

Innovation and development in agricultural and food systems

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Introduction - Reviving perspectives on innovation in agriculture and food systems

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Innovation has become an essential issue for our societies. It is ever-present in the discourses of economic and political actors and is the subject of dedicated policies. New structures such as clusters and platforms are built around it, and it is now incarnate in the figure of the contemporary hero, the creator of the start-up. The issue of innovation has also gained an important place in the scientific world, as shown by the growing number of studies and research activities devoted to it, the creation of learned societies and specialized journals testifying to the legitimization of an academic field on innovation studies (Fagerberg and Verspagen, 2009; Godin, 2014).

1. Innovating to survive in the contemporary world

Much more than a fashionable notion or buzzword, innovation has become a key issue for companies, policies and, more generally, society. In the Global North as in the Global South, innovating, i.e. introducing a novelty in an economic and social environment, appears more than ever as a factor of competitiveness for enterprises, leading to cost reductions, improved productivity or product quality, or the creation of new markets in a context of globalized competition (Porter and Heppelmann, 2014). In an extension of Schumpeter's (1934) work, innovation is more widely reaffirmed as a source of macro-economic growth, at the heart now of a 'knowledge economy', deriving value from creativity, learning and communication (Foray, 2004; Stiglitz and Greenwald, 2014). It is also put forward as a solution to the problems generated by economic development itself, especially in the ecological, energy and food fields, leading to what Callon *et al.* (2015) call a regime of the economy of techno-scientific promises. Finally, across frontiers opened up by new technologies, in the digital and biotechnology fields for example, innovation is envisaged as the possible catalyst of a more radical social transformation, moving the world towards increased knowledge sharing (Rifkin, 2011), transhumanism (Ferry, 2016) and a break with the current forms of capitalism (Latouche, 2006).

Of course, critical points of view question this craze for innovation (Godin and Vinck, 2017; Petit, 2015). Both creative and destructive, innovation can lead to social exclusion, destroy jobs and businesses, result in monopolies and misappropriations, and generate new technical and societal risks that need to be understood and addressed (Joly *et al.*, 2015; Temple *et al.*, 2018). But these critics often end up relying on the notion of innovation itself to suggest, or sometimes rehabilitate, alternative paths or avenues of resistance, for example through innovations qualified as 'social' or 'frugal'. Whether in the scientific, political, industrial arenas, or more broadly those of entrepreneurship and the media, innovation appears as a notion that is open to analysis, encouragement and criticism regarding societal changes. But it is also capable of underpinning the transformations of our contemporary societies.

This primacy of innovation seems to have won over every corner of society, attracting attention, debate and engagement in all its economic sectors. It is in this context that this book presents contemporary perspectives on innovation in one of

these sectors: agriculture and food. Several books and collection of studies have helped shed light on the issue of innovation in agriculture from different disciplinary and geographical perspectives (Chauveau and Yung, 1993; INRA and École des Mines, 1998; Rajalahti, 2012; Coudel *et al.*, 2013; Touzard *et al.*, 2014). But very often, for the scientific community studying innovation, agriculture is just one sectoral study case among many others, alongside health or transport, even if issues specific to agriculture can be raised (Malerba, 2006; RRI, 2014). This book aims to present an up-to-date reflection on the specificities of innovation in the agricultural and food sectors, in the backdrop of the reconfigured relationships between agriculture, food and human societies.

2. Including agricultural innovation in societal debates

The issue of innovation in the agricultural and agrifood sectors is indeed the subject of many debates reflecting the transformations of contemporary societies, moving the traditional boundaries between countries of the Global North and those of the Global South, between the rural and the urban, and even between economic growth and social development. These debates lead to the politicization of innovation and to the revitalization of its approaches at several levels.

A first level concerns political and ethical debates on which innovations to favour and which to reject. The criteria for what is or is not a ‘good’ innovation vary across societies, social groups, and historical periods. In the agricultural sector, biotechnology and genetically modified organisms are apt illustrations of these debates and the manner in which they can divide societies. Where some see a sign of progress and, for example, a way of reducing the use of pesticides or of improving food production, others see only a strategy to increase the profits of multinational firms, reduce the farmers’ autonomy or jeopardize the gene pool (Bernard de Raymond, 2010). Debates swirl around not only the proven impacts of innovation, but also the different types of risks (social, economic, health, etc.) associated with it (Beck, 2001). Given that an innovation cannot be considered good just because it is an innovation and, depending on the criteria selected and the importance accorded – or not – to certain types of impacts, it is the very nature of innovations which becomes open to debate.

A second level of debate concerns the aims of innovation, in a context subject to new local and global challenges. During the 20th century, innovation was implicitly and, later, explicitly part and parcel of the idea of economic growth and progress. Today however, it asserts itself as a process with a plurality of goals, responding to the major challenges that confront societies and public policies. Food security, the maintenance of biodiversity and the fight against pollution and climate change are representative examples of these major challenges, sparking an exponential number of initiatives and, consequently, innovations. These goals are themselves open to debate, sometimes revised, hierarchized, or recombined in political processes. Thus, climate-smart agriculture, promoted by the FAO (2013) to encourage the adoption of agricultural innovations meant to address climate and food security challenges, finds itself being subjected to debate, because it is suspected by some countries and non-governmental organizations of being an attempt at greenwashing and an example of the dissemination of technologies controlled by industrialized countries.

These debates on the aims of innovation lead to others on the targets of innovation. Behind this third level of debate are often reflections, expounded upon in abundant

literature, on improving the performance of enterprises (upstream or downstream firms, farms). In reaction, or in parallel, other reflections stress the necessity of channelling the efforts devoted to innovation, whether originating from the public sector or the private sector, in favour of populations that are economically or socially the most vulnerable, such as the policies incentivizing innovation for family farming in Latin America (Goulet, 2016). The idea is that the benefits accruing to some people due to innovation do not necessarily reach others through a trickle-down effect. However, the risk is that this line of thinking will end up supporting a vision of innovation by categories of targets (rich *vs* poor) or markets (effective *vs* ineffective), denying the natural interdependencies between processes and the need for transversal and encompassing approaches (Klein *et al.*, 2014).

A fourth discussion level takes the previous one a little further and raises the issue of who is doing the innovating. While Schumpeter (1934) theorizes the innovative entrepreneur, and innovation analyses generally accord value to the inventions of researchers and engineers, the innovative capacity of other actors (especially farmers, artisans and consumers) often remains little recognized. A series of debates have then followed around studies refuting their role as simple receptacles or beneficiaries, and highlighting, in the agricultural sector in particular, endogenous, local, or even peasant innovation, sometimes at the risk of advocating a populist approach (Thomsons and Scoone, 1994). While this encompassing or restrictive recognition of innovators has a mainly symbolic and political value, very often it also becomes a key factor when an effective collective response to a development issue has to be formulated.

These considerations open up a last level of debate, around the ‘how’: How does innovation emerge? How should it be conceived? How to support and evaluate it? It is no longer the innovations themselves that are under discussion, nor their goals, nor even their beneficiaries or their originators, but the way to develop them and make them emerge. This debate is mainly centred around the contestation of the so-called ‘top-down’ models of innovation¹, which have had a profound impact on agricultural development (Chambers, 1983; Darré, 1999). The general idea is instead to involve a growing number of heterogeneous actors in the development of innovations, and to create a new innovation regime, one that is more democratic and based on collective experimentation (Von Hippel, 2005; Callon *et al.*, 2015). This idea is gaining ground, even in the public policies concerning the agricultural sector, and is reflected in particular in a better identification of the innovations produced by farmers on their farms and by the creation of local innovation platforms and territorial ‘living labs’². The ‘right’ way of innovating thus becomes the subject of debate, of research, and of contrasting positions taken by different actors concerned by agricultural and food issues.

3. Analysing innovation as a multidimensional process

The perspectives on agricultural innovation presented in this book draw inspiration

¹ Top-down innovation is one that is proposed and promoted by some actors (for example, the research community) for the benefit of other actors (farmers, for example). It contrasts with bottom-up innovation, developed by the actors for their own benefit (farmers, for example) and who seek support elsewhere for it.

² The living lab is both a methodology and a place where citizens, inhabitants and users are considered as key actors in research and innovation processes.

from these different debates and help enrich them while analysing them. But these perspectives are also based on a large corpus of recent academic contributions in economics, management, sociology, geography and agronomy, all areas that share common approaches to innovation, and which are found in two important multidisciplinary scientific communities: 'Innovation Studies' and 'Science and Technology Studies'³.

More than the mere introduction or adoption of a novelty in a socio-economic system, innovation is analysed in the work of these two communities, across all disciplines, as a process that results from the interactions between several actors, intervening in a given context and reflecting an intention to change. While innovation can certainly be characterized in different ways depending on its purpose (a product *vs* a process), its nature (technical *vs* organizational, ad-hoc *vs* systemic, etc.) or the characteristics of its emergence and its deployment in the system under consideration (radical *vs* incremental, endogenous *vs* exogenous, top-down *vs* bottom-up, etc.), it always results, in fact, from the synergy between three dimensions: technical, organizational and institutional. Thus, Leeuwis and Van den Ban (2004) believe that an innovation combines the implementation of new techniques and practices (constituting the 'hardware'), new knowledge and ways of thinking ('software') and new institutions and organizations ('orgware'). The work of the sociologists of the *École des Mines* in France in the 1980s, and their contributions to actor-network theory (Akrich *et al.*, 1988a,b), for their part, emphasized the socio-technical dimensions of innovations, encouraging researchers to overcome technical or social reductionisms in the analysis of innovation processes.

In line with Schumpeter's (1934) approaches, many current approaches to innovation also believe that entrepreneurs play a key role because they seize opportunities to innovate by taking risks. This role of the entrepreneur manifests itself in agriculture through the farmer who innovates (Chauveau *et al.*, 1999) or through the entrepreneur acting under the organizations' radar (Hall and Dorai, 2012). But even more than through these individuals, sometimes called 'champions of innovation', it is through the construction of knowledge and capacities within networks of actors that innovation in agriculture takes place (Klerkx *et al.*, 2010). These formal or informal networks can be characterized by a set of more or less close relationships between individuals and/or organizations. A wide range of collective and individual learning processes take place in order to produce knowledge that can be useful in bringing about the desired change (Faure *et al.*, 2014). The function of intermediation (or facilitation) between actors is thus fundamental (Klerkx *et al.*, 2010) to stimulate interactions, encourage negotiations, mobilize resources, help novelties emerge or be rediscovered, or allow the capitalization of experiences. The networks' configuration changes continuously during the innovation processes, favouring the creation of new links but causing some others to disappear.

Innovation is thus understood as a complex, constantly changing and unpredictable process, which is difficult, if not impossible, to control (Akrich *et al.*, 1988a,b; Leeuwis and Van Den Ban, 2004). Indeed, every innovation process experiences

³ Innovations Studies, largely influenced by economists, analyse innovation at different scales (local or national), with a particular focus on innovation systems. Science and Technology Studies, promoted mainly by sociologists, explore the relationships between scientific research and society to produce technological innovations.

accelerations, slowdowns and crises, and since innovations are subject to a selection mechanism, they are not all viable (Nelson, 1993). But the complexity of the process can also be studied using frameworks that delineate its trajectory, characterize different phases or moments of the innovation, and identify its stylized sequences. The recourse to actor-network theory thus refers to the stages of problematization, engagement, enrolment and mobilization of actors (Akrich *et al.*, 1988a,b). Studies on innovations in socio-technical transitions (Geels and Schot, 2007) show how they can emerge in niches that allow them to mature or, on the contrary, hasten their elimination, then expand, spread in their original form or in a new form and, ultimately, modify the dominant socio-technical regimes. Institutional and macro-economic environments thus play an important role, through the rules, norms and values that either support the dominant trajectory or allow the emergence and development of niche innovations.

Innovation can also be analysed in the more structured framework of national, regional or sectoral innovation systems promoted by innovation studies (Martin, 2012). Schematically, an innovation system aims to encompass, at the same time, the actors, networks, knowledge and institutions that influence innovation in a given space. It includes all the actors contributing to the innovation, i.e., the research community, intermediate actors, professional organizations, companies, the State with its public policies, etc. In this perspective, innovation results from the application of the outputs of scientific research only in some cases. Moreover, when the research community is involved in an innovation, there are many iterations between researchers and their partners, until they achieve one or more innovations, deployed by other categories of actors (farmers, firms, organizations). Such an analysis, in terms of innovation systems, makes it possible to examine not only development processes and innovation policies, but also the impacts of innovations (Klerkx *et al.*, 2010; Touzard *et al.*, 2014).

4. Studying and supporting innovation in agriculture

In this book, we want to examine and enrich the perspectives on innovation specifically in agriculture and the food sector. We do so by basing ourselves on the substantial body of recent research on innovation across disciplines. By using reviews and analyses of case studies undertaken in Europe and in many countries of the Global South, we aim to fulfil a twofold ambition. The first is to offer an update on the state of progress on themes for which the issue of innovation is key, especially in connection with the periodisation of the major transformations of the agricultural sector and with regards to major societal challenges. The second ambition is to present a posture that research on innovation can adopt, at the intersection of analyses that contribute to societal debates and support for addressing societal challenges.

This book's contributors all share a systemic approach to innovation, forged and translated into multidisciplinary research practices within the same research unit, the 'Innovation' joint research unit⁴ in Montpellier, France. A common analytical

⁴ The 'Innovation and Development' joint research unit, created in the mid-2000s, brings together some 90 researchers, research scholars and PhD students from the French Agricultural Research Centre for International Development (CIRAD), the National Institute of Agricultural Research (INRA) and the National Institute of Higher Education in Agricultural Sciences of Montpellier (Montpellier SupAgro). The research conducted in the unit is of a multidisciplinary nature

approach and framework for innovation in agricultural and food systems has thus been constructed from a triple perspective. The first is to identify, study, characterize and describe accurately the mechanisms that lead to innovation. The aim is to produce factual knowledge, concepts and analytical frameworks whose scope is generic, sometimes applicable outside the agricultural and rural sectors. It is also a matter of qualifying innovation models and evaluating the impacts of these innovations. The second perspective is to use situations of innovation or, more generally, of change, as advanced observation posts to understand and characterize agricultural transformations. Innovation processes are in fact spaces of imbalance, transformation and rearrangement, a window on how actors act, how resources are used and transformed and, ultimately, how agricultural and food systems evolve. The third perspective aims to support actors who innovate, not only through participatory research or action research, but also by developing methods to encourage the emergence, deployment and adoption of innovations at the scale of the farm and of groups of heterogeneous actors, and to build the capacities of these actors to innovate.

By maintaining these three perspectives, researchers can contribute to academic and societal debates with original analyses that are useful in conceiving innovations with the actors of agricultural and food systems. Such research efforts can lead to reflection support tools for these actors and to methods of intervention for support mechanisms, help strengthen research and development or advisory organizations, and participate in the development of innovation and research policies. This book addresses all of these considerations in four parts, whose contents we describe in greater detail below.

5. Structure of the book

5.1. History and positioning of studies on innovation in agriculture

The book's first part provides an overview of the thinking on innovation in agriculture from a historical perspective, which culminates by taking into account the current and major societal challenges of our time.

Chapter 1 explores the history of innovation and its uses in agriculture by dividing the past into three distinct periods, based more specifically on the perspectives and contributions of economics and sociology. Until the Second World War, the concept of innovation was little used and it was instead the issue of technical progress that took centre stage. Over the next four decades, diffusionist approaches to innovation dominated the research world, before the emergence, starting in the 1980s, of criticism of the agricultural development model and of a shift in thinking about innovation.

In Chapter 2, the current characteristics of innovations in agriculture and food systems are analysed by examining their sectoral specificities, which are based on the relationships that agricultural and food activities have with nature, space and societies. These innovations are also characterized today by the convergence of global challenges as shown by research regarding transitions, be they ecological, climate-driven, digital, social or concerning food.

(agriculture, economics, sociology, geography, management sciences, law). The unit's work is spread across the globe (southern Europe, Africa, southeast Asia, Latin America).

Chapter 3 shows that science and technology contribute to the transformation of agricultural worlds through the creation of national and international agricultural research institutions during the latter half of the 20th century. In particular in the context of a crisis of confidence in the industrial agricultural model and of transformations specific to the scientific field, these institutions are being compelled to re-draw the contours of their contributions to innovation.

5.2. Current forms and figures of innovation

The second part examines the different visions of innovation according to different disciplinary points of view (agronomy, geography, economics, management, sociology). It also examines them according to different innovation domains (production systems, food systems, organizations, territory).

Chapter 4 discusses agroecological innovation and shows that the characteristics inherent to agroecology make it a distinct process of innovation, leading to a revamping of approaches and of support and advisory services provided to farmers.

Chapter 5 identifies the food sector as conducive to social innovations, which in particular help to address issues of access to good quality food by people in vulnerable situations. Social innovation is then understood as a relationship-based and contextualized process, built over time by singular individuals, and supported by mediation resources.

Chapter 6 shows that localized agrifood systems (LAFS) have a constant need for technical and organizational innovations. By providing an understanding of LAFS, this chapter sheds light on these collective and localized innovation processes that involve farmers and small agrifood businesses, and identify ways of supporting the actors involved.

Chapter 7 mobilizes the concept of territorial innovation to apprehend the multiple dimensions of the relationships between agriculture and the city and thus to understand the transformations of agriculture in the context of urban society. Innovation becomes territorial through the accumulation of micro-changes that end up influencing the practices of urban and rural actors, as well as the uses and norms that regulate the relationships between agriculture and the city.

5.3. Innovating in supporting and accompanying innovation

The third part focuses on supporting innovation, by discussing the diversity of research and advisory services that aim to promote innovation, and by proposing methods of intervention to support processes of innovation involving farmers or heterogeneous groups of actors. The research presented in this third part is based on analyses and experience gained from working for several years with advisory and support actors.

Chapter 8 thus discusses the different functions of existing innovation support systems, especially in the Global South. The authors show that a variety of mechanisms is necessary to create conditions favourable to innovation and to support collectives step by step, depending on their capacities and their learning needs.

Chapter 9 shows why and how researchers associate with non-researcher actors who are engaged in the transformation of reality in an action research in partnership in order to build knowledge production mechanisms with them. Action research in partnership can be seen as an innovation because it involves significant changes in

research mechanisms, most notably of their governance, methods and practices.

Chapter 10 presents approaches to co-design innovative farming systems based on a high level of interactions between the actors involved. A range of intermediary objects, such as modelling or on-farm experimentation, are used to facilitate these interactions and to promote learning.

Chapter 11 discusses the evolution of agricultural advisory services and the variety of methods for providing it. It shows that the choice of an advisory method depends not only on the nature of the problem to be addressed and the solutions to be implemented, but also on the capacities of the advisers, the objectives set by advisory organizations and the mechanisms for the governance and funding of agricultural advisory services.

Chapter 12 deals with the support or ‘accompaniment’ of multi-actor collectives to facilitate innovation by comparing two intervention approaches. These approaches aim at facilitating the emergence of solutions and action plans negotiated within peer groups or arenas of heterogeneous actors. The chapter analyses the points common to these approaches as well as their differences to draw lessons for the support of such collectives.

5.4. Evaluating the effects of innovation on the dynamics of development

The fourth and last part of the book covers the evaluation of the effects of innovations on the dynamics of development, starting with questions of purpose and ethics, and going on to issues concerning methods of evaluation used to measure the effects.

Chapter 13 aims to clarify the place of morality and ethics in innovation processes. The evaluation focuses in particular on the actors’ moral judgments. In support of the results of an action-research approach on alternatives to the industrial slaughter of farm animals, the chapter shows how livestock farmers place their moral responsibility for their animals at the centre of an innovation process: on-farm slaughter.

Chapter 14 discusses the demands by donors, national research and development agencies and civil society actors for the evaluation of research and development programmes. It presents the different evaluation methods that can be used, as well as the trade-offs to be made in order to choose the approach that is most appropriate for the innovation under study and for the issues raised by the evaluation.

Chapter 15 discusses multi-criteria evaluation tools to explore the effects and impacts of technical and organizational innovations. It discusses three methodological issues: the taking into account of the multiple dimensions of innovation, actor participation in identifying and developing evaluation criteria and indicators, and the manner in which to arrive at a final assessment through the choice of measurement methods.

Chapter 16, the last chapter, presents *ex ante* and *ex post* evaluations of agricultural production systems using computer tools (simulation, modelling). When used *ex post*, these tools make it possible to evaluate the effects of adopting an innovation on the performance of existing farms. When used *ex ante*, these tools become aids to dialogue and decision-making, and make it possible to test different scenarios with farmers and technicians.

The four parts of this book present the research of scientists from different

disciplines, and show the collective dynamics at work within a joint research unit. Research laboratories, just like groups of actors associated with innovation processes, are composed of diverse individuals, differentiated by their functions, their approaches and their perceptions of ground realities. In both cases, it is precisely this pluralism and the interactions it generates that make it possible for novelties to emerge in the form of new ideas, new research practices and new products. We hope that you, the reader, find this book stimulating and useful.

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