

# Digital agriculture

## 08 **How can precision livestock farming contribute to the principles of agroecology?**

Ludovic Brossard, Clément Allain & Jean-Baptiste Menassol.

Livestock farming systems are facing major currents of transitions with growing consideration for agroecology, “One Health and One Welfare” concepts, and increasing integration of digital technologies and sciences. Precision livestock farming technologies can contribute to the pillars of agroecology, for instance through precision feeding to reduce the inputs required for production; sensors and automata can also help to adopt management practices to improve global health and welfare of animals and farmers. Furthermore, digital technologies can help maintain or promote agroecological livestock farming systems through solutions that monitor animals, and facilitate the management and traceability of practices in more extensive systems, such as mountain farming or pastoralism. Therefore, new technologies have the potential to support agroecological transitions, but will not be the driving force behind these transitions. Possible negative externalities, such as environmental impact of digital technologies must also be weighed against their positive internalities for a successful and sustainable integration of digital tools into agroecological livestock farming systems.

## 15 **The development of digital technology: What prospects for organic farming?**

Éléonore Schnebelin, Pierre Labarthe & Jean-Marc Touzard.

Digital technologies are being promoted to meet the challenges of agriculture, regardless of the production model, whether conventional or organic. However, research conducted as part of a thesis in the Occitania region shows that organic farming stakeholders have expectations, perceptions, projects, and uses for these technologies that are partly specific. While digital issues are common to the entire agricultural sector, particularly in terms of sharing information and improving working conditions, organic farming is different because of its technical practices, system design needs, standards, and values, all of which affect the expectations of its stakeholders with regard to digital technology. The results reveal oppositions between organic agriculture and certain types of digital technologies, but they also point to the existence of innovation trajectories that associate digital technology with this agriculture, which calls into question the evolution of its model.

## 20 **From data to autonomous processing for agroecology**

Roland Lenain & Christophe Aubé.

The development of digital sciences is a real challenge to improve decision-making in agriculture, and move towards the application of less damaging and more agroecological principles. Beyond decision-making, the realization of agronomic tasks requiring high levels of precision, increased passage frequencies, and discrimination capabilities, also requires significant advances and borrowing from robotic technologies. In this article, we show the interest of such technologies for agriculture in general, and for agroecology in particular. After a short overview of the existing technologies, we present the expectations of the different agricultural sectors, the persistent obstacles, and the relative perspectives for the agricultural robotics, an emerging field in digital agriculture. This field, thus, clearly appears as an essential component of the agricultural evolution towards more virtuous practices.

**28 Logistics and marketing perspectives of blockchain-based agri-food traceability: Case studies of Walmart and Carrefour uses**

Florent Saucède.

To restore consumer trust and confidence in food systems, some retailers and manufacturers exploit the blockchain technology to support the total traceability of their supply chains. We analyze how Walmart and Carrefour, two pioneers of food blockchains, use this technology. We show how it contributes to the dimensions and stakes of traceability. We characterize two contrasting approaches. The first one aims to control food safety by improving the piloting and the functioning of supply chains. The second one is marketing-oriented, and aims at building consumer trust by mobilizing supply chain actors to co-construct a set of facts and evidence, put into a narrative to bring transparency on the origin of products and the virtuous practices of the actors who participate in their quality.

**35 Digital sales platforms: What opportunity(ies) for producers?**

Romane Guillot, Magali Aubert & Anne Mione.

E-commerce is now penetrating the food sector, particularly through digital marketing platforms. Food system stakeholders are wondering: Do these organizations strengthen the link/connection between producers and consumers? Do they promote fairer remuneration for farmers? Do they introduce new risks for them? These platforms facilitate the exchange of information and limit certain costs associated with marketing. However, they can create power asymmetries and imbalances in value sharing. The instability of the sector and the addition of digital and distribution giants raise many questions about the evolution of platforms. In this context, vigilance on the part of producers is essential in order to choose the platforms best suited to their needs.

**41 Reconfiguration of food value chains – between logistics and traceability**

Dr Fatima El Hadad-Gauthier & Dr Isabelle Piot-Lepetit.

The rise of digitalisation is fueling a dynamics of reconfiguration of food value chains. This article explores two rising challenges: Logistics and traceability. These issues are crucial for food value chains because of the very specific characteristics of food products, such as perishability, shelf life constraints, quality variability, sanitary risks, market uncertainty, and the increasing distance between producer and consumer due to the markets' globalization.

**47 What effect is the digitalization of agriculture having on consulting services?**

Pierre Labarthe.

The objective of this article is to present the issues associated with the digitalization of agriculture through the example of the effect of digital technologies on agricultural consulting. Advisory services have played a very important role in the dynamics of technical change in the agricultural sector. These services, historically based on the advisors' skills and on direct interactions between farmers and advisors (individual advice, group advice, etc.), are increasingly using digital tools (software, decision-support tools, applications for tablets and smartphones, etc.). We highlight three fundamental issues related to digitalization: The effect of digital technologies on access to knowledge for a diversity of farmers; the evolution of skills within organizations providing advice; and the broader transformations induced in the agricultural innovation system.

**53 Digital tools: The issues of the coordination of actors and the sharing and valorization of data**

Soazig Di Bianco & Mohamed Ghali.

The rise of digital tools and the massive production of data have been transforming the coordination of actors in innovation processes. This article aims to examine the transformation and issues of actor coordination around two axes: The sharing and enhancement of data; the design and use of digital technologies. This study is based on survey data from actors in the dairy cattle sector and stakeholders in the design and use of milking robots and agricultural drones. We show that the rise of digital technologies is strengthening management strategies (bipartisan alliances) for data sharing, and is standardizing innovation processes. We discuss the effects of these changes, in particular the polarization of actors on the dynamics of innovation in agriculture.

**60 How to successfully crowdsource spatialized observations in agriculture?**

Léo Pichon.

Agriculture has embarked on transitions (agro-ecological, digital, etc.) to meet the complex and sometimes contradictory challenges it faces. The collaborative collection of spatialized observations is a relevant tool for collectively building the new knowledge needed for these transitions. However, this type of project is still underdeveloped in agriculture. Our objective with this article is to propose elements of understanding of the specificities of crowdsourcing projects of spatialized observations in agriculture, in order to identify the factors or characteristics to be favored in these projects so that they develop more widely. The spatial and temporal structure of the studied phenomena, the asynchronous and heterotopic character of the obtained datasets, and the fact that the participants are professionals seem to be the main characteristics to consider in order to favor the success of this type of projects.

**67 Digital technology at the service of the different phases of creation and use of serious games in agriculture**

Gilles Martel, Médulline Terrier-Gesbert, François Johany & Sylvain Dernas.

Serious games are developing in a significant way, including in the agricultural world. Although serious, they must still include the characteristics of games, such as second degree, decision-making, rules, uncertainty, and minimization of consequences. Apart from video games, such as Farming Simulator, the supply of games in the agricultural domain is very diverse, but mainly “analog”. Nevertheless, digital technology is present in the various stages of game creation: The creation of the data included in the game, the operation of the game and the simulation of the effects of the players’ decisions, the immersive capacity of the game, the dissemination and capitalization on the use of and learning from the game. Digital technology is therefore a major ally in the development of serious games, and goes far beyond simple mobilization in the context of video games.

**74 Access to agricultural data: the areas of intervention of the law and of the contract**

Laura Tomasso.

Access to data raises questions for the players of the digital agriculture sector, considering that the number of applicable laws increases and that it leaves less and less room for parties’ agreement. However, the agreement to be entered between the parties complements the applicable laws and remains the fundamental tool

framing commercial relationships. It is thus necessary to analyze the areas of intervention of the law and those of the contract regarding access to agricultural data, whether they be public, private, personal, non-personal, aggregated or not.

**79 The role of professional agricultural organizations in building a climate of trust conducive to the exchange and use of data of the agricultural sector**

Guillaume Joyau.

Data is a source of great concern for the agricultural sector. Indeed, the potential for valorization is very important, and it is absolutely clear that, in order to respond positively to the objectives set by the various national and European policies, the exploitation of data of the agricultural sector will be indispensable. However, it seems crucial to the professional agricultural organizations that this exploitation be done for the benefit of all, including the farmers. Farmers are often the economic operators who generate the data, but they do not have the capacity to manage the exploitation and analysis of these data sets alone. Therefore, professional organizations, and first and foremost agricultural unions, are gathering on these issues in anticipation in order to mobilize the appropriate tools and to establish the most balanced regulatory framework possible. Finally, the European Commission's initiative, initiated with the "European Data Strategy" in February 2020, and the four regulations that followed, are totally in line with the concerns of these organizations.

**85 Can farmer training accompany the development of digital agriculture?**

Béatrice Dingli & Sylvie Bourgeais.

Certain of the role of training in the development of digital technology in agricultural enterprises, the board of directors of VIVEA, the training insurance fund for farm managers, has opened up a new development and financing priority in its 2021-2026 Strategic Plan.

After a prospective study entitled "What skills for digital agriculture?", conducted in 2019 by the firms JBG consultants and Eurynome associés, and funded by VIVEA and the Direccte Occitanie, VIVEA has led several workshops in 2022 to determine, to date, the skills that could or should be quickly developed to enable farmers who wish to do so to run their farm(s) using digital tools, and, thus, lighten their work. Digital agriculture also means building exchanges, dialogue, and feedback.

This article will present the challenges of digital farming and the prospects for change in five years, the vision of experts and the vision of farm managers and agricultural advisors, an approach by sector of digital adoption, the obstacles identified to its development, and the impact on the profession. We will conclude with the training needs identified and the five types of skills that we wish to highlight and strengthen.

VIVEA will support the development of a training offer aimed to reflect on the needs of farm managers, leading to an informed choice of digital solutions. The appropriation of data analysis methods also seems essential to us. It will also be up to us to make digital technology accessible to the most remote people, and to act for the common good of all.

**97 Start-ups and digital innovation in the agri-food sector**

Dr Isabelle Piot-Lepetit & Mauro Florez.

Start-up companies represent a powerful innovation process to push forward digital innovation and develop disruptive products and services based on digital

technologies. At the same time, they challenge well-established companies that need to involve themselves in more ambidextrous innovation processes to stay competitive, pushing them to launch initiatives focusing on both internal innovations and organizational changes and external or open innovation opportunities.

**103 Innovation paths in digital agriculture:  
Living labs and Digifermes®, devices for co-innovation**

Jacques-Eric Bergez, Mehdi Siné & Muriel Mambrini.

The agro-ecological transition requires profound changes in production, processing, and consumption systems, which require new modes of governance. Living labs propose a scheme for co-development of responsible and shared innovation. However, the intrinsically plural aspect of data, knowledge, devices, etc. militates for the mobilization of new digital solutions. Our hypothesis is that the living laboratories for the agro-ecological transition will open up, in the digital domain, capacities to seize more complex issues, and opportunities to put the user at the center. In any case, it will be a digital technology with a view to serving the common good, a responsible digital technology. Through a framework of analysis and the operationalization of this framework on two examples (the Digifermes® and Occitanum), we show the emerging properties of this digital technology, and the levers that remain to be crossed for a shared and sustainable benefit.

**122 What place for hackathons to support digital innovation  
in agriculture?**

François Brun, Mathieu Rajaoba & François Gaudin.

French and international agriculture is in the midst of a digital transformation, mobilizing various technologies that offer the potential to develop new services for farmers and the agricultural world. Various forms of animation have emerged within the digital agriculture community: Start-up weekends, hackathons, and data challenges. What is behind these different activities and what is their role in the collective innovation process? What is the point of organizing a hackathon close to farmers? What contribution do hackathons in agriculture make to data-driven innovation?

**133 The AgroTIC mobilab to meet farmers**

Bruno Tisseyre & Simon Moinard.

Introduced by the MIT in 2014, “High-Low Tech” is about low-cost new technology innovations that can be self-built. Their low price and usefulness is generating strong interest in agriculture, but they do require some skills that are not currently assimilated by the agricultural world.

In order to popularize this environment in the agricultural sector, the Institut Agro Montpellier has set up the mobilab AgroTIC, a traveling facility visiting farmers to present them with all the diversity of High-Low Tech digital tools. The mobilab AgroTIC’s activities bring out farmers’ concrete needs, and the projects set up as a result of these needs can be used to answer scientific and teaching questions. The dynamic also interests companies that see it as a way to survey farmers on the issue of digital technology.

**139 Global adoption of digital agriculture**

Simon Cook, Elizabeth Jackson & Davide Cammarano.

The term “digital agriculture” inspires excitement, confusion, and skepticism amongst investors and scientists alike. Rapid growth in the use of digital

technology in agriculture seems inevitable, if only because adoption in food systems must, at some stage, accelerate simply to match that of other sectors. But how is this adoption occurring globally? This short paper explains the contrasting forms digital agriculture is likely to take in four types of systems that are based on: Commodities; high-value product; subsistence farming; and nature-based solutions.

**148 Inclusive digital agriculture?**

**The case of family farming in West Africa**

Pascal Bonnet, Jean-Daniel Cesaro, Chloé Alexandre, Anna Sow, Mathieu Roche & Nicolas Paget.

The authors present a preliminary analysis of the arrival of digital technologies in African family farming, and open up avenues of research on the conditions under which digital technology can contribute to inclusive development or, on the contrary, deepen the already deep-rooted divides between urban and rural areas, and between wage-based export agriculture and family farming, which is predominant on the continent and has different needs. Through a few illustrations of services and technologies used by farm households, the authors show that digital agriculture *sensu largo* is predominant compared to precision agriculture *sensu stricto*. They present the actors involved in the development of services: Sector companies, the State, professional organizations. Finally, they conclude with a few analytical frameworks that could usefully be mobilized to conduct future research on the effect of these technologies on inclusiveness and fragmentation.

**157 Digital deployment in agriculture in France**

Sarah Djafour & Bruno Tisseyre.

The Observatory of Digital Uses in Agriculture was created in 2016 with the support of a business chair (AgroTIC Chair) and a “Convergence Institute” (#DigitAg institute). Its goal is to provide objective information on the adoption of digital tools and professional services in agriculture in France. The studies carried out are based on a participatory approach that strongly involves digital service companies in agriculture. These studies focus on a particular digital tool or service, and aim to quantify its level of adoption. Since the Observatory was created, eleven studies have been conducted on different technologies, which makes it possible to consolidate a comprehensive vision of the adoption of digital tools and services in France. According to these studies, the most adopted digital technologies are those that provide an immediate perceived benefit (work comfort, ergonomics, etc.), that are easy to use, and whose deployment is not affected by compatibility problems with other equipment on the farm.