**Towards an e-infrastructure for**

**Open Science in Agri-food:**

**Vision paper**

*Draft version – 27th November 2017*

# Vision

In 2030 food business operationswill produce healthy nutritious foods for all, produced through input-efficient methods and supporting a thriving environment. Food Systems will operate as collaborative networks that are constantly seeking to improve their economic, environmental and social performance for all actors of the network, and those food systems can be region specific, in local territories, but also global. The food systems contribute to the achievement of a wide range of objectives as captured by the Sustainable Development Goals[[1]](#footnote-1) such as achieving food security, mitigating global warming, ensuring good health and preserving biodiversity.

These inclusive and resilient food systems are supported by open science based knowledge systems to stimulate further innovations. As such a food system is necessarily knowledge intensive. The food business operations create and use knowledge on the production of foods, environmental effects, its processing, distribution, its nutritional values and its healthy consequence, requiring to look beyond the individual value chains, individual crops or livestock types, and farm types. In the open science based knowledge hub, researchers

1. openly collaborate with different societal stakeholders to further improve the functioning of the food system;
2. create a systems approach including the impacts and consequences in the whole food systems in their research, not studying effects and disciplines in isolation;
3. undertake fully data- and knowledge-driven research, in which transparent data / knowledge is ubiquitously driving the research, and researcher rapidly plug-n-play different data / knowledge sources to quantify and estimate effects in a robust way;
4. work impact-based, to place their research in the broader societal context and show what the implications of the research are.

# Challenges to realise the Vision

Realising the vision by 2030 requires a transition in research to systemic, integrative, multidisciplinary and global approaches. As part of this transition research in agriculture and food needs to embrace *digitalization, transparency and collaboration*.

The agri-food sector relies on a complex science that requires multidisciplinary, multiscale and geolocation-based approaches. This implies a significant amount and variety of agricultural data and models, which has been increasing exponentially with the adoption of more and more systemic perspectives, the automation of data collection (e.g. thanks to robots, UAV, connected sensors), new engineering tools such as in the omics field, as well as with the development of new types of data sources (e.g. Internet of Things, crowd-sourcing, text mining). More generally, natural and societal phenomena are being described by more and more massive data at different scales, from various sources and with different resolutions.

In order to achieve the vision, the ability to share, access and integrate heterogeneous knowledgeis a key issue in order to tackle today’s societal challenges. Especially in addressing climate change impacts on food security, providing healthy and nutritious food to all, developing sustainable food value chains as well as providing support for local agricultural development. In order to address these growing challenges faced by the global food system, more and more research and innovation is depending on suitable exploitation of knowledgeresources and digital technologies: harmonized information exchange standards, high-technology equipment, high-speed broadband, connected sensors, data sharing and exploration, modeling and coding, intensive simulation, social networks, etc.

The transparency challenge requires the embrace of “Open Science”, which engages research institutions in the digital transition for each phase of the knowledge production cycle for innovation (i.e. design of research questions; production, analysis and simulation of data; dissemination of knowledge; knowledge transfer and innovation).

For collaboration it will be required to connect not only researchers amongst themselves, but also researchers with other societal players. The ambition is to achieve an efficient dataflow between Research, Farming, Supply Chain stakeholders, consumer including communication to policy makers to speed up development and innovation.

Therefore, it is necessary to design an open e-science framework and related facilities or e-infrastructures that enable to share and connect data / knowledge, computing and storage resources, codes and data-mining algorithms, models and ontologies, as well as expertise, efforts and best practices.

# Benefits in realising the Vision

Agri-food science and innovation would benefit hugely from a common knowledgeecosystem. Produced and used by diverse stakeholders including academic researchers but also – and of course – farmers, the industry, extension services and – last but not least – citizens, a shared global knowledge space will help build the infrastructures that will propel the agri-food sector forward.

Addressing the challenges of digitalization, transparency and collaboration will generate the following benefits:

* Speeding up the transfer of knowledge: As in all sciences, open science will reduce the time to access to knowledge for farmers or extension services, private companies linked to the agri-food sector and also for education. Access to this knowledge is also a key issue for developing countries.
* Increasing knowledge spill-overs to the economy: Globally, in the agri-food sector, open data helps shape best practices. Transparency around targets, subsidy distribution and pricing, for example, creates incentives which affect the behaviours of producers, regulators and consumers. It also helps the public authorities to make better decisions.
* Addressing global challenges more effectively: When studying climate change and its impact on agriculture, food security and safety, free access to knowledge / data from all over the world is of great importance. It is therefore strategic for publicly-funded research in agriculture and environment to adopt the "FAIR principles"[[2]](#footnote-2) for data / knowledge and also open access to publications.
* Promoting citizens’ engagement in science and research: As a science of observation, Agricultural sciences should strongly benefit from "citizen science" projects collecting information from farmers which help to better understand ecosystem functioning. In return, farmers and the food processing sector could better manage their production having access to knowledge bases. For the consumers this would result in more food security and safety.
* Improve food safety and well-being through transparent food supply chains preventing food-fraud and criminal activities (e.g. melamine or horse-meat crisis)

# Rules of engagement and Principles

To achieve the vision and overcome the challenges of digitalization, transparency and collaboration, we believe the following rules of engagement and principles will support this transformation:

* Scientific research is enhanced through seamless use not only of research data throughout the scholarly community, but also of data from the farms and the supply chain, as well as environmental NGOs.
* The Food business operators benefit from easier access to new technological and scientific developments, which will be verified more quickly.
* The Supply Chain has improved information for consumers, retailers and producers.
* We will assure universal knowledgeaccess and promote a knowledge-sharing culture at community level, but we recognise different levels of data openness and we see the FAIR principles as the guide. We recognize and foster diversity. Data, information and knowledge has to be organized in an ecosystem of commons and private. We see the need for regulations to avoid the establishment of data monopolies and we will support the implementation of those regulations.
* We emphasize the need to enable researchers to easily explore, integrate and simulate their own data / knowledge as well as data / knowledge that have been produced by others within or outside their community and that are complementary in terms of objects of study, scales and disciplines.
* We need to harness the power of data produced by Farmers and by Land observation, which includes Precision Agriculture but is not limited to it. Farms need to become Labs linked to scientific research.
* We strongly believe that data / knowledge management starts with research planning, data production, in the lab, on the field or at the observational level. We aim for a strong collaboration with equipment producers for introducing common data sharing principles and standards.
* We will support interoperability across data sources and agree on standards without reinventing wheels. Standards need to be open and shared. Standards need to be crossdisciplinary and co-defined with communities to ensure their adoption.
* We will build on existing infrastructures within our field as well as generic (i.e. technological) infrastructures, and establish specific infrastructures and services as relevant for agriculture and food science to stimulate collaboration in an open way.
* We will foster distributed efforts and flexible governance for long-term empowerment by and sustainability within the agri-food community. We will help develop appropriate business models for data sharing and related services, especially for our “common goods” such as those supporting semantic interoperability and data discovery.
* We need to develop skills and capacity.
* We want to construct not only a European Community, but an international network. Big Agricultural Sciences are in the Global South, we will link up our initiatives with those of G20 and G77 countries.

1. <http://www.un.org/sustainabledevelopment/sustainable-development-goals/> [↑](#footnote-ref-1)
2. <https://www.force11.org/fairprinciples> [↑](#footnote-ref-2)