaller agri-food innovators that focus on digital, data-driven offerings find it particularly difficult to access financing in order to grow, as opposed to financing to launch a start-up. During the interviews with agri-food companies, 61% of small companies with revenues below €10 million per year reported that obtaining financing had been "difficult" or "very difficult." These companies have typically developed an innovation and are in the process of setting up final pilots or entering the market. Mobilising sufficient equity is the largest financing constraint for these smaller agri-food innovators wishing to grow their business. This is particularly true for digital innovators that use a virtual business model and do not have a financial record to demonstrate their accomplishments.

The equity volumes required to finance this scale-up phase are comparatively small. The agri-food innovators with the largest difficulties in obtaining equity finance are seek up to €5 million, and very few are seek up to €30 million. However, according to specialised investors, the small volumes of financing are not the barrier. The effort needed to conduct due diligence and process the investment decision takes time due to the specificities of the sector. Hence, even specialised investors cannot cater for a larger number of companies that need equity. Digital Innovation Hubs could support these investors in their due diligence processes.

On the financing side, the study suggests exploring the idea of setting up a financial instrument (or an investment platform) providing low-volume financing to agri-food innovators with a higher-risk profile (due to longer lead times and high seasonality as well as a lack of conventional collateral). The ticket sizes could range from €250,000 to €5 million. Fund managers have indicated that a fund of about €50 million to €100 million should be able to support the activities of 75 to 100 small-scale innovators in the European sector. Investors from the private or public sector (such as national promotional banks) should be engaged to commit capital to these funds. There could also be financing options under the European Agricultural Fund for Rural Development, which would further stimulate innovation in the agri-food sector.

Recommendation 4: Empower Digital Innovation Hubs to further prioritise their support for the digitalisation of the agri-food value chain

The findings show that digital innovations and data-sharing technologies can be highly disruptive and create considerable value for the agri-food sector. For example, blockchain-based applications that integrate the entire value chain are particularly appealing because they make it possible to store and exchange information from different operators along a food product's supply chain in a decentralised and tamper-proof system.

Digital Innovation Hubs help small businesses, large industries, start-ups, researchers, accelerators and investors. They aim to create the best conditions for long-term business success for everyone involved. These hubs can develop test cases, for example, on the application of blockchain technologies or other digitalisation technologies to help the development and uptake of agri-food innovations. Young farmers and small agri-food entrepreneurs who are changing the business model when taking over a company are particularly open to new technologies and require specific support. Hubs can also provide comfort to investors because, when they provide services to a company, this guarantees a certain level of quality. Hubs can provide a local contact point too, and act as a bridge for the regional community, which increases connectivity.

An EU-supported project called SmartAgriHubs is trying to build an extensive network of Digital Innovation Hubs across Europe to help agriculture. The project is supporting a broad digital transformation of the European farming and food sector. With a €20 million budget co-funded by the European Union, the project aims to set up 140 Digital Innovation Hubs, nine regional clusters and 28 flagship innovation experiments. These kinds of initiatives will have a major impact on the digital capabilities of the agri-food industry. To build on this initiative, we need targeted input at local, national and European levels to make sure everyone understands the objectives and to organise the financial resources.

Recommendation 5: More field labs to increase the scale-up of new technologies and innovations

Agri-food innovators not only lack financing but also need knowledge and expertise. Larger agri-food corporations are more likely to innovate if they use knowledge-transfer approaches like open collaboration platforms or field labs. These labs enable small-scale industry innovators to collaborate on projects via open innovation platforms or hubs (such as HENRi@Nestlé and The Unilever Foundry, established by Nestlé and Unilever). In such a setting, the labs usually provide resources such as venture capital, market knowledge or testing facilities for the small-scale innovators. In turn, the labs gain access to new technologies and disruptive innovations from the smaller and more agile companies. The labs can incorporate these innovations into their global production processes and product portfolio.

Mid-caps and even larger corporations often do not have the resources to establish and manage field labs with numerous stakeholders on their own. To enhance innovation and unlock innovation financing, we recommend that the European Commission support the expansion of field labs, perhaps with the financial and technical assistance of national innovation agencies, national promotional banks or the EIB Group.

Agri-food mid-caps could work together to set up field labs comprising a number of small-scale innovators. This would jump-start business development. For example, a brewery or a dairy and a packaging innovator could set up a field lab with small-scale innovators that develop digital solutions to safely share data among the farmer, the manufacturer and the packaging company. These solutions could increase the shelf life of the drinks. The cluster could include innovators from the packaging sector that develop smart labelling technologies. The mid-caps involved can use the products and technologies developed by the small-scale companies and improve their innovation capabilities and competitiveness. Field labs may also help unleash corporate venture capital for scaling up promising technologies and introducing them to the market. Larger firms could take an equity stake in or enter into a joint venture arrangement with a small but innovative firm, and they could also provide management and marketing expertise.

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Glossary

Abbreviation	Explanation
AMS	Automated milking systems
ASEAN	Association of Southeast Asian Nations
CAP	Common Agricultural Policy
CAPEX	Capital expenditure
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CNC	Computer numerical control
COSME	Competitiveness of Enterprises and Small and Medium-Sized Enterprises
DG	Directorate-General
DIH	Digital Innovation Hub
EAFRD	European Agricultural Fund for Rural Development
EASME	Executive Agency for Small and Medium-Sized Enterprises
EBITDA	Earnings before interest, taxes, depreciation and amortisation
EIAH	European Investment Advisory Hub
EIC	European Innovation Council
EC	European Commission
EFSI	European Fund for Strategic Investments
EIB	European Investment Bank
EIF	European Investment Fund
EIT	European Institute of Innovation and Technology
ERDF	European Regional Development Fund
ESF	European Social Fund
GMO	Genetically modified organism
KET	Key enabling technologies
KIC	Knowledge and Innovation Communities
NPB	National promotional bank
NPI	National promotional institution

OEM	Original equipment manufacturer
OES	Original equipment supplier
R&D	Research and development
R&I	Research and innovation
SDGs	Sustainable Development Goals
SME	Small and medium-sized enterprise
VC	Venture capital

1. Introduction

The agri-food sector is an important pillar of the European economy

The agri-food sector is an important element of the EU's economy, contributing significantly to Europe's overall economic performance. The revenues generated by the sector (in agriculture as well as food and beverages) total €1,450 billion¹, equating to 9% of GDP. This is significantly more than in the US, where agri-food amounts to 5.5% of GDP. The food and drink industry contributes 15.4% to the overall EU industrial production.² This contribution is larger than other key industries such as the automotive industry at 13% or engineered products (machinery and equipment) at 9%.

The agri-food sector creates a large number of jobs. Around 15.4 million people are employed in the agri-food sector in the EU (11.2 million in agriculture and 4.2 million in the food and drink industry).³ This represents 6.9% of the EU's workforce and surpasses other key sectors of the economy, such as the automotive industry, which employs 13.3 million people or 6.1% of the EU's workforce.⁴ Compared to other industrial or service-oriented sectors, agri-food is a significant employer in disadvantaged regions, due to the decentralised nature of food processing and regionally integrated value chains.

Over the past decade, the EU has become a strong exporter of agri-food products, with exports doubling between 2006 and 2016. In 2013, Europe overtook the US as the world's largest exporter in the agri-food sector. Exports amounted to €102 billion in 2016, representing a 17.3% share of Europe's total exports. At the same time, agri-food exports generated a positive trade balance for the EU with a surplus of almost €30 billion. The EU's largest agri-food export markets are China, the US and ASEAN countries, which are characterised by increasing purchasing power and robust economic growth, thus offering further potential for growth.⁵

The European agri-food sector has proven to be particularly resilient to economic downturns. During the financial crisis of 2008/2009, Europe's key industrial sectors like automotive, manufacturing and engineered products saw revenues decrease by up to 25% and employment decrease by up to 15%.⁶ In contrast, the agri-food sector saw hardly any decline in revenue and employment during the crisis. This resilience of the European agri-food industry had a stabilising effect on European GDP and labour market indicators. The future GDP contribution and employment rate of the agri-food sector are likely to remain steady even under adverse conditions.

Innovation in the European agri-food sector faces a complex set of challenges

The European agri-food sector is significantly fragmented, which tends to impede higher productivity. On the production side, 73% of all farms in Europe are small-scale "family businesses" employing no or only a minimal additional workforce. The average number of employees per company in the food and drink industry is 15 (compared to 123 in the automotive industry and 32 in engineered products) and 99.1% of these companies are SMEs, often still using traditional craft and small-trade business models. These companies employ 62% of the workforce in the sector and generate approximately half of the sector's revenue. In total, labour productivity in the agri-food sector is only 63% of that of the automotive sector and 71% of that of the engineered products sector.

The European agri-food sector lacks growth dynamics. At an average growth rate of 0.7% from 2008-2017, total sales in the European food and drink sector have clearly underperformed compared to the sales growth rate in the US (1.6% per annum) and China (10.8% per annum) over the same period.⁷

¹ FoodDrinkEurope, 2017

² FoodDrinkEurope, 2017

³ FoodDrinkEurope, 2017

⁴ ACEA, 2017

⁵ FoodDrinkEurope, 2017

⁶ FoodDrinkEurope, 2017

⁷ IHS Markit, 2018

This is, in part, because Europe lags behind in terms of investment in agri-innovation. While R&D expenditure within the EU's food and drink sector alone amounted to €2.8 billion in 2017, European agri-food companies invest less than their non-European competitors. Only 0.2% of their revenue is used for innovation, compared with American or Japanese competitors whose average innovation spending is 0.44% and 0.65% of their revenue, respectively. Around 46% of European agri-food companies report that they innovated over a recent three-year period (including marketing and organisation innovation). Over the same period, only 9% of them introduced technology-driven process or product innovations. Just 20% of agri-food companies undertake any in-house R&D, while less than 2% engage in R&D collaborations or partnerships.⁸

Furthermore, there is significant underinvestment of venture capital and related forms of financing critical for innovation in both the agri-food sector globally and in Europe in particular. Since 2010, venture capital and corporation-funded investment in food-system-related start-ups amounted to approximately €12 billion, while comparable healthcare start-ups attracted approximately €124 billion in investment over the same period. The EU also trails behind the US; in 2017, single venture capital investments in US-based agri-food start-up companies (excluding retail businesses and restaurants) reached €3.7 billion.⁹ Total venture capital investment in the US is four times higher than in the EU per year.¹⁰

Lack of access to finance is therefore by far the most prominent barrier to innovation reported by European agri-food companies, with over a third citing financing problems (e.g. lack of credit or equity, lack of grants or subsidies) as the most important reason. Reasons such as a low uptake of innovation by the market (11%) and too much market competition (11%) are cited less frequently.¹¹

Current financial market conditions add to the challenge of effectively financing innovative agri-food companies. Liquidity at near-zero interest rates should be available to finance innovation thanks to the monetary easing policy of the European Central Bank. However, regulatory standards for capital requirements (e.g. Basel III) are a significant hurdle for commercial banks seeking to facilitate investment and may partly offset the stimulating effect of liquidity. In addition, the risk profile of many commercial banks with respect to the agri-food sector has not changed in recent years. This means that despite high liquidity in the European banking market, most commercial banks favour conservative, track record-based business models, resulting in an undersupply of debt financing for innovators.

There are macroeconomic, social, environmental and policy challenges ahead for the European agri-food sector that can only be resolved with innovation. The global demand for food is projected to increase by up to 98% by 2050, while the available arable land is projected to remain largely unchanged. The combined agri-food and food logistics sector accounts for approximately 30% of the world's energy demand and strongly depends on non-renewable sources of energy. Thus, innovation in the agri-food sector can help the EU reach its climate action target. Nearly one third of global food production – 1.3 billion tonnes of food – is lost or wasted annually.

⁸ FoodDrinkEurope, 2017

⁹ AgFunder, 2018

¹⁰ PwC/CB Insights, 2018

¹¹ FoodDrinkEurope, 2017

Furthermore, there is an ongoing trend towards organic, sustainably produced food. The EU crop area under organic production increased by 21% from 2012 to 2016.¹² Ongoing innovation in the areas of plant treatment, energy efficiency, waste management and supply chains will be needed to maintain this trend. In response to this and recent international policy developments like the United Nation's SDGs and the 21st Conference of the Parties agreement (COP21), the EC's Research and Innovation Directorate-General (DG) launched the FOOD 2030 initiative. The initiative aims to develop a coherent research and innovation agenda for sustainable food and nutrition systems. It has adopted a food system approach, connecting all relevant players and stakeholders along the food value chain, including scientists, businesses and consumers.¹³

Innovation in the agri-food sector is also dependent on consumer preferences. Consumers want safe, healthy food products of high quality.¹⁴ There is a growing group of people, especially younger people, willing to pay more for sustainable agri-food products.¹⁵ At the same time, the trend towards individualised and customised products facilitates innovation by increasing the variety of products.

Europe's agri-food industry is faced with the rapid spread of digital technologies. Digital innovation tends to be cost-intensive, data-sensitive and fraught with risk, but it also offers significant efficiency gains and new revenue models, with technologies like the Internet of Things, precision agriculture, robotics, data analytics and e-commerce applications. These technologies may fundamentally alter the agri-food industry, from the farm to the consumer.

Objectives of this study

The EIB and the EC have embarked on several initiatives to further strengthen innovation in the sector. However, a targeted **analysis of the access-to-finance conditions for innovation in the European agri-food sector is currently missing.**

Against this backdrop, this study aims to achieve the following objectives:

- > Provide a focused, up-to-date agri-food sector snapshot, with particular emphasis on innovative agri-food companies, their business models, financing needs and potential financing bottlenecks.
- > Provide clear insights into available instruments for agri-food financing, their use and effectiveness for innovation financing, and a description and assessment of potential financing gaps.
- > Provide a thorough review of current European and international best practices in agri-food R&D and innovation financing.
- > Provide a clear set of recommendations on how to improve access-to-finance conditions for the European agri-food sector.

¹² Eurostat, 2018

¹³ <https://ec.europa.eu/transparency/regdoc/rep/10102/2016/EN/SWD-2016-319-F1-EN-MAIN.PDF>

¹⁴ European Commission, 2018f

¹⁵ In the Special Eurobarometer 442 from March 2016 (fieldwork in November-December 2015) on "Attitudes of Europeans towards Animal Welfare," 59% of EU citizens mentioned they would be prepared to pay more for products sourced from animal welfare-friendly production systems. Younger respondents are more willing to pay for such products than older people (65% of respondents aged 15-24 years versus 55% of respondents aged 55+), European Commission, 2016.

The study is structured as follows: the conceptualised methodology used for data gathering is in chapter 2, with derived patterns and topics in chapter 3, and the findings in chapter 4. An analysis of the existing landscape of key public and private sector financial instruments in Europe given in chapter 5, followed by a clear set of recommendations in chapter 6.

2. Methodology of the study

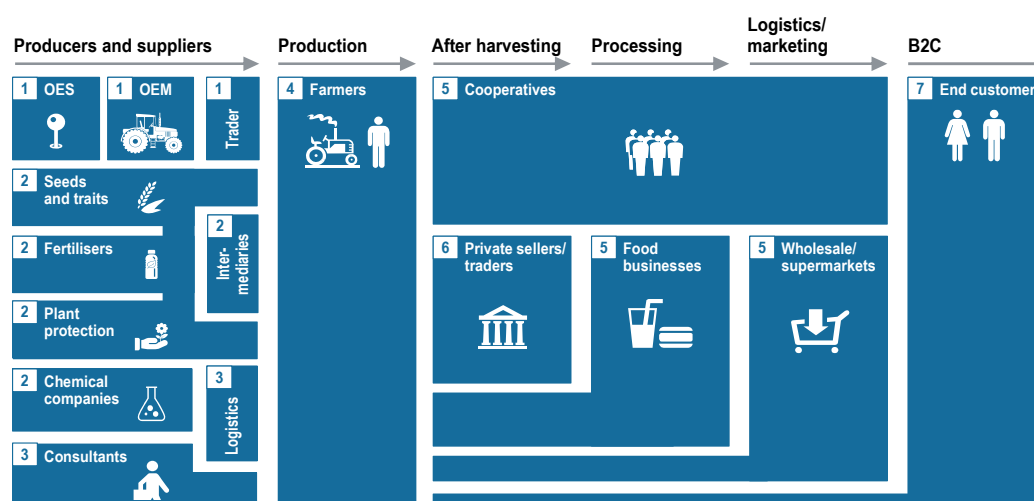
Due to the diversity of the European agri-food sector, we applied a broad methodology to this study. Section 2.1 presents the elements of our methodology, the scope of the agri-food sector, a definition of innovation and the interviewees for our study. Section 2.2 provides an overview of how we substantiated the results of our interaction with market participants.

2.1 Core elements of the study's methodology

The agri-food sector – definition of relevant subsectors

Mapping the agri-food supply chain illustrates the **diversity and complexity of the sector**. Applying a broad definition, the value chain starts at the supplier level (i.e. seeds, fertilisers, equipment) and spans production, trading, processing, food logistics and the retail sector.

Figure 4: Agri-food value chain

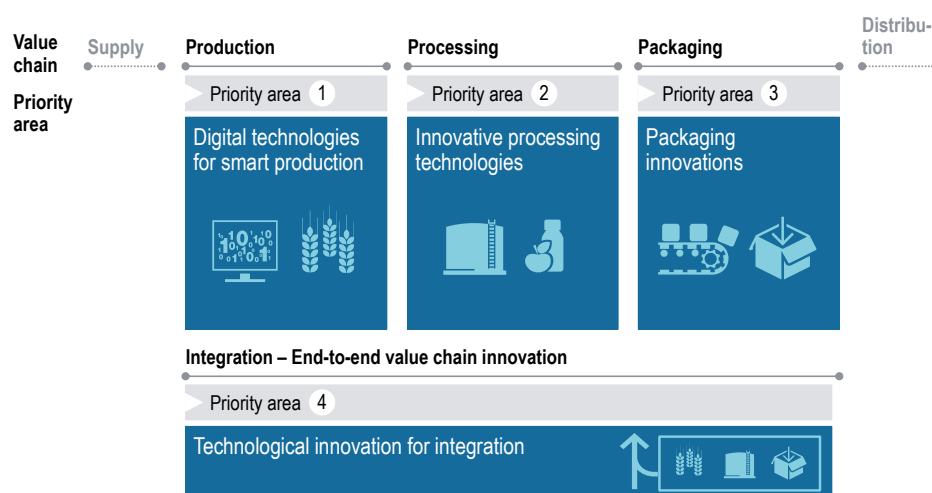


Our study concentrates on four segments of the value chain (**priority areas**), chosen as policy focus areas by the EIB and the EC, with a particular exposure to innovation:

- > **Digital technologies for smart production** can make agri-food production more efficient and sustainable by reducing the use of fertilisers and crop protection chemicals.¹⁶
- > **Innovative processing technologies** can facilitate adaptation to changing consumer trends and enhance the efficiency of food manufacturing.
- > **Packaging innovations** can help to reduce waste with biodegradable packaging materials and novel contact materials that increase the shelf life of food.
- > **Technological innovation for integration** can optimise the use of resources and improve transparency by linking data from different segments along the agri-food value chain.

¹⁶ This study focuses on companies that develop and sell innovative technologies for agricultural production (i.e. farming). The financing of agricultural production itself is outside the scope of this study.

Figure 5: Priority areas along the agri-food value chain



“Smart technologies” is the underlying concept for innovation

In this study, we apply “smart technologies”, a concept from innovation research, to identify and assess innovation. Public entities use this concept widely in their strategic innovation agendas (see for example Sweden's national “Smart industry” strategy¹⁷). We define “smart technologies” as follows:

- > The potential to generate significant growth and employment in their sector.
- > The ability to strengthen the competitiveness and attractiveness of their sector on a global scale (including attracting young people into the industry).
- > Little resistance from broader society (e.g. unlike genetically modified food).
- > Leveraging potential to achieve overarching policy targets (e.g. in the fields of food safety, transparency and sustainability, including reducing the amount of food wasted).
- > Availability (now or soon) on the market, but not yet fully exploited by market participants.

Examples of innovative subsectors within the selected priority areas

To illustrate the importance and innovation potential of the selected priority areas, we have listed the innovative subsectors in each priority area with high potential for smart technologies.

Innovative subsectors in the first priority area, **digital technologies for smart production**:

- > **Horticulture** is an innovative sector with a strong base in Europe. It produced around 18 million tonnes of tomatoes in the 2016/2017 campaign and Europe accounts for around 10% of worldwide tomato production.¹⁸ Glasshouses for horticultural production can be built almost anywhere, making production close to the place of consumption possible.¹⁹
- > The **poultry** subsector is important for the supply of high-value animal protein. Demand for poultry is global due to few religious restrictions. EU poultry exports are expected to reach

¹⁷ Swedish Ministry for Enterprise and Innovation, 2016

¹⁸ European Commission, 2017b

¹⁹ European Plant Science Organisation, 2014

1.7 million tonnes by 2026, an increase of 15% compared to today. According to expert assessments the subsector could improve on innovation and has much to gain from smart technologies.

- > Europe's **dairy** subsector includes 600,000 dairy farms and 12,000 processing facilities and it employs about 300,000 people. The European dairy industry has much to gain from data-based digital innovations. The uptake of automated milking systems (AMS) will lead to an exponential increase of data, providing a good opportunity for improved data management. An AMS stores around 200,000 data points per year for a single cow.²⁰
- > **Arable farming** occupies the biggest surface area in the EU, after grassland and green fodder (together 60% of Europe's surface area). The EU precision farming market is projected to grow by roughly 14% per year until 2020.²¹ This will help the arable farming subsector to leverage the potential of big data, according to expert assessments.

Innovative subsectors in the second priority area, **innovative processing technologies**:

- > Processing of **meat** comprises roughly 20% of the turnover of Europe's food and drink industry, corresponding to €220 billion in 2013.²² The competitiveness of the EU's meat industry is low compared to other countries.²³ Innovations like alternative meat additives based on nanotechnology could help the EU meat industry gain a competitive edge.²⁴
- > Europe's **beverage** industry comprises roughly 14% of the turnover of Europe's food and drink industry, equalling about €154 billion in 2013. The EU is a net exporter of beverages and the subsector is globally competitive.²⁵ Expert assessments suggest the beverage sector can expand its competitive edge by embracing innovative processing technologies.
- > The European market for **specialty food ingredients** is worth about €14 billion (2015), which represents approximately 40% of the global market. The subsector comprises about 200 companies that spend roughly 5% of their turnover on research.

Innovative subsectors in the third priority area related to the **food packaging industry**:

- > New contact **materials**, especially bio-based and biodegradable plastics, offer high growth potential. Global production of bioplastics is predicted to increase from 2 million tonnes in 2015 to 9.5 million tonnes in 2020. Europe's share of the global bioplastics market is forecasted to shrink from 13% in 2015 to 6.9% in 2020.²⁶
- > Global markets for food and beverage packaging **machinery** are forecasted to grow 6.5% annually, but the European markets will grow by only 5.7% per annum. However, European machinery producers are well-equipped to expand their exports in other world regions.²⁷
- > The growing e-commerce market for groceries is leading to new opportunities in packaging **process** optimisation, e.g. highly individualised packaging. Rapid digitalisation as well as a

²⁰ Revue Laitière Française, 2016

²¹ European Commission, 2014; Dressler, Gundermann, Keese, Aulbur & Zhang, 2015

²² FoodDrinkEurope, 2017

²³ ESCIP Consortium, 2016

²⁴ Ramchandraiah, Han & Chin, 2015

²⁵ ESCIP Consortium, 2016

²⁶ Hochschule Hannover, 2016; van den Oever, Molenveld, van der Zee & Bos, 2017

²⁷ The Freedonia Group, Inc., 2015

rising demand for transparency and food safety is predicted to drive the growth of the European smart food label market.²⁸

Innovative subsectors in the fourth priority area, **technological innovations for integration along the agri-food value chain**:

- > Companies that adopt **big data** analytics can increase productivity by 5-10%. In general, big data practices in Europe could add 1.9% to GDP between 2014 and 2020.²⁹ The EU precision farming market is forecasted to grow at 14% annually until 2020. To realise the huge growth potential that digitalisation and big data analysis offer, the currently weak data exchange and interoperability along the agri-food value chain³⁰ needs to improve.
- > The agri-food sector needs to foster the development and uptake of **software integration** solutions, enabling data-sharing and monitoring across subsectors and value chain segments. Software ecosystems and digital platforms offer multiple opportunities for integrating relevant data.

Determining the relevant size of agri-food companies considered in this study

There is a broad consensus among both independent studies³¹ and the EIB's access-to-finance studies³² that **larger-scale companies do not suffer from significant access-to-finance problems**. A review of the financing situation of some of Europe's largest agri-business companies confirms this view. In 2017, Nestlé S.A., Bayer AG, Unilever N.V. and Danone S.A. had a combined total debt of €80 billion,³³ more than 275 times higher than the amount of venture capital invested in American agri-food start-ups during the same period. The majority of Europe's large agri-food corporations enjoy investment-grade ratings, allowing financing for innovation at a relatively low cost of capital. Therefore, large companies fall outside the scope of this study. On the other hand, the **EU's SME definition** (companies with less than €50 million revenue and less than 250 employees) appears **too rigid** for determining a company size-based cut-off point, as it would exclude a number of well-established innovators with the characteristics of mid-cap companies. Therefore, the study also takes larger companies into consideration.

At the other end of the company size continuum are start-ups and innovative small and micro-companies. The sector is characterised by SMEs, but there are also indications that small, R&D-driven start-ups contribute significantly to innovation in the sector. Therefore, these innovative small companies (with less than ten employees) are included in the study, but we limit the scope to innovations that reach at least **technology readiness level 7** (technological innovations for which a prototype has been demonstrated in an operational environment).

²⁸ Nielsen, 2015a

²⁹ European Parliamentary Research Service, 2016

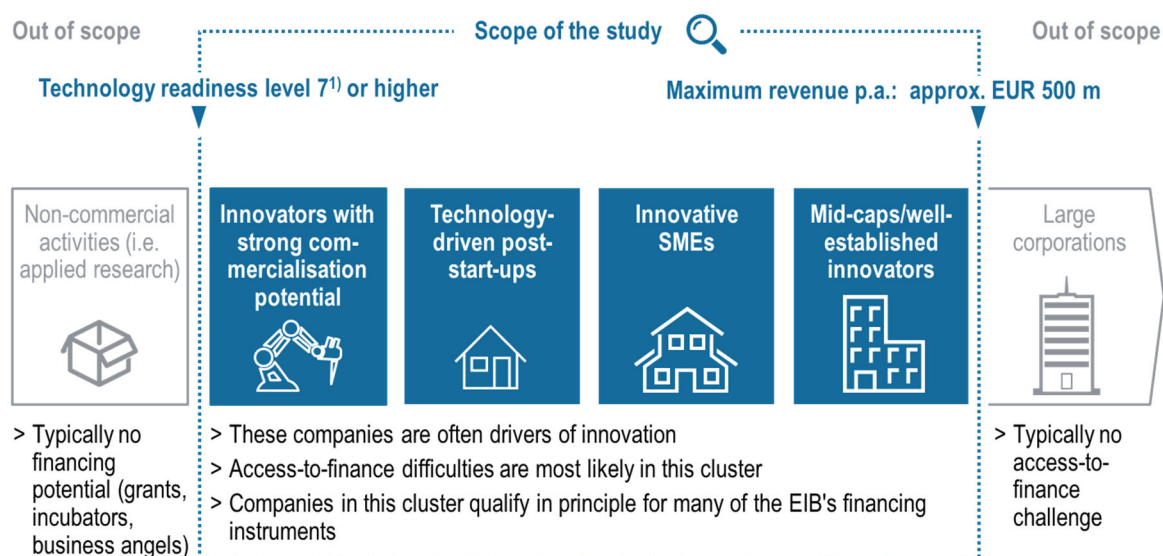
³⁰ Poppe, 2016; Dressler, Gundermann, Keese, Aulbur & Zhang, 2015

³¹ OECD, 2006

³² EIB, 2018b; EIB, 2016a

³³ The total short-term and long-term debt figures for the individual companies are: Nestlé S.A., €23 billion; Bayer AG, €14 billion; Unilever N.V., €24 billion; Danone S.A., €19 billion.

Figure 6: Scope: technology readiness level and company size



¹⁾Technology readiness level 7 applies to technological innovations for which a prototype has been demonstrated in an operational environment

Selection of relevant agri-food companies

Based on the criteria outlined in this section we compiled a long list of around 140 companies from EU Member States and Horizon 2020 Associated Countries, of these 40 agreed to be interviewed.

Interviewing relevant agri-food companies

We compiled an **interview guideline** for interviews with company CEOs or CFOs. The questionnaire followed the typical “financing journey” of a company, from assessing financing needs to the search for financial institutions, the negotiation process, the financing conditions achieved and an assessment of the outcome from the company's point of view.

Criteria for the selection of financial institutions

As the illustration below shows, we focused on five types of financial institutions. We compiled a long list of 60 financial institutions and interviewed 20.

Figure 7: Five types of financial institutions

Commercial banks



- > Limited readiness for risk taking leads banks to lend only to conservative businesses with established business models

Private equity



- > Equity financing is underrepresented as compared to other agri-food markets (e.g. the US, Israel) – mostly due to investment volume and risk, but also because of the historically strong role of banks as financiers
- > New banking regulation (Basel III) tends to increase risk aversion among banks and could increase the need for equity instruments

Cooperatives and foundations



- > Cooperatives and foundations might enable innovation through grouped investment

Public banks



- > Public banks possess various important levers
- > Public banks provide financing instruments that can often be blended with public grants
- > New/adjusted financing instruments need to be clearly impact generating and should not cannibalise commercial market offers

Corporate venture capital



- > In the US, corporate venture capital is already an important player for financing innovation in the agri-food sector
- > Open innovation platforms allow corporate ventures to finance and get hold of cutting-edge innovation, especially by start-up companies
- > In the coming years, corporate venture capital might gain importance for financing innovation in the European agri-food sector

Source: Roland Berger

2.2 Complementary elements to the study's methodology

The following activities were undertaken to contextualise the methodology outlined previously and to deepen, validate and balance the findings and results of the study.

- > **Exploratory interviews:** before the expert interviews, we conducted five exploratory interviews with market participants selected from producers, research associations and financial institutions.
- > **Conference participation and expert exchanges:** the project team took part in the “Digitalising agriculture and food value chains” conference (November 2017) organised by the EC's DG for Agriculture and Rural Development and the DG for Research and Innovation as part of the Horizon 2020 Societal Challenge 2 InfoWeek.
- > **Study review:** we reviewed approximately 50 publications and reports related to innovation financing in the agri-food sector.
- > **Expert workshops:** we conducted two workshops to deepen and consolidate the study findings. The first workshop was hosted by the EC and had representatives from Europe-wide sector federations and private equity. The second workshop was hosted by Wageningen University and Research with participants from the agricultural and banking sectors.

3. Survey results

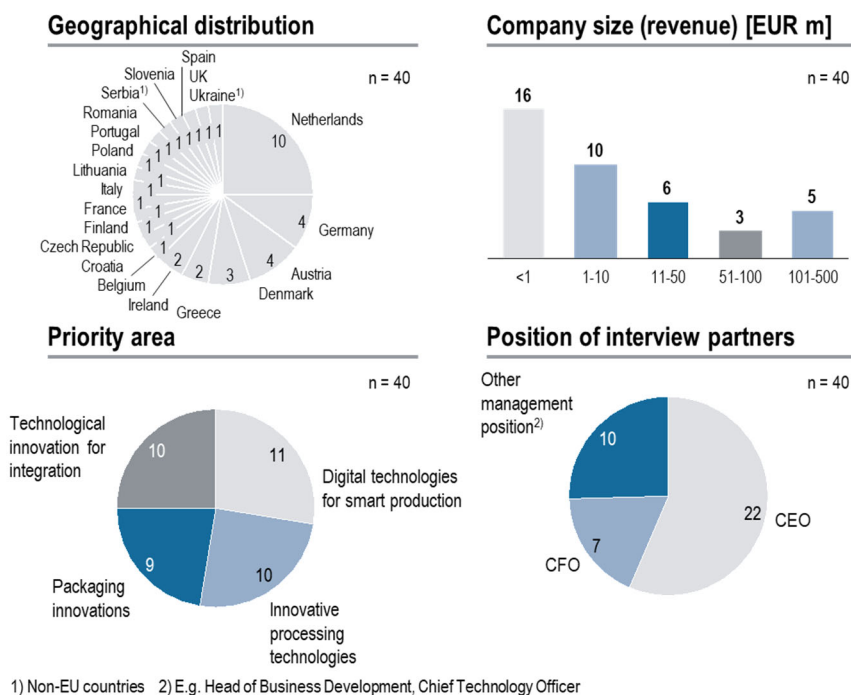
This chapter provides an overview of the results from the interviews conducted with agri-food innovators and financiers.

We conducted interviews with representatives from 40 agri-food innovators. The identified priority areas were equally represented in the sample and the relatively high share of small companies reflects the sector.³⁴ The median workforce size in the sample was 29 employees. Well-established companies and recently established start-ups from many different countries were included.³⁵

³⁴ For details on the structure of the sector please see section 4.1.

³⁵ The large share of companies based in the Netherlands is due to the country's strong footprint in agri-food and agri-food innovation. The Dutch economy is the EU's largest and the world's second largest agri-food exporter (Government of the Netherlands, 2018). Between 2012 and 2017, only German innovators obtained more agri-tech patents than Dutch innovators (analysis based on data from the European Patent Office). Furthermore, Dutch agri-food producers generate among the highest incomes in Europe in terms of gross value added and farm net value added (Hill & Bradley, 2015; European Commission, 2018n). As higher incomes enable farms to invest more, the uptake of innovative technologies should positively correlate with farm income. This data shows that the Netherlands is an important agri-food economy and a hotspot for agri-food innovation.

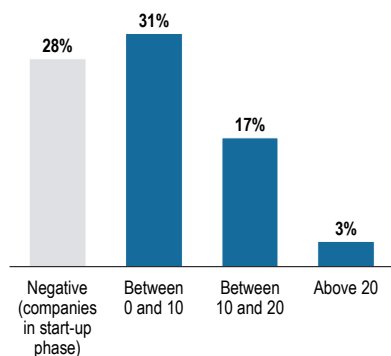
Figure 8: Overview of agri-food companies interviewed



Analytical outcomes from interviews with agri-food innovators

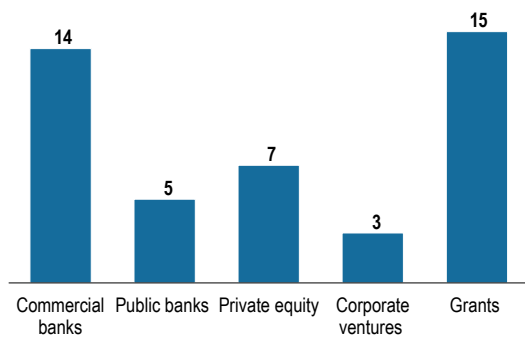
The majority of companies interviewed are **moderately profitable**. There are many start-ups with negative EBITDA margins seeking financing. The financing requirements of start-ups range from €25,000 to €100,000 while the financing amounts required by well-established, larger innovators go beyond €100 million. The median financing sought amounts to €1.5 million.

Figure 9: EBITDA margin of companies interviewed



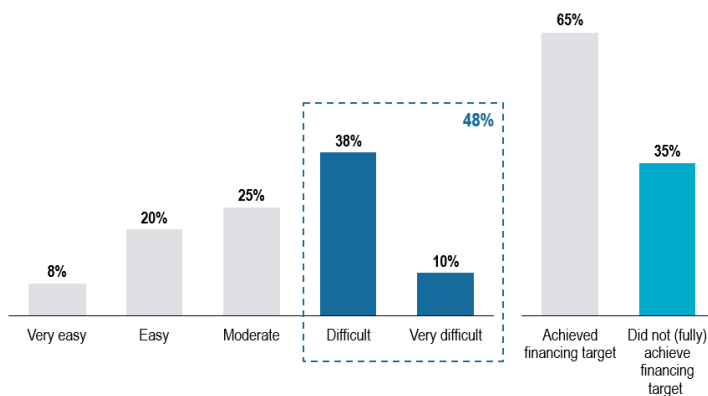
Commercial banks play a major role as funding sources for the sampled agri-food innovators, underlying the strong reliance on traditional borrower-lender relationships. Only seven companies indicated receiving financing from private equity, two of which were small-scale innovators with revenues below €1 million. The high number of grants (15) reflects the impact of the EU's research and start-up funding policy – seven out of the 15 companies that had received grants are small-scale innovators.

Figure 10: Funding sources of companies interviewed (multiple answers possible)



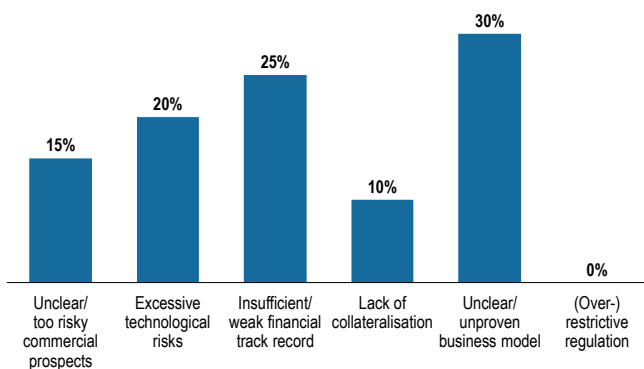
Nevertheless, there is clearly a **perceived difficulty in obtaining access to finance**. Half of all agri-food innovators interviewed reported experiencing significant access-to-finance difficulties; of these, nine are small-scale innovators. Of the companies interviewed, 14 (35%) did not (fully) achieve their targeted funding aim of between €50,000 and €109 million. Of these, six reported revenues below €1 million and half did not achieve their R&D financing target. The median financing target was €1.2 million and the average €7.9 million.

Figure 11: Innovators: perceived difficulty in access to finance



The study identified several **showstoppers**. The most frequent problem was an unclear or unproven business model (30%). Despite innovation lying at the forefront of agri-food, the technological risk factor was seen as a showstopper by only 20%. More important were commercial aspects (market uptake, commercialisation prospects), which may be addressed with intelligent funding instruments that combine innovation financing with market knowledge, like the European Angels Fund of the EIF.

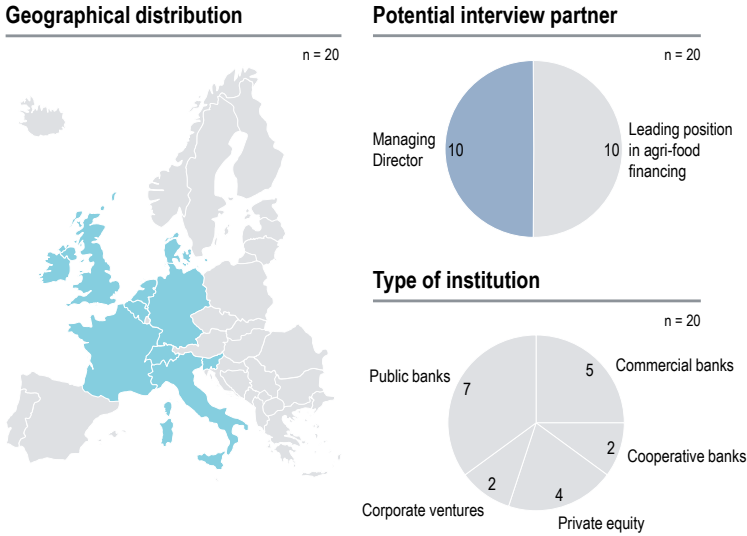
Figure 12: Innovators: reported showstoppers



In addition to funding, the study also investigated the need for **advisory services**. Only one in five innovators had heard of the advisory services offered by the EIB, but nine out of ten indicated that they would welcome some sort of advisory support, especially in the early stages of foundation.

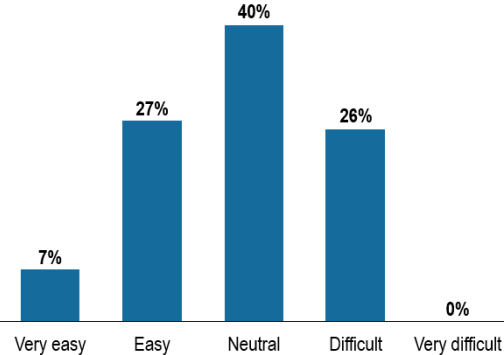
Analytical outcomes from interviews with agri-food financiers

Figure 13: Overview of agri-food financiers interviewed



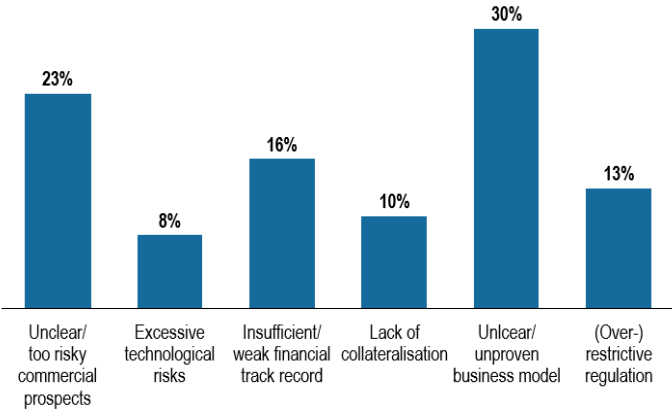
Interviews with financial institutions covered a wide range of countries and institutions. The typical amount provided by the interviewed institutions was between €50,000 and €20 million, with funding made available after a few days to six months and maturities ranging from five to 20 years. Around 16% of financiers reported that providing agri-food companies with funds was difficult; 33% said it was “easy” or “very easy”, and 40 % said the difficulties were neutral.

Figure 14: Financiers: perceived difficulty in access to finance



Cited by a third of agri-food innovators, the most commonly perceived showstopper was an unproven business model. Another third cited issues with a flawed business plan or bad management, without calling it a showstopper. Other risk flags were unclear/overly risky commercial prospects (23%), weak or insufficient financial track records (16%) and (over-)restrictive regulation (13%).

Figure 15: Financiers: reported showstoppers



4. Discussion of findings

4.1 Sector specifics: consumer demand for highly safe food products and the cyclical cash flows of many agri-food companies contribute to the sector being a risk-averse and cautious part of the European economy

KEY TAKEAWAYS

- > **Dependency on consumer demand and constant efforts to ensure brand loyalty favour incremental innovation in the agri-food sector. Additionally, high CAPEX requirements for innovative processes, as well as machinery and technology risk, contribute to a cautious position on innovation uptake along the European agri-chain.**
- > **The value creation of many agri-food companies depends on harvest cycles and seasonality of demand, resulting in cyclical cash flow and contributing to risk aversion and a slow uptake of innovation.**
- > **The European agri-food sector is largely cautious towards innovation and slow in innovation uptake compared to other industries. The sector is characterised predominantly by SMEs due to a low degree of consolidation.**

Dependency on consumer demand and constant efforts to ensure brand loyalty favour incremental innovation in the agri-food sector. Additionally, high capital expenditure (CAPEX) requirements for innovative processes, as well as machinery and technology risk, contribute to a cautious position on innovation uptake along the European agri-chain.

Innovation in the European agri-food chain is characterised by gradual changes. Agri-food companies face a constant need to cater to consumer tastes and maintain customer loyalty – consumers want safe, healthy food products of high quality and with an attractive appearance.³⁶ Therefore, agri-food businesses value incremental innovation, with rather predictable market effects, over disruptive innovation. For example, the yoghurt industry carefully identifies relevant customer segments before deciding on new packaging sizes, designs and flavours.³⁷ Even small changes often require high CAPEX, as machinery and the development of new processes are expensive, with pay-offs delayed by approval procedures. This underscores the sector's need for incremental innovation. Even small value chain changes can be highly innovative as Avantium proves with its plant-based packaging material.³⁸ The company's bio-based production process is highly complex and innovative with a small effect on the value chain. Only the packaging stage is affected while functionality for consumers remains the same as with traditional packaging.

³⁶ RSM, 2014; European Commission, 2018f

³⁷ Synerlink, 2018; Berry, 2015

³⁸ Avantium, 2018

VOICES FROM THE SECTOR

“Our customers have invested in machinery and now have large assets. With this set-up, they know their customer base. So for us, it is very hard to argue against a working status quo. Convincing them to modify anything in their processes means convincing them to leave their comfort zone.” – CEO of an innovative packaging company

“Market uncertainty is a major factor: what is the market size, the growth potential? Are consumers willing to pay or just interested? Those knowledge gaps are central when it comes to innovation. Uncertainty is the strongest opponent of innovation.” – CEO of an innovative packaging company

“The biggest challenge is to get the first 1% of the market and this comes down to consumer acceptance. The agri-food sector is characterised by slow innovation.” – CEO of an innovative food processing company

The value creation of many agri-food companies depends on harvest cycles and seasonality of demand, resulting in cyclical cash flow and contributing to risk aversion and a slow uptake of innovation.

Producers depend on natural **harvest cycles**. An average piglet takes 170 days to reach its slaughter weight, so at a hog farm, one hog section can raise about 3.2 hogs per year.³⁹ The farmer can control the breeding conditions, such as feed ingredients, temperature or piglet section. For innovation testing, this means a farmer has three trials in a year to optimise these parameters, which is extremely slow compared to the ongoing trend of rapid prototyping. As a comparison, with advanced manufacturing technologies, it is possible to build and test prototypes in less than 14 days.⁴⁰ The harvest cycles of crops are even longer. Corn can only be grown once a year. Also, the size of arable land is limited and is forecasted to decline.⁴¹ Thus, every hectare used for innovation activities reduces the size of land that can be used to produce crops and generate revenues. Furthermore, crop production is largely dependent on external factors, like weather conditions, making yield predictions highly complex. For some types of innovation, their effectiveness on the field can only be tested during harvest season. Thus, the agri-food sector sometimes implements innovations with a delay. John Deere, a leading agricultural machinery producer, launched its first GPS application in the market in 2002.⁴² In comparison, GPS navigation first appeared in cars in 1991.⁴³

³⁹ Industry experts

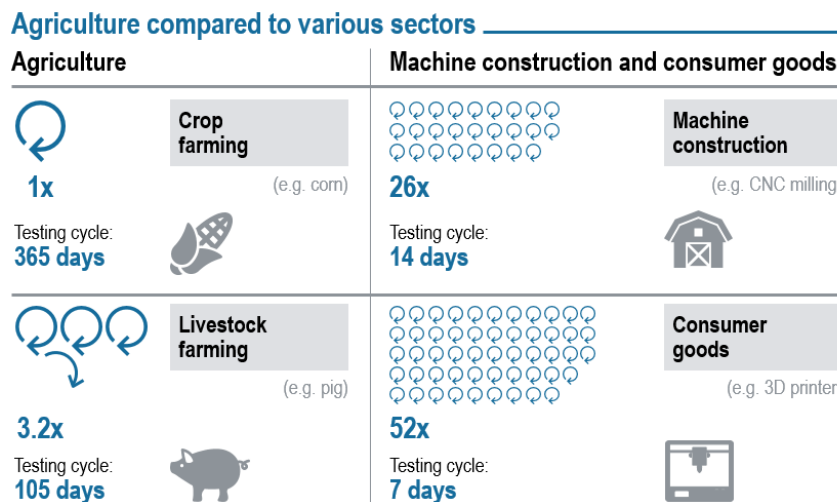
⁴⁰ Kylau, Goerlich & Mitchell, 2015; UYEE Prototype, no date; Niggulis, 2016

⁴¹ European Commission, 2017g

⁴² The John Deere Journal, 2016

⁴³ Artl, 2016

Figure 16: Possible innovation testing per year: agriculture compared to various sectors



Source: FoodDrinkEurope; Digitalist website; UYEE Prototype website; Shopify plus website

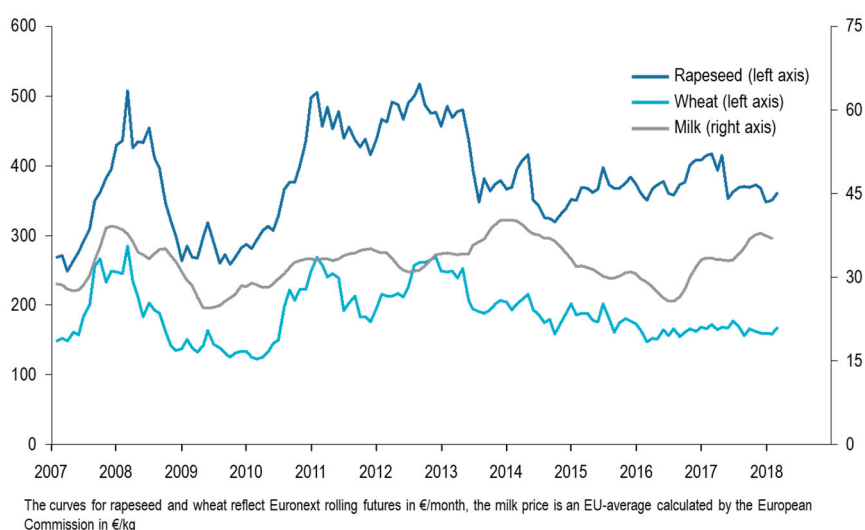
Seasonality of demand also affects the agri-food chain. Examples include, demand for goose at Christmas, chocolate on Easter Sunday and barbecue meat in the summer. This challenges agri-food producers' ability to set up adequate production capacity, as they need to strike a balance between the high and low demand seasons. To avoid excess production capacities in the off-season and ensure constant plant utilisation, agri-food producers build large stocks during the off-season, which allows them to supply the high demand that often significantly exceeds production capacities in the sales season. However, this negatively affects cash flow.

Harvest cycles and seasonality of demand lead to **cyclical cash flows**. Harvest cycles cause negative cash flows during the growing season and positive cash flows after harvest/slaughter. This is especially true for crop farming, as livestock farmers can manage cash flow through several breeding cycles.⁴⁴ Similarly, seasonality leads to negative cash flows in the off-season and building excess stock binds capital. During the sales season, the cash flow turns positive as sales exceed production and stock is sold off.

Cash flow is also affected greatly by market volatility. Market prices and quantities can significantly change over time, and both regulation and deregulation can also have an impact. The European sugar industry, for example, contends that the end of the sugar quota in 2017 and opening-up of the EU market led to increased sugar imports and price drops.

⁴⁴ Matthews, 2018

Figure 17: Market prices of agri-food commodities



Source: Bloomberg

In summary, companies in the agri-food sector face a high degree of uncertainty in cash flow, turnover and income. This represents a barrier to investment and financing of innovation, particularly in the long term. Thus, the evident prudence towards innovation and slow innovation uptake in the agri-food sector is not the result of scepticism but of specific market characteristics.

VOICES FROM THE SECTOR

“Among the main reasons for long innovation cycles are seasonality in the market and harvest cycles at the farm. Often, innovation testing and promoting to potential customers can only be done during certain periods.” – CEO of a company offering innovative technologies for food processing

“A bank requires in-depth understanding of the agricultural sector. Our cash flow varies extremely over the year, due to the cyclicity of the sector and our business. Banks without a sector-specific understanding run away in fear rather than giving us a loan.” – CEO of a large agri-food producer

“For our business, seasonality in terms of harvest cycles and consumer demand is a major factor. Our customers have to pay for our services early in the season, but mostly generate a profit only at the end of the season.” – CEO of a company offering digital technologies for integration along the value chain

Therefore, the European agri-food sector is largely cautious about innovation and slow in taking up innovation compared to other industries. The sector is characterised predominantly by SMEs due to a low degree of consolidation.

About 75% of those interviewed for the study agreed that the European agri-food sector is conservative and slow in taking up innovation. The arguments put forward were multi-layered, ranging from EU regulations to market fragmentation to dependency on crop harvest cycles.

VOICES FROM THE SECTOR

“The European food processing market is very fragmented with a lot of competition – most food companies are afraid of investments in new technologies because their focus is on safety rather than on innovation.” – CEO of a food processing company

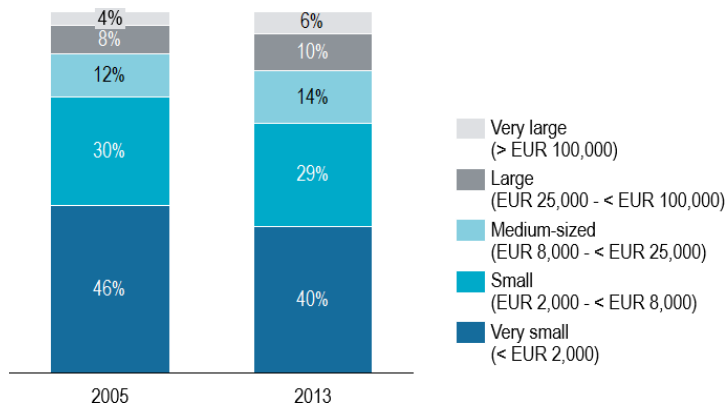
“Compared to other tech industries, the European agri-food sector is conservative. This is mostly caused by the characteristics of this relatively fragmented sector.” – CEO of an agri-tech company

“The European agri-food market is conservative and market uptake of innovation is slow. High market fragmentation leads to information asymmetries, which complicates the diffusion of innovation.” – CEO of an agri-tech company

Most European farms are small or very small. Only 6% of all farms generate a standard output⁴⁵ above €100,000 per year, and 69% generate an output of less than €8,000 per year. This is partly due to the high number of “part-time” farms. Agricultural production has shown signs of gradual consolidation, with very large and large farms increasing slowly over recent years and predicted to continue to do so.⁴⁶ However, the slow speed of consolidation suggests that the European agricultural sector is very likely to remain fragmented in the coming decades.⁴⁷

Similarly, over 99% of all European companies in the food and drink industry are SMEs, generating half of the industry’s revenues.⁴⁸ Very few European companies generate revenues of over €1 billion per year. However, SMEs are still important to European labour markets as they employ more than 60% of the industry’s workforce. Furthermore, fragmentation helps to distribute wealth across Europe, including rural areas, whereas large companies often concentrate on very few locations with the goal of a lean and efficient corporate structure.

Figure 18: Share of total number of farm holdings by economic size of farm



Source: Eurostat

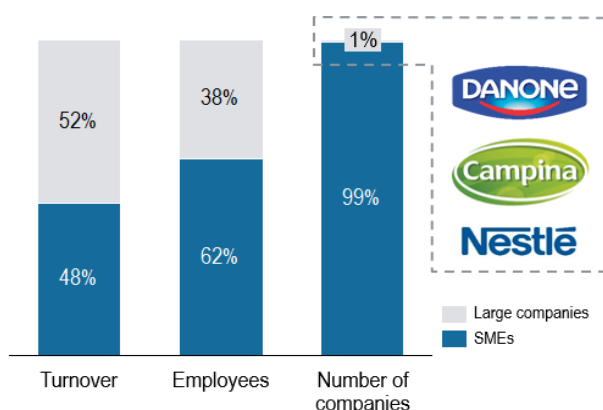
⁴⁵ As defined by Eurostat, “the standard output of an agricultural product (crop or livestock) is the average monetary value of the agricultural output at farm-gate price” (Eurostat, 2017).

⁴⁶ In Germany, the agricultural area per farm is increasing (2001: 39 ha; 2016: 60 ha), whereas the total agricultural area is decreasing (2001: 17.0 billion ha; 2016: 16.7 billion ha) (Destatis, 2018).

⁴⁷ The share of very large farms increased by 2% in eight years.

⁴⁸ Eurostat, 2018

Figure 19: The market for food and drinks



Source: FoodDrinkEurope

Innovations that require adoption/adjustment across the entire value chain (e.g. systemic innovations), such as food tracking technologies,⁴⁹ are much more difficult to adopt and implement if the value chain is fragmented and complex. Furthermore, small businesses that are typically involved in local supply chains face difficulties achieving economies of scale. Large-scale innovations require large-scale farming areas to work efficiently in order to pay off the high initial investments. For example, autonomous farming robots for orchards and plantations⁵⁰ start at €150,000; for many businesses, this represents a significant financial barrier to adoption.⁵¹

VOICES FROM THE SECTOR

“The cost/benefit ratio has to make sense for the farmer at first sight. Additionally, feasibility for the specific farm must be clear. Sometimes we forget that the main task of the farmer is to produce; everything else needs to be intuitive and easy.” – CEO of a small-scale company offering smart technologies for agri-food production

“Our clients [farmers] want to see how the technology works beforehand. In this sense, they are prudent. But we understand that farmers depend on our technology once implemented. Therefore, a reliable service is a key selling argument.” – CEO of an innovative agri-tech company

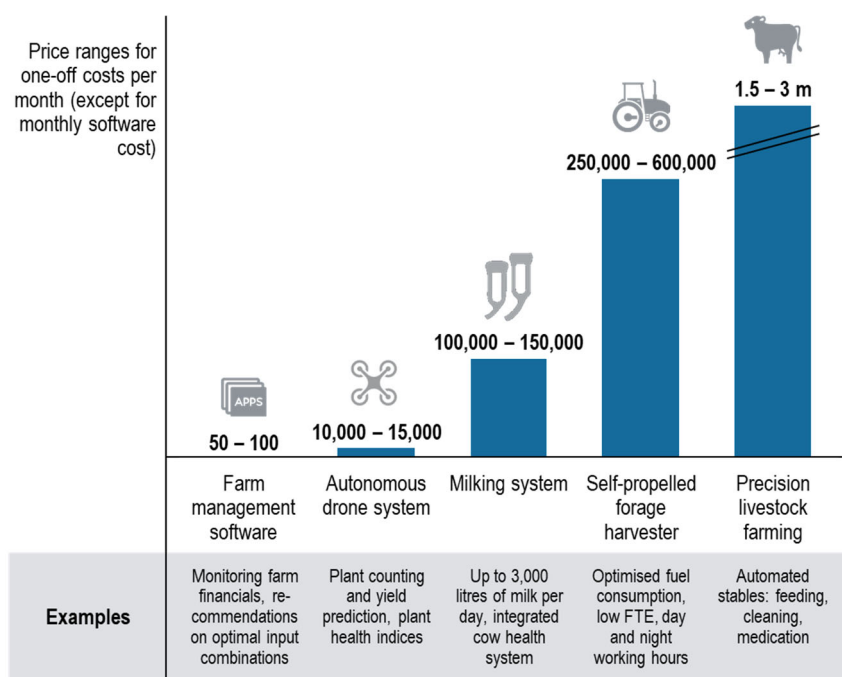
“Farmers are quite conservative. In our experience, they do not invest much per year and are quite risk-averse. Hence, it is key to convince the farmer of the added value. Data handling is also crucial.” – CEO of an innovative agri-tech company

⁴⁹ Food tracking technologies require the use of sensors and data transmitters by all participants in the value chain. Additionally, an independent entity or technology is required to collect and monitor the data (see also finding 2).

⁵⁰ An autonomous vehicle that “does all the work in orchards and plantations,” such as plant protection and breeding. It is controlled through a web browser and can be programmed to handle already existing applications at the farm.

⁵¹ Carley, 2017

Figure 20: Example prices of agricultural innovations



Source: Berckmanns 2017; John Deere website; DeLaval; PrecisionHawk website; Droneparts website; phone interviews with agricultural dealers

Interviewees presented the farmers' perspectives as follows. Software innovation is cheap, but it carries the danger of disclosing core farm data to external service providers. Hardware innovation is expensive and data appears safe, but prices often exceed farmers' budgets and the expected benefits – i.e. innovation pay-offs – seem uncertain. As a result, farmers are cautious about innovation, so a common strategy is to “wait and see”, keeping an eye on experience with innovations at other farms and waiting for any eventual price drops. In cases where all farmers “wait and see”, the strategy appears to be a vicious cycle, which is difficult to break for innovators. Though a variety of payment models exist, such as monthly subscriptions, interviewees agreed that farmers' prudence represents a major challenge in facilitating innovation.

4.2 Key areas of innovation: digitalisation, consumer health and sustainability are the main drivers of innovation in the agri-food sector

KEY TAKEAWAYS

- > **Digital, data-driven solutions appear to be the most disruptive innovations in agri-food production with significant potential to re-shape agricultural value chains and profitability among market players**
- > **Innovations in the food processing part of the value chain aim to increase consumer health and digitally connect processing facilities, while also targeting increased energy and resource efficiency**
- > **In packaging, bio-based and biodegradable materials are a key area of innovation activity**

Digital, data-driven solutions appear to be the most disruptive innovations in agri-food production with significant potential to re-shape agricultural value chains and profitability among market players.

All of the agri-tech companies interviewed stressed the importance of digital, data-driven solutions for innovation in agri-food production.⁵² Precision farming is already enabling farmers to track their production digitally. For example, GPS soil sampling allows them to create soil fertility maps with their fields' available nutrients, pH levels and other data, which can be used to optimise production in terms of their decisions on seeds, fertilisers and other inputs. They can also integrate farm data on farm management areas: field or animal parameters (including weather), financial figures, inventory levels, etc. In addition, emerging agri-tech companies are putting more effort into aggregating and analysing farm data. Study participants pointed out that the big data algorithms they employ enable quick and rational decision-making in complex farm surroundings. Input usage is not only optimised in terms of animal or plant growth, but also with regard to cost/benefit ratios. Procurement strategies are automatically derived from input planning, which can in turn lead to tight inventory management. Thus, digital farm management can increase profitability and sustainability.

VOICES FROM THE SECTOR

“Our innovation is to gather all the data that is produced on a farm, analyse it and provide the farmer with an integrated dashboard that gives an overview of all relevant indicators. This enables near real-time monitoring of animal health and productivity.” – CEO of a company providing digital technologies for smart agri-food production

“Our software provides recommendations based on farm parameter analyses. Only two out of ten farmers in Europe use such modern, fully integrated farm management software. Therefore, software can unlock hidden potential in Europe's agri-food productivity.” – CEO of a company offering digital technologies for smart production

Collecting and analysing data from a farm is key for digital innovations that enable integration along the value chain.⁵³ Technologies like blockchain-based smart monitoring systems aim to increase supply chain transparency by allowing the product to be traced back to a specific farm.⁵⁴ The transparency achieved helps build consumer trust and improve food safety. According to interviewees active in blockchain development, the technology ensures secure (unchangeable) monitoring of product parameters along the value chain, such as temperature, time to market, etc.⁵⁵ For example, interrupted freezer chains can easily be detected.

VOICES FROM THE SECTOR

“The most important innovations in agri-tech are blockchain-based technologies, big data analyses to make sense of the huge amount of data, and cloud technology.” – Director of an agri-food advisory service

⁵² Agri-food is not the only sector impacted by digital technologies. Digital technologies like high-performance computing have become critical enabling technologies for industrial research and development across Europe, see for example EIB, 2018e.

⁵³ Poppe, 2016; Dressler, Gundermann, Keese, Aulbur & Zhang, 2015

⁵⁴ Kritikos, 2017

⁵⁵ Blockchain: a blockchain records data across a peer-to-peer network. Every participant can see the data and verify or reject it using consensus algorithms. Approved data is entered into the ledger as a collection of “blocks” and stored in a chronological “chain” that cannot be altered (SAP, 2018).

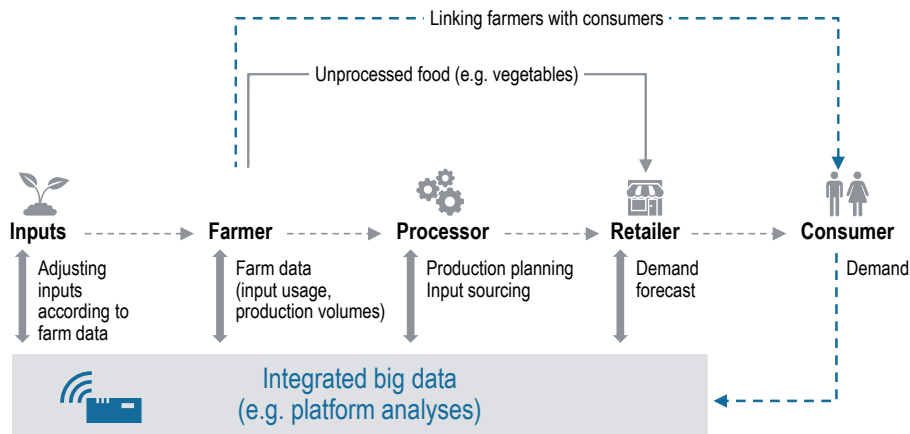
“From our perspective, we see blockchain and decentralisation as huge game changers in the agri-food sector.” – CEO of a company developing innovative technologies for integration along the value chain

“Digitalisation can increase consumer trust by ensuring transparency along the whole agri-food value chain.” – Founder of a company developing innovative technologies for food processing

However, data integration to monitor supply chains is only the first step, as holistic data integration has the potential to become the next disruptive innovation in agriculture.⁵⁶ Real-time data integration and analysis enable automation along the entire value chain, thereby reducing the cost of trade. Through shared farm inventory levels and input consumption, input producers could automatically ensure in-time resupply without intermediaries. In this way, farm inventory levels could be kept at a minimum, input producers could accurately plan production and the margin paid to intermediaries could be saved. Linking agri-food producers with processors or retailers has similar efficiency effects. When processors or retailers share planned demand with farmers, it reduces farmers' uncertainty regarding crop/livestock choices, quantities and prices. At the same time, farmers can transmit their expected supply (quantity and quality) to help processors and retailers plan their supply sources, shrinking again the role of intermediaries. Hence, real-time data integration and analysis could enable a sustainable, lean and accurate agri-food chain.⁵⁷

An evolving topic in relation to the agri-food value chain is the provision of holistic agri-food platforms. At the time of this study, three of the companies interviewed were aiming to become or enable platforms in the agri-food sector. Conceivable options include large-scale platforms that directly link agri-food producers with consumers, or retailers that act as a platform and steer the entire chain with their demand forecasting. Using big data algorithms, platforms could source the production according to their demand forecast. The demand forecast is derived from aggregated consumer data, while integrating individual farm management data for all farms that are active on the platform optimises production. By analysing the integrated farm data, algorithms can allocate the best fields and input combinations per crop and generate production plans accordingly. To ensure the use of correct inputs, platforms would need to provide all required inputs to the farmers, such as seeds (livestock), pesticides (medication), and fertiliser (feed). Moreover, algorithms can be deployed to determine the sowing (growing) and harvesting (slaughtering) point in time. Platforms appear to be the data-driven solutions that have the most potential for disruptive effects on efficiency parameters in the agri-food chain (time to market, quality, waste, etc.).

Figure 21: Schematic overview of data integration along the agri-food value chain



⁵⁶ Estes, 2016, for the significance of high-performance computing as an enabling technology for R&D see also EIB, 2018e.

⁵⁷ Pierce, 2013

Although the global view is positive, the effects of value chain transparency and data integration on individual chain members is the subject of debate. These solutions not only have the potential to re-shape agricultural value chains, but also to re-shape profitability among market players. However, agri-food producers feel threatened by the idea of remaining only labour and field/stable providers in the production chain. In addition, complete transparency regarding inputs, production parameters and outputs reveals their production and financials, putting them in a weak negotiating position, which is not an incentive to share data. Interviewees also said that farmers are very sensitive about their data. Thus, a solution might be “farmer-governed data cooperatives”, like GiSC, the Grower Information Service Cooperation, which provides secure data storage and anonymises farm data. GiSC members can aggregate and benchmark their operational data with that of other members,⁵⁸ benefiting from data integration and analyses, while still being able to decide on their level of transparency. Data ownership or transparency most likely influences the effects of integrated data-driven solutions in the agricultural value chain. Therefore, data cooperatives might offer a solution to the problems associated with data and privacy. It follows that prospective challenges concerning data integration appear to be simultaneously technical, analytical and managerial.⁵⁹

In summary, data-driven solutions have the potential to disrupt agricultural value chains, but there are outstanding challenges such as data ownership and the degree of transparency.

VOICES FROM THE SECTOR

“Digitalisation is set to disrupt traditional value chains; transparency on the input and output data of agri-food producers can unlock high productivity potential. However, producers (farmers) are the ones most likely to see their margins shrink as a result of transparency.” – CEO of a company offering digital technologies for smart production

“We want to directly connect the farmer with the consumer. This will make the agri-food producer less dependent on retailers and empower the farmer to differentiate his product not by price, but by quality.” – CTO of a company developing innovative technologies for integration along the value chain

Innovations in the food processing part of the value chain aim to increase consumer health and digitally connect processing facilities, while also targeting increased energy and resource efficiency

The development of healthy food ingredients reflects the general trend towards a healthier lifestyle.⁶⁰ As a result, the development and production of food ingredients is a promising and growing subsector of the food processing industry.⁶¹ Study participants active in the field reported a reasonable level of interest from large industry players. According to the British Food Foundation, “functional foods deliver additional or enhanced benefits over and above their basic nutritional value.”⁶² One example is yoghurt enriched with pre- and probiotics to improve consumer health.⁶³ Functional food may lead to personalised nutrition, and several young enterprises already claim to provide personalised nutrition plans using big data algorithms.⁶⁴ The healthy food trend is driving clean and sustainable

⁵⁸ <https://www.gisc.coop/about/>

⁵⁹ Musher, 2016

⁶⁰ Nielsen, 2015b

⁶¹ Business Insider, 2014

⁶² British Nutrition Foundation, 2018

⁶³ Danone Nutricia Research, 2018

⁶⁴ Habit, 2018; Nutrino, 2018

food processing practices (non-GMO, free of gluten or animal derivatives, etc.).⁶⁵ Insect-based burger patties, for example, have intensified attention on innovative animal protein substitutes.⁶⁶

However, most of the larger food processing companies⁶⁷ surveyed in this study are focusing on incremental product innovations or variations of existing products with low fat/sugar. In the same manner, they consider digitalisation to be mainly for the purpose of efficiency increases in production processes rather than for product innovation.

VOICES FROM THE SECTOR

“We develop products that increase the health of consumers – for example healthy fibres and proteins.” – Research director of an innovative food processing company

“We have invented a new extruding technology that enables us to produce texturised plant protein that mimics chicken perfectly.” – CEO of an innovative food processing company specialised in producing meat substitutes

“The digitalisation of our production is the main trend in the food processing sector. Digitalisation might also change the relationship with the customer.” – Financing expert from a mid-cap food processing company

“Many of the technologies still used today in food processing, e.g. in fermentation, are already archaic. The potential for increases in energy and resource efficiency are massive.” – Market analyst, strategic agri-food investor

In packaging, bio-based and biodegradable materials are a key area of innovation activity

These materials have the potential to significantly reduce waste and the use of non-renewable resources, and follow the trend of increasing sustainability awareness. The EU has outlined the importance of bioplastics in several strategies for promoting cleaner technologies to fight climate change, such as the Europe 2020 strategy.⁶⁸ The FOOD 2030 initiative also prioritises the circularity and resource efficiency of food systems. In 2017, the German Government approved a new law encouraging the use of recycled material or material from renewable sources in packaging.⁶⁹ It came into force in 2019 and may motivate other EU countries to follow suit.

However, the sector is dominated by incremental product innovations. Of the nine innovative packaging companies interviewed during the study, only four were developing bio-based or biodegradable packaging materials. Uncertainty about consumers' willingness to pay was mentioned as a major reason for primarily incremental innovations. A common view is that there is an ongoing trend towards sustainability, but the willingness to pay for it remains unclear. According to the CEO of a packaging company: “Consumers say they want bio-packaging, but they don't say that they'll pay for it.” Therefore, financial support could help the uptake of cleaner technologies.

According to packaging producers interviewed for this study and in line with arguments for incremental innovations, digitalisation in packaging relates mainly to improvements in production. Increased data monitoring and analyses are used to optimise production management as well as lean inventory management.

⁶⁵ Wiklund, 2015

⁶⁶ DW, 2017

⁶⁷ Turnover > €100 million

⁶⁸ European Commission, 2018e; European Bioplastics, 2018

⁶⁹ European Bioplastics, 2017

VOICES FROM THE SECTOR

“Our main success factor within the food packaging industry is our strong product innovation. We are currently developing biodegradable polymers that can be used as a sustainable alternative to regular plastic packaging.” – CEO of an innovative packaging company

“We have developed a technology in real life that can replace 99% of all plastic packaging solutions.” – Board member of an innovative packaging company

“Digitalisation and big data analysis are mainly applied within production processes, supporting us with better monitoring and forecasting to improve management and reduce outages.” – CEO of an innovative packaging materials company

4.3 Important barrier to innovation uptake: there is a significant “uptake barrier” for novel technologies and processes on the part of most agri-food producers

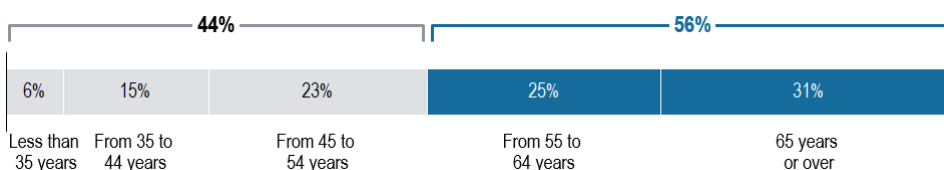
KEY TAKEAWAYS

- > **Most farmers in Europe tend to rely on tried-and-tested practices and have little professional exposure to IT-based innovation, making the uptake of data-driven innovations difficult**
- > **However, given the risk that innovations often pose to the revenue model of many producers, reluctance to take up disruptive technologies is often rational and justified**

Most farmers in Europe tend to rely on tried-and-tested practices and have little professional exposure to IT-based innovation, making the uptake of data-driven innovations difficult

This can partly be explained by the age of Europe's farmers (see below). The age of farmers differs widely between European countries: 72% of Austrian farmers are younger than 55, while in Portugal 74% of farmers are at least 55 years old. Across the continent, 56% of all farmers are 55 or older, with 31% being 65 or older. This means that most European farmers were trained and educated before digital tools became widespread. However, the data indicates that a generational change in the European farming sector may occur soon. According to the agri-tech companies interviewed, this represents an opportunity for the uptake of data-driven solutions. Younger generations grew up in a digital environment and so many have a basic understanding of technology. One study participant put it this way: “We recognised that our commercial success depends significantly on the farmers’ familiarity with technology. So, we place hope in the next generation and are trying to familiarise farmers with technology at the same time. Unfortunately, we’re having some difficulties with the latter.”

Figure 22: Age of farmers in the EU



Source: Eurostat

VOICES FROM THE SECTOR

“There is strong resistance to change among farmers. This has to do with the fact that the average farmer is more than 55 years old.” – Director of an IT company offering smart farming solutions

However, given the risk that innovations often pose to the revenue model of many producers, reluctance to take up disruptive technologies is often rational and justified

As outlined in the findings of this study, farmers are often a weak link in the agri-food value chain. They fear giving away even more bargaining power if they share their data along the value chain. As the outcome of a new technology can often only be assessed once per year, this makes it risky for farmers to test unproven technologies. As interviewees said in the study, “In the end farmers take a risk on our innovation.” In other words, implementing innovation may put an entire harvest in jeopardy, whereas the innovator remains relatively unaffected. Consequently, farmers' scepticism towards entirely new and disruptive technologies is reasonable, but not impossible to overcome.

VOICES FROM THE SECTOR

“Once implemented, farmers depend fully on our technology. In a way, it is not us as developers who take on the risk of our technology, but the farmers. And from experience, new technologies do have minor bugs at the beginning – making it difficult to find first adopters.” – CEO of a small-scale agri-tech company

“As soon as an innovation is proven to function and to be of value to the farmer, many farmers aim to implement it. But it is hard for an innovation to reach that point.” – CFO of a large European agri-food producer

4.4 Protagonists of innovation: innovation is most intensively driven by highly agile small-scale companies

KEY TAKEAWAYS

- > **Data-based, digital and potentially disruptive innovations are largely driven by start-up and post-start-up companies**
- > **Larger, well-capitalised industry players tend to take up these innovations through open, collaborative platforms and other knowledge-transfer approaches**
- > **Although this “ecosystem” of smaller and larger companies is functional, it does not enable state-of-the-art European research and innovation to be fully leveraged across different countries and subsectors of the industry**

Data-based, digital and potentially disruptive innovations are largely driven by start-up and post-start-up companies

Of the 18 agri-food companies with data-driven innovations in our study, only one company generates revenues above €50 million. This figure even includes revenues from data-driven solutions for sectors other than agri-food. Two thirds (67%) of the companies developing data-driven innovations generate revenues below €1 million. In this context, the European Big Data Value Forum states, “The landscape of stakeholders exhibits an interesting game between powerful tech companies, venture

capitalists and often small start-ups and new entrants.”⁷⁰ Strong tech companies investing in agriculture are mainly US-based, such as IBM, Google, Microsoft, etc.⁷¹

Two examples from our interview sample illustrate the typical business models of digital small-scale companies. Agrivi, a company that provides fully integrated farm management software (see Case Study in the Executive Summary), offers three different subscription models, ranging from USD 29 to USD 99 per month. Another company, Tagologic, offers a tool enabling consumers to scan a barcode to access information about the supplier, contents, origin and production process of a specific product. The service is paid for by the vendor on a per-tag basis.

VOICES FROM THE SECTOR

“The transformation of the sector comes from small-scale companies.” – Director of an agri-food research platform

“Unless we see more of the small disruptive innovators getting off the ground, we will not overcome the inertia of the sector. We need a system change across all subsectors of the industry. It is one minute to 12 to change the industry.” – President of an agri-food innovation consortium

Larger, well-capitalised industry players tend to take up these innovations through open, collaborative platforms and other knowledge-transfer approaches

Large established agri-food corporations are mostly well-capitalised and have the means to sustain state-of-the-art research departments, making them important drivers of innovation. However, they also typically invest considerably in building brand reputation,⁷² so that protecting reputation – for example by maintaining product safety – remains an innovation priority. Accordingly, they tend to favour continuous, process-related innovation over disruptive innovation.

As a result, agile, small-scale companies often drive disruptive innovations. To participate early in innovation and incorporate technology without risking brand reputation, large agri-food players gravitate towards setting up corporate venture capital funds or innovation platforms. In doing so, they can utilise not only their financial power, but also sector-specific human capital and knowledge. Over the last two decades, large agri-food companies have launched many corporate venture capital funds to invest in promising start-ups, such as “Danone Manifesto Ventures” or “Life Ventures by Nestlé”.⁷³ Innovation platforms for establishing partnerships with external innovators in academia and start-up companies seem to have become more popular. Nestlé started an open innovation platform in 2016 and Unilever also has an innovation platform.⁷⁴ However, agri-food corporations might be surpassed by tech companies, like Google and Microsoft, for data-based and digital innovations.

Although this “ecosystem” of smaller and larger companies is functional, it does not enable state-of-the-art European research and innovation to be fully leveraged across different countries and subsectors of the industry

Study interviewees largely believe in Europe's agri-food innovation talent, but they doubt its ability to utilise it. Besides market fragmentation, evidence of cooperation with high-quality European research is not overly apparent. As an example of beneficial cooperation, four leading universities in the Netherlands are working together to intensify collaboration in education and research, as well as to strengthen interaction with industry.⁷⁵ One of their projects is incorporated in the Dutch “smart industry

⁷⁰ Big Data Value Association, 2018

⁷¹ Plume, 2016; Reuters, 2016; Anderson, 2017

⁷² Taylor, 2017; Adage, 2015

⁷³ Danone Manifesto Ventures, 2018; Nestlé, 2002

⁷⁴ HENRiNestlé, 2018b; The Unilever Foundry, 2018

⁷⁵ 4TU, 2018

initiative” and its “field labs”,⁷⁶ and Unilever is building its “Global Food Innovation Centre” in Wageningen⁷⁷ (see box on “Sustainable Food Initiative’s cooperation with field labs”).

Cooperation between innovative SMEs and larger companies can benefit the commercialisation of innovative products. However, establishing and managing ecosystems where small-scale innovators collaborate with an established industry operator require both financial and human capital. Mid-cap companies with revenues below €500 million lack the resources of large corporations and cannot incorporate the innovation potential of small-scale companies via an innovation ecosystem.⁷⁸

The European sector may be bought out by foreign investors or become reliant on foreign products if it does not manage to scale up its own agri-food innovation. Recent developments in the consumer tech industry, where mostly US or Chinese corporations generate and own user data, underline the urgency of unified European research and reliable links with the industry.⁷⁹ European agri-food companies could become dependent on data-driven innovations from the US or China, with non-European companies owning the data. Agri-tech study participants emphasised that in a digital economy owning the data means owning the means of production.

VOICES FROM THE SECTOR

“The European market is heavily subsidised, and the status quo is well-organised by institutions and business associations – it is a well-oiled machine along the whole agri-food value chain. This makes it hard for innovative methods to succeed.” – CEO of an innovative agri-food production company

“We have a lot of talent in Europe. But I have my doubts about whether we really put this talent to use for innovation in the agri-food sector.” – Research director of an innovative food processing company

“Companies in the US are ahead because they have economies of scale that are not possible in Europe. And China will catch up very quickly and most likely overtake us on production quantity and quality and on innovation.” – Director of an agri-food advisory service

“We are exporting to many different European markets and the biggest challenge is the high degree of fragmentation within Europe. National product adaptations due to a fragmented regulatory landscape make it hard to reach a critical mass in production to achieve economies of scale.” – CEO of an innovative packaging company

“In our opinion, there is no European farming market: all countries are very different. French farms are huge in size – similar to the Netherlands, but technology use differs greatly between the two countries. For example, flying drones above fields is mostly prohibited in the Netherlands, whereas drones can fly everywhere in France.” – CEO of an agri-tech company

SUSTAINABLE FOOD INITIATIVE’S COOPERATION WITH FIELD LABS

In 2017, Unilever, Wageningen University and Research, the Institute for Sustainable Process Technology and Top Institute Food and Nutrition initiated the Sustainable Food Initiative (SFI) to

⁷⁶ Smart Industry, 2017

⁷⁷ Invest in Holland, 2017

⁷⁸ The amount spent on research and development by Nestlé and Unilever is even higher than the annual revenue of large mid-caps: in 2017, Nestlé spent €1.5 billion on research and development and Unilever spent €0.9 billion.

⁷⁹ Brown, 2015; DataFloo, 2018; The Wall Street Journal, 2017

find sustainable solutions for future food demand. Wageningen University and Research was chosen as the hub for the initiative and facilitates cooperation among researchers and innovators from knowledge institutions, corporations and start-ups on the development of sustainable food solutions.⁸⁰

In October 2018, the SFI announced a plan to closely cooperate with field labs, which typically comprise around ten companies, mostly SMEs that join forces to develop, test and implement new technologies. The field labs are created bottom-up and mostly evolve in a regional ecosystem of industry players along a specific value chain, for example dairy farming.⁸¹

In order to enter into cooperation, these field labs have to present their approach and business plan to the SFI. If the field lab's work corresponds with the goals of the SFI and it has a viable business plan including the necessary funds, the SFI offers access to its infrastructure. This mainly comprises access to experts and facilities, such as a packaging laboratory for testing sustainable packaging technologies. For example, Unilever's experts can provide off-the-shelf knowledge on aspects such as regulations outside the Netherlands. According to a food R&D expert, many companies cannot scale their innovation because they do not have the capacity to adapt a product to regulations across Europe. Therefore, Unilever's expertise as a global corporation can help the participants in a field lab grow their business beyond the Netherlands.

In turn, the SFI and its initiators benefit from cooperation with field labs because they provide a very good opportunity to test technologies that are developed in the course of the Food Innovation Centre's R&D activities. By connecting relevant experts from the field labs with researchers from knowledge institutions and corporate R&D departments, the knowledge and expertise of the users of new products and technologies can be directly involved in the R&D process and help adapt them to better fit requirements.

4.5 Focus areas for innovation in food processing and packaging: many companies focus on incremental innovation – potential of disruptive new technologies tends to be underestimated

KEY TAKEAWAYS

- > **Most agri-food processing and packaging companies aim to continuously improve their processes instead of investing in potentially disruptive technologies that could profoundly improve energy and resource efficiency, cost structures and value chains**
- > **Given that both industries are highly cost-driven and heavily asset-based, this reluctance to invest in disruptive innovations is partly due to industry structures and business models**

Most agri-food processing and packaging companies aim to continuously improve their processes instead of investing in potentially disruptive technologies

Most of the companies interviewed focus on incremental innovation (e.g. improved processing times, incremental improvements in resource inputs for production, energy efficiency measures). At the same time, interviews and market insights indicate significant potential for more disruptive innovation ready to be rolled out in the broader market. Examples include the broad-based use of bio-based packaging materials for food products, novel processing technologies like new fermentation

⁸⁰ NIZO, 2018

⁸¹ Smart Industry, 2018

processes that require significantly less energy and resource input, and digitalisation approaches that monitor entire supply chains enabling a rapid response to deficiencies in the chain, such as insufficient cooling, thereby saving food. However, the study participants largely agree that the general trend towards incremental innovation hampers sustainability improvements in the sector.

VOICES FROM THE SECTOR

“Most food processing companies are afraid of technologies that might damage their reputation. But they should not only optimise their processes, but also pay attention to improving their products.” – CEO of an innovative food processing company

Given that both sectors are highly cost-driven and heavily asset-based, this reluctance to invest in disruptive innovations is partly due to industry structures and business models

Study participants active in processing or packaging stated that incremental innovation, often in the direction of cost efficiency, is primarily the result of cost-driven and asset-based production.⁸² The business models of agri-food processing and packaging companies depend on machinery, so implementing disruptive technologies requires large investments at high risk. If technology fails, it can have significant effects on a company's performance and decrease margins. If innovation is not accepted from the demand side or new production processes damage the product, fundamental revenue losses could ensue. This also puts the company's reputation in jeopardy – a major worry for study participants. Both sectors are highly cost-driven, which acts like a brake on innovation adaptation. In this respect, participants reported an unwillingness to invest in the packaging and processing side if clients or regulations did not require it. A major reason given was that the **key differentiation criterion in agri-food remains price rather than quality**.

Another issue is that launching new (innovative) ingredients, molecules or food products takes significantly longer than reformulating existing ones, with regulation compliance part of the equation. The payback times of costs in both cases are similar (3-5 years), so the investment breakeven point of innovative new products is considerably longer. At the same time, the investment in a new food product is almost four times higher than a similar investment in a new ingredient.⁸³ This means innovative products require more time and money to enter the market, and are therefore riskier.

To some degree, regulation appears to be a reasonable means to facilitate innovation, e.g. towards sustainability. The “EU Packaging and Packaging Waste Directive” aims to reduce waste and increase sustainability in Europe,⁸⁴ while fostering sustainable technologies like bio-based and biodegradable packaging. The EU also recently approved new regulations to simplify bringing new and innovative foods to market.⁸⁵ Novel foods “can be newly developed, innovative food and food produced using new technologies and production processes [...]”.⁸⁶ In this respect, deregulation or simplification can also be a tool to enable innovation.

These measures show how European legislation, for regulation or deregulation, can influence agri-food sector innovation. In both cases, evidence is provided from study participants. Interviewees active in bio-packaging and food processing appreciated the course set by those measures.

⁸² Spinner, 2014

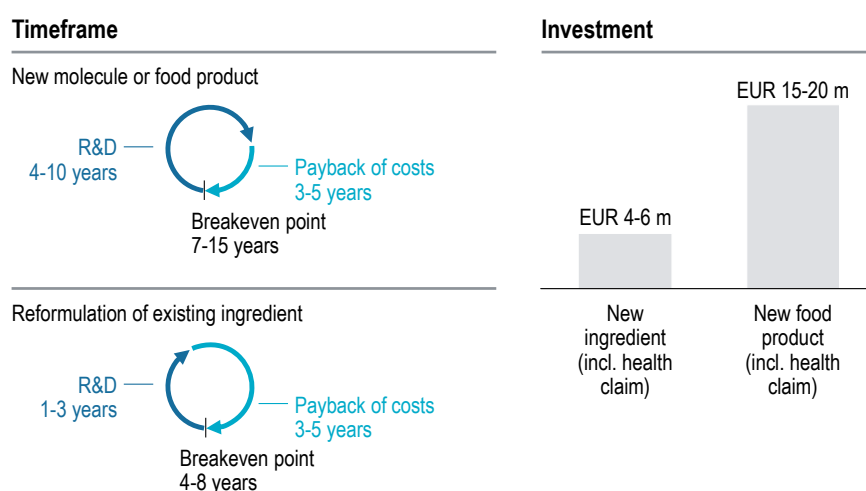
⁸³ EU Specialty Food Ingredients, 2017

⁸⁴ European, 2018

⁸⁵ European Commission, 2018h; EUR-Lex, 2015

⁸⁶ European Commission, 2018i

Figure 23: R&D and market launch



Source: EU Specialty Food Ingredients; European Food Safety Authority

VOICES FROM THE SECTOR

“Differentiation is key. In the agri-food sector, most companies differentiate more on price than on quality.” – CTO of a company developing innovative technologies for integration along the value chain

“Regulation is a huge barrier to innovation – especially given the long innovation cycles in agri-tech.” – Director of an agri-food advisory service

“The packaging industry is highly cost-driven and will not change until required by law to do so. The industry is simply not interested in digital solutions – they are deemed too risky. As long as the current system works, no one will change.” – Board member of an innovative packaging company

“Most market players have invested in large assets and they have a customer base. Thus, it is hard to convince them to change their habits and step outside their comfort zone.” – CEO of an innovative packaging company

4.6 Importance of “digital” solutions: data-driven technologies and services are key innovations for integration along the value chain

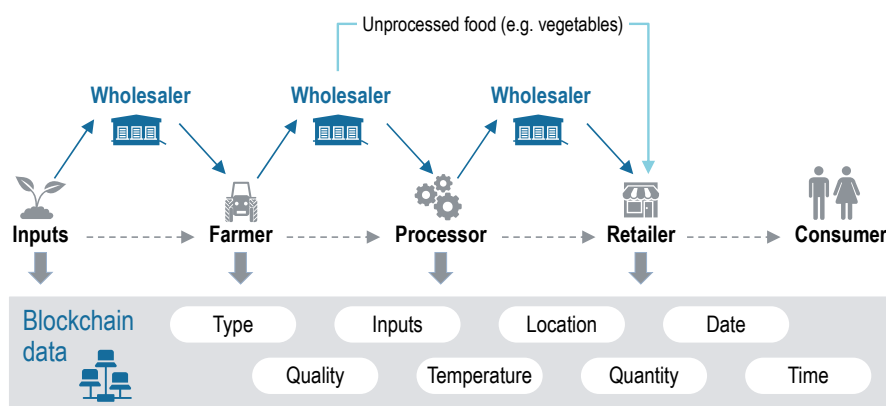
KEY TAKEAWAYS

- > **Digital, data-driven innovations for integration along the value chain are very likely to have a profound and disruptive impact on the established, rather traditional value chains in the European agri-food sector**
- > **The effective use and fast scale-up of these technologies will be of key importance for Europe's competitiveness in the agri-food sector on a global scale**
- > **A broad uptake of data-driven innovations for integration along the value chain could be fostered by setting fair rules on data ownership and data protection that incentivise data-sharing**

Digital, data-driven innovations for integration along the value chain are very likely to have a profound and disruptive impact on the established, rather traditional value chains in the European agri-food sector

Today's agri-food value chain comprises many transactions between different stakeholders in the agri-food subsectors, including wholesalers and intermediaries for commodities, equipment and processed goods. These transactions generate costs as every additional player wants a share of the profits and every additional transaction increases the risk of incorrect product handling or fraud, as demonstrated by the scandal of horsemeat in lasagne in 2013.⁸⁷ Study participants and researchers are convinced that data-driven innovations can reduce both sorts of transaction costs by increasing efficiency and transparency.⁸⁸ One innovation many study participants pointed to was distributed ledger technologies⁸⁹ like blockchain. According to agri-food experts, blockchain technology can increase transparency in agri-food value chains because it stores all transactions immutably allowing them to be traced. It can also increase efficiency by replacing cost-intensive paper or traditional IT reporting, while also reducing the risk of fraud, corruption and data tampering.

Figure 24: Blockchain in the agri-food value chain



Source: Eurostat

VOICES FROM THE SECTOR

“Blockchain and decentralisation are important game changers. Their influence on the sector will be huge.” – CEO of a company developing blockchain-based technologies for integration along the agri-food value chain

“Blockchain is one of the most important innovations in agri-food because it can solve the problem of information asymmetry.” – Director of an agri-food advisory

However, blockchain and similar distributed databases are still emerging technologies, especially in sectors other than the financial industry (see box on “Challenges in applying blockchain technology in agri-food”).

⁸⁷ BBC News, 2013

⁸⁸ De Clercq, Vats & Biel, 2018

⁸⁹ Distributed ledger technology: a distributed ledger is a database of transactions that is shared and synchronised across multiple computers and locations – without centralised control. Each party owns an identical copy of the record, which is automatically updated as soon as any additions are made (SAP, 2018).

CHALLENGES IN APPLYING BLOCKCHAIN TECHNOLOGY IN AGRI-FOOD

Blockchain technology's potential impact on agri-food value chains was demonstrated by a pilot study conducted as a public–private partnership project by Wageningen Economic Research and TNO, with 12 other organisations.⁹⁰ The study created a proof of concept for using the technology along the agri-food value chain for table grapes. It showed that blockchain technology can be used to keep track of different certificates (e.g. on organic cultivation) involved in the table grapes supply chain from producer to the consumer, including farmers, certification authorities, auditors, traders, shippers and retailers.

Both market participants and literature point to a number of challenges related to the application of blockchain technology in the agri-food sector.

- > **Scalability:** all transactions conducted via distributed ledger technology are stored in “blocks” that add to previous transactions, forming a blockchain. This results in the high traceability of each transaction but also limits the number of transactions that can be processed per second. For successful implementation in the agri-food sector, the blockchain technology must be able to handle greater data throughput than is currently possible.⁹¹ Storing all transactions also means that blockchains increase in size over time. For example, the current size of the blockchain for the cryptocurrency Bitcoin is over 165 gigabytes.⁹² As every user has a complete copy of the blockchain, keeping the size manageable for all users is a challenge for the scalability of blockchain technology.
- > **Privacy:** total transparency is a key feature of blockchain technology. All transactions are visible to all users because everyone has a complete copy of the blockchain. Since almost every business depends on some degree of opacity, this feature is a liability in its application to business processes. Therefore, the technology must be adapted for agri-food applications to ensure business confidentiality by making transaction data only visible to the relevant subset of users/businesses.
- > **Interoperability:** for the adoption of blockchain-based technologies in the agri-food sector, it is essential that the blockchain is able to communicate with the current legacy systems of all users. Additionally, different blockchain architectures should be interoperable to allow different blockchain-based applications to be integrated.

The effective use and fast scale-up of these technologies will be of key importance for Europe's competitiveness in the agri-food sector on a global scale

Over the last decade, the European agri-food industry has slightly increased its world market share, while value added and labour productivity in the sector have weakened. A likely explanation for this contradiction is that the high-quality reputation of Europe's agri-food sector has compensated for the decreasing labour productivity.⁹³ Blockchain-based integration could increase both the efficiency and the transparency of the European agri-food sector.⁹⁴ Agri-tech interviewees agreed that with data-driven technologies, labour productivity could be strengthened while still increasing the quality and security of European agri-food products.

VOICES FROM THE SECTOR

⁹⁰ Ge, Brewster, Spek, Smeenk & Top, 2017

⁹¹ Also see EIB, 2018e

⁹² Blockchain, 2018

⁹³ ESCIP Consortium, 2016

⁹⁴ Ge, Brewster, Spek, Smeenk & Top, 2017; De Clercq, Vats & Biel, 2018

“Digitalisation can increase the trust of consumers by making the whole food production process more transparent.” – CEO of an innovative food processing company

“Digitalisation is set to disrupt traditional agricultural value chains. Transparency on the input and output data of agri-food producers can unlock high productivity potential.” – CEO of a small-scale company offering digital innovations for integration along the value chain

4.7 Importance of specialisation and sector experience on the financing side: lenders and investors in the agri-food market need to be highly proficient and must be able to provide “patient capital”

KEY TAKEAWAYS

- > **Lenders and investors must know how to manage the risks associated with high volatility and they must be able to provide “patient capital”**

Strong seasonality and high volatility of market prices largely determine the revenues and cash flows of agri-food producers. Furthermore, margins in agri-food production and processing are typically low and innovation cycles are long, resulting in returns on investment below the market average. In our sample, 60% of agri-food production and processing companies reported positive EBITDA margins below 10% and 27% reported negative EBITDA margins (see below). Since there are many post-start-up and innovative companies in the sample, it is no surprise that some of them do not generate profits. However, interviewees from the financing side have confirmed that both agri-food production and processing are often low-margin sectors compared to other sectors such as software or pharmaceuticals. These sectors are comparable due to the role of software (e.g. blockchain) in future agriculture and that development of new food ingredients or functional food is similar to pharmaceutical development (high CAPEX; time to market of up to ten years; investment paybacks after 15 years). Pharmaceutical businesses have high R&D expenses, but typically achieve high prices with their products, which are protected by patents.

Figure 25: EBITDA margins of agri-food innovators in the production and processing sector

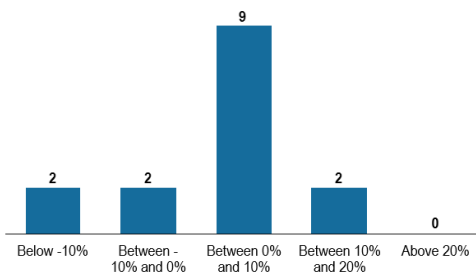
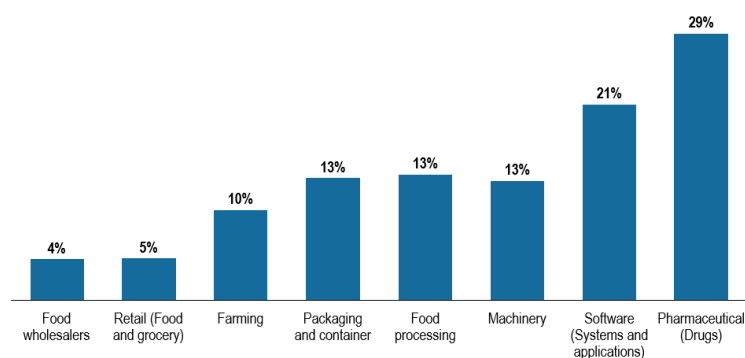


Figure 26: EBITDA margins of selected industries in Europe 2017



Source: NYU; Roland Berger

VOICES FROM THE SECTOR

“In agri-business, you can forget about the revenue in the business plan: the price depends on global markets and the quantity on the weather. What you can look at is the margin, except if you have a company that sells branded products.” – Head of debt financing of a large cooperative bank

“You need to be patient if you want to invest in the agri-food sector. Being a successful investor in agri-food is more difficult than in other sectors.” – Managing director of a venture capital fund

Lenders and investors must therefore know how to manage the risks associated with high volatility and they must be able to provide “patient capital”

Nearly all of the financing and funding institutions interviewed stressed the importance of in-depth sector knowledge and highly specialised teams. For banks, it is important to be familiar with the specifics of the agri-food sector to manage the higher risks associated with lending to innovative companies. Sector-specific knowledge enables lenders to better assess the chances of success for particular innovations and deal with their risks. This not only includes knowledge about farms and farming, but also awareness of how to refinance loans via sector-specific instruments.

Equity investors should consider agri-food sector characteristics when determining holding periods. According to a European venture capital fund specialising in innovative agri-food companies, long innovation cycles and high market volatility require “patient capital”. The fund cites an average holding period of nine years, which is much longer than the market average of six years⁹⁵ and even longer than that determined by the recent study on Key Enabling Technologies (KET) (holding market average of five years).⁹⁶ In financing, banks report maturities of up to 30 years for farmland acquisitions. Even for buildings (e.g. cowsheds), they calculate with terms of up to 20 years instead of ten years as in other sectors. Similarly, banks indicate longer investment periods for agri-food innovations. In their opinion, secured investments are important and require an especially sophisticated resource and equity base. “Patient capital” is once again essential.

⁹⁵ Lewis, 2017

⁹⁶ EIB, 2016a

VOICES FROM THE SECTOR

“If you look at our fund, the average holding period is nine years. This is a very long period. Other funds come from the digital or the finance industry and are not used to holding equity in companies for a period that long.” – Managing director of a corporate venture capital fund

“We finance projects that other banks wouldn't finance, because they are not as familiar as we are with this kind of business. But I wouldn't call this more risk-prone; it is due to the fact that we know the sector very well.” – Director of agri-banking section of a public bank with a specialised agri-food team

“We know how the businesses think and therefore we can also assess the risks.” – Head of syndicated loans section of a cooperative bank

“The plants need longer maturity periods. The better the credit standing, the more you are also in the position to shape the conditions. The art is to mitigate volatility in the business model through solid asset-backed securities and repurchase deals.” – Head of debt financing section of a large cooperative bank

“In the agri-sector, longer maturity is necessary. For land it's up to 30 years, but also for buildings like cowsheds it's up to 20 years, as opposed to five-to-ten years in other branches of the economy. Payback in agricultural commodity production is quite slow. Investing in brand new technologies must be secured with more own resources or equity.” – Director of agri-banking section of a public bank

4.8 Structure of the funding landscape: the European funding landscape is fragmented and highly complex

KEY TAKEAWAYS

- > **Despite the significant demand for agri-food financing and funding as well as a wide range of respective offerings from financial institutions, supply does not meet the market's demand in an effective way**
- > **High administrative burdens, difficult access to information and the complexity of the “ecosystem” of available instruments prevent a more effective use of existing offerings**

Despite the significant demand for agri-food financing and funding as well as a wide range of respective offerings from financial institutions, supply does not meet the market's demand in an effective way

While established market players can usually rely on a network of financing and funding institutions, small-scale post-start-up agri-food companies mostly have trouble navigating Europe's multilevel financing and funding landscape. Communication about the offerings of the EIB and related institutions has improved in recent years, but market participants have often not heard of specific instruments for agri-food innovations like the EIB's Agriculture and Bioeconomy Programme Loan.⁹⁷

⁹⁷ EIB, 2018f

The EC's Framework Programmes for Research and Technological Development (currently Horizon 2020) are widely respected as an essential instrument for funding cutting-edge basic research. However, the programmes so far were not intended to fund innovation on a broad scale and do not finance the scale-up of marketable innovations. Study participants confirmed the framework programmes' overall impact on financing innovation in the agri-food sector is limited. The FOOD 2030 initiative⁹⁸ might help as it will concentrate and consolidate agri-food measures and thereby increase the focus on the agri-food sector.⁹⁹ In addition, in the new Horizon Europe proposal, the European Innovation Council (EIC) plans to provide new financial tools including venture capital.¹⁰⁰

Besides framework programmes, a wide range of financing and funding instruments are available on European, national and regional levels.¹⁰¹ These instruments are set up with different objectives and therefore require applicants to meet widely differing conditions. Small-scale companies that operate with a limited staff often fail in selecting the right instruments for their specific needs.

Most market participants are also unaware of the EIB and EIF offerings – not surprising given the EIB usually provides indirect financing to small-scale and mid-cap companies.¹⁰² In this respect, interviewees agreed that the advice offered under the InnovFin Advisory programme can facilitate an adequate overview of financial concepts tailored to individual situations and requirements.¹⁰³

Study participants also appreciated the InnovFin SME Guarantee Facility, which helps them to access loans, leases and guarantees between €25,000 and €7.5 million.¹⁰⁴ In the same manner, the EIB is working with (e.g. through the European Investment Advisory Hub) and supporting the collaborative initiative EIF-NPI Equity Platform.¹⁰⁵ This is a promising initiative as it aims to share knowledge and best practices between the EIF and NPIs or banks (NPs) across EU Member States. By coordinating national institutions and banks, the initiative can facilitate smaller loan sizes and support defragmentation of Europe's innovation financing. As depicted throughout this finding, SMEs in this study largely favour defragmentation of European financing instruments and public and private equity markets.

VOICES FROM THE SECTOR

“The communication of different instruments and programmes should be improved. For us it was very difficult to see what projects or programmes were best suited.” – CEO of an innovative agri-food company

“The EIB has become more visible in recent months and has shed more light on its different facilities. However, we hope that the process is not finished yet – the EIB could further improve the overview of their different facilities and their respective eligibility criteria.” – CEO of an innovative processing company

“One of major problems with Horizon 2020 is the long time between application and money disbursement. If companies wait for money, their innovation will be lost.” – CEO of an innovative packaging company

⁹⁸ European Commission, 2016b

⁹⁹ Fit4Food 2030, 2018

¹⁰⁰ <https://ec.europa.eu/research/eic/index.cfm?pg=home>

¹⁰¹ EIB, 2018d

¹⁰² EIB, 2018c. Products for early-stage enterprises and SMEs are "indirect" and therefore offered by financial intermediaries.

¹⁰³ While InnovFin's Light Project Advisory programme is not set up for information dissemination, it does include advice on financial instruments as well as funding sources and their eligibility criteria, see EIF, 2018e.

¹⁰⁴ EIF, 2018d

¹⁰⁵ EIF, 2018c

“We also talked to private equity, but the problem is, they just want to talk to you. If they see you make at least €500,000 turnover – then it starts to be interesting for them.” – CEO of a small-scale company developing digital technologies for smart production

High administrative burdens, difficult access to information and the complexity of the “ecosystem” of available instruments prevent a more efficient use of existing offerings

Since public funding is meant to benefit society at large, grants usually come with many strings attached, and so market participants find publicly-funded projects overly complex and cumbersome. These administrative hurdles are difficult to overcome. Small-scale companies in particular report frustration with application procedures as they lack the resources to efficiently handle complex application and reporting requirements. Some study interviewees even indicated distress resulting from the EU's financing landscape as a reason for choosing private or commercial lenders.

VOICES FROM THE SECTOR

“We sought funds - nationally and on EU level. We even spent a lot of money on consultants to teach us how to make a correct application for EU funds. But, in the end, we never succeeded.” – Board Member of an innovative packaging company

“There has been a good effort to reduce the administrative hurdles for Horizon 2020. Still, the timing of an application could be compressed.” – CEO of an innovative packaging company

“We decided against EU funds because, for that, we would have had to cooperate with too many other companies.” – CEO of an innovative food processing company

“In general, getting grants is very difficult - the relevant institutions and their respective grants are a maze that is hard to navigate.” – CFO of an innovative agri-food company

4.9 Market structure on the financing side: financing in the European agri-food sector is mainly offered by a small group of specialised banks; only a few equity investors have so far entered the market

KEY TAKEAWAYS

- > **Established agri-food companies that are seeking bank loans can rely on a financial ecosystem comprising a small number of specialised banks that are well-adapted to the market conditions and often supported by guarantees from public banks**
- > **There are only a few specialised equity investors that have the required sector-specific knowledge and experience to invest in disruptive agri-food innovators**

Established agri-food companies that are seeking bank loans can rely on a financial ecosystem comprising a small number of specialised banks that are well-adapted to the market conditions and often supported by guarantees from public banks

Established agri-food companies typically rely on bank loans to finance innovative investments, because they often have a financial track record and long-standing relationship with at least one bank. Since sector-specific knowledge is essential, the national agri-food lending landscapes are usually divided among a small number of banks with specialised agri-food teams. This enables the banks to adapt to the specific conditions of the market. Specialised agri-food banks also have experience with

arranging securities from public banks, thereby providing access to financing for agri-food companies that less specialised lenders would be reluctant to finance.

VOICES FROM THE SECTOR

“We have a specialised agri-food department with approximately 100 people. Therefore, we are able to soundly assess risk and finance agricultural companies on the primary level.” – Director of agri-banking section of a public bank

However, there are only a few equity investors that have the required sector-specific knowledge and experience to invest in disruptive agri-food innovators

Due to long innovation cycles and slow uptake of innovation, the scalability of new products and services in the agri-food sector takes longer than in other sectors, and low margins diminish the returns of private equity investors. Investors with a background in digital consumer technologies must lower their expectations regarding the scalability and returns of innovative agri-food companies. Despite the EU's progress in creating a single market, fragmentation along national borders still slows down the scalability of business models. Furthermore, successful investing in innovative agri-food companies requires longer holding periods than usual. Since most equity investors lack the knowledge to assess the potential of innovative agri-food companies and to handle the specifics of the agri-food market, the agri-food financing system lacks equity capital.

VOICES FROM THE SECTOR

“We do invest in spin-offs from universities, but they are simply too small at the beginning. Our economic model favours the bigger tickets. If you invest in early-stage companies, you need to cover a lot of them to spread your portfolio. However, I am pretty sure that for every good innovation there are some specialised investors.” – Managing partner of a private equity fund focusing on investments in the agri-food sector

“Even venture capital investors in Europe are very conservative: we are now struggling for €5 million in equity. American VC investors would have been willing to provide us with USD 25 million if we'd moved our operations to the US.” – CEO of a company developing innovative technologies for integration along the value chain

4.10 SME innovator's typical need: small-scale innovators in the agri-food sector are primarily looking for “intelligent money” from equity investors

KEY TAKEAWAYS

- > **Small-scale, disruptive agri-food companies typically need long-term equity investors if they want to quickly scale up their business**
- > **These companies not only need capital, they are specifically looking for an investor with industry knowledge and relevant networks**
- > **Hence, disruptive innovation in the agri-food sector depends on a vibrant ecosystem of specialised equity investors which offer capital and knowledge – in short, "intelligent" money**

Small-scale, disruptive agri-food companies typically need long-term equity investors if they want to quickly scale up their business

Post-start-up companies typically cannot obtain bank loans because they lack a financial track record and often do not generate steady returns and have negative cash flows. In our interviews, 58% of the agri-food companies with revenues below €1 million reported negative EBITDA margins. In fact, debt appears to be the wrong instrument for companies that do not (yet) generate returns that can be used for repayment. Instead, some of the post-start-up companies have stated the need for high-risk equity investors like venture capital funds to finance them until they become profitable.

VOICES FROM THE SECTOR

“Asking banks for funding is only possible when you've generated the first stable, longer-term revenues.” – CEO of a small-scale company developing digital technologies for smart production

“We went through the start-up ecosystem on the EU level in 2013-17; beyond that we are looking at the Horizon 2020 calls. When we applied to commercial banks, we had to be liable for everything – almost the same as taking a private loan actually.” – CEO of a company developing blockchain-based technologies for integration along the agri-food value chain

“We never took loans – always equity. With the risk profile of the company we were not able to raise debt in the early stages.” – CFO of an innovative packaging materials company

These companies not only need capital, they are specifically looking for an investor with industry knowledge and relevant networks

Sector-specific knowledge of a potential investor appears to be one of the main selection criteria for small agri-food innovators. They want to be sure the investor understands the sector before discussing financial conditions like a possible equity share in return for the investment.

Investors with in-depth sector knowledge are perceived as providing much added value to an agri-food company. They are trusted to stay on board for a longer period, accommodating the long innovation cycles, to offer expertise and to act as a valuable sparring partner and mentor. Thus, the investor can help improve the team's product and increase its marketability. Study participants also said sector-specific investors can help them access relevant industry networks. Overall, they have the potential to make market entry and business development easier, as well as helping companies scale up faster.

VOICES FROM THE SECTOR

“We wanted to have the right people on board. The investors should understand our business and support it with their experience. Thus, the network perspective was very important for us.” – CEO of an innovative food processing company

“An important criterion for selecting an investor was the added value: investors with strong knowledge of the agri-food sector are more flexible and can support us much better.” – CEO of a company offering digital technologies for smart production

Hence, disruptive innovation in the agri-food sector depends on a vibrant ecosystem of specialised equity investors which offer capital and knowledge – in short, “intelligent” money

While public funding for basic research is key for generating a steady flow of innovative ideas and disruptive technologies, private equity investors are needed to support the development, market entry and scale-up of innovative agri-food companies. As study participants emphasised, equity investors not only provide capital but can also play a role in guiding the companies' management teams – especially if these companies lack business know-how. During the study, investors pointed out that agri-food innovators are not always good entrepreneurs. Therefore, equity investors with sector-

specific experience are important to further improve the strategies and business plans of small-scale innovators. In this respect, profound market knowledge and agri-food specialisation contribute significantly to the eventual success of equity investors.

VOICES FROM THE SECTOR

“There is quite a need in the early phase of innovative agri-food companies not only to provide finance but also to offer support. As an investor, you not only need to identify the best companies, but you must also bring them up to world-class level.” – Financing expert of an innovation centre run by a commercial bank

“We need to start this bottom-up, with courses on entrepreneurship in the agri-food sector. Innovators in Europe are often not good entrepreneurs.” – Principal of a venture capital fund

“We are seeking an investor who understands the market and our business model. An investor who provides access to capital as well as relevant industry networks and can provide some advice, mentoring and guidance.” – CEO of a small IT and data management provider for agri-food companies

4.11 Financing gap: a visible financing gap (“valley of death”) exists regarding the effective scale-up of smaller companies in the revenue bracket of €0.25-5 million per annum

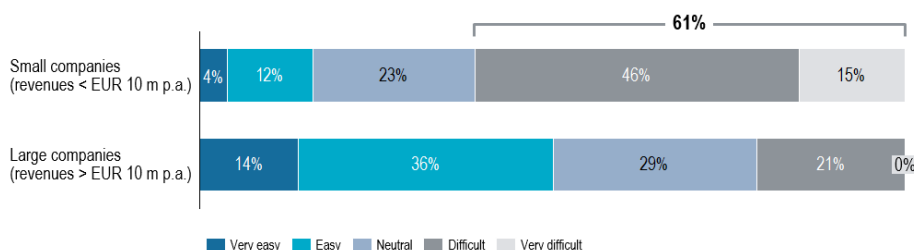
KEY TAKEAWAYS

- > **Small companies in the post-start-up/scale-up phase that require investments of more than €0.25 million have problems accessing finance**
- > **In contrast, start-up and pre-start-up financing is relatively abundant via incubators, accelerators, research centres and EU research programmes**
- > **Larger-scale companies typically finance their innovation-related activities through cash flows from their operations or through debt financing by commercial banks without significant access-to-finance problems**

Small companies in the post-start-up/scale-up phase that require investments of more than €0.25 million have problems accessing finance

During the interviews, 61% of small agri-food companies with revenues below €10 million per year reported that obtaining financing had been “difficult” or “very difficult”. These companies have typically developed their innovation and are setting up final pilots or entering the market.

Figure 27: Access-to-finance difficulties



VOICES FROM THE SECTOR

“The rationale behind the valley of death: it’s much easier to get grants that are small. But then companies need a certain amount of money to finish the job – making the product marketable and scaling their business.” – Financing expert of an innovation centre run by a commercial bank

“If I didn’t have the money myself, I don’t know if my company would still exist.” – CEO of an IT solutions provider for agri-food producers

“We have noticed together with the private sector that there is a gap in the middle, in the range of €0.5 million to €2 million.” – Director of a public enterprise fund

“There is a financing gap when innovative companies want to scale up, there is a valley of death, there is no bridge over it.” – Financing expert of a national public bank

In contrast, start-up and pre-start-up financing is relatively abundant via incubators, accelerators, research centres and EU research programmes.

More than half of all small companies in our study used public grants during the seed and start-up phase of their company. They reported problems mainly in the scale-up phase when they tried to grow their business and enter the market on a broader scale. Small companies that reported access-to-finance difficulties were looking for between €0.25 million and €1.5 million. Financial institutions agreed that there is a visible funding gap when it comes to growth money.

VOICES FROM THE SECTOR

“You almost have too much financing on the incubator level. But when it comes to further developing innovative companies and scaling up, there is a financing gap.” – Managing director of a corporate venture capital fund

Larger-scale companies typically finance their innovation-related activities through cash flows from their operations or through debt financing by commercial banks without significant access-to-finance problems

Only 21% of the larger-scale companies with annual revenues above €10 million reported that obtaining access to finance had been “difficult” and none found it “very difficult”. A solid revenue base enables these companies to finance many innovation-related activities out of their own cash flow. Whenever an investment is too large to be financed like this, these companies normally boast a solid financial track record so they can obtain financing via loans from commercial banks.

VOICES FROM THE SECTOR

“We finance our innovations out of cash flow; only sometimes are bank loans necessary.” – Financing expert of a large agri-food company

“I do not see how a functioning business with a sound track record could have issues with securing financing for innovations.” – Financing expert of a medium-sized packaging company

“We are able to finance our business, R&D and investments fully from our own cash flow.” – CEO of a medium-sized packaging company

“For us, access to finance is not a topic we are interested in – we don’t have problems refinancing innovations.” – CEO of a medium-sized company developing innovative products for the food processing industry

4.12 Barrier for digital innovators: digital innovators find it hard to obtain the necessary financing

KEY TAKEAWAYS

- > Although they are often the drivers of significant innovation, businesses focusing on digital, data-driven offerings find it hard to obtain adequate access to finance, often due to the lack of collateral and a track record, and an unproven business model
- > The long lead times for innovation in the agri-food sector exceed most venture capital investors' rather short-term-driven profitability expectations

Although they are often the drivers of significant innovation, businesses focusing on digital, data-driven offerings find it hard to obtain adequate access to finance, often due to a lack of collateral and a track record, and an unproven business model

Almost all companies pushing data-driven innovation are small companies and lack a financial track record. All but one of the digital innovators in our sample generate revenues below €10 million per annum. Even when they are scaling up and generating first revenues, digital innovators cannot provide meaningful amounts of collateral unlike other start-ups, as they are relying on a new and virtual business model. Thus, potential lenders or investors cannot draw on any precedent to help them evaluate the business case of a digital innovator.

VOICES FROM THE SECTOR

“If you look at funding in Europe, you see that if you have a product you can hold in your hands, it's no problem to get funding, but software – that's virtual, and the people who do the evaluations, they do not have any knowledge in this sector.” – CEO of an IT solutions provider for agri-food producers

“One of the main problems with obtaining financing was that potential lenders did not understand our business model.” – Managing director of a company digitalising data from agri-food producers and enabling data-sharing along the value chain

“The problem is that banks don't see software development as valuable collateral. For them this means high-risk financing.” – CEO of a company offering farm data integration

VOICES FROM THE SECTOR

“We are beneficiaries of research development grants from European projects. In this way, access to finance was easier than through private investors. Agri-food remains a more conventional sector with regard to digitalisation. Hence, schemes to help digital innovation are important. Agri-food is still ‘not sexy enough’ for venture capital investors.” – CEO of a company developing blockchain-based technologies for integration along the agri-food value chain

The long lead times for innovation in the agri-food sector exceed most venture capital investors' rather short-term-driven profitability expectations

Many venture capital investors have a background in consumer tech or finance, but are simply not prepared to sustain companies with promising business models in digital agri-food long enough to make them successful on a large scale. Additionally, profit margins in the agri-food sector are below market average, decreasing the possible return on investment for investors.

Digital innovators in agri-food lack the collateral and track record required to be bankable and the sector lacks proficient venture capital investors. Hence, it is difficult for digital agri-food innovators to obtain financing on the private market.

VOICES FROM THE SECTOR

“Most venture capital funds come from the digital consumer sector or from the finance industry and are not used to holding equity in companies for a period that long. So, you’ll need to kind of educate the VCs.” – Managing director of a corporate venture capital fund

“With an equally strong value proposition and team, it’s much more difficult to get funding in the agri-food sector than in other sectors.” – CEO of a private equity fund

5. Financial instruments mapping and analysis and funding gap

This chapter provides an overview of existing European efforts to fund and finance innovation in the agri-food sector, so that recommendations will complement the existing landscape where necessary and not create overlapping activities. It also includes a broader view of international and private sector examples of best practices that could help to alleviate the discrepancies.

5.1 Key European innovation funding and financing programmes in the agri-food sector

The agri-food sector is highly diverse and receives strong support from the EU

Financing for the agri-food sector is well established at the EU level. The CAP is a key European policy and, at nearly 40% of the total EU budget (€62.8 billion in 2017), agriculture-related spending, accounts for a significant share of the total.¹⁰⁶ The CAP operates within the EU's Multiannual Financial Framework, which sets the limit for the annual general budget for seven years. Clearly, the EU acknowledges the importance of the sector, as EU-level spending replaces most of the national investments in the sector to achieve a coherent policy.

CAP financing can be clustered in three forms¹⁰⁷:

1. Direct payments (€41 billion – 65%)

Meant to cushion the inherent seasonality and unpredictability of the sector to achieve sustainability and food security.¹⁰⁸

2. Market measures (€3.2 billion – 5%)

Mostly ad hoc implemented measures to overcome limited periods of specific need e.g. export support.

3. Rural development programmes (€18.7 billion – 30%)

Programmes mainly aimed at assisting farms and SMEs in the agri-food sector, includes a focus on innovation.

Additional instruments exist to fund European innovation in the agri-food sector

Complementary to the agri-food-specific CAP funding, there are dedicated opportunities to fund research and innovation through **European innovation enabling programmes**.¹⁰⁹

The following illustration gives an overview of European financing opportunities for the agri-food sector. There is a small overlap between the CAP and innovation instruments. The rural development programmes are part of the CAP and also provide opportunities for innovation financing.

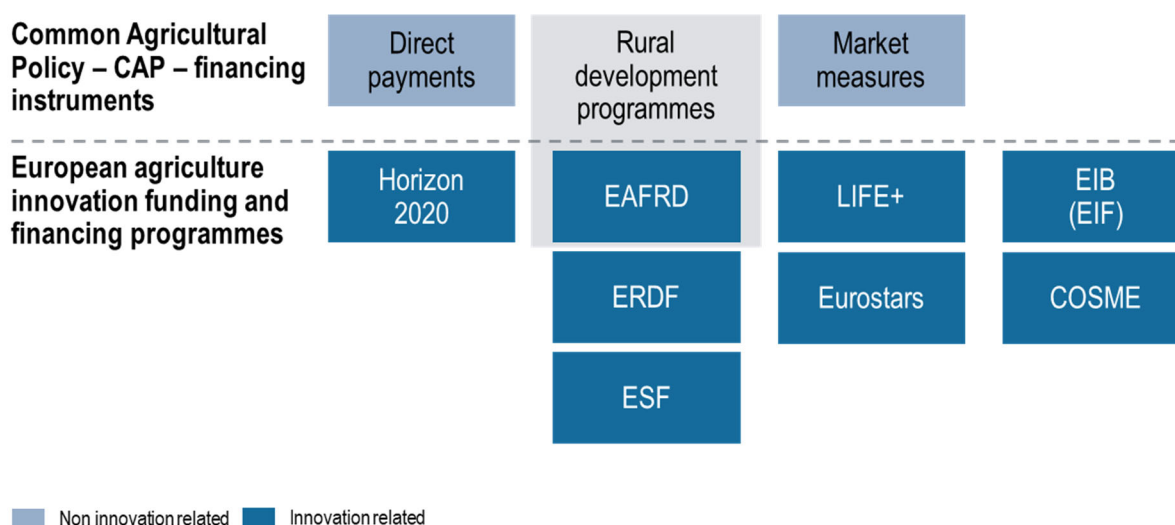
¹⁰⁶ European Commission, 2018c

¹⁰⁷ Share of overall budget for 2016

¹⁰⁸ European Commission, 2018b

¹⁰⁹ Although most programmes are not agri-food-specific, they fund a wide range of sectors and thus provide opportunities for the agri-food sector.

Figure 28: Europe has two general means to fund the agri-food sector



Source: EIF; EAFRD; ERDF; ESF; Roland Berger

Figure 29: Overview of a selection of EU agri-innovation funding and financing programmes

Programmes	Size ¹¹⁰	Types of financing	Main innovation focus
European Agricultural Fund for Rural Development (EAFRD)	~€100 billion	Grants, subsidies	Pilot projects for the development of new products; cooperation among small operators; cooperation for product promotion
European Regional Development Fund (ERDF)	~€200 billion	Mainly grants (other instruments dependent on Member States' operational programmes)	Advisory services for the commercialisation of innovation; investment in infrastructure, equipment, pilot product lines for innovation or research purpose; cooperation and networking
European Social Fund (ESF)	~€121 billion	Grants (and add-ons by Member States)	Development of skills; export performance; adaptation to structural changes (innovation)
Horizon 2020	~€80 billion	Grants, knowledge-based services, SME instrument	Food security; sustainable agriculture and forestry; marine; maritime and inland water; bioeconomy research projects
EUROSTARS	~€0.3 billion	Grants	Market-oriented R&D projects led by SMEs; long-term industrial initiatives that aim to

¹¹⁰ Total programme/financing volume.

			develop generic technologies of key importance
Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME)	~€2.3 billion	Different types of instruments depending on specific calls	Access to finance via guarantees; market access support; support for entrepreneurs
European Investment Bank (EIB) ¹¹¹	~€32.8 billion	Covers various financing instruments internally and by on-lending activities	Lending, blending and advising
European Investment Fund (EIF) – as part of EIB Group	~€1 billion	Equity, venture capital, microfinance – via intermediaries	Financial support for micro-enterprises and SMEs through intermediaries
LIFE+	~€1.66 billion ¹¹²	Grants (call for proposals)	Biodiversity projects; knowledge exchange projects; climate change adaptation; projects reducing CO ₂ emissions

Innovation-related financing is still only a fraction of the EU's agri-food sector spending

There are two large-scale instruments forming part of the central financing instrument for agri-food, the CAP, which should strengthen innovation: the ERDF and the EAFRD. They combine resources of approximately €1.03 billion per year for innovation funding in the agri-food sector. This represents only around 1.6% of the total CAP budget for 2016. Additional funds are available, especially under the EIB and Horizon 2020. During the last five years (2014-2018), the EIB has provided €32.8 billion of co-financing to the agriculture/bioeconomy sector (with 88.5% in EU countries). The EIB finances projects across the agricultural, fisheries, food and forestry value chains, focusing on food quality and security, sustainable and inclusive rural development, climate-smart production, innovation, resource efficiency and forestry.

The multi-actor approach under Horizon 2020 is a valuable concept for connecting researchers and practitioners, and has €1 billion linked to the agri-food sector (see below). The €10.4 billion yearly Horizon 2020 budget for research and innovation is not earmarked for the agri-food sector. Instead the funds are shared among all sectors, resulting in fierce competition. However, there is potential to shift priorities. For example, Horizon 2020's successor, Horizon Europe¹¹³, could earmark more funds for research on agri-food-related programme sections.

What multi-actor means: **requirements for multi-actor projects**

The multi-actor approach aims to make innovation more demand-driven, and should therefore ensure the genuine and sufficient involvement of various players (end-users such as farmers/farmers' groups, forest-related groups, fishers/fishers' groups, advisors, businesses, etc.) throughout the project: from planning to implementation, to the dissemination of results and a possible demonstration phase. A multi-actor project proposal needs to demonstrate:

- > How the project proposal's objectives and planning are targeting the needs/problems and opportunities of end-users.
- > How it complements existing research and best practices.

¹¹¹ For 2014-2018

¹¹² For 2018-2020

¹¹³ https://ec.europa.eu/commission/sites/beta-political/files/communication-modern-budget-may_2018_en.pdf

Barriers to access in the EU innovation instrument landscape tend to be high because the large variety of programmes are implemented by a range of different authorities on regional, national and EU level

This difference in the programmes' implementation adds a layer of complexity to European innovation financing for the agri-food sector. Innovation financing is spread out over many different programmes and authorities. While programmes on the European level are managed either by the EC or the EIB, dedicated local managing authorities disburse the national and regional instruments. The bases for the national or regional implementation of funding are the so-called operational programmes that are aligned between the EC and regional/national levels.

The EIB's innovation offering that is relevant for agri-food companies is important

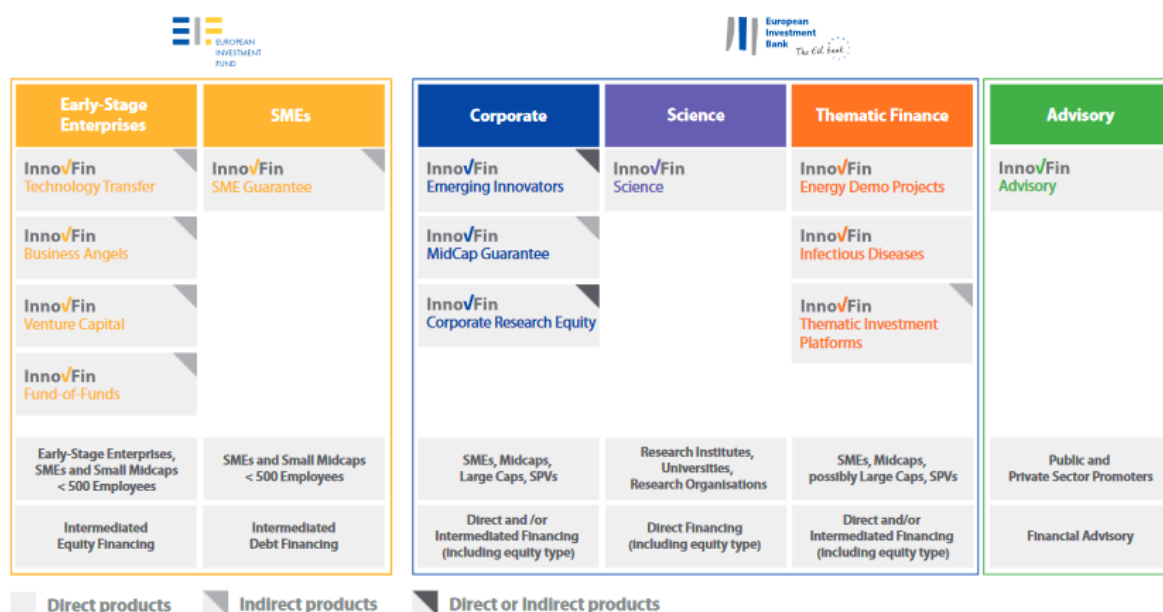
One of the EIB's vehicles for the financing of innovation in agri-food is InnovFin (see below), which is a cooperation initiative between the EIB, the EIF and the EC under the Horizon 2020 programme. InnovFin, like other EIF products and COSME, is applicable and relevant as it caters for smaller companies. One of the most explicit results from the interview phase with agri-food companies was the insight that businesses with problems in securing financing are rather small, often with a limited track record (start-ups), and require investments typically below €6 million.¹¹⁴

The EIB has additional programmes that address innovation in the agri-food sector. The most comprehensive one is the Agriculture and Bioeconomy Programme Loan that takes an inclusive approach and provides funding along the entire value chain (from natural resources through to wholesale and retail). It specifically funds innovation, particularly research, development and innovation programmes of three to five years, first of a kind/demonstration projects, advanced manufacturing and logistics, smart production, innovative bio-based industries including blue bioeconomy and digitalisation and Internet of Things. Eligible companies are SMEs, mid-cap cooperatives and larger private sector enterprises. The minimum loan size is €7.5 million.

To address this gap, smaller scale investments in the sector are financed using mostly intermediated on-lending mechanisms or co-investment in private financing vehicles, such as specific funds. In intermediated lending, the EIB does not lend directly based on individual investment decisions, but it trusts partner institutions to act on its behalf. It relies on a respective national or local institution or market participant. The financing experience of agri-food companies shows that they tend to trust their local financial institution and appreciate receiving financing in the local set-up.

¹¹⁴ Of study respondents, 36% require less than €1 million and 88% require less than €6 million.

Figure 30: InnovFin suite of financial and advisory products



Source: InnovFin

SME guarantee products are well-received by market participants, but are not necessarily drivers of breakthrough innovation in a prudent market environment

The interviews found positive examples of debt being secured through programmes backed by the EIB and EIF InnovFin SME Guarantee programme. Market players benefit from the on-lending approach as it often allows them to continue close cooperation with their main bank. These trusted relationships enable a higher market penetration of SME financing products. Companies that fulfil the risk profile requirements for debt financing are typically not the main innovators in the agri-food market. Breakthrough innovation is driven by start-ups, which are typically not eligible for debt financing because they have non-existent cash flows and no balance sheet track record. Their needs are much more equity-oriented, which parallels the conclusion that the equity gap is larger than the debt gap in the European agri-food sector.

Wider-range EIB services can further help agri-food innovators

Next to pure financing, targeted support for the identification, preparation and development of investment projects is provided by the European Investment Advisory Hub (EIAH)¹¹⁵. One of its areas of focus is research, development and innovation. Conceived as a partnership between the EIB and the EC within the framework of the Investment Plan for Europe, the Advisory Hub offers support to project promoters as advisory service agreements. These instruments are very useful, but are not specifically targeted at innovation within the agri-food sector.

Additionally, there is the InnovFin Advisory programme,¹¹⁶ which guides its clients on the structuring of their R&I projects to improve their access to finance. This service helps them to capitalise on their strengths and adjust elements such as their business model, governance, funding sources and financing structure. Several innovators in the agri-food sector have been supported to date.

¹¹⁵ <https://eiah.eib.org/>

¹¹⁶ <https://www.eib.org/en/products/advising/innovfin-advisory/index.htm>

InnovFin services and associated opportunities meet some of the innovation financing and advisory needs of the agri-food market, but tend to figure prominently among the innovation drivers in the market

The broad range of instruments that cover investments, knowledge transfer and access to expert networks are in line with the requirements mentioned by interviewees and some of the successful examples in the market (see best practices). On the client side, even the implementation through intermediaries close to the market is a positive. The main impression of the EIB in the market is positive, but it is also associated with high transaction volumes and offerings for large companies. Therefore, many small companies are not familiar with the offerings in detail. InnovFin opportunities are often overlooked if the companies do not have a well-informed local partner that engages with InnovFin. During the market survey, an innovative SME from the processing sector stressed that it was only able to obtain a bank loan because its local bank knew the EIB's offerings and could therefore back the loan under the InnovFin SME Guarantee Facility.

The EIF is also a well-recognised partner in the market for innovation financing

The variety of equity and debt instruments provided by the EIF offers companies the flexibility to select financing that fits their situation. The mostly private partners or NPIs¹¹⁷ that are engaged in and lead individual transaction management are experts in their fields and have the necessary market knowledge to finance innovation successfully.

5.2 Discrepancy between sector's innovation financing needs and current European offering

The current innovation finance offering only partially serves the actual demand on the market

The agri-food sector requires knowledgeable investors and long-term instruments to serve the needs of customers. The current instrument landscape only partially caters for that need. The EU funding and financing environment consists predominately of time-limited grants for innovation and research-related project activities. To effectively foster innovation in the sector, time-restricted project support (in the case of grants) is not sufficient.

Implementation close to the market and tailored to local needs is positive for the agri-food sector and even offers an opportunity to secure equity funding

Specific sector knowledge is a very helpful prerequisite for successful market interaction. EU instruments like the EAFRD or the ERDF operate through decentralised managing authorities on the national or regional level. The EIB and the EIF also work closely with local intermediaries that often specialise in the agri-food sector, which ensures tailored support for innovative companies.

An innovative agri-food company from southern Europe in the study exemplifies this. The company was founded with the help of an angel investor. Later, Horizon 2020 and an Operational Programme under the European Regional Development Fund funded research and development activities for a novel food processing technology. The company then obtained a loan from a local commercial bank backed by the InnovFin SME Guarantee Facility to develop a pilot line and enter the market.

The dominance of short-term funding (in particular grants) for innovation hinders the full potential of the European agri-food innovation landscape

Most EU programmes are exclusively focused on grants that are allocated to specific projects with a short to mid-term timeline. Because the agri-food sector experiences long innovation lead times and long innovation cycles, this is inadequate. Longer-term instruments like debt or equity vehicles are needed, as was highlighted by the interviewees. Financiers need to be prepared to accept long

¹¹⁷ Appointed national financial intermediaries of the EIB

maturity and payback periods. The EIF is the main vehicle offering equity and know-how as grant alternatives to start-ups and small companies. The missing long-term perspective in otherwise volatile markets is a typical function of a public investor. The average venture capital fund stays invested in a single company for roughly six years,¹¹⁸ but agri-food innovation requires much longer holding periods, averaging about nine years.

The predominant focus on start-ups, micro-enterprises and SMEs is necessary to drive innovation, but has created a blind spot for important market structures and innovation enablers

Small companies often initiate disruptive innovation in the agri-food sector, but they are hampered by resource constraints. Capacities to drive the future market lie with larger SMEs and the few dominating upstream players (e.g. large food and drink companies), which typically acquire small innovative companies and close the gap between the innovative idea and the commercialisation. It is therefore important to foster collaboration formats between small companies and larger players in the agri-food sector. The EU funded projects need to adopt an integrative role and create opportunities for sector-wide exchange. An example of the important role of large corporations is Avantium, a pioneer in renewable chemistry and bio-based material that is also used for food packaging. The company was founded as a spin-off from Royal Dutch Shell and supported by an international consortium. In 2016, the company started a joint venture with BASF and since 2017 Avantium has been listed on the Euronext stock exchange.

The current state of discussion about the next Research and Innovation Framework Programme past 2020 hints at a positive pathway for innovation, in line with the needs of the agri-food sector

The review of the current innovation system has revealed some key challenges in translating research into marketable innovation. The new framework programme aims to improve this by giving more opportunity to EU institutions to co-create markets, shape them and therefore set a strategic direction. In this context, the EIC is being discussed as an expert authority to engage with higher-risk endeavours. In its pilot phase, the EIC relies on four specific instruments¹¹⁹ with a total budget of €2.6 billion. The approach would overcome the current highly intermediated system for the innovation funding of small market players. It could also be a step towards a stronger integration of private and EU strategic expert perspectives on market development and innovations. While the EIC in its current format would look at the few ground-breaking European innovations and not at the mainstream market, the experience and structure of the EIC could be inspire the adaptation of existing or the setting-up of new innovation formats.

5.3 Selected international best practices

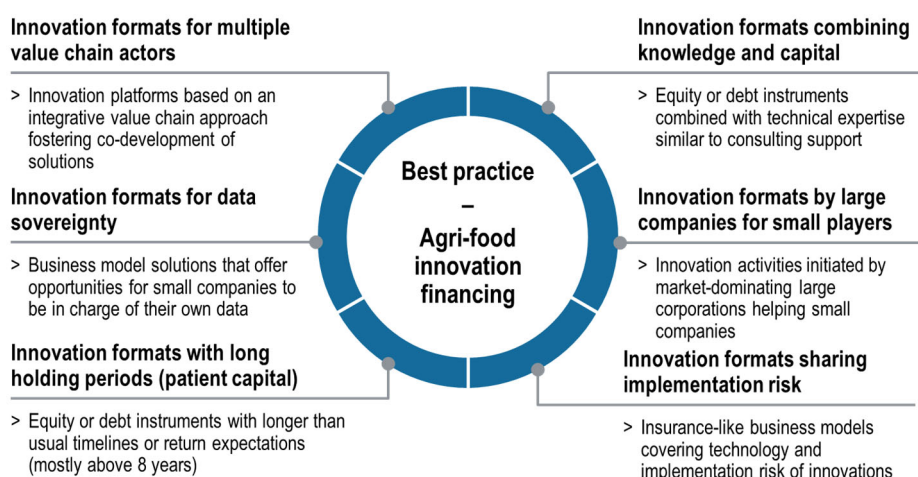
Relevant public and private approaches successfully foster innovation within the agri-food sector

Public and private organisations are active in innovation financing in large worldwide agricultural markets. Successful instruments have been developed and implemented in specific markets to foster national agri-food business. We review positive examples from successful innovation formats as well as relevant business model developments. There are specifically six distinct innovation and business model formats (see below) that can be used as a starting point.

¹¹⁸ Lewis, 2017

¹¹⁹ See https://ec.europa.eu/research/eic/pdf/eic_instruments_table.pdf (accessed: 09.08.2018)

Figure 31: Best practice landscape in innovation funding for the agri-food sector



5.3.1 Innovation formats for multiple value chain participants



Cooperation formats along different value chain segments are main facilitators of innovation

The increasing complexity and connectivity of value chain segments has resulted in a new way of innovating. Players from different segments often trigger productive innovation through knowledge exchange and co-innovation. An example is EIT Food, a European Knowledge and Innovation Community that connects researchers, businesses and start-ups from different segments to support innovative and economically sustainable initiatives, such as zero-waste approaches. Another example is the business-led consortium FoodNexus that aims to build collaboration among companies and knowledge institutions from different segments of the European food sector.

Sponsored platforms that establish an easily accessible framework for cooperative innovation lower the boundaries for participation from all agri-food value chain segments. It is an inclusive form of innovation facilitation that typically comes free of charge to attract the target group. It also overcomes major systemic hurdles between large powerful players and smaller enterprises with less bargaining power. The cooperative platforms often take names such as “innovation labs” or “field labs” to highlight the institutionalised approach. For example, the Dutch Food Valley provides the infrastructure for closer collaboration between entities that typically do not work together on innovation projects. Through informal events and an online platform for knowledge sharing, it helps initiate the discussion about value chain-overarching innovation projects.¹²⁰

¹²⁰ Food Valley, 2018

Figure 32: Fact sheet – Food Valley

<p>Key data</p>  <p>Instrument name: Food Valley</p> <p>Managing/funding entity: Co-funded by the Dutch Province of Gelderland</p> <p>Country, year of foundation: Netherlands, 2004</p> <hr/> <p>Type: Debt <input type="checkbox"/> Equity <input type="checkbox"/> Advisory <input checked="" type="checkbox"/> Other <input checked="" type="checkbox"/></p> <p>> Food Valley is intended to create conditions so that food manufacturers and knowledge institutes can work together in developing new and innovating food concepts</p> <hr/> <p>Related value chain segment(s)</p>  <p>> Food Valley offers as products: cluster development and business clusters</p>	<p>Highlighted feature (best practice identified)</p> <p>Innovation along the value chain – Proving innovation strength through value chain collaboration</p> <p>> Food Valley aims to stimulate the innovative power of the Dutch agri-food cluster by creating connections and collaboration between companies, knowledge institutes and governments</p> <hr/> <p>Innovations system: Key stakeholders and their functions</p> <p>> Food Valley organisation: Holds networking and informational events and creates exposure</p> <p>> Agri-food value chain actors: Receive the opportunity to collaborate and obtain information</p> <p>> World Food Innovations: Is Food Valley's online collaboration platform to discover and share developments, insights and innovative solutions</p>	<p>Access-to-finance challenges to agri-food innovators that could be addressed by implementing a similar instrument on a European level</p> <p>> Challenge: Actors among the agri-food value chain rarely collaborate</p> <p>> Possible approach offered by instrument: Networking events held several times a year: members-only events and events with participants seeking knowledge and business partners</p> <hr/> <p>> Challenge: Small actors lack the necessary exposure</p> <p>> Possible approach offered by instrument: Food Valley helps to attract international media coverage of its members through websites, publications and presentations</p> <hr/> <p>> Challenge: Actors lack the necessary knowledge to innovate</p> <p>> Possible approach offered by instrument: Business and innovation meetings with speakers from the food industry, ingredient industry, research organisations and academia inform and facilitate Food Valley's members in sharing and obtaining the knowledge they need</p>
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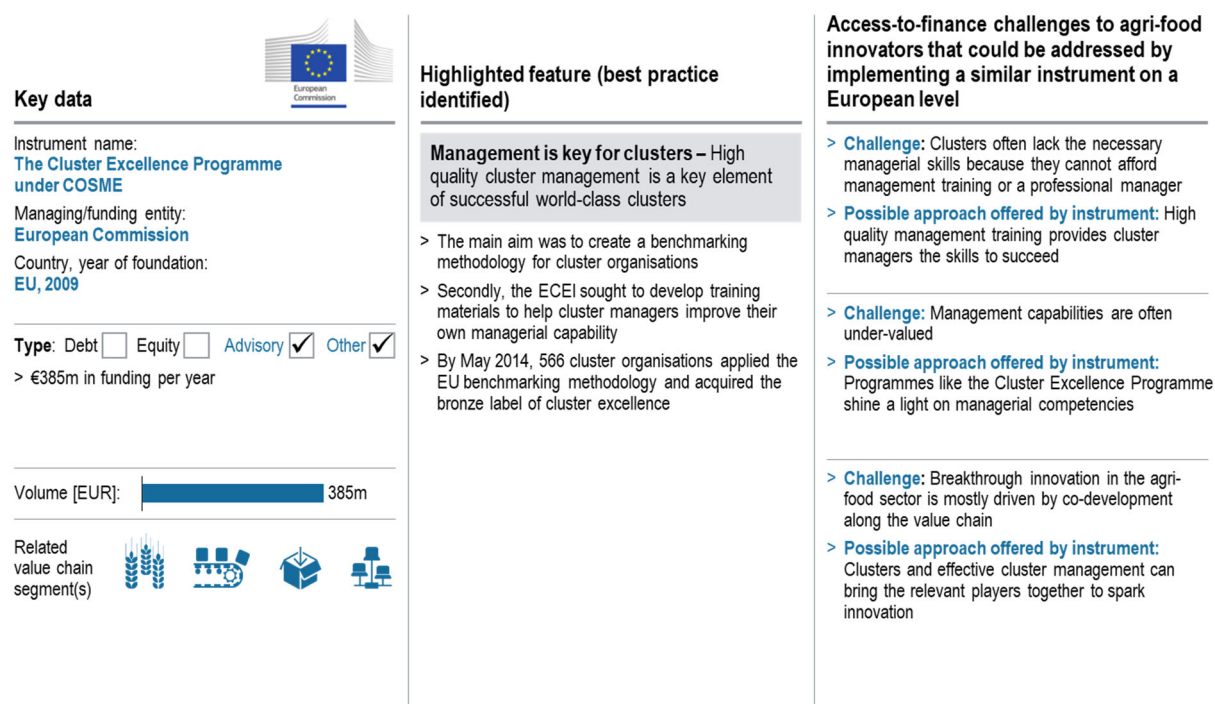
Source: Food Valley website

Another example is the Cluster Excellence Programme, which focuses on the role of the leading entity in a co-development project. This is vital in implementing integrated value chain innovation projects because a strong driving force is necessary to advance these complex¹²¹ projects. The programme offers capacity building for managers of multi-stakeholder projects and provides professional high-quality management training in cooperation with established academic institutions.¹²²

¹²¹ Increased complexity comes from the integration of several players with individual interests into one innovation process.

¹²² EASME, 2014b

Figure 33: Fact sheet – EU Cluster Excellence Programme under COSME



Source: Cluster Excellence Programme website

5.3.2 Innovation formats combining knowledge and capital

The combination of investments with sector expertise is essential for the commercialisation of innovation

One key challenge in the European context is bringing research results through innovative solutions to the market. Not mastering this is still the most relevant criticism for European research and innovation policy and funding mechanisms.¹²³ To facilitate the transition, agri-food market participants said the investing institution should have sector expertise, as a knowledgeable investor understands the volatility of the agri-food sector, cyclical developments and unsteady cash flows.

Disruptive innovative companies (mostly start-ups in the agri-food sector) often lack the capacity to commercialise their developments. The sector expertise of the long-established networks in the supply chain or among potential clients can help. Corporate ventures or innovation platforms initiated by large players on the agri-food market (e.g. Unilever, Nestlé, BayWa, etc.) are the first choice for many start-ups seeking financing. The possibility of receiving sector insights, reviewing business concepts and challenging product viability with dedicated specialists is a strong pull factor.

An additional format that could become relevant in the context of linking innovation financing to knowledge provision is innovation vouchers. Typically, economic development agencies offer technical assistance through registered experts for SMEs that can apply for a “voucher”. However, state aid considerations restrict the usage of this solution, particularly in the agricultural sector. An example of this conflict is the well-established innovation voucher programme of Enterprise Ireland that restricts agricultural companies from applying.¹²⁴ One best practice in linking capital and knowledge is the Australian accelerator SproutX. This accelerator focuses exclusively on agri-food

¹²³ European Commission, 2017e

¹²⁴ Enterprise Ireland, 2018

start-ups and places emphasis on providing start-ups not only capital in the form of equity, but also expert knowledge of the industry and introductions to industrial and institutional networks.¹²⁵

Figure 34: Fact sheet – Accelerator SproutX



Source: SproutX website

5.3.3 Innovation formats by large companies for small players

Canada has taken strong policy measures to strengthen innovation capacities to retain the competitiveness of its strategically important agri-food sector. It has tailored a successful public support scheme for innovation topics and the fragmented agri-food sector is a specific focus of public innovation investment. The National Department of Agriculture and Agri-Food (AAFC) has understood specific market challenges well and translated them into its main public funding scheme called Growing Forward 2 in cooperation with the Canadian provinces and territories.

Canada succeeds in fostering innovation from the start until market introduction

The large-scale programmes, initiated by the AAFC, offer a broad instrument range under a centralised programme. The funding and financing landscape seems less heterogeneous and less distributed across different responsible entities. The instruments are carefully implemented with respect to each innovation project. Early-stage innovation receives smaller amounts of non-repayable funding. Later stage innovation close to market introduction can access larger debt financing tranches. The instruments can be specifically adapted to the stage of the innovation cycle and the expected cash flows. Accordingly, one central platform supports innovation throughout the long-lasting innovation cycle in the agri-food sector.

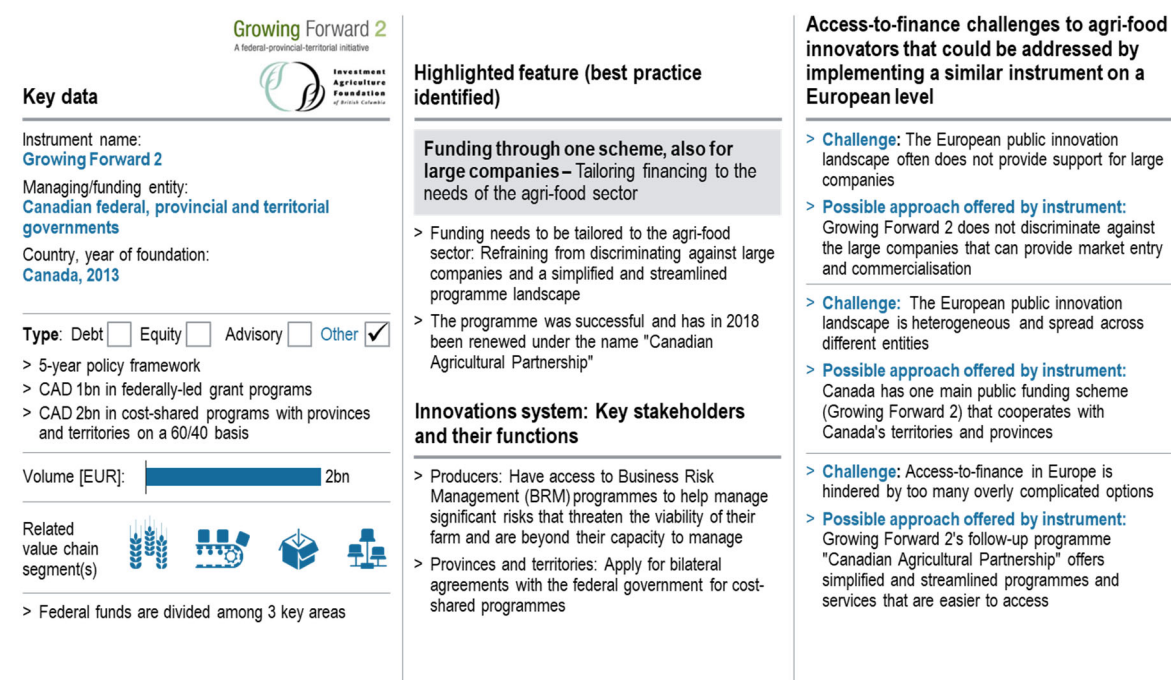
Corporate ventures and corporate innovation formats are key drivers of innovation

Canada offers specific support for large companies, as they can push forward the market introduction of innovations. This means that many upstream farmers and producers can implement innovative processes and technologies developed by the larger industry players. Large-scale corporations also

¹²⁵ SproutX, 2018

initiate innovation formats and knowledge transfer for smaller market players (e.g. HENRi@Nestlé and The Unilever Foundry). Canada supports large-scale companies in their long-lasting and cash-burning innovation cycles or in their innovation facilitation processes by offering cost sharing. While European public innovation focuses on start-ups and SMEs, the Canadian support schemes do not discriminate against some of the most important innovation players: large companies. Canada's funding programme Growing Forward 2 can serve as best practice guidance for European funding instruments. This programme, renewed as the Canadian Agricultural Partnership in 2018, offers simplified and streamlined funding programmes and is Canada's main public funding scheme.¹²⁶

Figure 35: Fact sheet – Canadian Growing Forward 2 programme



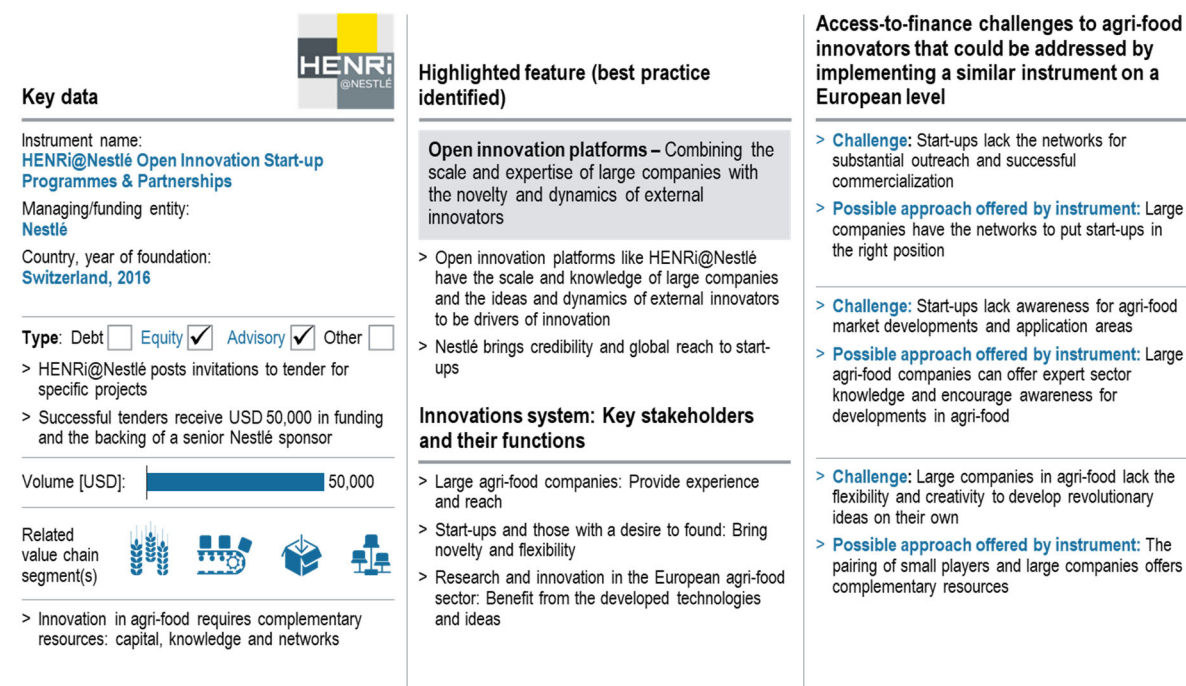
Source: Canadian Department of Agriculture and Agri-Food website

Another best practice example is Nestlé's HENRi@Nestlé Open Innovation Start-up Programmes and Partnerships platform. Nestlé brings the size and networks of a large company while start-ups bring the ideas. This combination creates a unique environment to develop new products and processes. In addition, Nestlé provides equity seed funding for successful start-ups.¹²⁷

¹²⁶ Agriculture and Agri-Food Canada, 2018a

¹²⁷ HENRi Nestlé, 2018a

Figure 36: Fact sheet – HENRi@Nestlé



Source: HENRi@Nestlé website

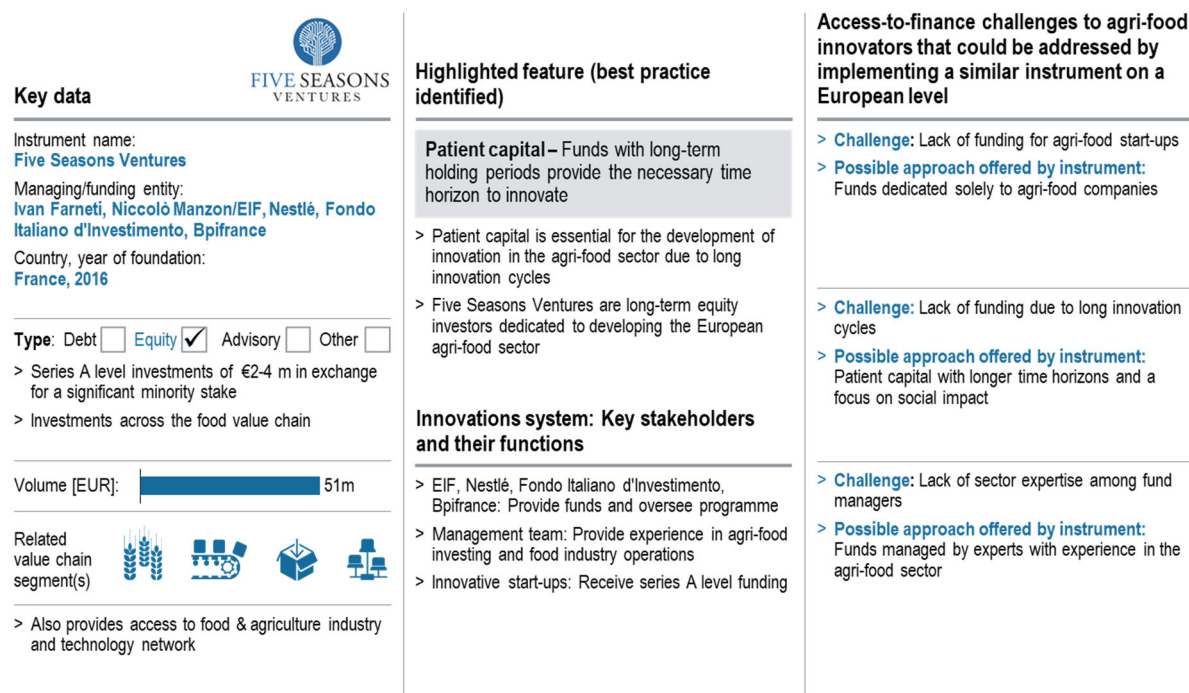
5.3.4 Innovation formats with long holding periods (patient capital)

Agri-food investment experts advocate long holding periods in the sector

Specialised investors with considerable market knowledge and experience lead the innovation landscape in the agri-food sector. Their strategies focus on long-term involvement with suitable long-term instruments. Because of the long innovation lead times and lengthy innovation cycles, sustainable pay-off can only materialise over the long run. One way that investors choose to speed up the pay-off process is by injecting larger-scale investments of up to approximately €20 million. These investments are either large minority stakes or venture debt offerings to facilitate rapid innovation commercialisation and associated growth. Offering a variety of equity and debt instruments with substantial investment and long holding periods facilitates a reliable and sustainable framework for agri-food businesses. Contrary to the typical challenges of strong volatility in the sector, innovation can be planned better and be more effective through this long-term approach. For example, the venture capital fund Five Seasons Ventures, backed by the EIF through a co-investment role, focuses solely on agri-food start-ups and provides between €2 and 4 million in the first round. Its managers have extensive experience in the agri-food sector and provide capital with the long-term holding periods that are necessary to develop this sector.¹²⁸

¹²⁸ Five Season Ventures, 2018

Figure 37: Fact sheet – Five Seasons Ventures



Source: Five Seasons Ventures website

5.3.5 Innovation formats sharing implementation risk

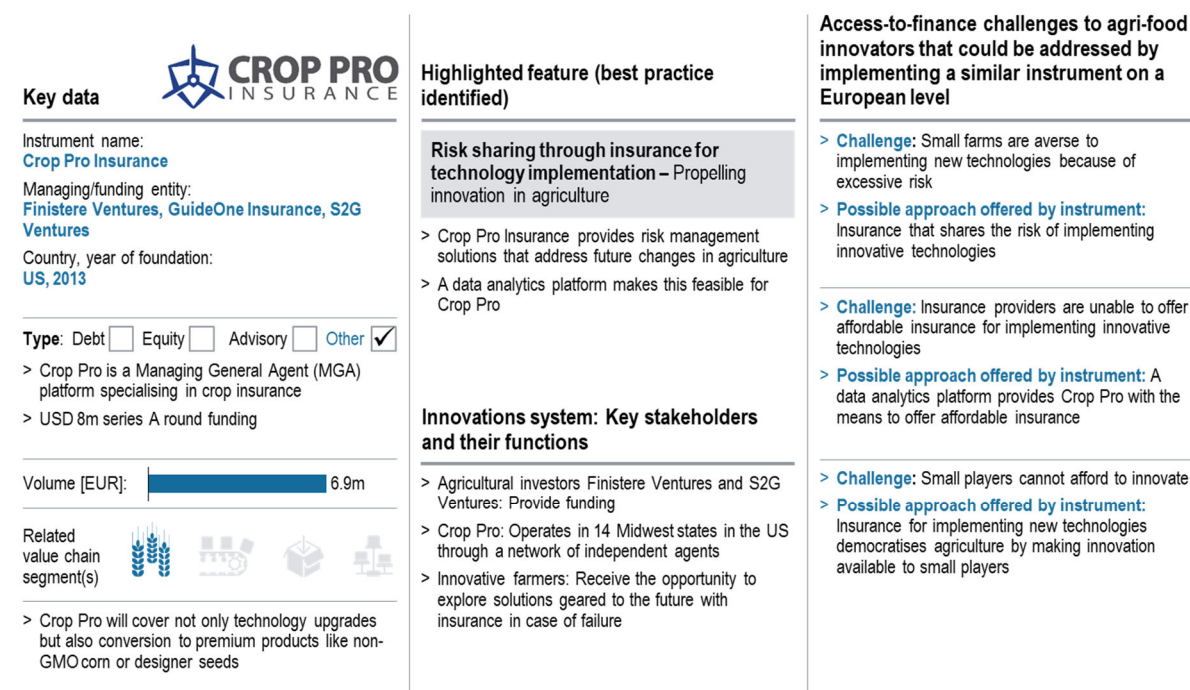
Implementation insurance for new technology can be a lever to activate a prudent agri-food companies in terms of carrying out innovation projects

Some agri-food companies do not have the flexibility for additional investments in technology that do not guarantee superior results. Many companies are simply not willing risk failure. One recent development to counter this is the introduction of an “insurance” model. It covers the risk of introducing innovative products or processes into company's own business model. The concept guarantees the necessary return and cash flows even if the implementation of the innovation is faced with some challenges.

Best practice in this field is demonstrated by the US start-up Crop Pro Insurance. It may even be one of the first companies to provide insurance for technology implementation in agriculture. Crop Pro Insurance uses data analytics to estimate risks associated with introducing new technology. Its pricing is dynamic and the big data approach helps the company market this offering.¹²⁹

¹²⁹ Crop Pro Insurance, 2018

Figure 38: Fact sheet – Crop Pro Insurance



Source: Crop Pro Insurance website, Roland Berger

Source: Crop Pro Insurance website

5.3.6 Innovation formats for data sovereignty

Building business models around data from the agri-food players can be a major driver of innovation

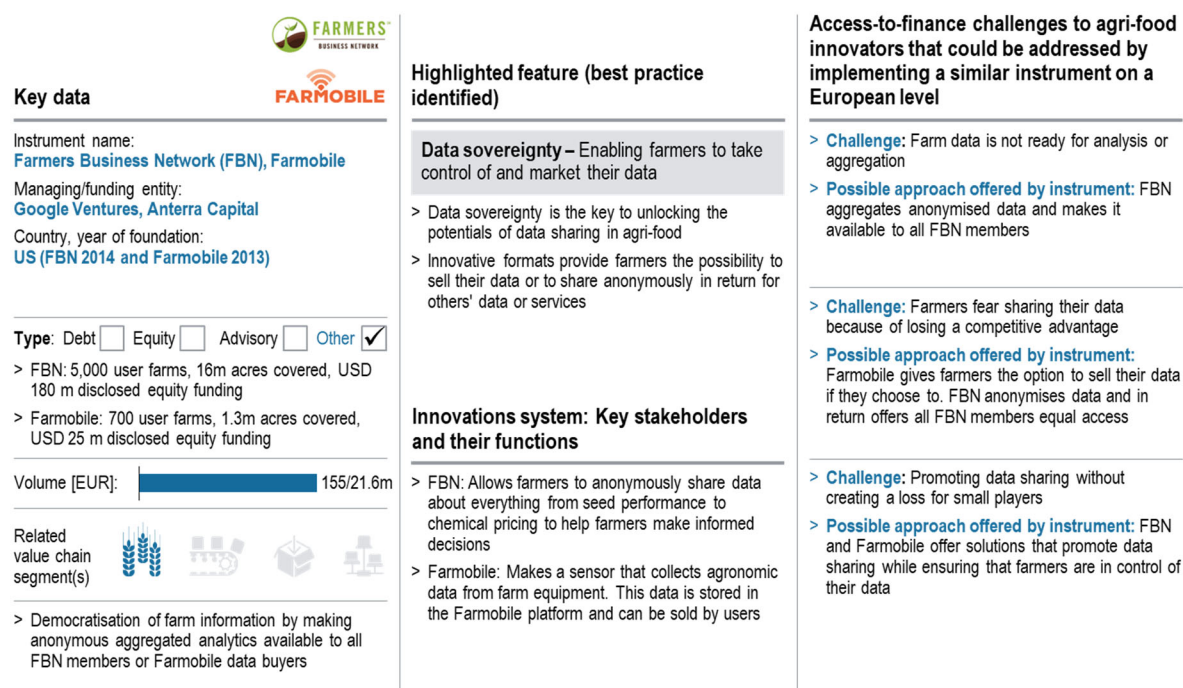
The majority of agri-food companies are not in control of their data or monetisation options. They are unaware of or unclear on how to monetise their own data. Additionally, they are often closely integrated in a larger value chain concept in which one big player from the sector receives different kinds of performance and quality data from its smaller suppliers. In this case, the data are gathered, transferred and monetised by the larger player in the value chain. There is accordingly a need for emancipation in order for companies to control their own data and fully exploit the market potential. Innovation formats and financing should look at business model innovations and enable smaller agri-food players to use innovative technology or methods to access and market their own data.

Two best practice examples are the data-sharing firms Farmers Business Network (FBN) and Farmobile. FBN allows farmers to anonymously share data about everything from seed performance to chemical pricing. It then aggregates the anonymous data and makes it available to all FBN members. This way, small-scale farmers can access a pool of experience to make business decisions based on empirical data and benchmarking.¹³⁰ Farmobile produces a sensor that collects agronomic data from farm equipment. This data are stored in the Farmobile platform and can be sold by users. It gives the individual farmer the possibility to capitalise on their data.¹³¹

¹³⁰ Farmers Business Network, 2018

¹³¹ Farmobile, 2018

Figure 39: Fact sheet – Farmers Business Network and Farmobile



Source: Farmers Business Network website; Farmobile website

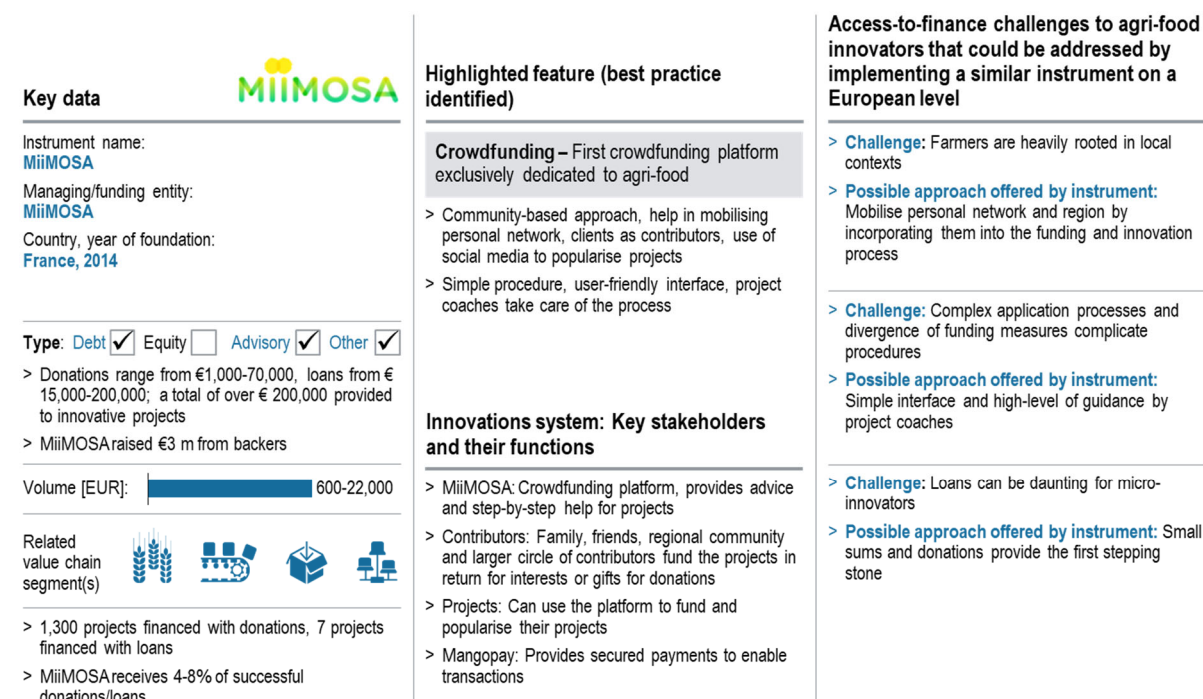
5.3.7 Innovation formats leveraging communities

Micro-innovation can be fuelled by crowdfunding platforms that profit from the agri-food anchorage within communities.

Crowdfunding has developed as a new method of raising money. Usually by relying on a close network of family, friends and acquaintances as a starting point, it uses social media to extend the circle of people willing to fund a project. In agri-food, the link between new innovations and consumers is short, as new products are normally consumer goods. Moreover, considering the high relevance of the agri-food sector in the eye of the public, agri-food has the potential to motivate a large number of individuals to contribute to new ideas.

A best practice example is MiiMOSA, a crowdfunding platform from France. It makes the process of launching projects on its platform easy for innovators with a simple user interface. After a quick registration, a project coach contacts the agri-food innovator to guide it through the process. Funding can take two forms. Donations typically range from a few to several hundred euros, which are “repaid” with project-related products, events or simple thank you postcards and fundraising campaigns of 90 days. Project loans have a maturity of three to 83 months and come with interest rates of 2-5%. MiiMOSA finances itself through successful projects, taking 8% of donations and a little over 4% of loans. Agri-food innovators profit from a simple financing process and can strengthen relationships with end-consumers. The innovations financed depend on the projects submitted by agri-food players. Empirically in the past, the focus was more on business model innovations than on high-tech innovations.

Figure 40: Fact sheet – MiiMOSA



Source: MiiMOSA website

5.4 EU-US comparison of investment levels

In order to compare debt and equity investment levels between the EU and the US, we adopted a methodology similar to that applied in another EIB study.¹³² It is important to recognise the significant difference in terms of market characteristics and size, and innovation appetite between the two markets. Hence, this analysis is not a precise calculation but rather an approximation yielding an order of magnitude of the differences between the investment levels in the EU versus the US.

We analysed the total amount of equity invested by venture capital funds, private equity funds and similar investors in the agri-food sector in 2017. In Europe, the equity invested amounted to USD 1.72 billion (€1.53 billion) while a much higher amount of USD 4.55 billion (€4.03 billion) was invested in the US¹³³, a difference of USD 2.83 billion (€2.51 billion).

In order to adjust for the different market sizes and market structures in both Europe and the US, we have related this initial result to the respective number of innovative agri-food companies in both markets. In Europe, there are 285,000 SMEs in the agri-food sector, only 46% of which are actually innovating. Another 10% of the 285,000 European agri-food SMEs would be willing to innovate, however they are prevented by a lack of credit or private equity.¹³⁴ Together we consider these two categories of SMEs as innovative. In the US, the total number of agri-food SMEs is considerably lower at approximately 82,000.¹³⁵ Broken down to firm level, the average European innovative agri-food SME receives nearly USD 11,000 (€9,755) in equity. Its US equivalent receives close to USD 99,000 (€87,793), which amounts to an average difference of USD 88,000 (€78,038). Thus, adjusted for

¹³² EIB, 2018b

¹³³ AgFunder, 2018

¹³⁴ FoodDrinkEurope, 2017

¹³⁵ United States Census Bureau, 2018

diverging market size (by using the number of innovative SMEs in the agri-food sector in Europe and the US) and converted from USD to EUR at current exchange rates, we see that in the US there is about €11-13 billion of additional equity invested in innovative agri-food SMEs.

We took a slightly different approach to debt financing. McCahery, Lopez de Silanes, Schoenmaker & Stanistic (2015) provide information on the assumed debt funding gaps for SMEs in major European countries and the US, expressed in relation to the GDP size of those regions. According to the study, the funding gap for SMEs in the US amounts to at least 1.1% of the country's GDP or USD 204 billion and for SMEs in Europe to at least 3.7% of GDP, or USD 632 billion. By further correcting for the share of the agri-food sector in the overall GDP and the number of innovative SMEs, we find difference in debt financing for innovative agri-food companies of about a €10-12 billion. The total difference in investment levels between the US and the EU (debt and equity) amounts to approximately €21-25 billion per annum, which is most likely a conservative estimate.

The magnitude of the difference in investment intensity further justifies targeted market interventions aiming to mobilise more debt and equity funding for both innovative agri-food SMEs (innovators) and agri-food businesses (adopters). More general measures to increase the competitiveness of the sector in Europe, e.g. stronger technology uptake by potential users of new technologies, increased efforts in research and development, and measures to ensure more broad-based attention to the challenges faced by European agri-food investors will also need to be considered.

6. Recommendations

Based on our analysis, the compiled findings and the analysis of financial instruments in Europe as well as international best practice examples, we have developed five recommendations – three to address the access-to-finance challenges and two to focus on the broader enabling environment.

Since the 2013 CAP reform and the shift towards the abolition of production and market support mechanisms, demand for new agri-food financing mechanisms has steadily increased. As a result, a range of financial instruments is available (e.g. from the EIB Group), such as loans, equity products and advisory services (e.g. to national and regional governments) and guarantees.

Although the study confirms the broader rationale behind these instruments (confirming barriers and opportunities), it also shows the need for even more tailored and creative approaches to financing the development and uptake of new exciting technologies, for example in the digital remit.

6.1 Further develop and strengthen crowd-lending platforms (crowdfunding) dedicated to agri-food innovators

Agri-food is more than a strategically important economic sector. It is of great societal importance as affordable and sustainable nutrition is a core theme for Europe's population.¹³⁶ People, especially young people, are increasingly willing to pay for sustainable food products.¹³⁷ This is important, as the sector is extremely price-sensitive.

A possible solution for the access-to-finance constraints of smaller agri-food innovators, which would connect consumers to agri-food SMEs, is crowdfunding. Crowdfunding has gained significant interest recently, especially in the US,¹³⁸ but European platforms are starting to emerge as well.¹³⁹ The agri-food sector appears suitable for crowdfunding as the connection between the investor and the company (i.e. the agri-food innovator and its product/service) may be fairly close geographically, and conceptually. This could be supported by blockchain technology, offering transparency and a direct connection between the investor and the SME. Furthermore, the result of the investment is likely to be obvious and tangible. For example, a company developing sustainable packaging that can be bought at a local supermarket or farmer's market in the area where investors live and shop offers a direct connection between the investment and the investor.

The market alone will not fill the financing gap for small-scale agri-food innovators (particularly for applying smart technologies), which suggests that there is space for leveraging public financial institutions. Studies show that the return expectations of investors in sustainable investment are lower than those of a typical venture capitalist. This can be used for further funding of agri-food in Europe by enabling the public to lend to or invest in SMEs through crowdfunding platforms. In addition to

¹³⁶ In the Special Eurobarometer 473 of February 2018 (fieldwork in December 2017) on "Europeans, Agriculture and the CAP," 55% of citizens see "providing safe, healthy and good quality food" as one of the main responsibilities of farmers. In addition, respondents mention ensuring the welfare of farmed animals (28%), protecting the environment and tackling climate change (25%) and supplying a diversity of quality products (22%) (European Commission, 2018f).

¹³⁷ In the Special Eurobarometer 442 of March 2016 (fieldwork in November-December 2015) on "Attitudes of Europeans towards Animal Welfare," 59% of EU respondents said they would be prepared to pay more for products sourced from animal welfare-friendly production systems. Younger respondents are more willing to pay for such products than older people (65% of respondents aged 15-24 versus 55% of respondents aged 55+) (European Commission, 2016).

¹³⁸ Total crowdfunding volume raised worldwide rose from USD 2.7 billion in 2012 to USD 34.4 billion in 2015. In the US, the crowdfunding volume in 2015 was USD 17.25 billion while in Europe the volume was USD 6.48 billion (CrowdExpert, 2016).

¹³⁹ In March 2018, as part of its Fintech Action Plan, the EC proposed new rules for crowdfunding services aimed at helping platforms grow across Europe. The proposals include a pan-European label for such platforms to facilitate their operation across the EU (European Parliament, 2017).

partially addressing the financing gap, crowdfunding for agri-food would help raise awareness of the sector's importance and create a direct local/regional link. It could also have a positive effect on a bank's decision to finance agri-food projects, due to the equity contribution to SME capital.

The potential of crowdfunding platforms to support agri-food innovations, and the role of public financial institutions (like the NPBs and the EIB Group) should be further explored. The first step could be to establish pilots in European agri-food sector innovation hotspots. This could start via established platforms such as Oneplanetcrowd in the Netherlands, which focuses on sustainable investments. In 2017, the EIB Group, through the EIF, joined forces with the European-based Lendix platform to increase crowd-lending for businesses via a joint investment fund backed by €18.5m. Similar relevant platforms could potentially benefit from this type of support, enabling additional investments to be mobilised.

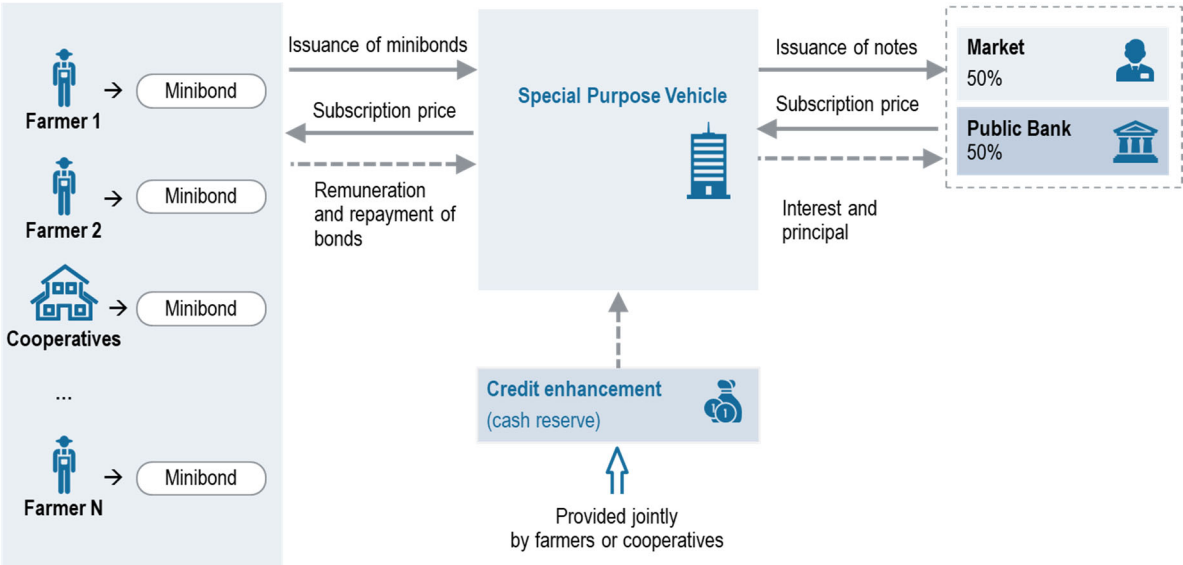
Setting up a crowdfunding programme and strengthening existing ones, could facilitate lending to agri-food producers that want to invest in smart technologies, increase the adoption of innovations and bring public attention to the importance of innovations in the sector.

6.2 Enable the issuance of mini-bonds to share risks and unlock investments in agri-food innovations

The agri-food sector is generally risk-averse. This is partially due to the high cyclical nature of cash flows caused by harvest cycles and the seasonality of demand, as our findings show. The food processing and packaging industry is highly cost-driven and heavily asset-based, leading to a reluctance to invest in disruptive innovations. Hence, investment in and uptake of innovations is slow due to the associated (financial) risks perceived by farmers, SMEs and commercial banks. This prevents mostly farmers and SMEs in agri-food processing and packaging from taking up smart technologies.

In order to address this barrier to investment, the issuance and securitisation of mini-bonds at regional, national and perhaps European levels is worth exploring. Mini-bonds could provide farmers and SMEs with additional financing to invest in innovation and share the risk with other farmers/SMEs, for example through the involvement of cooperatives (see below).

Figure 41: Illustration of financial structure based on the emission of mini-bonds



In 2012 and 2013, the Italian Government introduced legislation to facilitate the issue of debt instruments for non-listed companies (with >10 staff and >€2 million turnover) as a response to the sovereign debt crisis. With the support of an advisor, small and medium-sized companies issued mini-bonds and provided investment opportunities. In 2016, the Italian cooperative Faro Società Cooperativa Agricola SpA was one of the issuers of mini-bonds, showing their suitability for attracting finance in the agri-food sector. Similar mini-bond markets exist in the UK (British bonds which are listed on the Order Book for Retail Bonds), France (segments dedicated to SME bond issues), Spain (Mercado Alternativo de Renta), Germany and Norway.

Once the legal framework and trading systems are in place, derived innovative securitisation structures can be designed. A structure that demonstrates the functionality was developed by eight Italian water utilities in the Veneto Region in 2014 (Viveracqua) together with the EIB.¹⁴⁰ This initiative uses mini-bonds in combination with the well-established Italian securitisation legal framework, to finance small and medium-sized water companies experiencing difficulties in accessing bank finance for long maturities with a defined risk profile. The mini-bonds were issued on a cross-collateralised basis by the eight utilities. This was the first case of self-financing by medium-sized enterprises on the capital markets through securitisation without the direct help of a bank as an intermediary. Based on the mini-bonds issued by the water companies, a single class of asset-backed securities (notes) was issued by a special purpose vehicle (SPV). These notes were subsequently purchased by investors and by the EIB (50/50). The ultimate borrowers and beneficiaries are the Italian water companies, which will finance their long-term investment plans.

A similar instrument with European farmers, cooperatives and small agri-food businesses could be explored. It would allow farmers and agri-food businesses investing in the uptake of innovations to issue mini-bonds on a cross-collateralised basis to enable a larger loan, possibly supported by a credit enhancement instrument (either through their own resources or through another group). Jointly, they would have a better credit standing due to risk diversification and credit enhancement. Furthermore, this could result in higher liquidity due to the larger issue size and the diversity of borrowers.¹⁴¹ Overall, this instrument also reduces the risk of information asymmetry by requiring numerous farmers/SMEs to trust each other, thereby boosting investor confidence.

6.3 Explore the development of risk-sharing financial instruments dedicated to digital, data-driven agri-food innovators

The market analysis shows that smaller agri-food innovators have difficulty in accessing financing for the scale-up phase in particular (as opposed to financing for the start-up and pre-start-up phases). During interviews with agri-food companies, 61% of small companies with revenues below €10 million per year reported that it had been “difficult” or “very difficult” to obtain financing. These companies have typically developed their innovation and are setting up final pilots or entering the market. Mobilising sufficient equity is their largest financing constraint, particularly for digital innovators who operate a virtual business model and cannot demonstrate a financial record of accomplishment.

The equity volumes required to finance scale-up phases are comparatively small. The agri-food innovators with the largest difficulties in obtaining equity finance seek investment volumes of up to €5 million (most less than €2.5 million) and very few seek up to €30 million of equity. However, according to specialist investors, the small ticket sizes are not the barrier. The effort needed to conduct due diligence and process the investment decision takes time due to the specifics of the sector. Hence, even specialist investors cannot cater for a larger number of companies in need of equity. DIHs could support these investors in their due diligence processes.

¹⁴⁰ Viveracqua, 2014

¹⁴¹ In the case of Viveracqua, the yield was higher than Italian sovereign bonds, remunerating the investors for the less liquid instrument.

On the financing side, the study suggests exploring the idea of setting up a purpose-driven financial instrument (e.g. an investment platform) to provide low-volume equity to higher-risk agri-food innovators. The ticket sizes could range from €0.25 million – €5 million. Fund managers have said a fund of about €50-100 million (potentially benefiting up to 75-100 companies in Europe) should be sufficient to support the activities of the small-scale innovators in the ecosystem. Investors from the private or public sector (such as NPBs) should be involved in committing capital to these funds.

A bespoke financial instrument providing equity for higher-risk financing with longer lead times could close part of the agri-food innovation financing gap that agri-food innovators face. Thus, this recommendation directly addresses the structural access-to-finance problem faced by the smaller agri-food innovators. Finally, synergies could be further explored with the financing options under EAFRD, which might further stimulate innovation in the agri-food sector.

6.4 Empower Digital Innovation Hubs (DIHs) to further prioritise their support for the digitalisation of the agri-food value chain

The findings show that digital innovations and data-sharing technologies have a highly disruptive potential for the agri-food sector and offer major value creation potential. For example, blockchain-based applications that integrate the entire agri-food value chain make it possible to store and exchange information from different operators along a food product's supply chain in a decentralised and more tamper-proof system.

OriginTrail¹⁴² allows consumers to trace the origin of poultry products in Slovenia to find out which animal farmer's meat is included in the final product. The firm works with the meat-processing company Perutnina Ptuj, which has reorganised its IT to provide OriginTrail's application with information on the supplier of each meat batch. The data are stored in a blockchain, making it practically impossible to tamper with. Consumers can use OriginTrail's smartphone application to scan the barcode of poultry products produced by Perutnina Ptuj. After having entered the expiry date and the lot number, the app shows which farmer provided the meat in the specific product the consumer is about to purchase. They can thereby trace the food product along the value chain, providing quality assurance and transparency.¹⁴³

Most agri-food market participants are fairly risk-averse, and the uptake of agri-food innovations is slow. DIHs are ecosystems that consist of SMEs, large industries, start-ups, researchers, accelerators and investors, and aim to create the best conditions for long-term business success. DIHs can help develop use cases on, for example, the application of blockchain technologies, as a catalyst for the development and uptake of innovations. Young farmers and SME agri-food entrepreneurs are particularly open to new technologies and require specific support. Likewise, DIHs can provide comfort to investors by guaranteeing a certain level of project quality. DIHs also provide a local contact point and a link to the regional community, facilitating greater connectivity.

For example, the SmartAgriHubs project enables a broad digital transformation of the European farming and food sector. With a €20 million budget co-funded by the EU, the project aims to build an extensive pan-European network of DIHs. It will involve 140 DIHs, nine regional clusters and 28 flagship innovation experiments. These initiatives will help the digital transformation of the agri-food industry. Building on this will involve targeted and tailored input at local, national and European levels with an alignment of objectives and financial resources.

¹⁴² Origin Trail, 2018

¹⁴³ OriginTrail, 2017

6.5 More field labs to increase the scale-up of new technologies and innovations

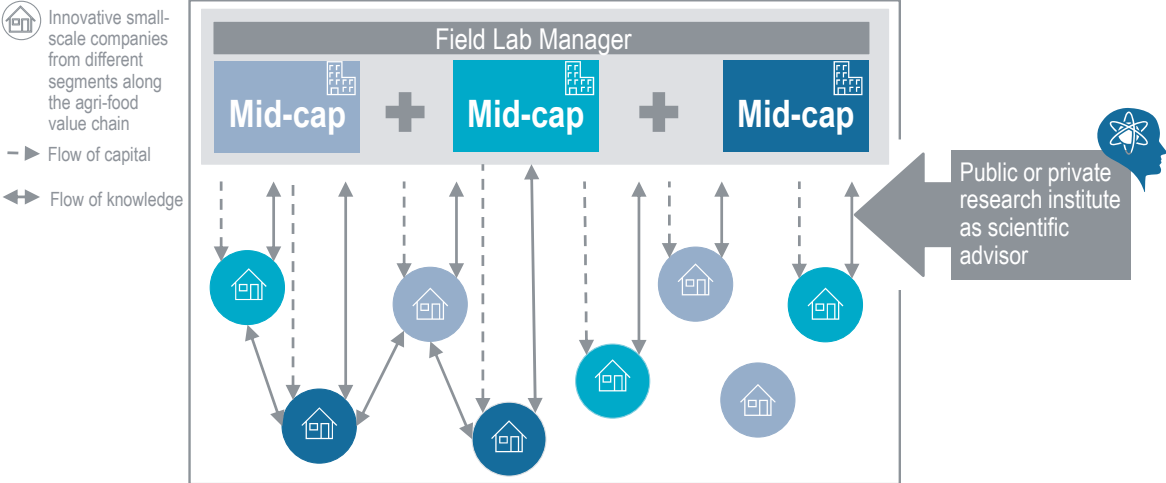
The market consultation shows that agri-food innovators are also in need of knowledge and expertise. Larger agri-food corporations enhance their innovation capabilities by knowledge-transfer approaches like open collaboration platforms or field labs, enabling them to collaborate with small-scale industry innovators via open innovation platforms or hubs (e.g. HENRi@Nestlé and The Unilever Foundry, established by Nestlé and Unilever, respectively). The corporations usually provide resources such as venture capital, market knowledge or testing facilities to the small-scale innovators. In turn, they gain access to new technologies and potentially disruptive innovations, which they can incorporate into their (global) production processes and/or product portfolio.

Mid-caps and even larger corporations often do not have the resources to establish and manage field labs on their own. To enhance sector-wide innovation capabilities and unlock additional innovation financing, we recommend that the EC, potentially with the financial and/or technical services provided by national innovation agencies, NPBs/NPIs or the EIB Group, support the broader roll-out of such field labs.

Agri-food mid-caps could collaboratively set up field labs comprising several small-scale innovators to jump-start business development. For example, beverage manufacturers and a packaging innovator could jointly set up a field lab with small-scale innovators that develop digital solutions to safely share relevant data between the farmer, the manufacturer and the packaging company. These solutions could help to increase the shelf life of the drinks produced. The cluster could also include innovators from the packaging sector that develop smart labelling technologies. The mid-caps involved can take up the products and technologies developed by the small-scale companies and thereby improve their innovation capabilities and their competitiveness. Field labs may also help unleash corporate venture capital for scaling up promising technologies and introducing them to the market (larger firms can take an equity stake/or enter into a joint venture arrangement with a small innovative or specialist firm, to which it may also provide expertise).

Since companies are often unwilling to collaborate if they have knowledge appropriation concerns,¹⁴⁴ it is important to set up an intellectual property (IP) model that determines the value appropriation potential for all field lab partners.

Figure 42: Potential set-up of a field lab by mid-cap companies



¹⁴⁴ Heimann and Nickerson, 2004

Mid-cap companies could benefit from these field labs because they could take up and incorporate highly innovative products or technologies much faster. Because the field labs would ideally include companies from different segments along the value chain, technologies for value chain integration could be easily tested and improved. This could lead to the faster development of these technologies and a higher number of market-ready innovations. Furthermore, integration of different stakeholders along the agri-food value chain would foster a systemic approach to agri-food innovation and is therefore consistent with the FOOD 2030 initiative's food systems approach. Through potentially associated financial advisory services, small-scale innovators would obtain access to both equity capital and market knowledge.

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