Crossing two niches of agroecological innovation: the case of organic farming and conservation agriculture

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Abstract: Among the different paradigms addressing the issue of the transition of agri-food systems, we situate our study in the agroecological paradigm, considering that agri-food issue includes employment, food governance, environment and consumption (Stassart et al. 2012). Within this framework, the present communication discusses the processes of "ecologisation" of agri-food systems through the analysis of the interactions between two agroecological niches: organic farming and conservation agriculture. Organic farming is a well-known model that prohibits the use of chemicals, that is subjected to public regulation and clearly identified on the market. Conservation agriculture aims to maintain soil fertility and prevent soil erosion through the application of minimal soil disturbance (reduced tillage), permanent soil cover and crop rotations. This model is recognized by the FAO but has less visibility in society than organic farming.

In previous works, we mobilized the multi-level perspective of the Sustainability Transition Studies (Geels and Schot 2007) and developed the metaphor of the *insularization* to characterize the specificities of the transition process to conservation agriculture. The present communication uses this theoretical framework to analyze several farmers' transition pathways that articulate organic agriculture and conservation agriculture. The analysis will consider how these two models converge on some aspects while simultaneously presenting several technical, organizational and cognitive incompatibilities. It will aim to understand how farmers connect or disconnect these two models in different ways. Besides, this investigation seeks to provide a better comprehension of the crossing of different niches of innovation, the challenges and obstacles it brings about and the potential in term of sustainability.

Keywords: organic farming, conservation agriculture, Sustainable Transition Studies, lock-in

Introduction

Among the different paradigms addressing the issue of the transition of agri-food systems, we situate our study in the agroecological paradigm, considering that agri-food issue includes employment, food governance, environment and consumption (Stassart et al. 2012). Within this framework, the present communication discusses the processes of "ecologisation" of agri-food systems through the analysis of the interactions between two agroecological niches: organic farming and conservation agriculture. Conservation agriculture (CA) and organic farming (OF) are two agricultural models based on different founding principles. Organic farming, in its lightest version, is based on the non-use of chemical inputs. Conservation agriculture is usually defined by three main principles (Kassam et al., 2009, 2010; Lahmar, 2010 ; Scopel et al., 2013) : 1) minimal disturbance of the soil (reduced tillage or no-tillage[240]) ; 2) soil cover (by crop residue or cover crops) ; 3) appropriated crop rotation (to control weeds, pests and diseases).

[240] There is a wide range of reduced tillage techniques: they all have in common the non-inversion of the soil and aim to shallower cultivation. They can go from quite deep tillage (sub-soiling) to no-tillage (direct seeding). Therefore, a large diversity of terms

Empirical observations and several studies demonstrate that, nowadays, there is a growing number of dynamics of convergence between CA and OF (Fleury et al., 2011; Peigné et al., 2007). The convergence of the two models has a great potential in term of sustainable transition but, so far, it raises many difficulties and remains very challenging for farmers.

Based on the analysis of farmers' trajectories in the Walloon region (South of Belgium), this communication aims to understand how farmers cross the two niches (what are the transition pathways that allow the convergence of the two niches?), what are the main difficulties they face and what can sustainable transition learn from the crossing of the two niches?

Organic farming and conservation agriculture

In the Walloon region (South of Belgium), our investigation area, several farmers experienced reduced tillage in the early 1980's. Since then, the Walloon agricultural surface under reduced tillage has expanded and, nowadays, is estimated to be between 15 and 20% for winter wheat crops and less than 10% for other crops (Greenotec 2012). Although the Walloon surface under organic farming is smaller (7,6% in 2012) than the one under reduced tillage, conservation agriculture has less visibility in the society. This is a consequence of the difference in their respective historical development and official recognition: CA is a professional model developed mainly by farmers while OF involved, since its beginning, farmers but also consumers and social movement. In terms of recognition by public policies, CA is acknowledged by some initernational institution like the FAO as a model for sustainable agriculture and soil conservation. It is supported in various ways by some national or regional governments: by the founding of farmers' organizations or research programs, through agri-environmental incentives, etc. But CA remains a way of producing that is not clearly identifiable - no private standard book - that has no legal framework and that has no translation in terme of qualificatrion of product . At the opposite, OF is a production method that has expand to processing and marking through the officially defined by a European regulation (since 1991). Based on his environmental added value it is supported by public policies in various ways : financial incentive for conversion and organic farming , public regulation on certification and linked to the organic qualification of product it has a market recognition.

The position of the two models regarding the conventional agricultural model is very different. Historically, OF carried a critic of the dominant agricultural model and built itself in opposition to the conventional agricultural model[241], while the position of CA regarding the dominant model is more complex and ambiguous. AC and OF rest also on various critic of conventional agriculture research program and the knowledge production of sciences with different historical roots and perspectives.

In previous works, we analyzed the transition to conservation agriculture with the multi-level perspective of the Sustainability Transition Studies (Geels and Schot, 2007). In this perspective, transitional processes are interpreted as being the dynamics of inter-action between three analytical levels defined as follows:

- *Niches of innovation* are spaces where radical new approaches emerge to then mature and progress while remaining more or less protected from the pressure of selection exerted by the *regime*.

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might be used to describe reduced cultivation (see Kassam et al., 2009): reduced tillage, minimum tillage, conservation tillage, etc. No-tillage, zero-tillage, no-till techniques and direct seeding refer more specifically to the non-disturbance of the soil. In this paper, we use the term "reduced tillage" to embrace all the techniques that do not encompass plowing.

[241] Nowadays, the situation of OF is a bit more nuanced and its distinctive features with the regime are less clear (Guthman, 2004; Vankeerberghen, 2011) but OF remains a niche clearly distinct from the conventional agricultural model thanks to the certification of its products.

- *Socio-technical regimes* are sets of norms, standards, beliefs, regulations, and cognitive routines, which direct and stabilize the trajectories of practices within a given orientation.
- *Socio-technical landscape* is the environment considered to be exogenous in relation to the *regime.* It encompasses macro-economies, large-scale models of cultural representations, and macro-political trends and developments. (Geels and Schot, 2007)

To describe the process whereby links between the *niche* and the *regime* can be created, Grin and van Staveren (2007) proposed the notion of *anchoring*. The authors suggest that *niche* experimentation, which emerged outside of the regime, becomes anchored in the *regime*. In previous works, we inverted this notion of *anchoring* to demonstrate how, in the case of conservation agriculture, the notion of *insularization* can describe the relations between *niche* and *regime* (Vankeerberghen et al. *forthcoming*). Contrary to the process of *anchoring*, the founding principle of conservation agriculture is a detachment from plowing, considered as an institution of the *regime* of conventional agriculture production (Lal et al., 2007; Goulet and Vinck, 2012). Farmers' trajectories analysis show that conservation agriculture is a *niche* that emerges within the *regime* of conventional agriculture and not on its fringe as it is usually the case for niches, and for instance, as it is the case for organic farming. The process of insularization thus stems from socio-technical transformations associated with transitional detachment from the conventional agricultural *regime.* It allows new trajectories of learning and practices – the island detaching itself from the continent – while drawing some of its normative techniques and models from conventional agriculture – the continent. Conservation agriculture is a niche that has ruptures but also strong continuities with the regime.

According to the multi-level perspective, the emergence and the development of OF and CA regarding the agricultural regime are very different. It has several consequences in terms of transition pathways, innovation processes, professional references and identifications.

Dynamics of convergence

Even if, nowadays, there is a growing number of dynamics of convergence between CA and OF (Fleury et al., 2011; Peigné et al., 2007; Thomas, 2009), the number of farmers who associate CA and OF is very small. Intuitively we understand that the combination of no-tillage and no-use of herbicide is a strong challenge in agriculture to manage the competition between "crop" and "weeds"

Who are the farmers who cross the two models? There is a wide diversity among each model (Van Dam, 2005; Vankeerberghen, 2012) (diversity of techniques and practices, environmental concerns, identities, criteria of professional excellence, etc.) and some farmers' profiles are more likely to cross conservation agriculture and organic farming methods (Fleury et al. 2011). We will examine two kinds of transition pathways that cross OF and CA[242].

From organic farming to conservation agriculture

The first transition pattern is the case of organic farmers who are interested in reducing tillage for economic, agronomic or environmental reasons (lowering fuel consumption and labor, preserving biological life in soil, improving soil fertility, preventing soil erosion).

Hermann's trajectory

[242] The trajectories that we have described are archetypal trajectories of farmers that cross the boundaries between conservation agriculture and organic agriculture. They are part of a wider sample of 6 trajectories that we could design from a two years research project about quality of soil and sustainable agriculture (and from a present survey in organic agriculture(Vankeerberghen et al. forthcoming).

Passionate about biodiversity, Hermann switched to OF in 1998, six years after his installation in the farm of his grand-parents. One of Hermann's main motivations in farming is to promote living beings: *"I think that farmers' role is to promote living things the most they can do. The insecticides, pesticides, organic fertilizers the farmers use have a negative impact on life, it kills life. I try to do the opposite: I promote life"*. Hermann also likes to investigate new methods that might help him in fulfilling his main goal. During the years after his conversion to OF, Hermann investigated successively Ramial Chipped Wood technique, permaculture, biodynamy and, more recently, conservation agriculture and agroforestery. Besides promoting life in his farm, all these techniques are also means for Hermann to improve his farming system and to find solution to some problems he faces: decrease in yields, difficulties in weed control, stagnation of humus rate, etc.

Hermann learnt about conservation agriculture through some activities organized by Greenotec (a Walloon association promoting CA) and through the visit of Manfred Wenz's farm (a famous German farmer who combine no-tillage and organic farming). According to Hermann's experience, there is a convergence between OF and CA on three points: cover crops methods, long crop rotations and the improvement of biological life in the soil. But, so far, Hermann did not drop plowing: in his current system, complete reduced tillage is technically impossible.

From conservation agriculture to organic farming

The second transition pattern is the case of farmers in conservation agriculture who are concerned about the impact of pesticides on the biological life and the quality of their soils and who find in organic farming techniques means to reduce their use of pesticides.

It is important to discern the case of farmers who integrate organic farming techniques in their system (see Claude's story) and the case of farmers who completely switch to organic farming (and become officially certified) (see Emmanuel's story).

Claude's trajectory

In the late 1990's, several years after taking over his parents' farm, Claude began to learn about reduced tillage techniques.

« After I'd been plowing and using older methods for many years, I began noticing - year by year and almost always in the same spots – that the plow kept coming back up… I just couldn't get it to go deeper into the ground. I figured it had to be some kind of compression or subsidence. The soil was so hard I couldn't do anything with it. […] And in spring I could see there was surface water building up in some places. Then, one day a guy from [French company] invited me to go and have a look at farms that were using products of the firm and where they had done no plowing for a few years».

This proved to be a major turning point for Claude: *«Wow! I hardly slept for a week… Just couldn't get it out of my mind».* From that moment, he experiment reduced tillage in his farm and went on a learning process on conservation agriculture (reading books and journals, attending training, visiting other farms). From this learning process, the microbiological life of soil then became central to Christian's activity and his assessment of his farming practices. He attributes diverse functions to living organisms present in the soil, to roots and to cover crops: decompaction and aeration of the soil, improvement of its structure and porosity, decomposition of organic matter, nutrients cycling, etc. In this view, the most important thing is to preserve and improve the biological life in the soil because of the essential roles it plays in production.

In our hypothesis, the emergence of this "living soil" conception can be considered as a tipping point in the insularization process as it induces a large reconfiguration of farmers' cognitive rep-

resentations and practices (Vankeerberghen et al., forthcoming). For farmers like Claude, soil conservation is achieved through reduced tillage but also through diversified cover-crops, the requalification of some principles of fertilization and pesticides reduction.

Claude began to reduce his use of fertilizers. He believes that one should interfere with the soil as little as possible and continuously so that the humification process is not disrupted, but sustained. To do so, he developed diversified cover crops. Several years after his start with reduced tillage and cover crops, Claude began to reduce his use of pesticides because of their negative impact on soil life. Claude's ideal system is organic farming. But he faces several difficulties to switch completely to OF mainly related to pesticides cessation. Obstacles in pesticides reductions are to be considered within the whole agro-food system (Ricci, 2010; Lamine et al., 2010) and regarding the social norms valued in agriculture as well as "professional excellence" criteria (Cerf et al., 2010; Vankeerberghen, 2011). Our field data identify four kinds of obstacles making it problematic for farmers to give up using synthetic chemicals. The first one is the lack of alternative to chemical herbicides for weed control and cover crops destruction. The second one is the almost generalized absence of resistant varieties that makes crop protection very much dependent on chemicals. It is nevertheless interesting to note that several of the farmers we met grow a mix of wheat (often three varieties) to reduce the crop's vulnerability. The third obstacle is the crop rotation systems used by most of the farmers (usually biennial or triennial cycles) that make weed control and disease management harder. One of the barriers to the lengthening of crop rotation is the difficulty of selling diversification crops on the market (Lamine et al., 2010). In the case of Claude, the presence of sugar beet and potatoes that generate a high income but are damaging his soil structure is also a problem in his crop rotation. Eventually, high yield targets – a feature of the yield-oriented paradigm of the dominant agricultural *regime* (Mardsen, 2012) – constitute an obstacle to the stoppage of the use of pesticides as a decrease in the use of pesticides can cause a decrease in crops yields (even if that does not mean a decrease in farm incomes).

Another obstacle that appears in Claude's discourses is related to his professional identity and the negative image he has of some organic farmers he qualified as "hippies", "baba cool", etc. This is a quite frequent difficulty for new organic farmers or farmers who show interest in organic farming (Vankeerberghen, 2011).

Claude is a typical case of farmers who tend towards OF and who integrate some of its techniques but without switch to OF. A conversion to OF would involve a very deep reconfiguration of his farming system (crop rotation, crops and varieties, professional identity, etc.) that is not possible for him nowadays.

Emmanuel's trajectory

Emmanuel's trajectory is very different from Claude's. In the middle of the 1990's, Emmanuel started with reduced tillage on his parents' farm. He learnt about reduced through the technical consultant of a tillage machinery company and was convinced about the system when he visited his farm. About 10 years later, Emmanuel took over the family farm. Simultaneously, he developed direct seeding and diversified cover crops that became the keystone of his farming system. From this moment, he began to select his cereal varieties in concordance with his cover crops. At that time, he also started to reduce his pesticides use. His main motivation to do so was the preservation of his health: "I had health problem when I was a child and I've always been concerned about my health", he explained. He decided to switch to OF and became certified in 2013. He explained that he needed to wait for his soil to be "ready" for the switch, meaning that he wanted to improve its structure and its self-fertility243. Moreover, he needed to master the techniques of diversified cover-crops and direct seeding and to find the right technical adaptation to

[243] This shows that the temporality of the transition partly depends on the temporality of the soil transformation.

maintain his system in organic farming. The main difficulty he pointed out was the complete cessation of herbicides use. To manage it, he developed the strip-till technique244, associated with diversified cover crops.

Emmanuel doesn't face the same difficulties as Claude does because he has no sugar beet in his crop rotation. Besides, he is planning to integrate vegetables in his system to improve his crop rotation and to develop direct sales in his farm (to sell cereals for animal feeding, flour made of his cereals, vegetables and potatoes). For him, this project is fundamental to have a good added-value on his organic production but also to lengthen his crop rotation.

Emmanuel did not mention any difficulties related to his professional identity while he switched to OF. He says he's always been different from other farmers ("marginal" as he says) and he doesn't care much about other farmers' opinions. He does not seem to share the dominant criteria of "professional excellence" in agriculture.

Discussion

The farmers' trajectories described here above show dynamics that generate crossing and exchanges of techniques, knowledge and learning process between OF and CA. These dynamics take place at individual levels (farmers' practices) but also at a collective level in farmers' organizations (such as BASE and TCS journal in France), hybrid networks of private operators (machine company – bioactivators (TMP) , cooperative (in France)…) and research institutes (such as FiBL in Switzerland, ISARA Lyon in France, etc.). In term of sustainable transition, the crossings between OF and CA, their successes and difficulties, are interesting for several reasons. First, they reveal the weaknesses – vulnerability?- of each model in term of sustainability: while affirming their founding principles and given them visibility, each model put aside (and even sometimes hides) other underlying principles. In the case of conservation agriculture, that is the dependency of the system to chemical herbicides (and more specifically of glyphosate) (Goulet, 2008). For organic farming, it is the repetitive tillage and plowing (Fleury et al., 2011). Then, the crossings between OF and CA spur the farmers to go further in their transition process towards sustainability. Third, the technical challenges they create are driving forces for innovation. But so far, the crossing of the two models is challenging for farmers that have to deal with several difficulties.

Before going further in the discussion, we must clarify that the hybridation of techniques from the two models doesn't imply the hybridation of models (as professional references). While, for farmers in CA, a reduction of pesticides and the use of some organic farming techniques might easily be implemented, a complete switch to OF is more difficult to achieve. For organic farmers, reduced tillage is quite easy to implement but zero-tillage is rarely used. In both case, the main obstacle is technical: weed control, destruction of cover crop and of temporary pastures. These functions are fulfilled by plowing and repetitive tillage in OF and by herbicides in CA (Fleury et al., 2011; Peigné et al., 2007). A hybridation of the two models implies a deep reconfiguration of the farming systems that might be difficult to achieve for many reasons. First, it might be hampered by socio-technical lock-in. A good example is the difficulty in extending crop rotation (one of the solution for weed control without tillage and herbicide): for farmers, the extension of crop rotation implies the investment in new machinery but also the development of new market opportunities (that might not exist for some crops). Second, such a transition needs time: most of the farmers who succeed in crossing the two niches have a long-time transition. Many farmers associate the time of the transition with the time the soil needs to improve its self-fertility and its structure, a condition that helps in the combination of OF and CA, according to them. In previous work, we demonstrate how transition to CA can be characterized as an insularization process

[244] Strip-till technique consists in tilling the soil very superficially only in the seed row.

made of successive detachment from the conventional agricultural regime (detachment from plowing, detachment from the main soil conception (associated with the development of a "living soil" conception), detachment from fertilizers, from pesticides, from the yield oriented paradigm, etc.) (Vankeerberghen et al. *forthcoming*). Farmers who have gone far in their detachment process are more likely to switch to OF. Eventually, such a reconfiguration of a farming system often faces an obstacle related to farmers' professional identities. Each model also suffers from negative associated images: for many organic farmers, conservation agriculture is "for those who use pesticides" (Schneider et al., 2012). For many farmers in conservation agriculture, organic farming is not professional enough or has a "hippies" image. In this last case, farmers who detached from the dominant criteria of professional excellence are more likely to switch to OF, such as Emmanuel.

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