Boosting innovative Digitech Value chains for Agrofood, forestry and environment

GRANT AGREEMENT N. 777890

DELIVERABLE D1.1

Digital Trends Map for the Agro food, Forestry and Environment sector

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Table of Contents

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1 INTRODUCTION

This document presents the report D.1.1 - Digital Trends Map for the Agrofood, Forestry and Environment sector, within the Task "Mapping the Digital Trends for the Agrofood, Forestry and Environment sector's" of the DIVA Project. The projected received funding from the European Union's Horizon 2020 Innovation Action under the Call INNOSUP 01-2016-2017: Cluster facilitated for new industrial value chains.

The document is organized in the following sections:

- Identification of the Drivers of Change;
- Business Trends Map
  - Methodology, with the identification of the several steps undertaken to select a restricted list of Trends;
  - Business Trends List, this chapter listed the six trends identified, it described the trends within the agrofood, forestry and environment sector. Lastly, Digital Solutions that address the Trend were identified.
- Visual Trend Map

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2 DRIVERS OF CHANGE

"Drivers of Change investigate the key global issues driving change in our societies and markets".[1]

There are a number of drivers shaping the Agrofood, forestry and environment sector, for example, OECD (2010) reported urbanization and climate change as main challenges for agriculture sector. Another study, considered population growth (Maggio et al., 2015) and increased wealth, greater purchasing power, and higher demand for processed food, as pressure sources to the food value chain (Godfray et al., 2010) and for the overuse of natural resources. Finally, globalization has led to a interconnect market and complex trade standards (Cucagna and Goldsmith, 2018).

Figure 1 – Five drivers of change have been selected for the DIVA project

[1] https://www.driversofchange.com/tools/doc/

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Urbanization

In 2025, 5 billion of the world's population will live in towns and cities. By 2050, 2/3 of the population will likely be urban, giving rise to new natural resource management issues.

Natural resource problems will be exacerbated by the growth of megacities of an as-yet unforeseeable size[2].

Population

In 2050, the global population will have risen to 9.1 billion people. The least developed countries will have the biggest population share, rising from 5.4 to 7.9 billion inhabitants against 1.2 billion in the wealthy countries by 2050. This estimate is up from the last UN published figures in 2004[3].

Demand Shift

By the middle of this century, we will watch an increased wealth, greater purchasing power, and higher demand for processed food, meat, dairy, and fish (Godfray et al., 2010).

Climate change

The effects of climate change will primarily influence agriculture via alterations in plant growth, with alterations in water availability, nutrient availability, increased temperature and elevated CO2.

Globalization

The Agrofood chain has become long and complex. It comprises of farmers, processors, distributors, wholesalers, traders, purchasing companies, supermarket chains, retailers, and consumers all around the world.

[2] http://www.effat.org/sites/default/files/news/13874/en-experts-report-demographic-change-final.pdf
[3] http://www.effat.org/sites/default/files/news/13874/en-experts-report-demographic-change-final.pdf

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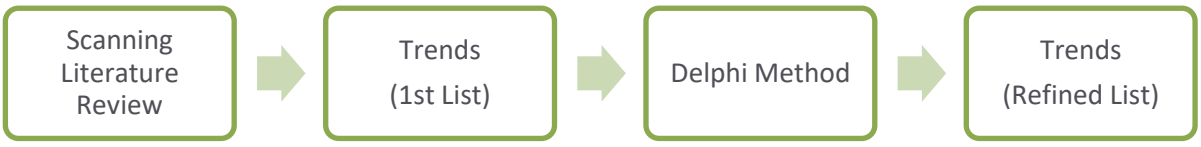
3 BUSINESS TRENDS

Methodology

The methodology for the development of the Digital Trend Map encompasses four major steps:



Scanning Literature Review

The first step begins with a literature scanning activity. The review includes bibliography includes 37 documents from two main distinct sources, scientific articles with a more academic perspective s and reports from Consultancy, Industry and Government organizations that brings the practical vision from the actors in this economic sector (the full list is available in Annex A). The Reports accounted for 37 documents (55,22%) and the academic papers represented 30 documents (44,78%).

To ensure quality and time relevance to the literature review, the bibliography consists mainly of recent documents. Documents written between 2016 and 2018 account for 71,64% (total number of 48 documents).

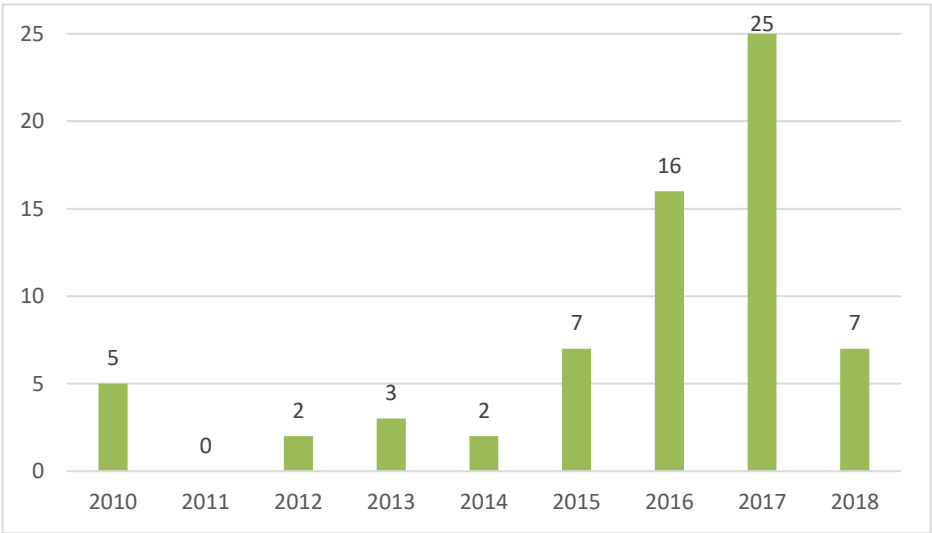


Figure 2 –Number of Papers and Reports by year

Trends (1st List)

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With the reading and examination of these documents, we are able to identify and frame trends that possibly will have an impact in the agrofood, forestry and environment sector.

This scanning activity resulted in 10 recurrent trends:

1. AgroEcology
2. Business Model Innovation
3. Circular Economy
4. Consumer's Choice
5. Data Economy
6. Digital Economy
7. On Demand Economy
8. Sharing Economy
9. Social Well being
10. Sustainable Intensification

Delphi Method

To complement and validate the literature review, the second step of this methodology included the validation of the identified trends by a group of experts in this area. The Delphi method (Brown, 1968) is a long-range forecasting technique that elicits, refines, and draws upon the collective opinion and expertise of a panel of experts (Geist, 2010).

The first list of Trends and corresponding definitions was presented to a panel of seven experts that ranked the relevance of the identified trends to the agrofood sector and evaluated the possibility of cross-fertilization to the forestry and environment sector. The ranking evaluation comprises a scale from 1 to 5, with 1 representing Not Relevant and 5 represent Highly Relevant.

Trends (Refined List)

The Delphi method technique requires feedback of individual contributions, some opportunity for individuals to revise understandings and some degree of anonymity for the individual responses. This way, besides the evaluation of the Trend Relevancy in a quantitative scale, the respondents have the opportunity to suggest or comments the identified trends and their definition. DIVA partners reach a consensus on a list of 6 trends. Comments concerning the definitions have been implemented and an in-depth literature review was conducted with the aim of identifying more specific challenges and opportunities. A work in progress document is presented below

To ensure transparency and quality, the selection of the Trends needed to satisfy the requirement of having 5 answers with an evaluation of 4 or 5 (See Figure 3).

	R1	R2	R3	R4	R5	R6	R7
Primary topics							
Agroecology	2	4	3	3	3	4	2
Business Model Innovation	4	3	5	4	2	5	4
Circular Economy	2	4	5	3	5	5	5

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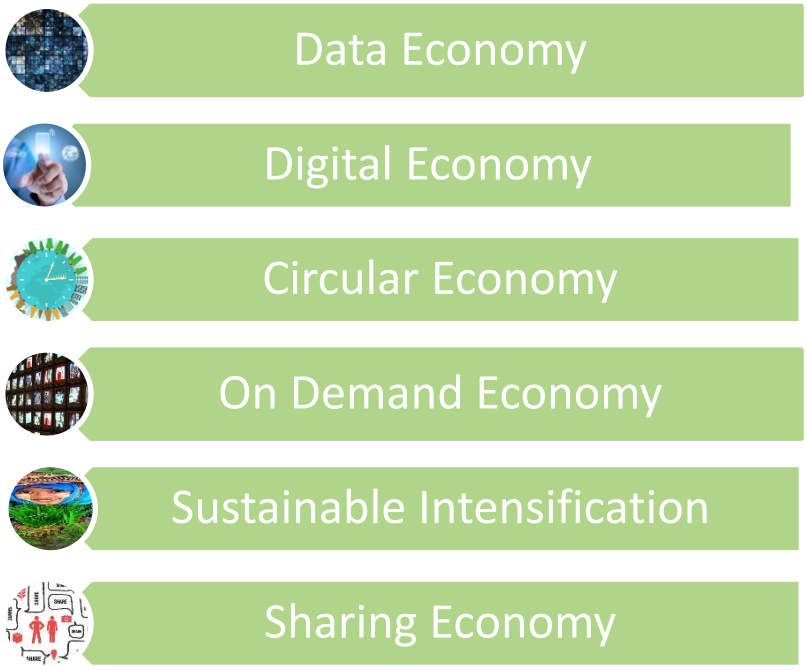
Consumer Choice	3	3	4	4	4	4	4
Data Economy	5	5	5	5	5	4	5
Digital Economy	4	5	5	4	5	5	4
On Demand Economy	4	4	4	4	3	4	5
Sharing Economy	4	5	3	5	5	3	4
Social Well Being	3	3	4	3	3	4	1
Sustainable Intensification	3	3	4	4	5	5	5

Figure 3 – Responses from the Delphi Survey

Business Trends Selection

To address contemporary agro food, forestry and environment challenges, DIVA TREND MAP seeks to inspire transformative innovations.

6 TRENDS HAVE BEEN SELECTED FOR THE DIVA PROJECT



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Data Economy

Stakeholders in data sources, exploiters and consumers create a set of economic activities around the asset that has become increasingly strategic: Data.

As the Internet of Things (IoT) grows, data is collected in so many places and in such vast quantities that its potential has yet to be fulfilled. Some of the scenarios in which data assists are decision making, product tracing, safety and gaining consumer insights. It is becoming so important that many new business models heavily rely on this strategic asset.

As data becomes so valuable, concerns arise around security, privacy and ownership. Owners of data develop a reluctant attitude to share and aggregate data, leaving a lot of value for industry and a variety of research fields untouched. Technologies such as the blockchain have the potential to solve some issues by storing, sharing and verifying data securely.

Management is becoming increasingly data driven throughout every stage of the value chain with the development of Information services, decision support systems; and predictive models and more throughout every stage of the value chain. These services however should keep in mind the final goal of data: To extract value by delivering meaningful and actionable information to users. This way data helps actors have a positive impact on the main challenge of the agro food, forestry and environment sectors: sustainability.

We are looking for Digital Solutions to:

- Facilitate interoperability for horizontal and vertical collaboration of business partners
- Leverage and stimulate data aggregation that allows the generation of new scientific knowledge.
- Convert the knowledge into predictive analysis and decision support tools.
- Unlock the potential of shared data.
- Ensure data security, protection and authenticity

Digital Economy

A digital transformation provides social and economic benefits resulting from online connections among people, businesses, devices, data and processes.

As the digital transformation unfolds, industries become smarter through communication, optimization and automation. Therefore, competitive advantage relies increasingly on technological

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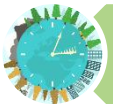
innovation. The technology adoption among some SMEs in the agricultural industry however has been slow due to investment and a skill gap. Within the retail and marketing sectors technological innovation provides many new business opportunities, but the need of some is questionable.

Technology adoption leads to an increase of digital enablers in the value chain and provide the potential to monitor the status of products throughout a supply chain that can become increasingly complex. This allows not only the optimization of internal and external processes but also the improvement of food safety. Data is not only collected about location, but also about variables such as temperature and pH levels that will reveal information about a products quality. Subsequently, smart packaging can communicate relevant product characteristics and fulfill the consumer's need for more information.

Some technologies such as smart tags supported by QR or Barcodes are ready for adoption. For other innovations to take place further development is required such as sufficient computational power and energy autonomy.

We are looking for Digital Solutions to:

- Facilitate the management, automation and optimization of processes internally and between operations in the value chain.
- Extract value from the traceability of products. Some of the opportunities lie in product safety and the properties of products such as packaging.
- Promote and aid the adoption of technology such as Fintech and Elearning.



Circular Economy

More value can be extracted from resources by using them more efficiently and for longer through sharing, reusing, repairing and recycling.

It is Important in the circular economy to use resources more efficiently throughout the process and to address the current wasteful system. Initiatives to either close or narrow the loop can take place at the company level, but also through local initiatives and sector organization. An example of it can be found in the promising bio economy concept which proves that the circular economy can serve to reduce environmental as well as economic costs. It is not only about preserving value, but also about driving revenue.

The circular economy is one response to deal with higher and more volatile commodity prices. Products such as farm equipment can be provided as a service, and recycling offers opportunities as the number of consumer touch points is increased.

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Closing and tightening the resource loop requires significant effort and is not an incremental innovation. Different partnerships with a variety of stakeholders are required to collaborate in order to achieve a bioregional food system that optimizes water, energy and waste.

Digital technologies are essential to guide transformations. Sharing and integrating information about the location, availability and quality of resources optimizes inputs and minimizes transaction costs and uncertainty.

We are looking for Digital Solutions to:

- Educate and create awareness about the circular economy
- Capture value from transparency by communicating origin and other product attributes
- Form networks of stakeholders to connect, collaborate and co create in a bioregional system.
- Optimize operations by reducing risks, transaction costs and uncertainty.

On Demand Economy

Digital marketplaces have led to the immediate provisioning of goods and services as well as employment becoming detached, agile and adaptable.

Delivery has become safer and more reliable because of a smaller information gap. Brick and mortar stores are transformed into web shops and consumers are experiencing same day delivery as the new norm thanks to algorithmic efficiency.

Logistics have become a competitive advantage and the mindset "can't touch won't buy" belongs to the past. The next generation of logistics is fueled by technologies such as 3D printing.

The connection of people through digital infrastructures has resulted in the detachment of work and workplace. Last mile food deliverers are independent and are experiencing new levels of labor flexibility. Throughout the value chain, expertise and temporary labor will be available on demand by matching supply and demand.

For such temporary jobs, individuals can acquire highly sought-after 21st century skills. Especially in the agro-food sector with the unfolding of digitization training and expertise is required. Opportunities exist to find synergy between on demand learning and on demand labor.

There is however a dark side to this "cloud-based labor"; extreme flexibility demands, uncertainty and low prices are to be feared in the new gig economy.

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We are looking for Digital Solutions to:

- Provide on demand labor and learning with social responsibility in mind.
- Provide micro, small and medium enterprises market and logistic access.
- Fulfill the highly personalized demand through mass customization.

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Sustainable Intensification

Efficiency gains are required while conserving natural resources and creating ecosystems that are resilient to climate change and market volatility.

Sustainable intensification is generally associated with the focus on intensifying the production side either through increased labor, input or technology. As the objective is to design an agri-food system that is sustainable in terms of economic, social and environmental perspectives, concepts of the circular and sharing economy are part of sustainable intensification as well.

One problem lies in the definition of sustainable. More research is required to understand all linkages, in order to reach scientifically based acceptable and shared norms that allow the implementation of cost-benefit analyses in daily management practices.

Digital Innovation Hubs aid the advancement of the sector through knowledge and technology transfer. Additionally, these Hubs provide the infrastructure for the formation and development of ideas by various actors. Other forms of open innovation are taking place such as governments opening research to agri-tech experts, the formation of multi-stakeholder communities, and supply chains collaborating to innovate.

For the durability of the system, the social aspects should not be neglected. Digital technologies need to increase access to opportunities of development through social inclusion and subsequently prevent rural abandonment.

We are looking for Digital Solutions to:

- Make cost benefit analyses based on all relevant perspectives
- Connect research to innovation and other forms of open innovation.
- Increase rural attractiveness

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Sharing Economy

Sharing is about reducing ownership and increasing access by making underutilized assets and services accessible to off and online communities.

The sharing of resources like cars and houses has shown to be a viable business model. Some argue these models to be part of an access economy rather than a sharing economy as sharing implies some altruistic nature. Alternative Food Networks are somewhere in the middle as consumers and producers collaborate. These short distribution chains like self-harvest gardens and community-supported agriculture could experience new growth and increased member retention as labor intensity can be decreased and organization optimized with the implementation of digital technologies.

The demand for local food, the need for shorter distribution channels and the unsustainable food system for small farmers have led to the rise of regional and local food hubs. By sharing value creation, the competitiveness of stakeholders is enhanced as well as the condition of the community itself. Examples are the formation of brands around regions, and the attraction of talent.

There are however situations in which companies prefer horizontal collaboration abroad due to a lack of trust and therefore limited information exchange. Hybrid approaches that generate profit to accomplish social and environmental objectives have the opportunity to fill an important gap in the industry.

We are looking for Digital Solutions to:

- Increase the amount of shared resources which may have traditionally been owned
- Optimize Alternative Food Networks processes
- Facilitate value creation by regional food hubs

4 VISUAL TREND MAP

"A trend map is a visual depiction of relevant trends influencing the system around a given topic. Developing a trend map can help a group deepen their

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understanding of an issue through exploring related history, identifying key external factors, and tracking shifts in social and cultural norms."[4]

Business Subtopic Trends

Act Local: To solve global problems action is needed at the local level. This is part of a new mindset that increasingly re-appreciates the local environment.

[4] Source: https://www.issuelab.org/resource/guide-to-trend-mapping.html

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Bio Economy: The invention, development, production and use of renewable biomass across all sectors to replace fossil fuels and produce other biobased products.

Business Model Innovation: Increased importance of sustainability and new technologies lead to opportunities for new business models to capture maximum value from innovation.

Data Aggregation: The aggregation of data will assist research communities, allow stakeholders to compare performance and the development of apps and services.

Data Sharing: The sharing of data between stakeholders in the value chain increases efficiency and safety but technical barriers and legislative uncertainties remain.

E-Commerce: By conducting business activities increasingly online, wider access exists to consumer goods, production inputs, financial services and more.

Energy Efficiency: Current energy intensive systems contain numerous opportunities for improvement based on monitoring, consumption reduction and renewable energy adoption.

Innovation hubs: To aid innovation and adoption these hubs and centers provide physical and digital infrastructure to facilitate connections and access to resources.

Precision Agriculture: Digital techniques measure variations among the field to add exactness to inputs and timing, resulting in higher yields and a lower environmental impact.

Reverse Logistics: Waste to be valorized needs to be collected and transported. This requires changes in behavior, careful organization and adaptation of transport.

Social Inclusion: It is about improving the terms on which individuals and groups take part in society by increasing access to develop opportunities

Traceability: The ability to follow the movement of a resource through various stages. This allows faster and precise identification of a product under review.

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6 ANNEX A

Nr	Authors	Title	Type
1	HM Government	A UK Strategy for Agricultural Technologies	Report
2	Corrado (2016)	Advances in DNA typing in the agro-food supply chain	Paper
3	OECD	Agricultural Policy Monitoring and Evaluation 2017	Report
4	Synthesis	Agriculture and Agri-Food Sector Strategy 2017	Report
5	IFAD	Agrifood markets and value chains	Report
6	Philip Farrelly	AgriFood Strategy 2025	Report
7	Ganeshkumar et al (2017)	Agri-Food Supply Chain Management. Literature Review	Paper
8	Fiore et al (2018)	Agri-food supply chain optimization through the SWOT analysis	Paper
9	Saitone and Sexton (2017)	Agri-food supply chain. Evolution and performance with conflicting consumer and societal demands	Paper
10	Falguera (2012)	An integrated approach to current trends in food consumption. Moving toward functional and organic products	Paper
11	Bronson and Knezevic (2016)	Big Data in food and agriculture	Paper
12	Wageningen	Blockchain for Agriculture and Food	Report
13	Tell et al (2016)	Business model innovation in the agri-food sector. A literature review	Paper
14	Wageningen	Business models urban agriculture	Report
15	Elghannam et al (2017)	Can social networks contribute to the development of short supply chains in the Spanish agri-food sector	Paper
16	OECD	Challenges for Agricultural Research	Report
17	Naik and Suresh (2018)	Challenges of creating sustainable agri-retail supply chains	Paper
18	European Commission	Climate and Environmental Challenges facing agriculture and rural areas	Report
19	Dania et al (2015)	Collaboration and Sustainable Agri-Food Suply Chain. A Literature Review	Paper
20	OECD	Competitiveness, Productivity and efficiency in the agricultural and agri-food sectors	Report

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21	Esteso et al (2018)	Conceptual framework for designing agri-food supply chains under uncertaintly by mathematical programming models	Paper
22	Wageningen	Cybersecurity in the Agrifood sector	Report
23	Akhtar et al (2016)	Data-driven and adaptive leadership contributing to sustainability. Global agri-food supply chains connected with emerging markets	Paper
24	FAO	Developing sustainable food value chains 2014	Report
25	European Commission	Digitising the Agri-food Sector. A research agenda for Horizon 2020	Report
26	Massey University	Disruptive technology in the agri-food sector. An examination of current and future influence on sustainability, bio-security and business effectiveness.	Report
27	Zeng et al (2016)	E-commerce in agri-food sector. A systematic literature review	Paper
28	EIP Agri	EIP-AGRI Seminar Digital Innovation Hubs for agriculture 2017	Report
29	EIP Agri	EIP-AGRI Workshop Innovation in the supply chain creating value together. Workshop Report 2018	Report
30	EIP Agri	EIP-AGRI Workshop on Data Sharing 2017	Report
31	Agriculture and Agrifood Canada	Emerging Food Innovation. Trends and Opportunities	Report
32	Euractive	EU farming getting smarter 2017	Report
33	IFA	Farm Profitability key to agri-food growth 2015	Report
34	Csiro	Food and Agribusiness. A roadmap for unlocking value-adding growth opportunities for Australia	Report
35	Dep. Agriculture, Food and Marine (Ireland)	Food Wise 2025	Report
36	Saritas and Kuzminov (2017)	Global challenges and trends in agriculture. Impacts on Russia and possible strategies for adaptation	Paper
37	Farm Europe	Global Food Forum. A new ambition for EU agri-food systems 2017	Report
38	Wolfert et al (2017)	Guidelines for governance of data sharing in agri-food networks	Paper
39	Harvey et al (2017)	How Competitive is the EU's Agri-Food Sector	Paper
40	OECD	How policies shape global food and agriculture value chains 2017	Report
41	OECD	Improving energy efficiency in the agro-food chain	Report

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42	Karantininis et al (2010)	Innovation and integration in the agri-food industry	Paper
43	Hofmann (2017)	Integrating Nature, People, and Technology To Tackle the Global Agri-Food Challenge	Paper
44	Sundmaeker et al (2016)	Internet of Food and Farm 2020	Paper
45	PWC	Megatrends impacting the European agrifood industry	Report
46	OECD	Method for estimating global trade in value added within agriculture and food value chain 2017	Report
47	Fraceto et al (2016)	Nanotechnology in Agriculture. Which Innovation Potential Does It Have	Paper
48	Pronti and Pagliarino (2018)	Not Just for Money. Crowdfunding a New Tool of open innovation to support the agro-food sector. Evidences on the italian market	Paper
49	OCED and FAO	OECD-FAO Guidance for Responsible Agriculture Supply Chains 2016	Report
50	Wolfert et al (2010)	Organizing information integration in agri-food. A method based on a service-oriented architecture and living lab approach	Paper
51	Iaia et al (2016)	Origin based agro-food products. How to communicate their experiential value online	Paper
52	FAO	Poster. The future of food and agriculture	Report
53	REEEP	Powering agrifood value chains	Report
54	FM	Review of the irish agri-food industry 2017-2018	Report
55	EIP Agri	Shaping the digital (r)evolution in agriculture	Report
56	Ramundo et al (2016)	State of the art of technology in the Food sector	Paper
57	Gold et al (2016)	Sustainable Global Agrifood Supply Chains. Exploring the Barriers	Paper
58	Teagasc	Teagasc Technology Foresight 2035	Report
59	KPMG	The agricultural and food value chain. Entering a new era of cooperation 2013	Report
60	OECD	The Benefits from Agricultural Research and Development, Innovation, and Productivity Growth	Report
61	Prism	The Future of Agri-Food	Report
62	Wajszczuk (2016)	The Role and Importance of Logistics in Agri-Food Supply Chains. An Overview of Empirical Findings	Paper

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63	Barth et al (2017)	Towards a Conceptual Framework of Sustainable Business Model Innovation in the Agri-Food Sector. A Systematic Literature Review	Paper
64	Introini et al (2018)	Traceability in the Food Supply Chain. Review of the literature from a technological perspective	Paper
65	Potter et al (2012)	Trends in product recalls within the agri-food industry	Paper
66	Howieson et al (2016)	Value chain analysis. An iterative and relational approach for agri-food chains	Paper
67	FAO	World Food and Agriculture towards 2030-50-80	Report