Diversifying strategies of agricultural cooperatives towards agro-ecological transition

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Abstract: French public authorities increased pressure on farmers to reduce their use of fertilizer and pesticide, which are considered as the main factors of water quality degradation. The co-operative sector collects agricultural products, and provides inputs to farmers. Those firms that constitute the dominant regime in France are thus directly concerned with this ecologisation of cropping systems. We analyzed the diversity of action plans on water quality conducted by two types of actors: cooperative groups (trade and supply union of farming cooperatives) and local farming cooperatives. We characterized their strategies of management of volumes and quality of the products as well as the innovations for water quality management. As a second step, we analyzed in detail the case of a cooperative involved in the creation of a new supply chain with an environmental strong potential in a vulnerable watershed. Surveys show that due to changes in the global landscape, cooperatives have invested heavily in service activities and technical advice on greening of agricultural practices. At the national level, this approach that relied on the expertise, tools, and extensive territorial presence of cooperatives, helps build databases of agricultural practices, and also perform environmental assessment and propose action plans on areas where water quality is threatened by pesticides and nitrogen. The implementation of these services is underpinned by the maintenance of the current level of agricultural products collected (dominant regime). Regarding water protection, very little is done regarding the use of breakthrough innovations such as crop diversification or changes in chemical input supply. At the local level there is a variety of cooperative behaviors partly related to their economic size. Large cooperatives rely on advice based on the agronomic tools developed at the national level to improve the efficiency of inputs used in vulnerable areas. Smaller structures can initiate or participate in real *territoire* projects often supported by local communities. They seek new forms of supply chains and aim a territorial management of cropping systems in catchment areas. These projects can be qualified as territorial innovations that are not yet well stabilized. The local case we analyzed gives us the opportunity to assess the main obstacles encountered by such innovative projects (in term of agronomy of practices and local supply chain management).

Keywords: agricultural cooperative, water quality, local project, territorial management, supply chain

Global context and goal

The intensification of French agriculture that started 40 years ago is confronted with two major issues stemming from the European community. The first is the obligation to reduce the use of pesticides because of both health and eco-toxicological risks associated with these products (Directive 2009/128/EC). In France, it is the national plan "Ecophyto" which meets the directive by setting a target of 50% reduction in the use of pesticides by 2018. The second Directive aims to protect water resources by 2015, fighting against, in particular, agricultural pollution due to nitrates and pesticides (Directive 2000/60/EC). These European regulations that have been translated into French laws are implemented jointly in the "Grenelle catchments" plan. After a quick return on the current organization of the agricultural-product collection and the input supply chain for French farmers, we present the "Grenelle catchments" plan indicating how this plan may challenge the dominant agribusiness system. Our paper is an initial approach to the adaptation of the dominant system exposed to a "landscape" evolution in the particular context of the "Grenelle catchments". It also aims to analyze an example of breakthrough innovation that appeared in this new context. For us, the question was to understand how the cooperative system could adapt itself to this new deal and what type of innovation could emerge in this new context.

Towards a lock-in effect for agricultural product collection and input supply chains

French farmers have access to a network of services facilitating access to technical advice, inputs and the marketing of their products. Some organizations, such as chambers of agriculture or management centers focus only on technical and economic advice. Other structures associate marketing of agricultural products, inputs and advisory activity related to the choice of crops and input use on these crops. Among these commercial outfits, we distinguish private suppliers from agricultural cooperatives that belong to farmers. Our work is about agricultural cooperatives and their unions. It aims to understand how these cooperatives are impacted in their operation by the calls for ecological transition supported by European directives.

In France the cooperative sector is dominant. It is estimated that in 2010, 75% of French farmers were members of at least one cooperative and at the same date the cooperative sector accounted for 74% of the collection of cereals and 66% for the input supply for these productions (Coop de France, 2010). Historically, agricultural cooperatives have been a response developed by farmers to crises they have met. Thus the first French agricultural cooperative was created by a farmer in 1888 in response to a dairy crisis in Charente (Claverie, 1999). Initiated by farmers, cooperatives have been encouraged by the state through legal and financial incentives (Courieux and Dedieu, 2011). The evolution of the common agricultural policy related to the development of agricultural trade unionism led cooperatives to increase their competitiveness to go to the conquest of foreign markets (Nicolas, 1988). These elements led to the establishment of a dominant regime heavily intensified. Cooperatives negotiate input prices from pesticide and fertilizer producers for farmers to whom they sell it with a profit, which makes them dependent on sales of these products. Similarly, infrastructures (silos, warehouses) of the cooperatives require secured deliveries in quantity and quality that justify the use of chemical inputs by farmers. In the case of wheat, Lamine et al. (2011) showed that the technical innovations of the last 40 years have led to a shift from a curative use of pesticides to a systematic use up to a locked-in situation making it difficult to reduce usage. Vanloqueren and Baret (2008) showed that the use of multi-resistant wheat cultivars requiring little input is hampered by this lock-in effect. Similarly Lamine et al. (2010) made the same observation for the extension of integrated pest management for wheat showing that this lock-in is also due to millers' requests.

How could the Grenelle catchment plan be at the origin of new strategies?

The "Grenelle catchment" plan (GCP) aims at restoring raw water quality before delivering to users. It's an innovating plan in so far as it focuses on non-point source pollution and not only on point source pollution as former plans did. As a consequence, this new plan is extends over larger

areas than those required by point source pollution protection plans. The GCP imposed a procedure in 3 points for each of the 500 catchments listed on the plan: (1) delimitation of the catchment area (2) carrying out of an assessment of agricultural pressure (3) building and implementation of an action plan. The GCP is a way to comply with the EU Water Framework Directive requests but Grenelle catchments are also preferential areas for the implementation of the Ecophyto plan. The French administration pressures local authorities to extend this approach initiated with a set of 500 catchments to the 34,000 French catchments. The action plans (step 3 of the GCP's procedure) operate on a voluntary basis but authorities can turn it into mandatory measures when changes in cultivation practices are not sufficient. The large concerned areas, the explicit willingness to remediate the use of pesticides and the risk of other mandatory practices constitute a serious change in the global landscape for the dominant socio-technical regime built on the agricultural cooperative system.

The studied structures from national to local levels

We started our study with a survey at the level of national cooperative structures. This led us to identify 5 local cooperatives that reflected a diversity in both status and position. At the national level the analysis focused on two structures: Coop de France and InVivo. Coop de France has a role of professional representation of cooperatives and InVivo, is a union of more than 200 cooperatives aimed at pooling (2) bargaining power to purchase and market (2) expertise and innovation capacities (e.g. development of decision support tools for farmers). Two of the 5 local cooperatives were very large cooperatives with more than 10,000 members resulting from a merging of smaller cooperatives. The territory of these cooperatives frequently covers several French "départements" with some subsidiaries abroad. Two of the 5 local cooperatives were intermediate in size from 2,000 to 5,000 members. At the time of our survey (2012), one of these two cooperatives was being merged with one of the two large cooperatives. This showed that the logic of increasing cooperative structures is always in action. The latest cooperative was of a much smaller size (less than 500 members) with a strong local anchorage. This first series of investigation helped us identify a breakthrough innovation in the smallest cooperative. We completed the survey about this innovation in 2013 to identify obstacles that may prevent its emergence.

For the first phase of the work carried out in 2012, we hypothesized that the adaptation levers of the cooperative to the changing global landscape lay in the three functions performed by these structures (Barataud et al., 2013):

1 - Consulting and service delivery: This function includes establishing technical references supported by experiments and developing Decision support tools (often designed elsewhere but locally parameterized), animation, communication and training of farmers. Cooperatives can play an important role in the evolution of agricultural practices. This prescription function is a potential lever to change the impact of cropping systems on water.

2 - Collection of products and quality: this function gives operators three potential levers on water quality: (i) the development of new low input crops, (ii) the decrease in regional specialization of production to reduce application of certain pesticides (e.g. wheat - chlortoluron) and (iii) the environmental labeling of crops grown with low input systems to increase the return on products on the market.

3 – Trade relations with input producers: it is assumed that facing more stringent regulations, agricultural cooperatives develop input supply strategies with producing companies (seed, pesticides, fertilizer) that can provide levers to participate in the protection of water resources .

The effects of these different levers on the ecologisation of cropping systems are not of the same potential amplitude or easiness to implement. For instance as long as input producers limit their proposals to chemicals products the effect of new trade strategies will always be limited even if

the results could be rapidly obtained due to the limited number of stakeholders involved. Levers connected to the function of collection of products and quality could be of great importance for biodiversity and disease control if it give farmers the opportunity to diversify their land use and lengthen their crop sequences. But the real implementation of this type of levers requires a series of numerous adaptations (technical, economical,…) (Meynard et al 2013) corresponding to a "re-configuration" transition as described by Geel and Schot (2007). Levers about consulting and service delivery are classical levers that can help adapt the practices but are often limited at the field level and for major crops Their effects will be limited if the other levers are not activated.

For the second phase carried out in 2013 on breakthrough innovation, we conducted surveys of the different partners involved to clarify what they initially expected from this innovation and to obtain their assessment of the first year of operation. These surveys aimed at clarifying possible improvements at each level studied (Cherbuin, 2013).

Major results about cooperatives' adaptation to the new context

National level

The main function mobilized in water conservation by federations and unions of agricultural co-operatives is that of services and consulting. These structures rely on the expertise of advisors who work on adjusting gradually the decision support tools to the water theme and offer new paid services. However, the levers associated with the functions of agricultural products collection or input supply are less mobilized. There is no real will to re-design production systems in depth, as this approach is judged too risky economically, but to identify areas at risk for water quality where to conduct some exemplary actions.

1 - Consulting and service delivery: InVivo operates on catchments from the first steps of agricultural diagnoses and action plans (in March 2012 there were 60 catchments monitored by InVivo , among which 25 Grenelle Catchments , 4 action plans validated and 2 implemented). Acting as an engineering office allows InVivo to identify for action plans measures that favor the increased efficiency of inputs (precision farming) rather than input use reduction measures specific of the classical agro-environmental programs (land acquisition, Organic farming, input reduction, land use conversion to grassland). This action in catchments areas helps InVivo developing its tools for fertilization recommendations or risk analysis of water pollution by pesticides. InVivo points out its high level of credibility with the administration because of their proximity to the farmers. Similarly they believe to be more credible in the eyes of farmers than a classic engineering office to achieve the expected goal without going into too strong regulatory constraints. InVivo does not consider as a conflict of interest the fact that agricultural cooperation provides both a diagnostic function (function of engineering office) and a significant commercial presence in the affected areas, preferring to highlight the technical synergies of such an organization.

The Regional networks of Coop de France organized in 6 regions, 267 trainings for the correct use of pesticides (Certiphyto). Coop de France reflected on the role of cooperatives and traders in water conservation. Coop de France also proposed to present to agents from Water Agencies the commitment of cooperative to water conservation. Federations and unions of cooperatives are also involved in the production of local references for the implementation of regulations: (i) regional expertise groups "nitrates" responsible for proposing technical references necessary for the operational implementation of the action program for the nitrate directive (ii) in the FARM Ecophyto 2018 network (Ministry of Agriculture). In Vivo highlights the part of this network managed by cooperatives (15% of the total number of farms) with a message stressing the need for associating business objectives (gross margin) and environmental ones. For InVivo, these

objectives should not be limited to water quality but should integrate biodiversity and greenhouse gas emissions.

2 - Collection of products and quality: Coop de France has established a label “Agri confiance” (stamped NF) which includes an Environmental Component (NF V 01007). Of the 130 cooperatives engaged in the Agri Confiance approach, 87% are committed to maintain good water quality. For In Vivo, this type of eco-labeling needs to be connected to a market (such as "water producers", for example) through contracts between communities and farmers but these contracts don’t exist at present.

Coop de France works on the possible extension of crops dedicated to biomass production like hemp, flax, miscanthus and switch grass to create powerful new opportunities for farmers with low environmental impacts, these crops were deemed low input users. This work is carried out with financial assistance from the French administration. Except for the study of these biomass potential supply chains by Coop de France, there is no initiative nationally scaled to encourage farmers to increase the length of their rotations. InVivo believes that the reduction of regional production specialization includes financial risk and that that risk shouldn’t be assumed by them.

3- Trade relations with input producers: Buying large amounts of pesticides allowed In Vivo to negotiate lower input prices. Today, under the pressure of regulations, the quality of the prescription provided among cooperative members seems to be of higher importance in the price negotiation by input suppliers who aim, by delegation, to ensure that their products are used in the best conditions to limit the risk of being banned by the legislature. This strategy results in warnings on certain combinations of active molecule, crops, soils, period and dose of application. It also results in the supply of authorized organic products including for "conventional" cropping systems. At the same time the strategy can lead to the complete ban of certain products on some priority areas for water protection. These are identified by the union of pesticides producers as areas where concentrations of active substances in water exceed regulatory thresholds and impose corrective actions.

Local level

All surveyed cooperatives fear that the action plans on the catchment areas lead to a reduction in their collection activity and a decline in their turnover. They therefore want to mitigate the impact of agricultural practices on water resources to limit the risk of collection reduction. All surveyed cooperatives say they want to develop a certification of environmental-friendly agricultural practices. The certification is seen as a way to offset the additional costs of production through better valuation in the market. Organic farming, a type of certification, is considered as a niche market that is not generalizable. Unions seek to draw benefits from water quality conservation practices that are intermediate between organic and “input intensive” cropping. One can quote the example of a "sustainable agriculture" specification proposed by a coop: for the function of input supply surveyed, cooperatives think in terms of product substitution relying on farm supply firms to provide alternatives to banned products. Various experiments are conducted by all cooperatives. Some are at the plot scale (e.g. experimentation on conservation agriculture). Others go so far as to the business model. Since 2012 a cooperative has been testing a reduction in frequency index treatment of 30% and associated reduction in nitrogen inputs, while aiming a market valuation of this environmental friendly production. Thus, in 2012, for each field complying with these “sustainable agriculture” specifications the cooperative paid an extra of 100 €/ha for wheat and barley without being sure of the valuation of the specifications in the market. Even if the Grenelle protocol has been a major driver of this policy, the cooperative didn’t limit the access to these specifications to farmers located in watershed (equity principles). The cooperative invests its own funds on coming markets that some food manufacturers charters suggest relayed by powerful communication campaigns.

"Large cooperatives" often have extensive agronomic services (i.e. twenty agents) for an adjusted use of inputs by farmers. Most of encountered cooperatives have adopted the charter of the cooperative advice of Coop de France, which specifically mentions that the remuneration of advisers is not linked to the volume of inputs sold. These cooperatives are involved in catchment's diagnostics with the help of InVivo and they mobilize decision support tools (DST) for agronomic advice. They don't try to develop specific collective action at the catchment level like the "territoire cooperative".

The only "territoire cooperative" we surveyed was facing severe environmental and production constraints. This cooperative was collecting products from a catchment area where the prohibition of manure spreading was in discussion. Farmers affiliated to this cooperative were also facing resistance to pesticides due to too short rotations. Thirdly, the crop supplying area of the cooperative include a biodiversity controlled area (CNRS Workshop Area) where take place an action plan for migratory birds. This cooperative decided to set up a local production of alfalfa (for longer rotations and birds habitats) valorized for local dairy farmers (limiting imports of proteins) belonging to the same coop for animal feeding supply. Anaerobic digestion of manure and methane production could allow drying alfalfa while allowing spreading of digestate on larger areas than the current manure so as not to reduce milk production in the catchment area. The development of local production and marketing of alfalfa structured by a cooperative is a real breakthrough innovation that we analyze in the next section. In a previous work (Bernard, 2010) we have shown that some collaboration already existed between dairy and cereal farms based on a reputation principle because local dairy farmers like to know where their forage comes from and how it has been elaborated. Working at the territorial level is a mean to work on such a reputation effect.

Analysis of a breakthrough innovation

At the time of the study, the development of a local alfalfa supply-chain is a not yet totally stabilized breakthrough innovation. The project integrates both actors in crop production and stakeholders in agricultural development as well as researchers. Indeed, it links a production program managed by the cooperative and a test plan managed by a research center (CNRS) in collaboration with INRA. Through this project, the cooperative wishes to play a leading role in the practice changes in its collection area and choses a contracting process in order to incite cereal farmers to produce alfalfa. The cooperative assures the signature of the contracts with the cereal farmers, the technical monitoring, the organization of the harvest operations by two Agricultural Works Company and the produced alfalfa commercialization to the local livestock farms. On the other hand, the research center wants to study the effects of different cropping practices of alfalfa on its associated ecosystem services (biodiversity, water quality, soil properties). The CNRS aims at a trade-off between productive objectives and environmental issues. The overall program is subsidized by public organisms (Water Agency and Regional Council).

We conducted an assessment over the first year of alfalfa supply-chain operation. Our analysis confirmed the agronomic and environmental interests of alfalfa in cereal rotations. As an example, the lengthening and the diversification of the crop rotation reduce the pressure of pests and diseases and so the pesticide use and the pressure on the water quality. Another advantage is the local protein production for livestock systems in the surrounding area. However, our analysis highlighted some obstacles to the setting up of such an innovative project. In 2012 the alfalfa surface area objectives were not reached. On the 500 ha that were initially envisaged, only 60 ha were implanted on dispersed and sometimes very small plots. The high dispersion and the fragmentation of the alfalfa surface area reduce the harvest operation speed and increase the transport costs. These characteristics of plots caused difficulties because spring was very rainy and so the period favorable to alfalfa harvest was very short. This results in both a low alfalfa quality and a yield loss. Moreover, the limited stock capacities combined with this difficult management of the

product quality contributed to the implementation of few plots the next year. Therefore, we are convinced that the durability of the short supply-chain is threatened by the limited development of alfalfa surface area. In order to stabilize the short supply-chain, it is also necessary to find a way to incite the livestock farmers to modify their forage system so they incorporate a regular supply in alfalfa.

On the basis of these observations, we formulated some propositions mainly to allow a development of the alfalfa area. First it would be necessary to secure the harvest logistic through a new production contract which would be more adapted to the harvest constraints. If the alfalfa plots stay much dispersed with the augmentation of the surface area, it is likely that some livestock farmers who have the material and the needed competences will be in charge of the harvest on some plots. So they would be service providers for the harvest operations. Indeed, on one hand, the cereal farmers trust the livestock farmers to optimize the yield at the harvest. On the other hand, the other livestock farmers who buy alfalfa trust them to manage at best the forage quality. Besides, the interviews conducted with livestock farmers raised the question of the alfalfa quality and its management which are central for the durability of the supply-chain. In particular, we show the interest of an alfalfa production mixed with other legumes or cereals rather than a "pure" alfalfa production which has a lower tolerance towards the adventives. According to the chosen quality levels, cropping practices which are more tolerant towards adventives (less herbicide) are possible but leads to a diversification of alfalfa products. Then, the diversification of alfalfa products requires new outlets such as rabbit or racehorse breeders. There are reasons to believe that the diversification asks also for conservation ways which are less sensitive than hay to climatic hazards such as granules. Finally, given the deficit in forage near our study area and the important importation of dehydrated alfalfa from Spain, it is likely that the increase in the alfalfa area will allow supplying the surrounding areas (Gâtines and Bocage Bressuirais). In view of the future increase of the alfalfa needs, it would appear likely that new alfalfa producers like livestock farmers will integrate the supply-chain. Moreover, as the purchasing and selling prices are the same in conventional and organic systems, it seems even possible to integrate organic systems in the supply-chain and reducing the pressure on ground water quality (no chemical input spread on these alfalfa areas).

Synthesis and follow up to work

The work carried out at the national level shows that facing the change in the global landscape of the cooperative unions, these latter absorb some innovations in the aim to slightly modify their operation in a kind of "transformation" pathway according to the typology of sociotechnical transition pathways proposed by Geels and Schot (2007). For instance the first generation of DST was designed to increase farmers' production with no concern about water pollution. For the "after Grenelle" generation of DST the impact on water quality has been integrated using models developed by agronomists and soil science specialists. Cooperative unions develop new guidance structured by an optimized use of pesticides but without jeopardizing the global amount of agricultural product collection through crop diversification. Without refusing the crop diversification in itself, these national structures wait that a market matures before investing in it, while conducting studies on some crops (fiber crops, biomass) that could allow this crop diversification within a few years to comply with consumers' demand. Large local cooperatives are in the same situation. Some midsize cooperatives try to develop specifications about low level input production that will ultimately promote the products to end consumers and thus help farmers recover their investment. At the same time they fear that this innovation could be re appropriated by mass-market retailing which is the dominant regime in France. The work done on the breakthrough innovation based on alfalfa shows both interest and limits of this approach. The "territoire cooperative" has no agronomic extension service for performing experiments and relies on the expertise of research organizations while being assisted by public funds. This breakthrough innovation is not well stabilized and may fail due to the reported limits. The experiment is currently ob-

served by bigger cooperatives who want to absorb this innovation on a larger scale with no specific considerations on pesticide use as alfalfa is considered as a low input crop compared to cereals whatever the way it is conducted. This situation can be compared to that of organic farming initially structured at the local level with and that has been integrated into mass-market retailing using the less binding European organic agriculture specifications. The elements presented are preliminary results that we will develop in the course of a new research project (Pestimut -Gen) starting in 2014.

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