

Increasing searches for autonomy among French farmers: a starting point for agroecology?

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Abstract

In Western European agriculture, an increasing number of conventional farmers are actively augmenting the autonomy of their farm enterprises. They do so, amongst others, through decreasing the external inputs, whilst simultaneously improving the use of internal resources. Thus, low external input farming systems emerge that increasingly enhance ecological processes. Simultaneously, the farmers involved may maintain key features of their entrepreneurial mode of farming. In this context, the network of French farm machinery cooperatives witnesses a movement of collective innovation experienced by farmer members to become more autonomous.

The present paper aims at better understanding this phenomenon visible within some French farm machinery co-ops. Our methodology is based on an exploratory survey of 15 machinery co-ops and a range of six in-depth case studies among them. Our work combines a farming system and a sociological approach. Most of the studied farmers mainly seek to become more autonomous from markets, notably from input markets. A part of them also claim to gain autonomy from advisory services and regulatory institutions. The current price volatility context appears as one of several decisive factors, of many of the farmers interviewed to seek the means to become more autonomous. The collective organisation provided by the socio-technical network of farmers' arrangements associated with their machinery co-op, has allowed them to benefit from favourable conditions under which to undertake the new practices.

We conclude by suggesting some lessons from these experiences to strengthen local networks of farmers' sharing arrangements as a conducive arena for agroecological transition.

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1. Introduction

In France, the current socioeconomic and ecological context (rising costs of animal feed, price volatility, droughts, new public regulations and private specifications, etc.) is increasingly leading farmers to innovate and develop their autonomy. To do so, conventional farmers are implementing new practices such as self-provisioning strategies, legumes integration, no-tillage, etc. Thus, different elements out of a broader agroecological strategy are being implemented (and further developed) by French farmers. Although they do so without referring to the concept of agroecology, they develop low-input and more diversified farming systems by making better use of the ecological functionalities of the agroecosystem. Simultaneously, they maintain key features of the conventional mode of farming such as high yields, automation, zero grazing.

The French National Federation of farm machinery cooperatives is particularly affected by this phenomenon. 11 000 farm machinery cooperatives exist in France, comprising one third of all French farmers. The leaders of this network have recently observed a movement of collective innovation experienced by farmers within their machinery co-ops, conducive to developing their autonomy.

This paper aims at appraising if this collective movement might be supported and strengthened to allow a broader agroecological transition in agricultural production. To do so, it will examine the main results of an action research programme which seeks to understand the phenomenon of collective innovation in the machinery co-op network which makes feasible the increasing searches for autonomy among conventional farmers. Who are these farmers who newly search for autonomy? How do they manage to reduce external input use whilst aiming to maintain a high level of production?

The first part of the article presents a brief literature review regarding the paradoxical interaction between farmers' searches for autonomy and agroecology. In the second part, we describe the functioning of the French farm machinery co-ops, before explaining our methodology. In the third part, we examine farmers' paths to develop their autonomy, as well as the contribution of the collective organisation to facilitate the change process. We then discuss the potential of the machinery co-ops for agroecological innovation.

2. Autonomy: a paradoxical interaction with agroecology

Before developing our examination of autonomy and agroecology, we explain on which definition of the latter we base our present work. Following Francis & *al.* (2003), we consider the agroecology as the development and application of ecological theory to the entire food systems, encompassing ecological, economic and social dimensions. From this broad approach, we particularly focus on the farm segment, including the territorial and landscape levels. At these levels, we examine the adaptations of the agricultural practices made individually and collectively by the farmers to design diversified farming systems tailored to local conditions which seek to enhance ecological processes and interactions, and to improve the sustainability of the local agroecosystems (Wezel & *al.*, 2015; Nicholls & *al.*, 2016).

2.1 Autonomy as a value

The literature review reveals that the concept of autonomy incorporates a multiplicity of interpretations and connotations, especially due to the national and ideological background. Emery (2015) highlights that the British political and social theorist Lukes has presented the autonomy as one of the three faces of liberty and maintained that it is achieved when an individual “subjects the

pressures and norms with which he is confronted to conscious and critical evaluation, and forms intentions and reaches practical decisions as the result of independent and rational reflection” (2006 [1973], p. 55). However, words of farmers throughout many parts of the world reveal that autonomy is often synonymous with independence and individualism, owing to the work of the dominant ideology, which is currently neoliberal ideology, which makes them appear so (Emery, 2015; Stok & *al.*, 2014).

Moreover, Lukes highlights that historically the concept of individualism had distinct connotations according to the national contexts. Born during the 19th century in France, it still carries in this country a pejorative connotation, suggesting the dissolution of the social system. In England, it had become synonymous with minimal state intervention and opposed to socialism. In the United States, it had become a usual word to qualify the economic liberalism, the limits of the government action and the individual freedom (2006 [1973]). This explains the multiple interpretations of the autonomy. For instance, Emery shows that for English farmers, autonomy and independence are often conflated with individualistic premises. He argues that this limits their involvement in collective action and thus increases their dependency on the structural and economic forces that impose real limitations on their work and lives (2015).

2.2. Autonomy as a guiding principle

In contrast with the autonomy considered as a value, some authors show how farmers may also value autonomy as a guiding principle or as a tool of navigation to manage the farm (Stock & Forney, 2014; Ploeg, 2008). From this approach, Forney calls for promoting autonomy to open new paths to make agriculture more sustainable (2016).

Actually, various authors have highlighted how the development of organic and alternative farming has been interlinked with farmers' striving to develop their autonomy and agency (Altieri & Toledo, 2011; Lucas & Sabourin, 2011; Coolsaeth, 2015). For instance, in France, the first certification standard for organic farming was developed in 1963 by a commercial organic fertiliser company founded by two agronomists, Lemaire and Boucher. They proposed a contract farming approach which offered a production method based on both external inputs, a specific wheat seed and a calcified algae, whose use allowed contracting farmers to sell their products by using the “Lemaire & Boucher” brand. A new association of producers and consumers, “Nature & Progrès”, emerged in 1964, partly as a critical approach toward this trade dimension. They also questioned the external inputs dependency induced by agricultural modernisation. They created the first French certification scheme for organic farming in 1970, including autonomy as an ordering principle (Nicourt, 2015). In the UK context, Morgan and Murdoch (2000) have assessed that organic farmers, compared with conventional farmers, are able to exercise more autonomy and control both in relation to means of production on their farm and to actors of the food chain.

Recent research has revealed how French organic farmers make compromises to deal with the autonomy principle. Nicourt (2013a) shows that organic pork breeders number only a few people in France, and have to face a context of trade vulnerability. Some of them choose to develop direct selling, sometimes with on-farm processing, which may create competition between their farming activities. As a result, the development of trade tasks often occurs to the detriment of crop and livestock production, which may be delegated to contractors, paid employees or to other farmers. Hellec and Blouet (2012) describe how new organic dairy companies have recently emerged and organized farmers' convert to organic farming. Their case study from eastern France shows that a dairy company wants to ensure its volume of business and then selects farmers with high productivity levels. These buy fodder from off-farm by using the exemptions allowed by the organic regulations.

Demeulenaere and Bonneuil (2010) and Goulet (2010) have studied two alternative agriculture movements: network of peasant seeds and communities of practice organised around no-tillage and direct seeding techniques. They observed a similar desire for farmers to manage their activities within their own means (i.e. without the support of third parties). Even if both movements seem to be distinct regarding the production systems practiced and the socio-political orientations, developing autonomy regarding advisory institutions and input markets is a common aim and they both rely on networking.

Recent work has also shown an increasing wish among conventional farmers to develop their autonomy: the context of economic and ecological uncertainty is currently strengthening and renewing farmers' striving for this across the board (Darnhoffer, 2010; Ploeg, 2008; Schneider and Niederle, 2010). Ploeg (2008: 152-154) identified six mechanisms through which farmers try to become more autonomous. To better face the input and commodity markets, which tend to increasingly operate in oligopolistic ways, 1) many farmers diversify their outputs in a range of ways, sometimes whilst simultaneously creating new market outlets. To better face the input markets, 2) farmers tend to develop low-input or more cost effective modes of farming. Thanks to these strategies, farmers may structure the relations with markets in ways that allow for autonomy. Farmers tend to increasingly base the process of production upon their own resources, especially by 3) re-grounding agriculture upon nature. It implies e.g. the revitalisation of soil biology, or the breeding of animals that can be fed with local resources. 4) Increasing the technical efficiency of the production processes as a long-term strategy allows to attain a higher production level with the same set of resources. This results from farmers' careful observation, small on-farm experiments and progressive improvement of the internal resources used and their potential synergies. 5) Pluri-activity, when it aims, among others at strengthening the total income and at scattering the economic risks, may be considered as a strategy to develop autonomy, for instance in relation to the bank credit. Finally, 6) local forms of cooperation among farmers contribute to delinking farmers from dependency on financial and industrial capital. These mechanisms are not mutually exclusive and may form a multi-faceted and articulated strategy to develop farmers' autonomy.

2.3. Autonomy at the collective level

Some social scientists demonstrate that opposition may occur between autonomy and sustainable farming. As Emery (2015) observes, the value in independence has often been used to explain the lack of cooperation among farmers, especially for collaborative agri-environmental schemes. This often leads policy makers to design these approaches through individual contracts with farmers. Doing so, they limit the possibility for farmers to interact and benefit from sharing of experiences to put the schemes into action. They also reduce the potential of landscape based approaches.

Farmers' searches for autonomy may face difficulties due to "path dependency" resulting from the dominant socio-technical regime that locks-in possibilities for agroecological transition (Vanloqueren and Baret, 2009). The collective organization of the farmers sometimes leads to efficient ways to overstep the sociotechnical lock-ins, by setting in niches of innovation, allowing novelty production and knowledge creation (Wiskerke & Ploeg, 2004; Stock & *al.*, 2014).

To conclude, farmers' searches for autonomy appear as a multi-faceted phenomenon, which has contributed to organic and agroecological farming development. Autonomy aiming at reducing the dependencies from markets, imposed top-down regulations and dominant technological regime appears as a robust tool for agroecology, especially whilst articulating cooperative approach between farmers. Thus, examining the potential of farm machinery co-ops for agroecological transition appears as a relevant issue.

3. Methods and materials

3.1 The machinery co-op: a socio-technical network of farmers' sharing arrangements

In France, the agricultural policies of 1960 and 1962 have framed the modernisation process, by strongly valuing farmers' collective organisation and action. As a result, farmers' organisations have become driving forces to implement a family productivist farm model in France (Nicolas, 1988; Nicourt, 2013b). This explains the widespread machinery co-op network, which currently comprises of more than 11,000 units throughout the French regions.

On average, a French machinery co-op includes 25 farmers, and the smallest are composed of 4 farmers, which is the authorised minimum membership. It is based on the commitment contract. For each member, the contract implies the commitment to use a minimum amount of one or several pieces of equipment for a multi-year period.

To share machinery in the best conditions, machinery co-op's members often organise machinery-sharing arrangements to avoid the constraints induced by the sharing situation. For instance, to avoid competition among members of the machinery co-op when specific climatic conditions are needed to successfully perform some operations. Farmers also organise labour-sharing arrangements, which may be the following: joint organisation of tasks, delegating to common paid employees, mutual aid, etc. The machinery co-ops network promotes the organisation of labour banks between farmers to facilitate labour exchanges between peers.

The habit of sharing equipment and working together may create a trust level that triggers other kinds of machinery-sharing arrangements between some members (often in a bilateral way), such as co-ownership. Some other resources-sharing arrangements may emerge or other kinds or collective arrangements, such as coordinated purchases pools (Lucas & al, 2014).

This is why the functioning of a machinery co-op cannot be understood without considering the whole socio-technical network of farmers' sharing arrangements that it is associated with (Dodier, 1995).

3.2 Methodology

Two theoretical frameworks from development studies and innovation sociology inspire our analysis. Work performed by the Dutch sociologist Ploeg (2008) regarding farmers' autonomy provided us with an analytical framework to examine farmers' strategies to develop their autonomy. Works of the French sociologist Darré (1996) deal with the knowledge development issue, generated by social interactions between farmers. According to Darré, a collective process occurs in dialogues between peers at the local level. In addition, individual farmers may simultaneously belong to other networks of dialogues, where they have access to other sources of knowledge, representations and narratives. This "multi-membership", as Darré calls it, is a source of novelties. These works have allowed us to focus on the experience of the farmers studied regarding the dialogical processes with their peers, which underpins the change process.

Our methodology is based on two processes.

First, we ran an exploratory survey of 15 farm machinery co-ops, covering different geographical contexts and farming systems. They were identified with the help of advisors of the machinery co-op network. In each selected co-op, some of the members had been engaged in sustainable practices requiring some pieces of the machinery co-op's equipment. Data collection took place

through semi-structured interviews with one or several leaders of each co-op. We focused on the history and activities of the machinery co-op, especially in relation to specific machinery allowing to develop sustainable practices. The exploratory survey allowed us to identify the search for autonomy as a common motivation among the different groups visited.

Secondly, we carried out in-depth research on six of these co-ops, whose members are engaged in legume introduction or no-tillage practices on their farms. Indeed, data of the national network of machinery co-ops currently reveal increasing investments in specific equipment regarding these practices. Thirty-six semi-structured individual interviews were conducted with farmer members of the six co-ops. The results of the interviews were recorded. They first were analysed via a discourse analysis to identify the conceptions regarding autonomy. Secondly, the analysis has allowed us to draw the socio-technical determinants of farmers' strategies.

4. Paths and practices for autonomy

A whole series of circumstances has occurred over about fifteen years in France that has triggered initiatives from farmers to decrease the use of external inputs. Most of the interviewed farmers allude to the notion of autonomy to explain their new practices.

4.1 Reducing external inputs

Most of the farmers interviewed explain how they seek to decrease external inputs to reduce their costs, especially because of the current price volatility context that has set in since 2007.

Some of the interviewees seek to produce more protein and legume crops and grass on farms to feed their animals. These ones may provide origin-based livestock products markets or be involved in direct selling with consumers. This new trend has emerged after important campaigns organised by environmental NGO (Greenpeace, WWF, etc.) during the 2000s against GMO soybean imported by the European livestock sector (Escobar, 2014). Moreover, one group of farmers were encouraged by their agricultural marketing cooperative to use less external inputs for an environmental product differentiation strategy.

Most of the interviewees have introduced legume through winter cover crops, in response to the various agri-environmental schemes requiring to cover the soil during winter.

Farmers allude to the aim to develop their autonomy when they explain the integration of these practices, allowing them to reduce external inputs and to improve internal resources and potentialities. This reveals that the interviewees choose to face the external prescriptions or pressures, such as price volatility, by actions that may contribute to strengthening their autonomy, especially by reducing their sensitivity to market fluctuations.

4.2 Mastering the farming system

Most of the farmers who were interviewed highlighted they wish to better master the technical processes whilst explaining their initiatives to develop autonomy.

Firstly, some of them describe their difficulty in accessing some external inputs. For instance, to introduce legumes, input suppliers do not always offer the right diversity of seeds at the right moment with a good price. To face this difficulty, many of the interviewees have decided to organise on-farm seed production. Another example: farmers who have to buy external fodder explain they have to face irregular quality problems. They experience the fodder market as a surplus market, easily affected by climate variations, which does not provide a constant and homogeneous fodder

quality. That is why they seek to improve their on-farm fodder production by developing means to limit the losses. They also make the most of winter cover crops to produce additional fodder.

Secondly, most of the arable and mixed crop-livestock farmers experience increasing “agronomic deadlocks” because of short rotations, loss of organic matter and over-tillage. This explains changes such as no-tillage, new crop integration, winter cover crop development with legume introduction, and strengthening of crop/livestock interfaces.

Thirdly, some of the interviewees claim to be more autonomous regarding advisory services. For instance, they have chosen not to externalise administrative tasks, such as accounting. This allows them to better know and master their own situations and have the means to properly guide their decision making. They also seek to avoid working with agricultural advisors who are simultaneously input salesmen, or they confront their advice with other sources of knowledge. Some of them have experienced difficulties to access to relevant information in relation to their new practices (especially about legumes cultivation) from advisory services.

Finally, the price volatility that has occurred since 2007 often appears in the farmers' narratives as the final straw. This is on top of the other disappointments regarding input markets and advisory services, and has become a triggering factor for farmers to organise the adequate means to face them. In this way, farmers try to get their farming practices away from input markets and dominant socio-technical institutions.

4.3 Progressing towards more sustainable practices

The on-farm change process is strongly based on the striving and the resources of the farmers rather than on mobilization of external techniques or inputs. So some of the farmers express the satisfaction they get by seeing the successful results of their own work and creativity. This encourages them to undertake new initiatives. This appears as a self-propelling dimension of autonomy development.

The current development of agri-environmental state policies and schemes may validate farmers to engage in reducing external inputs. Moreover, as reducing external inputs may be a way to make agriculture more environment-friendly, some of them have the feeling to meet the current general socio-political expectations. This does not appear as the starting motivation, but much more as an additional convincing factor. Indeed, the narratives of the interviewees reveal the paramount technical and productive norms and values in relation to their professional identification.

Most of the new practices, such as legume introduction, no-tillage and winter cover crops, are considered to contribute to climate mitigation by expert assessment (Pellerin & *al.*, 2013). Moreover, some of the interviewees, especially those engaged for more than ten years in a change process to develop their autonomy, nowadays reach a low level of external inputs, even to the extent to convert to organic farming.

5. The collective organisation to develop autonomy at the farm level

The network of arrangements associated with the farm machinery cooperatives make the practical integration of new practices feasible at farm level. Over the long term, farmers manage to develop the autonomy of the farming system that had a prior high level of external inputs and a current high level of productivity, thanks to the collective organisation.

5.1 The logistics challenge

The new practices to develop farmers' autonomy imply some backward moves with regard to two entrepreneurial farming trends: specialisation and externalisation. This has consequences for logistics. Crops and production specialisation allows management of the farm with a restricted set of equipment, i.e. machinery that is specific to a few crops or products. The use of external inputs may be considered as an externalisation process of the needed resource production. That is why developing self-provisioning or diversifying by introducing a new crop may imply new logistical needs, such as processing equipment, storage infrastructures, adapted machinery, etc.

Thus, dealing with a wide set of adjustable equipment to be able to diversify, to develop self-provisioning and/or to better ground the farming practices on their specific ecological conditions becomes a substantial challenge for farmers. That is why the farm machinery co-ops are a significant asset in facing this logistical challenge by reducing equipment costs owing to the shared investment. Moreover, farmer members with mechanical skills contribute to developing tailored technological solutions, even self-built or self-designed equipment. In doing so, farmers seek to strengthen the “multifunctionality” of each piece of equipment.

5.2 Better improvement and access to strategic resources

Some resource-sharing arrangements are organised from the socio-technical network associated with the machinery co-op organisation. They facilitate some collective self-provisioning strategies to reduce external inputs and to better access to strategic resources which are not well supplied through markets.

Seed-sharing is organised between farmers interviewed to avoid individual farmers having to multiply a wide set of the required seeds. The talks to collectively organise the multiplication work often emerge between farmers already associated through machinery- or labour-sharing arrangements, as well as through study groups.

Resource-exchange arrangements are sometimes organised between arable and livestock farmers to make the most of synergies between crops and livestock to better manage access to organic manure. Farmers of one of the studied machinery co-ops have organised an innovative arrangement about cover crops. Two sheep farmers arrange with neighbouring arable farmers to organise the grazing of cover crops by sheep. This allows the provision of organic manure to the soil during winter. In addition, the grazing of cover crops is an interesting way to reduce herbicide applications.

5.3 The role of the technical dialogues

The socio-technical network associated with the machinery co-op often functions as a network of technical dialogues between peers. These technical dialogues allow farmers to share their experiences, to compare their results and to confront their practices. Doing so, they can better draw valid conclusions from their on-farm observations. Labour-sharing arrangements are special opportunities for technical dialogues, because they allow each farmer to better know his peers' on-farm conditions and practices. The needed talks to share and adjust machinery also provide interesting opportunities for technical dialogues, through which machinery plays the role of the “intermediary object” among heterogeneous farmers.

The local technical dialogues network triggered from the machinery co-op functions better if some farmer members are connected to other networks or study groups, or interact with other sources of knowledge. In most of the studied machinery co-ops, some farmers are connected to a study group or a regional peer-to-peer network devoted to no-tillage farming. This allows them to regularly

participate in activities, such as training sessions, lectures, study trips, etc. Other farmers may benefit from the knowledge drawn from these activities through the technical dialogues with the “connected” farmers.

Each socio-technical network associated with the machinery co-op does not provide equal conditions for taking part in the technical dialogues. In some socio-technical networks, the technical dialogues tend to be more concentrated on a few farmers associated through multiple sharing arrangements.

Moreover, few study groups and networks exist in France devoted to legume improvement and integration in farming systems. As a result, the interviewed farmers face difficulties to better master and improve the practices regarding this topic. This appears as an “orphan topic” when compared with existing no-tillage networks (Landel, 2015) and visible progress among no-tillage practising farmers over the long term.

5.4 Optimising work organisation

Many labour-sharing arrangements are organised through the socio-technical network associated with the machinery co-op. We identify the following arrangements: joint organisation of the tasks to carry out, individual specialisation within farmers' groups, and mutual aid. These allow farmers to optimise the on-farm work organisation. Indeed, the changes may imply additional operations at the farm-level, such as experimental activities, observation and improvement of ecological processes, and coordination tasks (especially if the new practices induce integration of a new crop or activity). Several machinery co-ops studied seek to delegate some tasks to common paid employees, especially through newly emerging pools of employers among farmers. These may allow them to dedicate more time to experimental activities, or to participate in study groups or thematic networks to access to adequate knowledge to improve their practices.

6. Considering farmers' collective arrangements as a local arena for agroecological transition

These results show how the search for autonomy and the collective organisation lead the studied farmers towards low-input and more diversified farming systems with a better use of the ecological functionalities. In a context of disappointments regarding agricultural institutions, the machinery co-op, which is a self-controlled farmers' organisation, appears as a relevant support to ensure their autonomy. The discussed examples show how the incremental change process can result in a systemic change over the long term. Moreover, the cooperative principles of the machinery co-op also allow to make the practices durable over the long term. Indeed, the commitment contract engages each member to a minimal level of equipment use for several years. This was also observed by Ploeg in other agricultural contexts, that through cooperation between farmers, the on-farm shifts tend to become enduring (2008). Finally, these results also echo other studies highlighting the role of experience- and knowledge-sharing in farmers' networks (Forney, 2016; Compagnone & Hellec, 2015).

This research reveals how environmental schemes may benefit from existing collective farmers' arrangements to use them as a local arena for agroecological transition. First, we find it important to consider the farmers' search for autonomy as a potential starting point for agroecology. This is why we suggest to design the agri-environmental schemes at the local level in partnership with farmers' collectives. This seems to us a relevant way for farmers to participate in configuring the scheme in the sense that it strengthens their autonomy. Secondly, we highlight the need to support

technical dialogues within local networks of farmers' arrangements to facilitate equal conditions for farmers to take part in the dialogues. Thirdly, supporting the possible connections between study groups and peer-to-peer thematic networks with local farmers' arrangements appears as a strategic means to improve change processes.

Developing boundary spanning between conventional and organic farming communities appears as an interesting strategy regarding the role of the diverse sources of knowledge that interviewed farmers may access to and connect to improve their practices. That is why we call for new facilitation processes between organic and conventional farmers. We recommend putting shared items (machinery, equipment, strategic resources) centre-stage to facilitate dialogue, rather than belief systems and values. Indeed, in the studied machinery co-ops, the shared equipment and resources play a strategic role of "intermediary object" that facilitates technical dialogues. Indeed, to focus the dialogue on technical or material issues may avoid dealing with controversial ecological issues.

7. Conclusion

This paper highlights some features of the increasing concern among conventional farmers to develop their autonomy. In the last fifteen years, different ecological and socioeconomic pressures have triggered the need for farmers to gain more autonomy from the markets and the dominant sociotechnical regime. The studied farmers become more autonomous by reducing the external inputs and by improving the use of their internal resources.

They manage to develop their autonomy owing to both kinds of collective organisation. First, they are members of a farm machinery co-op which is associated with a local socio-technical network of farmers' sharing arrangements, which facilitates the cooperation among peers. These allow farmers to better face logistics needs, to improve and to access strategic resources and to optimise their work organisation. Secondly, some of the interviewed farmers belong to study groups or peer-to-peer thematic networks that connect them to different sources of knowledge. This allows them to get away from advisory services which fail to provide the required knowledge for agroecological transition. These "connected" farmers may share adequate knowledge and their vanguard experiences through the technical dialogues that occur in the local arrangement network associated with the machinery co-op.

The paper reveals the potential to make the most of existing collective farmers' arrangements to turn them into a local arena for agroecological transition.

The collective innovation movement visible in the machinery co-ops induces new questions for the national network. Firstly, study groups and peer-to-peer thematic networks are complementary farmers' organisations which allow machinery co-ops to act as strategic niches for agroecological innovation. More cross-disciplinary partnerships between these organisations, and including research institutions, appear essential to develop the means for farmers to become more autonomous. Secondly, any social movement currently appears as a voice of the conventional farmers who develop agroecological practices to become more autonomous. The national network of machinery co-ops might become a protagonist, perhaps with other farmers' organisations, to represent this social group and promote their concerns, striving, successful experiences and specific needs.

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References

- Altieri, M. A., & Toledo, V. M. (2011). The agroecological revolution in Latin America: rescuing nature, ensuring food sovereignty and empowering peasants. *Journal of Peasant Studies*, 38(3), 587–612.
- Compagnone, C., & Hellec, F. (2015). Farmers' Professional Dialogue Networks and Dynamics of Change: The Case of ICP and No-Tillage Adoption in Burgundy (France). *Rural Sociology*, 80(2), 248–273.
- Darnhofer, I. (2010). Strategies of family farms to strengthen their resilience. *Environmental Policy and Governance*, 20(4), 212–222.
- Darré, J.-P. (1996). *L'invention des pratiques dans l'agriculture : vulgarisation et production locale de connaissance*. Paris ; France: Karthala.
- Demeulenaere, E., & Bonneuil, C. (2010). Cultiver la biodiversité. Semences et identité paysanne. In B. Hervieu, N. Mayer, P. Muller, F. Purseigle, J. Rémy (Eds) *Les mondes agricoles en politique: De la fin des paysans au retour de la question agricole*, pp.73–92. Paris ; France: Presses de Sciences Po.
- Dodier, N. (1995). *Les hommes et les machines: la conscience collective dans les sociétés technicisées*. Paris; France: Editions Métailié.
- Emery, S. B. (2015). Independence and individualism: conflated values in farmer cooperation? *Agriculture and Human Values*, 32(1), 47–61.
- Escobar, M. (2014). *Dynamics within and between NGOs' influence strategies towards Business : The case of environmental NGOs mobilizing around soybean sustainability issues (2000-2013)*. PhD Thesis. Montpellier 1 University, Montpellier ; France.
- Forney, J. (2016). Blind spots in agri-environmental governance: some reflections and suggestions from Switzerland. *Review of Agricultural, Food and Environmental Studies*, 1–13.
- Francis, C., Lieblein, G., Gliessman, S., Breland, T. A., Creamer, N., Harwood, R., Poincelot, R. (2003). *Agroecology: The Ecology of Food Systems*. *Journal of Sustainable Agriculture*, 22, 99–118.
- Goulet, F. (2010). Nature et ré-enchantement du monde. In B. Hervieu, N. Mayer, P. Muller, F. Purseigle, J. Rémy (Eds) *Les mondes agricoles en politique: De la fin des paysans au retour de la question agricole*, pp.51–72. Paris ; France: Presses de Sciences Po.
- Hellec, F., & Blouet, A. (2012). Technicité versus autonomie. Deux conceptions de l'élevage laitier biologique dans l'est de la France. *Terrains & travaux*, 20, 157–172.
- Landel, P. (2015). Réseaux d'action publique et accès aux connaissances pour la «transition écologique». *Économie Rurale*, 347(3), 59–78.

- Lucas, V., & Sabourin, E. (2011). L'agroécologie brésilienne à l'épreuve de l'émancipation paysanne. (p. 18 p.). 5èmes Journées de recherches en sciences sociales INRA – SFER – CIRAD, Dijon
- Lucas, V., Gasselin, P., Thomas, F., & Vaquié, P.-F. (2014). Coopération Agricole de Production : Quand l'activité agricole se distribue entre exploitation et action collective de proximité. In P. Gasselin, J.-P. Choisis, S. Petit, F. Purseigle (Eds.). *L'agriculture en famille : travailler, réinventer, transmettre*. pp. 201–222. Paris ; France: EDP Sciences.
- Lukes, S. (2006). Individualism. ECPR Press.
- Morgan, K., & Murdoch, J. (2000). Organic vs. conventional agriculture: knowledge, power and innovation in the food chain. *Geoforum*, 31(2), 159–173.
- Nicholls, C., Altieri, M. & Vazquez, L. (2016). Agroecology: Principles for the Conversion and Redesign of Farming Systems. *Journal of Ecosystem & Ecography*, S5(1),1–8.
- Nicolas, P. (1988). Émergence, développement et rôle des coopératives agricoles en France. Aperçus sur une histoire séculaire. *Économie Rurale*, 184(184–186), 116–122.
- Nicourt, C. (2013a). De l'élevage au commerce. *Économie Rurale*, (3), 69–84.
- Nicourt, C. (2013b). *Être agriculteur aujourd'hui: l'individualisation du travail des agriculteurs*. Paris ; France : Editions Quae.
- Nicourt, C., Cabaret, J., Darduin, U., & Delanoë, M. (2015). Être intégré et bio. Vulnérabilité et compensation des éleveurs de volaille bio intégrés. *Review of Agricultural and Environmental Studies*, 96(2), 339–360.
- Pellerin, S., Bamière, L., Angers, D., Béline, F., Benoît, M., Butault, J. P., ... Pardon, L. (2013). Quelle contribution de l'agriculture française à la réduction des émissions de gaz à effets de serre ? Potentiel d'atténuation et coût de dix actions techniques. (Synthèse du rapport d'étude.). ADEME/INRA.
- Ploeg, J. D. van der. (2008). *The new peasantries : struggles for autonomy and sustainability in an era of empire and globalization*. London: Earthscan/Routledge.
- Schneider, S., & Niederle, P. A. (2010). Resistance strategies and diversification of rural livelihoods: the construction of autonomy among Brazilian family farmers. *The Journal of Peasant Studies*, 37(2), 379–405.
- Stock, P. V., Forney, J., Emery, S. B., & Wittman, H. (2014). Neoliberal natures on the farm: farmer autonomy and cooperation in comparative perspective. *Journal of Rural Studies*, 36, 411–422.
- Vanloqueren, G., & Baret, P. V. (2009). How agricultural research systems shape a technological regime that develops genetic engineering but locks out agroecological innovations. *Research Policy*, 38(6), 971–983.
- Wezel, A., Brives, H., Casagrande, M., Clément, C., Dufour, A., & Vandenbroucke, P. (2015). Agroecology-Territories: Places for Sustainable Agricultural and Food Systems and Biodiversity Conservation. *Agroecology and Sustainable Food Systems*
- Wiskerke, J. S. C., & Ploeg, J. D. van der. (2004). *Seeds of transition: essays on novelty production, niches and regimes in agriculture*. Assen: Van Gorcum Ltd.