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# Farmers-inventors in agro-equipment: logic of action, accompaniment, diffusion

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## Abstract

The current period of reorientation of agricultural production models, towards the limitation of inputs and respect for the environment, combined with the development of the potentialities offered by digital technology and robotics, would tend to make farming a place of technical inventions in agricultural equipment. These inventions, which could be the beginnings of potential innovations, are implemented, and often conceived, by farmers seeking either to invent objects, to combine new production techniques, or to adapt existing means, or still to improve or even to design systems of production of goods and services more or less in disruption with the systems already in place. But what logics are underlying these different inventions? The objective of this communication, drawing on several examples of farmer-inventors and innovators, is to report various experiences of technical inventions in agricultural equipment, from their origin, genesis, design, socio-economic environment, asking ourselves in particular about the distinctive characteristics of their sociological profiles. From there we identify some overall logics of actions developed around these inventions, through dimensions like the level of scale of the invention, the mode of realization, the functions of the technical object and how the farmer defines the "sustainability" of his/her system. Finally we suggest that it will question the forms of support and accompaniment in agro-equipment inventions. In addition to the new tools proposed by research and advice for the development of innovative production systems, endogenous inventions by farmers justify new attention that highlights their contribution to the reorientation of agricultural production models.

Keywords: invention, innovation, agro machinery, farmers.

## 1. Introduction

The current period of reorientation of agricultural production models towards the economy of inputs and respect for the environment, combined with the development of the potentialities offered by digital technology and robotics, would tend to make farming a place for technical inventions in agricultural equipment. These inventions, which could be the beginnings of potential innovations, are implemented, and often conceived, by farmers seeking either to invent objects, to combine new production techniques, or to adapt existing means, or still to improve or even to design systems of production of goods and services more or less in disruption with the systems already in place. As such we can ask what logic(s) underlying these different inventions answer and if it is possible to perceive, beyond the multiple individual initiatives, the foundation of the approaches of invention for these farmers. If these inventions cover an abundant and multifaceted aspect, the observation of the ground makes it possible to sketch some tendencies and the main types of logic, as well as their implications for the world of agro equipment: this is the objective of this communication.

As a first step, drawing on several examples of farmer-inventors, we report various experiences of technical inventions in agricultural equipment, from their origin, genesis, design, socio-economic environment, asking ourselves in particular about the distinctive characteristics of their sociological profiles (2). Then, from a reflection on the meanings of technical evolution, we identify some major approaches of actions developed around these inventions, from dimensions such as the scale level of the invention, the mode of realization, the functions of the technical object and how the farmer defines the "sustainability" of his system (3). Finally, we will question the forms of support and accompaniment in agro-equipment inventions. In addition to the new tools proposed by research and advice for the development of innovative production systems, endogenous inventions by farmers justify new attention that highlights their contribution to the reorientation of agricultural production models (4).

## 2. Portraits of farmers-inventors in agro-equipment: innovative practices and sociological profiles

Four professional accounts guide our analysis of emerging agricultural practices and sociological profiles of their initiators engaged in the transformation of their farms. We take as an example a permaculture farm, a second farm recently engaged in a reconversion in miscanthus grass culture, a third engaged in its practices towards sustainable development, and finally a winery at the origin of the design of a robot mowing grass. We summarize briefly the characteristics of the technical changes deployed in these four examples, which we successively address (2.1). Then in a second time we question the specificities of their profiles and their trajectories (2.2), before proposing categories of possible logics of invention (2.3).

### 2.1 Forms of agro machinery invention: four professional narratives

The first example is a permaculture farm which began in 2006: it was then necessary to recreate an "edible landscape" as existed in Normandy in the past, with the conviction of the need to integrate the problematic of the energy transition. This agro ecological conviction went hand in hand with an aesthetic and gustatory concern, supported by the desire to make it a reality in the setting of a beautiful Normandy valley. The choice of setting up

permaculture, from a few meetings and especially readings, was quickly confirmed. After a start in animal traction not completely satisfactory, the discovery of the writings of Eliot Coleman, an American market gardener himself strongly inspired by Parisian market gardeners of the nineteenth century, is the trigger. The introduction of flat planks and its corollary, the invention of a multitude of manual tools well adapted to this technique, leads to the gradual constitution, made of trial and error, of a true "technical permaculture". Nevertheless permaculture, as it has developed in this example, is not reduced to its technical dimension and joins a "global ecosystem project": including a whole diversity of ecosystem functions, in unstable equilibrium and permanent adaptation, where all cycles connect to each other (Perrine Hervé-Gruyer's story).

The second example concerns a "GAEC" (farmers' association) formed in 1980 with the concern to do differently, and otherwise. Over time, this leitmotiv is taking shape through several initiatives. First in the 1970s, with a farmer who is pioneering the use of the round baller; then this farmer tries out simplified farming techniques. At the same time, he is developing an ETA (company for agricultural services) activity around silage in large volumes. It is undoubtedly his idea to implement miscanthus grass in 2007, on almost all of its farm, which will generate several inventions: equipment for the storage, material for the harvest, until the invention of a machine to dust off. Thus it seems that it is above all the taste for the machines and the desire to invent that explains this trajectory carried out progressively outside the profession of farmer as it is practiced traditionally, with someone imagining itself somewhere between the farmer and the entrepreneur-innovator (Philippe Colin's story).

A third narrative shows a trajectory taken since 1980 with a gradually acquired conviction of combining socio-economic, energy and environmental issues. Starting from the takeover of the family farm in Vexin region, the farmer's approach consisted in progressively enriching the farm in various ecosystems: ponds, orchards, hedges, then in agroforestry. The environmental approach has gradually been refined and has been accompanied by a reconfiguration of plots in relation to their agronomic potential and not only according to the constraints of mechanization. Reconciling environment and economy also supposes a diversification of the markets: thus the sale on the farm is set up, bed and breakfast services are created, and visits are organized with schools, customers etc. Then the concern for energy autonomy has led the introduction of miscanthus on part of the land, used on site for the heating of buildings and the reception of visitors. In parallel, a service activity was developed via an ETA, with the revaluation of agricultural and agro-industrial by-products. The environmental approach in this activity is also present because it allows farmers and industrial customers to improve their efficiency. This farm model still needs to evolve in the future to improve its environmental efficiency without sacrificing its economic equilibrium (Michel Galmel's story).

Finally, a fourth professional narrative describes the development phases of the wine robot developed in the context of the takeover of the winery. Faced with the technical difficulty of mechanical weeding and the desire not to use herbicides, the idea of weeding by autonomous robots is gradually germinating. Starting from the problem to solve, that is to say the maintenance of the height of grass in the vineyard to an acceptable level and taking into account the constraint of spacing of the vines, the solution is concretized with a small size robot equipped with solar panels. It is a "design of necessity", built away from the "all-tractor model", which takes shape. In a second time, the need is felt to associate the micro approach with the possibilities offered by the connectivity and the use of the cloud. The solution consists of building a fleet of robots connected and managed by an algorithm, controlled online by a computer monitored by a "shepherd". The path of the invention could only be done by jointly reflecting on the associated business model. The future will probably see new adaptations of the device for functions such as surveillance or phytosanitary treatment, which will require according to the designers more knowledge in agronomy, agroecology and algorithmic (Xavier David-Beaulieu's story).

## 2.2. Sociological profiles and invention of innovative practices

These innovative agricultural models and practices developed by farmers in their farm leads us to question their profiles and sociological characteristics in order to understand their specific social trajectory which leads them to engage in the development of new practices. The first significant features of these innovative farmers are observed through self-definition and break with the logic of action that governed the agricultural activity of previous generations. This gap with respect to the norms that structure agricultural practices can be compared with the educational and professional trajectory of these farmers. Higher education and work experience prior to the resumption of farming has created the conditions for this break in the definition of their practices and the orientation of their development model. This rupture indirectly reflects a thwarted vocation of farmer. The resumption of farm is the result of a choice that does not seem to be always freely agreed but built socially under the weight of family norms. Taken between the family pressures on the farmer (Bessière, 2010) and his representations of the conditions of practice, the farmer will develop a deviant report with regard to the norms governing the activity and take a step back from the profession and its injunctions. This distancing opens other agricultural possibilities (business logic, development of startups, etc.) and other representations of the farmer's profession turned more towards entrepreneurship. In fact these farmers do not recognize themselves in the agricultural professional identity but define themselves from the image of the entrepreneur. This representation of the entrepreneur is based, in the speeches, on the image of a free, autonomous and self-determined individual,

always looking for innovations to implement to position oneself in still unexploited markets. The entrepreneur in agriculture will seize in his environment a set of resources that will enable him to build as such and develop singular action logic. These resources, which are conceived as "chances" that everyone could grasp and as the result of "chance", come from a social capital accumulated progressively through insertion among innovative environments and reactivated when needed. All this accumulated social capital allows access to certain events that offer opportunities for innovation while enriching a contact book. The study of the social trajectories of these farmers also highlights a distinctive socialization, where the economic, social, cultural capital held, acquired or inherited, makes it possible to relativize the risks related to these agricultural projects in development and to register farms in a process of differentiation through innovation.

### 2.3. Which approaches of the invention?

The testimonies of farmers allow us to identify three different logics of invention, and each of them cannot be solely thought in terms of adaptation to a request or an environment, or should be analyzed in terms of incremental evolution from a given socio-technical context. Thus, in the first analysis, farmers' logics of invention would differ in:

- (i) Logic of simplification of techniques and research of the "durable tool" but inserted into an existing agricultural system; the logic of technical invention is here rather to be sought in an effort to concretize the functions of the tool as such;
- (ii) Logic of the connected technical invention, where the invention of a new agro-equipment is carried out in relation to an information system, but the resulting new "technical set" is inserted in a system of existing production, which it intensifies on a specific function;
- (iii) Systemic logic of the invention, wherein the technical invention is designed and cannot be separated from the design of a production system it reconfigures in whole or in part; in this case, the invention is based either on the potentialities offered by the available agricultural equipment or on the addition of new techniques or even the suppression or transformation of techniques.

These sociological characteristics visible through the narratives of these farmers, now lead us to study the nature of the strategic choices and the logics of action developed by each farmer.

## 3. Farmers committed to invention and innovation: how are their practices guided?

Common elements, which we try to highlight, are revealed in these four postures unveiled by these professional stories. They correspond, according to the vocabulary developed by the theorists of technical evolution (Simondon, 2012, 2014a, Simondon, 2014b, Guchet, 2005, 2008) to a process of individuation of the farm (3.1). But, beyond the diversity observed, an active principle of solving the concrete problems encountered strongly guides their behavior (3.2).

### 3.1. The multiple ways of technical individuation of the farm

Everyone's strategic choices, justified by abstract considerations, or even by political commitments, seem to largely outweigh processes of adaptation to the immediate context. One could assume that each of them seeks to provide evidence of an imagined possibility, leading to specific directions that are both unpredictable and improbable. These farmers have shown their ability to guide their technical choices through a process of interactions between their projects as farmers, their specific agronomic context and their predefined or under construction market. The starting point of these innovations is often in the will of a better adaptation to the representation that is made of their activity, technical certainly, but also social and economic. To do this, they invent, adapt, and transform, their agro-equipment. Another common point of these technical choices lies in a strong representation of sustainable development, which supports the need to invent. For example, if Philippe Colin thinks he is no longer a peasant despite his agricultural social origins, we nevertheless feel a common need to invent a more sustainable "new form of agriculture".

But it is interesting to note that the very logic of the invention leads them to develop approaches from which their agricultural machinery evolution follows very distinct paths. The opposition between "high-tech" and "low-tech" seems foreign to them: they seek first and foremost local solutions to their problems, encountered on the ground, while remaining faithful to distinct representations of sustainable development. The narrative, after the fact, of their choices, and their "speaking true" have the authenticity of the lived experience and also show their reflexivity on the choices made. They accept to grope, to search, to make mistakes, but little by little they are able to change their trajectory and the conductive thread that allowed them to stay focus appears.

These farmers all display a position of decision-maker assumed in the face of sociotechnical choices, which finds its source in a form of autonomy and reflexivity on the place of the machines in their respective farms. Their technical choices seem to resonate with the words of Simondon (2014a): "the alienation is not caused by the machine, but by the non-knowledge of its nature and its essence". The appropriation by the farmer of all the objects and technical systems available to him gradually becomes part of his agricultural culture. In this agricultural culture, the agricultural farm reinvents also its insertion in the territories: these agricultural machinery evolutions

take most often support on new markets or new relations with the socioeconomic environment. These farms are imagined as integrated ecosystems in a concrete and pragmatic approach oriented towards the search for agri environmental efficiency (Griffon, 2013). To this end, the new precision agriculture tools adapted to the eco-agro-systemic requirements of the plots and the farm are apprehended at various levels of scale: the plot, the farm, the collective level, especially in interaction with other farmers, or beyond, as in the stories of Philippe Colin and Michel Galmel. At the same time, the promotion of small-scale agriculture is developing in two ways: a virtual absence of machinery in the context of a very technical and systemic approach (as with Perrine Hervé-Gruyer) or, on the contrary, an omnipresence of machines, while also claiming permaculture, in urban conditions as in the case of urban agriculture.

### 3.2. To solve concrete problems by the invention

Professional stories show farmers seeking solutions to their problems, whether it is value creation, market access or improving production conditions. In doing so, they become the seeds of a crisis: "[...] when techniques change, some of the human phenomena constituting a culture change less quickly and less drastically than technical objects [...]. These slowly evolving cultural contents, which were once in a relationship of reciprocal causality, in an organic totality constituting culture, with the technical forms that were appropriate to them, are now to be partially symbolic realities-in-between"(Simondon, 2014a, p. 24). Simondon also shows that "encyclopaedic enterprises do not appear in the phases of reciprocal causality between culture and civilization; they intervene during crises" (Simondon, 2014a, pp 93 - 95). So we can assume that the agricultural world is evolving towards a form of encyclopedism (Bontems, 2006) of which these inventor farmers are in a way the beginnings. Simondon opposes two figures of inadequate realization of encyclopedism: the self-taught and the idolater of the human supports of knowledge. The self-taught would be here the farmer, tried to bring everything back to himself, who would like to reinvent everything. The idolater is here represented by the population of those who want to advise the farmers by believing they know for him, from schemas and models already built and which would only have to be applied. Through the direct experience of learning skills, bringing together farmers, researchers, advisers, professionals and institutions, conventional schemes could be transformed. These new learning models creating the conditions for agricultural machinery invention and innovation will challenge top-down schemes. This would involve developing these partnerships for co-design, which are still lacking today, but are required by many farmers, in the context of an indispensable transition to sustainable agriculture and agribusiness.

This vision of the future leads us to question the processes and of the modes of diffusion of innovation in agriculture starting from the relation which is woven between the firms of the agro-machinery and the farmers. Consequently it will be necessary to ask the question of the accompaniment of the farmers towards the innovation but also of the new modalities of expression of the innovation in agriculture, innovations which one can describe as ascending because constructed by and for farmers. We will be able to question the real or idealized gain in terms of farmers' autonomy vis-à-vis firms, and the possible implications for agricultural machinery companies.

## 4. New forms of innovation in agricultural machinery and firm/farmer relationships

The situation of the relations between inventor farmers and firms must first be apprehended from a historical perspective analyzing the relationships that have developed between these two families of actors (4.1). The recent period opens a new era of "bottom-up innovation" that will probably question the methods of knowledge production and distribution between these actors (4.2), and question the new forms of support and intermediation for the invention and agricultural innovation (4.3).

### 4.1 Agricultural machinery companies and farmers business relations: A historical perspective

In the period of modernization of agriculture, farmers are faced with the need for "progress" and will, on the whole, integrate new innovations, new practices and new management strategies into their farms. In accordance with the political and professional injunctions of modernization, the innovations diffused from the 1950s to the 1970s follow a descending vertical pattern of integration in the farms (Purseigle, Hervieu, 2013). Research organizations are responsible for establishing and designing innovations to be disseminated through extension agencies to "farmer-receivers" (Darré, 1996). Then from the 1970s, intensive agricultural production models were criticized, as was the top-down model of innovation. The co-construction of new technical systems between farmers and research institutions is now valued to restore the creative and inventor role of the farmer. In a symptomatic way, social science research works in favor of a fight against "the racism of the intelligence" (Darré, 1999), with a strong recognition of the status of the farmer as a producer and a holder of knowledge. The importance of "local" knowledge specific to farmers to design and manage new production systems is recognized at the expense of the "recipes" of experimental science (Darré, 1999).

At the heart of this recognition of farmers' skills, agribusiness firms are not only positioning themselves as a sales interface for farmers but are also developing new action registers. Indeed, on the innovation diffusion stage, agricultural machinery firms will position themselves as important relays for farmers: they no longer only sell agricultural machinery but offer services to support farmers for innovation. The development of conservation

agriculture in France sheds light on the role of firms in supporting innovation (Goulet, 2013) and the formation of peer groups. One of the first strategies used by firms is to be closer to the field and farmers by ensuring the sale, technical advice and animation of user groups. Firms seek to break with the image of the "scrap merchant" by providing support, personalized advice, before and after the purchase, and this in a discreet way by the constitution of "communities of users" and the implementation network of farmers. Behind the firm, the "farmer-salesman" officiates with "peer-customers" (Goulet, 2011).

These communities form dialogue groups in the shape of peer networks and express the need to pool and share experiences. These groups of peers are no longer defined by their geographical anchoring but by their organization around specialized practices (organic farming, biodynamics, conservation agriculture, etc.) in which farmers seek knowledge in specialized fields, knowledge that experimental sciences do not offer them (Goulet, 2011). Firms also act on product-level communication and seek to influence practices by "stage managing" innovation. In the case of the establishment of conservation agriculture, actions are developed to weigh and communicate with public decision makers to build a third way between the conventional model and organic farming. This has been materialized with the creation of the IAD (Institut de l'Agriculture Durable, Sustainable Agriculture Institute), which shows a willingness to defend these innovations in the political field. In the end firms are similar to central actors in innovation processes by presenting themselves at different strategic stages, from the technical point of view, to the market and the advocates of public action (Goulet and Hernandez, 2013).

In the face of corporate strategies, the question of empowering farmers and their self-organization is now emerging outside the traditional institutions of management and the market sphere. Autonomy can be defined as "a desire for control and personal and/or collective appropriation of the conduct of technical itineraries without the intermediary of third parties" (Rémy, 2011). Thus, since the 2000s, we have been witnessing the emergence of upward innovation logics, built from the needs and problems encountered by farmers on the ground. This trend echoes the rejection of a Fordist model of innovation combined with a period of reorientation of agricultural production models and social demand.

#### 4.2 New modalities of invention and relations with the agricultural machinery companies

These findings question the forms of support and accompaniment for farmers in agro-equipment inventions. An unprecedented situation is observed in the field because alongside the new tools proposed by research, farmers develop their own inventions. A double question now arises. At first, the specificity of the accompaniment of the farmers in their approaches of invention appears in tension between on the one hand the framing of the current practices to answer the different regulations and on the other hand the support with these endogenous invention approaches. Secondly, this attention paid to farmers' inventions implies that we are also interested in the socio-economic context of their transformation and diffusion into innovations, with a legitimacy of the invention necessarily brought by the world of research/design, faced with the risk of dispossession of these farmers. Thus innovation in agriculture no longer refers only to the creation and distribution of a new product but also to the development of a service, as demonstrated by the example of VITIROVER, a company specializing in the provision of mowing grass robot between the vines.

Two vectors for developing these bottom-up innovations can be highlighted:

- A "product" logic: the observation of a lack of technical response to a problem encountered in the field leads farmers to invent and propose a solution. This is the case, for example, with the VITIROVER mowing grass robot, which replaces the chemical or mechanical weeding of vines. Similarly, the peculiarities of permaculture require specific tools designed from the observation of the needs of farmers who practice this technique.

- A "market" logic: the identification of a niche market or an agri chain reduces the dependence of the farm on its market and leads farmers to develop crops for which outlets are not managed by storage companies. This is the case, for example, with the cultivation of miscanthus grass, which is self-consumed and sold directly on the farm to private individuals and professionals. However at the heart of these innovative farms, we do not observe in all these examples a similar distance in regard to the use of the machine in agricultural practices as well as with the model of intensive agricultural production.

In order to highlight this divergence, we propose a schema of analysis where the intensity of the technical and machinery equipment on a vertical axis intersects with the "vision" of the farmer and of the farmer's ability of its innovations to maintain a "classic" agricultural model, even to perpetuate it by adapting it to the new requirements, or to question this system by developing an ecosystem vision, on a horizontal axis.



Thus within VITIROVER, technical simplification takes place at the heart of a model that is preserved and perpetuates identically. In contrast, permaculture is part of a simplification of the technique in favor of a model reinvented around the design of an agroecosystem. Lamont-Colin ETA company is at the heart of the technical invention for new uses, but without questioning the tractor. However, it does not just use a traditional tractor but adds new features to adapt it to new environmental and ecological requirements. Lastly, Les Ruelles Farm is committed to the development of new technical equipment and agricultural machinery for the conceptualization of a new ecosystem and a farm oriented towards sustainable development.

#### 4.3 Diversity of associated milieus and forms of accompaniment for innovation

Despite these different degrees of distance from the machine and the dominant agricultural development model, a common point is observed between these farmers, seen as actors in a position to appropriate knowledge and know-how to develop their activities by going beyond the unique horizon of their farms. At a minimum, it is a question of favoring/developing a mode of production, or a process, with the capture of a social circle larger than at the beginning. At maxima, it is a transformative vision of agriculture. The question of the diffusion of these innovative models, starting from a "first circle" of farmers who bring about change, remains open.

These agricultural machinery innovations also presuppose the existence (or even creation) of new associated milieus. Thus the relationships between farmers, advisers, suppliers and researchers seem to change in nature. Goulet (2011a, 2011b) explains the recent developments in the relationship between farmers, research and agricultural input companies. Agribusiness firms, among which the agricultural machinery, have deployed in recent years modes of action in the areas of support for innovation around technical units (such as no-tillage), in complementarity with commercial development actions. Thus companies' emphasis on production of a "sustainable agriculture economy based on the knowledge and experience of practitioners" (Goulet, 2011a, p. 386) could, in a contradictory way, be used to reveal existence and the potential of a technical capital peculiar to the actors of the agricultural world. The question that arises then is the forms that will take these devices of "co-production of knowledge", their speed of implementation and the respective places of firms, advisers, innovative farmers etc.

As a corollary, another question arises: in a period of intense - and rapid - digital upheavals into which we have entered, we can expect a deep redefinition of the roles of each. The finding is, therefore, that the actors involved have entered a period of increased interdependence. In parallel, the wishes (and the intentions) to act, to know and to invent of farmers, or at least a group of them, who are at the base of these technical evolutions, have never been so strong. These technical and organizational transformations will take place primarily through a coevolution in relation to associated milieus, innovation ecosystems, with new modalities, yet to be imagined, accompaniment, monitoring, co-design tools. These milieus also involve new forms of exchange and interaction, listening to the problems encountered in the field. It would be a question here of building, even organizing, processes of technical changes, such as we can already see them appearing in the different forms of platforms of open innovation (of the AgriLab type) or of collaborative economy (platform of knowledge intermediation between farmers like CoFarming). We make the hypothesis that the emergence of milieus associated with the evolution of agro-equipment will play in the near future the role of decisive catalyst that will make it possible (or accelerate) these

processes of technical evolution. The concrete experiences of disruptive farmers-inventors and innovators are still few: many obstacles (technological, psychological, institutional, and organizational) exist, but experiments, already at work in multiple initiatives in the field, could accelerate the processes.

## 5. Conclusion

What do the transformations of agro mechanization reveal in the context of contemporary agro technical evolution? The professional stories considered in this communication show us an agro technical world crossed by many questions, in accelerated transformation, and caught in a sense of crisis. Agriculture is at a pivotal moment in its historical evolution. In a more accentuated way, here focused on technical objects, we see farmers who are driven by the desire to understand the logics of possible evolution for their equipment, sometimes in reverse of "self-evident" representations. These farmers are above all eager to develop solutions that take into account new technologies, accumulated knowledge and local conditions of their insertion, which leads to the possible emergence of a new agricultural technical culture.

We will conclude on the hypothesis of a change of epistemological paradigm in the agricultural production approach, a change that should profoundly affect agro machinery. The development of agro ecological approaches and locally located innovations are strong indicators and lead to consider agro technical evolution as a process whose complexity must be accepted. Following the work of the theorists of technical evolution (Guchet, 2005, 2008; Simondon, 2014a, 2014b), we will call it a "new agricultural encyclopaedism". It seems likely that the development and diversification of "machines" in agriculture can no longer be apprehended without becoming aware of the knowledge necessary to master the design, the use and the dissemination. With this importance of design activities, it is likely that the know-how and skills of farmers will be elements to be taken into account in a renewed way in this great agro machinery transformation.

Today, conditions seem to be in place to achieve this transformation, thanks to the new tools of communication and exchange, to the new associated milieus in emergence, to the new modes of industrial production, to the tools of control of the precision, to the new forms of intermediation, to new agroecosystem design approaches (Berthet, 2016), while always taking into account, as a backdrop, increasing energy and ecological constraints.

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