Toward redesigning the relationship between farming systems and biodiversity conservation.

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Abstract: The fact that some farming practices support biodiversity makes biodiversity conservationists enter into spaces initially devoted to agriculture. This implies a change of paradigm: from a deterministic approach that separates human activities and nature to a dynamic approach that considers them in a co-evolution. Such a change assumes coordination between farming and biodiversity conservation practices. In this way, agri-environmental measures (AEM) are one of the main tools in Europe. Nevertheless, the efficiency of AEM is controversial. One criticism is that AEM reveal a weak spatial consistency and mainly produce easily reversible adjustments in extensive farming systems. In the present work, we introduce the results of an exploratory case conducted in Gaume (Belgian Lorraine). Using semi-structured interviews, we studied the coordination between these two activities in permanent meadows. Biodiversity is associated with permanent meadows shaped by cattle breeding and is more or less favored according to the specific implemented practices. We identified three farming trajectories on which the mobilization of AEM seems strongly dependent: one in beef farms and two in dairy farms. In dairy farms, practices implemented to respond to cattle's feeding exigencies make difficult the integration of AEM; although a searching-autonomy trajectory connects the farming systems with ecological functionalities and so, enhances the development of functional and ordinary biodiversity. Nevertheless, these forms of biodiversity are not part of the biodiversity conservation objectives. Then, we highlight a biodiversity conservation logic that is still engaged in a deterministic approach as in natural reserve. We make the hypothesis that considering other forms of biodiversity than vulnerable species at a landscape scale may extend the biodiversity action through a better account of farming realities and favor the evolving potentialities of the agroecosystems.

Keywords: biodiversity conservation, permanent meadow, dairy farm, redesigns

Introduction

The present work takes place in a context of change in the way the space devoted to farming and biodiversity conservation activities is allocated. These activities, which are usually carried out separately, are increasingly led to meet in spaces that may be called "shared lands". These meeting spaces are also places in which distinct logical determinants are confronted with the coordination and the choice of practices. Hence, coordinating practices questions the way these two activities are designed.

On the one hand, under modernization, a double process of intensification and specialization has transformed farming activities. This transformation is based on a production that is unconstrained by environmental conditions in order to increase performance. The change in farming practices that occurred relies on the promotion of technical rationality and an extended use of inputs, including chemical. The size of farms increases while their number decreases, and the territorial concentration of agricultural speculations grows. Such a design of farming activities leads to a decline of biodiversity from farming spaces.

On the other hand, biodiversity conservation has focused on the protection of remarkable species and habitats by creating reserves in which human activities are strongly reduced and controlled; and even forbidden. Such conservation activities assume a deterministic approach to ecosystems which are seen as the result of a long optimization that humans are supposed to have disturbed, and that must be preserved and restored as a natural habitat. Such a design of biodiversity conservation leads to a withdrawal of farming activities from spaces devoted to nature.

However, the classical view that farming and biodiversity conservation activities are carried out in separate spaces is challenged. First, biodiversity is associated with some forms of farming activities. Second, biodiversity play an essential role in the functioning of agroecosystems. Indeed, this acknowledgment supports a dynamic approach to ecosystems by conceiving biodiversity as the result of a co-evolution between nature and human activities (Chevassus et al., 2005). Ecosystems are not in equilibrium and periodic disturbances in the evolutionary limits are part of the development process of biodiversity (Meyer, 1994; Wallington et al., 2005). Farming activities and biodiversity are then thought to interact within the same spaces.

Grassland agroecosystems and especially permanent meadows represent an interesting case to illustrate the complexity of the relationships between farming practices and biodiversity (Tichit et al., 2012). Breeding activities shape the permanent meadows to which many open space species are associated. In particular, grassland use for pasture or mowing keeps these places open against the natural process of reforestation. However, the agricultural trajectory of modernization leads to an intensification of practices that yields a decreasing biodiversity. So, agricultural practices shape spaces in a way that is more or less favorable to the development of biodiversity depending on their level of intensity (Young et al., 2005).

Such a consideration makes biodiversity conservation enter into spaces which are initially only devoted to farming. A key challenge is then to coordinate these two activities. In Europe, this coordination is organized around agri-environmental policies. The majority of agri-environmental policies are designed as management practices: prescribed by biodiversity conservationists and implemented by farmers to obtain remuneration. The remuneration is a compensation for the theoretical loss of agricultural incomes due to the policies, with the idea of reducing the intensity of agricultural practices. The agri-environmental measures (AEM) are one of the main instances of these policies and are carried out by farmers on a voluntary and contractual basis.

Nevertheless, the efficiency of AEM is controversial (Tichit at al., 2012). First, these measures are mainly mobilized by extensive farming systems, which remain relatively in the margins of modernization. Therefore, AEM primarily produce adjustments of farming practices that were already rather favorable to biodiversity, and they have a low capacity to change the intensive practices of the modernization trajectory. Furthermore, AEM prescribe management measures at a plot scale, resulting in a weak spatial coordination of plots covered by a given contract. Finally, the risk of reversibility due to non-renewal of contracts is important (Young et al., 2005). These criticisms suggest that redesigning the agri-environmental coordination tools is necessary.

In our framework of reflection, public policies may be seen as the result of a stabilization of knowledge and codified in standards, and the way they are designed may be understood by examining their cognitive, normative, and instrumental dimensions. In other words, knowledge included in the formulation of the problem and the definition of the desired situation largely account for the choice of methods and instruments of intervention (Steyaert & Ollivier, 2007). In parallel, the problem solving process may be elaborated from a substantive or procedural rationality. A substantive rationality assumes goals and means defined by a central authority. A procedural rationality assumes a co-construction of goals and means through a dynamic interaction between stakeholders (collective action) in an iterative process (Steyaert et al., 2007).

In this reflexive view, we present the results of an exploratory case in Gaume (Belgian Lorraine) that was conducted in 2013 using semi-structured interviews. Nine farmers and eighteen land managers were met to discuss the topic of coordination between dairy farming and biodiversity conservation. Three focus groups were then organized to test a hypothesis of change. We conclude by proposing agroecology as a mediating concept for collective action.

Permanent meadows within dairy farms in Gaume (Belgium): A case study

Current situation

Gaume is a territory of stock farming and is characterized by a mosaic landscape that includes forest areas, grasslands and, to a lesser extent, crops used for animal feeding. Farming activities have shaped some forms of biodiversity and habitats that are considered as remarkable for the conservation of biodiversity. Hence, biodiversity conservationists are working on ways to maintain this biodiversity and go further by developing the strictest norms of protection in spaces devoted to farming production. The logic is a de-intensification of agricultural activities in order to restore habitats and protect vulnerable species.

The management of permanent meadows is the archetype of the developed operating logic and is conducted by minimizing interventions. For instance, the frequencies of mowing and livestock density are reduced and the use of soil enrichment or phyto-sanitary products may be forbidden. On the one hand, these conservation activities are concretized by the creation of natural reserves which are independent of farming spaces. Nevertheless, it's important to note that a process of contracting farmers for their management occurs. On the other hand, biodiversity conservationists offer an incentive for conducting practices to enhance biodiversity in farming spaces with agri-environmental measures.

Such an implementation of prescribed management practices is strongly dependent on the territorially farming trajectories. In beef farming, the production is mainly made of Limousine race cow-calf producers bearing the organic farming label and exporting animals to be fattened outside the region of Gaume. This production follows an extensive trajectory that makes the mobilization of agri-environmental policies easier by practice adjustments without asking for farming system redesign. The extensive feature of the trajectory is linked to the cow-calf producer activities that allow a relatively lean and coarse feeding of livestock.

In dairy farming, the situation is more complex. Lactating animals require a rich and homogenous feeding, so frequencies of mowing and livestock density will be high in order to exploit young forages that meet these food standards. Consequently, dairy farming does not usually implement the agri-environmental policies in permanent meadows. In addition, the mobilization mainly occurs for the management of marginal meadows outside the production system, such as for example, wet meadows used to feed dry cows.

We observed two distinct trajectories within dairy farming. First, the modernization trajectory bases the optimization of the farming system on robotization, food fortification, and the selection of a highly productive herd. A consequence of this mode of organization is shaping permanent meadows mainly constituted by the single ray-grass variety. Temporary meadows are set up following the same configuration to a lesser extent. Animals' feeding (mainly animals from the Holstein race) is supplemented for energy by self-produced corn and for protein by bought soyameal. This trajectory leads to a dairy production characterized by high performance but which also generates high production costs. It brings dairy farming toward a progressive increase of farming intensity, and therefore, a potential decline of biodiversity.

Second, a trajectory searching for autonomy bases the system optimization on acquiring new forage techniques that reconnect the system with ecological functionalities and decrease the input use. This mode of organization implies a diversification of the varieties in permanent meadows for instance by associating grasses and legumes. Animal's feeding is supplemented for energy with immature crop, and for proteins with alfalfa: both being more often self-produced. Note that temporary meadows are included in cultural rotations. Furthermore, these changes in the composition of the feed ration tend to be accompanied with a shift from the Holstein to the Montbeliarde race. This shift aims at increasing the robustness of the herd and to obtain animals that are able to get more value out of this feed ration. If dairy farming is accompanied by lower yields, production costs are also lower and thus ensure the profitability of the system. Moreover, some farms use the organic farming label and so generate a premium on the product. Such a design of dairy farming opens up new opportunities for biodiversity.

The logic of connecting the farming system to ecological functionalities mobilizes a functional biodiversity for production. For instance, inside permanent meadows, the increase of grass varieties may stimulate the animals' appetite. Constituting different strata of vegetation may also favor the resilience of grasslands towards more extreme weather events, such as periods of drought. Moreover, including legumes in forage mixtures may induce a decrease in the need for inputs by profiting from the capacity of legumes to convert atmospheric nitrogen into nitrogen available to plants. Such a development of functional biodiversity, defined in agricultural terms, additionally supports the development of ordinary biodiversity unplanned in the production. Indeed, for example, this design of dairy farming involves habitat diversification and a decrease of the impact due to the pesticides that may be used to control Rumex. In another way, biodiversity is then included in the production logic as a part of it rather than as a limiting factor linked to norms to be respected. This may contribute to change the farmers' representation of biodiversity. However, functional and ordinary forms of biodiversity are not part of the management objectives maintained by biodiversity conservationists.

Hypothesis of change

Biodiversity conservation regarded design is based on scientific knowledge built from a fixist approach to biodiversity (Gouyon, 2010). Such an approach assumes to understand and consider biodiversity in terms of quantity of species displayed in lists. Conservationists then make arbitrary choices between species; following vulnerability criteria, in order to determine those that they consider as important to protect. Management practices are finally determined and translated into standards on limited spaces: standards that are implemented through agri-environmental policies.

Such a biodiversity conservation design hampers its coordination with farming activities. This design remains bound to a deterministic approach to ecosystems and is conceived from the natural reserve logic. A central authority defines conservation priorities aiming at protecting a biodiversity vulnerable to farming by avoiding agricultural intensity. As a result, conservationists poorly consider production realities. For example, even in the searching-autonomy trajectory, lactating animals' food needs lead dairy farmers to implement mowing and pasturing practices in a way that excludes them from agri-environmental devices. Furthermore, by defining management standards on the only basis of vulnerability criteria, biodiversity conservation moves aside farming systems that generate other forms of biodiversity. Therefore, we make the hypothesis that biodiversity conservationists may play a more important role in permanent meadows if they enact a redesign of their activities based on:

A redefinition of expected biodiversity

Although conservation activities for vulnerable species are legitimate and rely on ecological considerations, the choice of the species to be protected is linked to value judgments that are beyond strict scientific findings. Moreover, the growing attention provided to the evolving potentialities of ecosystems highlights the role of functional and ordinary species, which are the most abundant, in the functioning of agroecosystems (Chevassus et al., 2005). In this way, a dynamic approach that valuates ecological processes more than a limited number of remarkable species may favor the resilience of ecosystems and the development of biodiversity in its various forms (Meyer, 1994). This assumes considering ecosystems in a trajectory of change and accepting the uncertainty of their evolution (Wallington et al., 2005 Moore et al., 2009). Note that, in our case, an autonomy-searching trajectory implies a farming system design which provides latitude for a dynamic approach. Therefore, we argue that such a biodiversity conservation approach can stimulate the redesigning of more intensive farming systems toward a reconnection with ecological functionalities, instead of producing easily reversible adjustments which are mainly realized in extensive farming systems.

A redefinition of the considered scale for action

Biodiversity within permanent meadows is influenced by intervening factors both on a plot and on a landscape scales. If, on the plot scale, these factors are linked to farming intensity, the heterogeneity and connectivity prevail on the landscape scale (Tichit et al., 2012). In this way, also considering the landscape scale leads to think biodiversity conservation in terms of proportions of farming uses rather than only in terms of farming intensity reduction (Sabatier et al., 2010). Therefore, implementing biodiversity conservation at such a scale assumes that different levels of farming intensity may be favorable if they are included in a consistent spatial arrangement. In that case, the main issue is the coordination of various practices adapted to the landscape potentialities including their ecological characteristics and their agricultural features such as related to farming speculations. Then, more intensive systems as in searching-autonomy trajectory, extensive systems, and even natural reserve can be complementary in the management of a landscape mosaic. Additionally, working at the landscape scale may facilitate the setting up of connectivity that supports biodiversity mobility and, in turn, its access to the heterogeneous habitats.

Conclusion and future research axis

Our case study of permanent meadows allowed us to evaluate a biodiversity conservation design that is still engaged in a deterministic approach. Such a design leads biodiversity conservationists to make choices between species to be protected that are based on vulnerability criteria. As a result, agricultural constrains are not much considered in the definition of the practice to be implemented in agri-environmental measures (AEM). The adoption of AEM by farmers is then strongly dependent on their farming trajectory. In this way, cow-calf producers in beef farming mobilize AEM easier than dairy producers of which lactating cattle have higher feeding exigencies. Although some dairy farms in a modernization trajectory shape permanent meadows with little interest for biodiversity, we also identified a searching-autonomy trajectory which connects the system with ecological functionalities and so, enhances the development of functional and ordinary biodiversity. Such a trajectory opens up opportunities to extend biodiversity conservation action if this latter includes other forms of biodiversity than vulnerable species. Therefore, we make the hypothesis that a dynamic approach that is focused on the evolving potentialities of the agroecosystems and is implemented at landscape scale can be relevant. Such an approach implies to coordinate practices of varying intensity and so, to manage various forms of biodiversity in a landscape mosaic considering both its ecological and agricultural features.

The next step of our work will be to test this hypothesis. The proposal that we made requires a learning process and an adaptation of the coordination between farmers and conservationists. Then, constituting a collective action seems suitable to support another way to mobilize existing knowledge and to produce innovative knowledge about biodiversity, ecological functionalities and farming systems. For this purpose, we suggest to use a mediating concept as a lever for action: agroecology. We consider this mediating concept as occupying a boundary position between different social worlds. Thus, it can be internalized by different actors while maintaining their identity (Guston, 2001).

Agroecology involves, first, biodiversity into the agricultural process and aims at reducing input use by integrating ecological principles with agricultural production (Gliessman, 1998; Altieri, 2002); that can be relevant to farmers in a search of autonomy and to conservationists interested in valuing the evolving potentialities of ecosystems. Moreover, in this way agricultural production rests on the exploitation of the synergies between agroecosystem components which requires reasoning at a landscape scale. Second, agroecology considers ecological functionalities as context-specific and changing according to farming practices. Therefore, cultural and socioeconomic aspects are important as well as environmental and technical features to understand farmers' practices choices. This entails regarding the farming system from the local context and included in the agro-food system (Stassart et al., 2012; Méndez et al., 2013). Methodologies that implicate actors with different types of knowledge are then required, such as for example involving farmers, ecologists, agronomists, sociologists in an iterative process of research. This is appropriated with the constitution of a collective action that assumes to move from a substantive to a procedural rationality. So, this topic will be the object of future studies. Empirical data are needed to understand the appropriation of the concept by the stakeholders and its potential to change practice and lead to the collective action.

Bibliography

Altieri, M. A. (2002). Agroecology: Principles and Strategies for Designing Sustainable FarmingSystems. In Agroecological Innovations. N. Uphoff. Earthscan Pub., England, London.

Chevassus-au-Louis, B., Barbault, R., & Blandin, P. (2005). Biodiversité, changements globaux et développement durable: De nouveaux concepts pour de nouvelles approches. In Pour la biodiversité – Manifeste pour une politique rénovée du patrimoine naturel. A Venir, France, Paris.

Gliessman, S. R. (1998). Agroecology: ecological processes in sustainable agriculture. CRC Press, Florida, Boca Raton.

Gouyon, P. H. (2010). Aux origines de la biodiversité: Les ressources génétiques. In Aux origines de l'environnement. P. H. Gouyon & H. Leriche. Fayard, France, Paris.

Guston, D. H. (2001). Boundary Organizations in Environmental Policy and Science: An Introduction. Science, Technology, & Human Values 26(4): 399-408.

Méndez, V. E., Bacon, C. M., Cohen, R. (2013). Agroecology as a Transdisciplinary, Participatory, and Action-Oriented Approach. Agroecology and Sustainable Food Systems 37(1): 3-18.

Meyer, J. L. (1994). The Dance of Nature: New Concepts in Ecology. Chicago-Kent Law Review 69(4): 875.

Moore, S. A., Wallington, T. j., Hobbs, R. J., Ehrlich, P. R., Holling, C. S., Levin S., Lindenmayer, D., Pahl-Wostl, C., Possingham, H., Turner, M. G., & Westoby, M. (2009). Diversity in Current Ecological Thinking: Implications for Environmental Management. Environmental Management 43(1):17-27.

Sabatier, R., Doyen, L., & Tichit, M. (2010). Reconciling production and conservation in agrolandscapes : does landscape heterogeneity help ? Innovation and Sustainable Development in Agriculture and food, 28 june-1st july 2010, 10.

Stassart, P. M., Baret, P., Grégoire, J. C., Hance, T., Mormont, M., Reheul, D., Stilmant, D., Vanloqueren, G. & Vissser, M. (2012). L'agroécologie: Trajectoire et potentiel pour une transition vers des systèmes alimentaires durables. In Agroéocologie, entre pratiques et sciences sociales. D. Van Dam, M. Streith , J. Nizet et P. M. Stassart. Educagri, France, Dijon.

Steyaert, P., Barzman, M., Billaud, J. P., Brives, H., Hubert, B., Ollivier, G., & Roche, B. (2007). The role of knowledge and research in facilitating social learning among stakeholders in natural resources management in the French Atlantic coastal wetlands. Environmental Science & Policy 10: 537-550.

Steyaert, P. & Ollivier, G. (2007). The European Water Framework Directive: how ecological assumptions frame technical ad social change. Ecology and society 12(1): 25.

Tichit, M., Magda, D., Durant, D., Lauvie, A. Lecrivain, E., Martel, G., Roche, B., de Sainte Marie, C., Sabatier, R., & Teillard, F. (2012). Systèmes d'élevage et biodiversité : des antagonismes aux synergies. Rencontres autour des Recherches sur les Ruminants, 19ème journée.

Wallington, T. J., R. J. Hobbs, & S. A. Moore 2005. Implications of current ecological thinking for biodiversity conservation: a review of the salient issues. Ecology and Society 10(1): 15.

Young, J., Watt, A., Nowicki, P., Alard, D., Clitherow, J., Henle, K., Johnson, R., Laczko, E., Ma-cCracken, D., Matouch, S., Niemela, J., & Richards, C. (2005). Toward sustainable land use: identifying and managing the conflicts between human activities and biodiversity conservation in Europe. Biodiversity and Conservation 14: 1641-1661.