

# ***Competing socio-technical transition pathways towards implementation of conservation policy aimed at enhancing hedgerow and grassland networks***

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## **Abstract:**

Rural landscapes containing hedgerow networks and permanent grassland have diminished in France and current legislation aims to conserve and restore such habitats and their wildlife. Our multidisciplinary study aimed to identify how livestock farm viability could be reconciled with biodiversity conservation planning policy, in three regions with hedgerow networks. The implementation of the green network policy is legally imposed, though local parties must determine the methods for achieving it at local level. Therefore, the state puts local authorities in charge of organising spatial, ecological planning, from farm scale up to the scale of a small region, a process involving a diversity of local stakeholders. We consider this process as a test case for upscaling and outscaling. The results of sociological analysis of interviews show that local stakeholders tend to envisage three different possible pathways to attaining the policy's requirements: (i) ecological knowledge-driven network design which promotes minority forms of agriculture (niche innovation); (ii) protection of the dominant socio-technical regime, as it is considered to have produced the hedgerow networks and their biodiversity; (iii) Agro-ecological innovation and reconfiguration of the socio-technical regime in order to better integrate biodiversity. Results from ecology and animal science / agronomy approaches shed additional light on the pathways envisaged. It emerged from this work that (i) ecological results do not necessarily provide clear recommendations about the optimal approach for land planning; (ii) the diversity of farming situations is such that one cannot consider that the contribution of each farmer to ecological continuities will be equal; (iii) increasing natural elements within livestock farms may be possible but must be achieved without neglecting the up-scaling dimension of ecological networks.

## **Keywords:**

Biodiversity conservation, ecological connectivity, crop-livestock farms, agriculture, governance, "Trame Verte et Bleue".

## Introduction

Currently nature conservation policy is evolving as society searches for ways to stop biodiversity decline. This international, shared objective should have been achieved by 2010, but failure to do so has called into question traditional conservation methods, which have been largely based on the preservation of protected areas that occupy a limited proportion of the land area. Now it is generally believed that limiting conservation action to such protected areas will not suffice and that a scaling-up of conservation efforts, to include the wider landscape, is needed (Jongman, Külvik, & Kristiansen, 2004). This approach implies a better integration of biodiversity conservation with regard to a diversity of land-users and human activities (Jongman & Kristiansen, 2001). One step in this direction is the introduction, in many European countries, of legislation to support the definition of ecological networks which should help to increase habitat availability and more particularly enhance connectivity, and thereby plant and animal dispersal, in the vast areas that are not subject to strict nature conservation laws (Bonnin *et al.*, 2007).

Agriculture is one of the major human activities to be concerned by this shift in policy; in France, farming occupies two thirds of the land and is associated with a considerable and partly highly specialised flora and fauna. It is also an activity known to have had major impacts on biodiversity over the past few decades. In Europe, agricultural intensification and homogenisation have led to declines in many groups of species and this is best illustrated by major losses in common farmland birds (Jiguet, 2010, Inger *et al.* 2015). These declines do not relate to rare or endangered species but to the common species that form the bulk of our ecosystems and that play key roles in the provision of ecosystem services. The focus of our conservation efforts therefore also has to shift to take into account this “common biodiversity”. In this context, attempts are being made to preserve and enhance farmland habitats of high ecological value. Among these, hedgerow networks and permanent grasslands represent two key types. At national scale, these habitats have generally diminished, but in north-western regions of France they are still present and are the focus of some considerable attention in the context of nature conservation in farming areas.

Since 2009, national legislation in France has required that ecological networks called “Trame verte et bleue” (TVB) be established at national, regional and local levels. Each level of organisation must define its own method for implementing the policy, using national guidelines. These guidelines explain the ecological basis for the legislation and the general methods to be used for defining and delimiting the areas of ecological continuity to be protected using appropriate planning laws; the precise form of implementation is open to regional and local interpretation. At the scale of each French “commune”, the smallest planning sub-unit, the network must be translated into the local land use planning document known as the “PLU” (Plan Local d’Urbanisme) and for larger rural and peri-urban areas these sub-units may be jointly administered by a cohesive planning document known as a “SCoT” (Schéma de Cohérence Territoriale). Hence this policy, by its very nature, cannot be limited to ecological considerations but must be directly reasoned in terms of the multiple landscape functions (farming, urban, industrial, recreational...) considered by planning documents. Therefore, at SCoT level, the negotiations involve a wide diversity of organisations of which farmers and their representatives constitute just one contributor (Allag-Dhuisme *et al.*, 2010).

In the context of rural landscapes dominated by agriculture, the policy will require stakeholders to think beyond the possible actions of individual farms in order to scale up to the minimum scale for TVB implementation which is the “commune” or group of “communes”. Only if this process of upscaling is successful will it be possible to preserve and enhance the ecological elements forming the desired, and hopefully ecologically functional, network. Hence, the success of this new policy will also depend on

outsourcing processes: on the involvement of a significant proportion of the farming community, on efficient coordination and on the capacity of local and farming communities to work together.

We are therefore concerned with the classical question of how agricultural change is operated and can be guided. Pioneered in France by (Mendras & Forsé, 1983), this field of research has in particular shown the importance of social configurations within peer groups and their influence on transformations to the ways we see and think (Darré, Le Guen, & Lémery, 1989). When considering current environmental policies, such approaches to the study of changes in standard practice meet with three limits. Firstly, changes to standard practice made in this context depend on objectives that are imposed by public policy. Secondly, these policies are declined regionally such that negotiation between local stakeholders must be arranged, posing the question of how farmers and farming groups interact with each other as well as with other types of stakeholder. Finally, the urgency of environmental problems leads us to explore radical forms of change to current farming systems (Turnheim et al., 2015). Geels (2004) proposed a framework for the analysis of transitions, defined as changes from one sociotechnical regime to another. Geels & Schot (2007) extended this work by suggesting different forms of transition pathway (transformation, de-alignment re-alignment, technological substitution and reconfiguration). These pathways involve varying degrees of reconfiguration of technologies, supporting infrastructures, business models and production systems as well as of consumer preferences and behaviour and they combine different levels of organisation (socio-technical landscape or regime, technological niche) in contrasting ways. This multi-level perspective (MLP) is interesting because it provides a framework for analysing the interactions between the institutional sphere and cultural dynamics within socio-professional groups, or in our case for considering the socio-technical processes that could enable a shift from a situation where some farmers preserve good quality habitats for wildlife, but in a fragmented configuration, to more coordinated and widespread nature protection. Although the MLP was originally based on an analysis of major technological revolutions of the past, we feel that it may also be useful for the study of transitions to come.

In this paper, our aim is to examine how various stakeholders involve themselves in setting up ecological networks in their locality. While our study does not go as far as examining the process of policy implementation, it does shed light on the specific question of how the farming sector's view may be fully taken into account during local negotiations. We describe and discuss the different views of stakeholders in relation to the possible transition pathways for achieving ecological network implementation. Ultimately we aimed to detect the pathways with the most potential to achieve the upscaling objectives of the nature conservation policy. In order to assess this, we will draw upon ecological and farm survey results from our multidisciplinary study.

## **Methods**

Our work was carried out in three study areas close to the urban centres of Angers, Nantes and La Roche-sur-Yon (with between 50 000 and 300 000 inhabitants) in north-western France, with different histories of collaboration between local stakeholders. These areas corresponded to three different "SCoT" planning documents and all contained relatively well-preserved hedgerow networks and permanent grasslands, with a dominance of livestock farming. In all three areas, the process of integrating ecological network policy (TVB) into the SCoT was in progress during the study period (2012-2015). We interviewed 26 stakeholders who had in the past or were at the time collaborating for TVB policy implementation in a variety of ways (consultancy or expertise, local consultation participant for planning document construction, persons employed in ecological network implementation). These stakeholders were local elected representatives, employees or representatives of professional farming organisations

or wildlife conservation organisations, or environmental consultants. Based on each respondent's account of their contribution to TVB policy implementation, semi-structured interviews were used to more thoroughly examine their view of the relationships between agriculture and biodiversity, and then more specifically in relation to ecological network policy. In parallel to these interviews, grey literature produced locally by nature conservationists and other professionals was analysed and 11 SCoT construction meetings were observed at one of the study sites (La Roche-sur-Yon). This qualitative material was analysed through a cross-analysis based on four main themes: representation of biodiversity, its links with agriculture, representations and judgements of the ways TVB policy is negotiated locally in order to enhance biodiversity, links made to related issues. We paid particular attention to the ways in which knowledge was used and presented and to the manner in which the diversity of farming situations was described. Based on this analysis we were able to give detailed descriptions of the different representations of the desired transition pathways for enhancing biodiversity, from farm to regional scale, using three Weberian ideal-types (Weber, 1992). The described viewpoints were subsequently linked to the three transition pathways proposed by Geels and Schot (2007), which they closely resembled.

We also drew upon results of farmer interviews conducted by a team of agronomists, animal scientists and sociologists, as well as the results of observations of the avifauna of the hedgerows and grasslands made by ecologists. Farmer interviews were carried out exclusively in the La Roche-sur-Yon study area in order to determine, using a number of approaches, how local farming systems might adapt to implementation of TVB policy. A first survey of 68 farms was used to describe the diversity of bovine mixed farming systems to include hedgerows and grassland and to classify these systems into groups on the basis of their animal production types, levels of intensification and of the spatial and temporal organisation of their cropping systems. Secondly, a sub-sample of 22 of these farms were questioned in more detail to assess the extent to which farmers had the possibility to modify the spatial and temporal organisation of hedges and grasslands, without changing their overall farm strategy. Thirdly, 20 mixed farms belonging to a single landscape unit were questioned individually and then in a group, about their willingness to adopt scenarios involving large increases in hedgerow length and grassland area. The ecological surveys aimed to determine the differences in bird communities of well-connected as opposed to isolated grasslands and hedgerows. In the Angers and La Roche-sur-Yon study areas, we identified two types of survey site: large areas of continuous permanent grassland and small remnants of permanent grassland surrounded by other land-uses, mainly crops. In one field within each of these areas we carried out bird surveys in two breeding seasons using standard territory mapping methodology and the total area surveyed was approximately 85 ha. These grasslands were always associated with well-preserved multi-tier hedgerows. The results from these three disciplines were used together to discuss the viewpoints and pathways and their possible impact, in ecological and agricultural terms, on future policy implementation and success.

## **Results**

Our interviews revealed that stakeholder viewpoints depended mainly on socio-professional category, and were not influenced by the specific contexts of each study site. The viewpoints regarding the best transition pathways for achieving the objectives of TVB policy were varied and this diversity could be structured around three ideal-types:

- (i) Ecological knowledge-driven network design which promotes minority forms of agriculture (niche innovation);

A proportion of the stakeholders that we questioned, mainly employees and managers of nature protection organisations, tended to view the development of ecological continuities as a project which should be based upon scientific ecological knowledge. They attached a great importance to landscape ecology and its concepts. Network construction should involve the acquisition of better knowledge of local ecology, based on ecological surveys and/or landscape analyses. This type of knowledge keeps farmers at a distance: at best they may be consulted to give permission to access to their land or information about their farm, but the data collected is analysed without their participation (in order to ensure objectivity) using analytical tools and spatial scales that tend to exclude them, such as spatial modelling of landscapes and aerial photography.

This posture leads them to an assessment of the relationships between different uses of rural areas and the maintenance of biodiversity. They distinguish two types of farming. On the one hand, most farmers have intensive, modernised practices, with short rotations, conventional farming methods and increasing areas devoted to cash crops. In some areas of France these farmers have seriously degraded local biodiversity. On the other hand there are farmers that contribute to biodiversity preservation. One survey respondent describes them, *“They have farming systems and practices that are ecologically compatible. This means that they are people already involved in alternative techniques, selling methods, farming practices. They are at the margins of conventional systems, and their installations rely on as little investment as possible; they are mostly organic farmers, who sell their produce locally.”*

Therefore these stakeholders perceive the fact that local authorities are now required by law to propose an ecological network as a window of opportunity which might allow groups of farmers considered virtuous to replace today’s conventional farmers. This situation also provides an opportunity for nature protection organisations themselves to display their expert knowledge (and sometimes to sell it to local authorities). This view corresponds to Geels and Schots’ “technological substitution”, whereby a network of stakeholders that represent a minority, composed of alternative farmers, militant organisations and groups of consumers, develop a niche innovation that matures and could come to substitute the dominant farming regime if a modification to the legislative framework favours its development.

- (ii) Protection of the socio-technical regime, as it is considered to have produced the hedgerow networks and their biodiversity;

This second view mostly belongs to elected representatives or project managers from professional farming organisations concerned with representation of farming interests (farmer’s unions, extension services). For this group, the link between farming and ecological networks is limited to the view that maintaining livestock farmers leads to the maintenance of hedgerow networks. The knowledge they use is of a sociological nature. They consider that the livestock farmers they represent are relatively homogeneous, with generally similar practices and a belief in the preservation of hedgerow networks and biodiversity. From their perspective, biodiversity declines are above all related to the difficulties facing the farming profession such as devalued food prices, the economic crisis (in particular for the meat industry), the unattractiveness of farming careers, urbanisation, political uncertainty relating to CAP reforms, etc. If adaptations to current practices are to be accepted, they must be compatible with farmers’ everyday concerns. From these stakeholders’ viewpoint, biodiversity preservation is also professional farming matter and they demand that a special delegation be put in charge of the design of the ecological network in rural and agricultural areas. Moreover, these stakeholders ask that the ecological objective be integrated into land planning documents along with the broader aim of maintenance of farmland in peri-urban areas. This leads them to defend the ecological functions of

farming areas, but also to demand that space for nature conservation be limited to allow room for agricultural production.

This posture corresponds to the socio-technical regime transformation pathway (Geels & Schot, 2007). As the socio-technical environment exerts pressure on farming, incremental innovations may be undertaken by the current farming majority. This pathway is characterised by adaptations resulting from a tension between niche stakeholders who defiantly point the way forward and socio-technical stakeholders who demand the right to transform their regime from the inside.

- (iii) Agro-ecological innovation and reconfiguration of the socio-technical regime in order to better integrate biodiversity

This is a view that is common among advisors and technicians from rural and farming development organisations. They see the relationships between agriculture and biodiversity in terms of techniques, citing, in no particular order of importance, a great diversity of beneficial methods: tractor-mounted flushing bars, planting hedgerow networks, woodland and grassland management, ecological infrastructure management (field margins, grassy strips, hedges, ponds, trees), etc. They quite accurately perceive a wide diversity of farming systems, but rarely judge them in terms of their impacts on biodiversity. When accompanying farmers they are more interested in identifying possibilities for improvement.

While these respondents have a clear vision of the types of innovation that are relevant for farmers and for biodiversity, the ways in which agricultural biodiversity can be defined and observed are of lesser importance than the fact that farmers are engaged in agro-ecological and innovative approaches. To achieve this aim, it is necessary to increase awareness, by experimenting, to produce reference results that will convince farmers of the merits of agroecology, and through training. For this group, the farm scale and farmer involvement are the key aims while local and regional approaches, and therefore ecological continuities, are only secondary concerns. Nonetheless, implementation of TVB policy is seen by some as an opportunity to increase farmer awareness, or to improve knowledge of the notion of ecological continuity, or indeed to develop training activities with financial input from local authorities.

This view corresponds to a socio-technical regime reconfiguration pathway (Geels & Schot, 2007). The socio-technical regime encounters pressure that encourages the development of agro-ecological innovations. This pressure may take the form of technological dead-ends, such as problems with the control of green cover as authorised chemical products are progressively banned, economic pressures, legal or political influences, development of environmental labelling schemes... In this context, the diversity of farming systems constitutes a resource, allowing stakeholders to pick from a whole repertoire of innovations that can be integrated into the socio-technical regime. In this way, the regime will be subject to both technological and sociological adjustments which could, over time, lead to a better coordination between farmers contributing to the construction of ecological continuities. These stakeholders envisage these reconfigurations as occurring within an agricultural sphere, in which they themselves play a coordinating role based on technical knowledge.

## **Discussion**

- a) Hedgerow or grasslands networks: a diversity of types, uses and ecological values**

The farm survey results revealed a real diversity of livestock farming systems, that related to both structural criteria (Utilised Agricultural Area, land parcel fragmentation, local soil and climate, workforce) and to conceptions of farming (specialisation versus diversification, intensification versus extensification, workforce or animals, ecological farming practices). Hence the areas and functions of grasslands within these systems vary greatly; we classified a number of types of grassland (short temporary, long temporary, long multi-species temporary, permanent) whose place in the farm depended on a number of important factors. Four archetypal production logics, with different degrees of flexibility, were identified. For each, with no change to production strategy, we found that it would be very difficult to modify the surface area and spatial arrangement of grasslands to improve their connectivity. In a few cases a reduction in the areas cultivated with maize could be envisaged, leading to a reduction in the security of the forage system and a change to the animal feeding strategy. It should be added that recent meat production crises have led a small number of farmers to rethink their production methods and to see grasslands as a means of reducing production costs; some are redesigning their farming systems to include more grassland.

Secondly, the farm surveys made it clear that to consider hedgerow-grassland continuity as a whole, was not practical from a farming perspective. These two habitat types were viewed in different ways by farmers and integrated in different ways into their farming systems. Development of grassland continuities represents a radical change for a majority of farmers. As far as hedgerows are concerned, farmers are more inclined to plant, as they view these landscape elements as positive and multi-functional. Hedgerows are usually replanted around permanent grasslands, much more rarely in field interiors. This does not significantly interfere with production strategy and can be considered as an incremental innovation.

From an ecological viewpoint, also, the characteristics and value of each habitat type need to be examined both separately as well as jointly. Landscape ecological research has tended to focus on the spatial configuration of wooded habitats and its effects on forest specialist species, often considering open farmland habitats to be less favourable for biodiversity. Semi-natural open habitats support different forms of biodiversity and more knowledge is needed about the value of increased connectivity of open habitats like grasslands. Our results focus on birds, though this taxonomic group cannot alone provide a full assessment of the value of hedgerow and grassland habitats for biodiversity. What is can do is provide an illustration of the complexity of ecological knowledge in relation to TVB policy. The bird surveys at our study sites showed that the majority of the nesting community utilised hedgerows while only two species of lark (Skylark *Alauda arvensis* and Woodlark *Lulula arborea*) used grasslands for ground-nesting. The majority of observations of feeding behaviour were also in shrubs or trees at the field margin. There was no positive effect of increasing grassland connectivity on overall species richness and abundance or on the presence of any functional group. A closer analysis of the species using hedgerows revealed that the community was dominated by generalist species that are able to adapt to most environments, along with several forest specialists. The levels of bird abundance observed in the Pays-de-la-Loire Region hedgerows were higher than average when compared with around 40 other studies in similar farming contexts. The value of wooded habitats was therefore clear for these species groups. However, farmland specialist species do not seem to benefit from the maintenance of these continuous areas of permanent grassland and their hedgerows. With one or two exceptions, farmland specialists were less abundant in our samples; hedgerow density was perhaps too high for true open specialists like Skylark, but we no doubt observed, at local scale, the results of recent steep declines in farmland bird populations measured at regional or national scales. Other authors have alerted conservationists to the need for appropriate protection strategies for open farmland specialist groups that are of greatest conservation concern (Filippi-Codaccioni et al., 2010).

## **b) The relative merits of the three pathways for TVB implementation**

We will now discuss the transition pathways envisaged during TVB construction with a view to highlighting the differences between the knowledge presented by stakeholders and that obtained by researchers at the Roche-sur-Yon study site.

(i) ecological knowledge-driven network design which promotes minority forms of agriculture  
This pathway is founded on a simplistic view of how hedgerows and grasslands are considered in agricultural systems that does not reflect the local situation. There are “good” and “bad” farming systems and not much in between; this dichotomy is particularly untrue as regards grasslands. In reality, a gradient of grassland use exists, ranging from grassland-based systems to total absence of this land-use type. Moreover, it relies upon a rather vague definition of grasslands, although a great diversity of grassland types can be found on farms. Even in the minority of farms that include a large proportion of grass (23% of farms are grassland-based), and that may therefore be considered desirable for this pathway, the grasslands present are of different types and the areas and spatial configuration of these are not necessarily optimal for conservation purposes.

Although this is the only pathway to base its views and actions upon ecological objectives and a clear attempt to implement policy to accentuate ecological connectivity and functions, it relies on a rather utopic view of ecological knowledge. It should be stressed that the results we obtained in our study cannot be generalised for all taxonomic groups, but they illustrate the complexity of ecological knowledge and the difficulty of guiding action based on this type of knowledge. What we and others have shown, is that increasing hedgerow density will have both positive and negative effects depending on the species considered. One of the TVB policy “target species” for the Pays-de-la-Loire Region is the Little Owl *Athene noctua*, a species that thrives in areas with grassland and *loose* hedgerow networks. For this species a degree of hedgerow maintenance is desirable, but not too much. However, for many farmland specialists of conservation concern, modifications to hedgerow networks will not suffice as their ecological needs depend on actions within the areas used for production. The broad ecological principles guiding TVB policy need to be accompanied by an analysis of context-specific ecological knowledge, which is sometimes lacking, to establish clear and shared objectives for biodiversity, and this represents a major challenge, also for the future assessment of policy success.

However, this pathway is the only one that recognises the major changes that up-scaling of grassland networks would require, and as such is likely to meet with various structural obstacles. For example, certain farms may not have enough suitable land for growing grassland or may not be in a position to evolve for economic reasons. In addition, this pathway’s view of the spatial arrangement of grasslands is at odds with the way in which farmers view these areas, i.e. above all in terms of their functions in relation to agricultural production. This is why this group aims to transform the dominant socio-technical system by aiding the installation of farmers possessing what they would term agro-ecological principles. It seems unlikely, at this stage, and without any other major disruption of socio-technical landscape, that the debates surrounding the implementation of TVB policy will allow this technological substitution to occur.

(ii) protection of the dominant socio-technical regime, as it is considered to have produce the hedgerow networks and their biodiversity

Like the previous pathway, the major limit of this pathway is the fact that it is based on a caricatured view of the local farming situation that considers the farming community as one homogeneous block. By protecting the dominant socio-technical regime while ignoring its internal diversity, this posture does not correspond to the local situation. In ecological terms, no objectives are defined and the diversity of environmental situations to be found locally is glossed over. Lastly, by demanding that TVB design be delegated to the farming sector, this approach prohibits out-scaling and cross-learning processes. This attitude reveals the many pressures to which farmers are subjected such as drops in milk and meat prices due to high costs associated with imported inputs or the effects of decreasing land availability due to urbanisation, and which farm sector representatives hope to address in the context of land planning negotiations.

(iii) agro-ecological innovation and reconfiguration of the socio-technical regime in order to better integrate biodiversity

This pathway is the one that best considers the diversity of farming situations observed locally, but it does not pose clear ecological objectives. Its main limit, as regards the implementation of landscape-level policy, is its focus on farm scale operations, therefore minimising the changes needed to achieve effective ecological grassland continuity. At landscape level, coordinated increases in grassland continuity are unlikely in the medium term, without more profound changes to farm production strategies. Through a process of incremental innovation, this pathway is more likely to achieve up-scaling of wooded habitat continuities.

A first major obstacle for TVB implementation seems therefore to be the definition of clear regional objectives from a diversity of stakeholder viewpoints. The way in which different types of knowledge, either ecological or socio-technical, are used to define objectives as well as the definition of the role of the farming sector in achieving these objectives are particular challenges.

### **c) Coping with diversity: a test for the transition pathways**

Here we will suggest ways to overcome this difficulty basing our analysis on i) what can be learned from a discussion of ecological objectives with a group of farmers and ii) an analysis of what local authorities make of this diversity of stakeholder viewpoints.

The farmer workshop involved livestock farmers with differing production methods. It confirmed that livestock farmers found it difficult to imagine making changes to areas of grassland (quantity, type or localisation) without also changing production logic (animal productivity, income, workforce organisation). For this reason, they were not able to agree upon a scenario for a future grassland network. Conversely, they were able to spontaneously imagine collective scenarios for creating hedgerow connectivity. This result confirms the importance of considering hedgerow and grassland continuities separately. The second clear result was the farmers' view that the most important factors limiting hedgerow development are the time needed for hedge maintenance and the risks of conflicts with adjacent landowners. Putting in place hedgerow networks would depend on the collaboration of local authorities, farmers and owners to plan planting, determine management methods in such a way as to minimise conflictual situations and promote and finance new hedgerows and maintenance initiatives. The workshop results seem to support a view of transition achieved by organising the combined inputs of a diversity of stakeholders (close to view iii).

Among the different stakeholders involved in local implementation of TVB policy, a final group plays a very specific role: they are the local authorities required by the state to put the legislation into practice. As such they organise the working methods between all the local stakeholders.

Elected representatives and civil servants of local authorities, or the consultants they mandate, coordinate the work of constructing an ecological network. Their view of the most suitable method for writing the ecological plan is situated between the ecological knowledge-driven network design viewpoint (i) and the socio-technical regime protection viewpoint (ii). The similarity with the naturalists is due to the importance often attached to the need for better local knowledge for policy implementation, resulting in ecological surveys being funded during network construction, to complement existing data. However, their vision differs from the first because they also give weight to majority social groups in the locality, therefore allowing agricultural extension services to make a significant contribution or even

delegating certain forms of expertise to such services. It also differs from all visions in the importance accorded to pre-existing protected areas (for nature or other purposes in urban areas), which for this group constitutes a base upon which the ecological network must be constructed.

As they conduct the project, they seek to organise a form of compromise between an ecological planning approach, strongly influenced by local ecological knowledge, and a more negotiated, political approach linking, in as much as local stakeholders are prepared to allow, areas already identified or protected by previous documents and legislation. In our study areas, this led to different levels of importance being accorded to nature protection organisations (local ecological expertise) or to agricultural organisations as work progressed. We can therefore see, as regards the three pathways previously described, that this group in charge of policy implementation see their role as attempting to conciliate the opposite views of the socio-technical regime and niche stakeholders but not at all as facilitators of agro-ecological innovation or reconfiguration of the socio-technical system.

## **Conclusion**

We showed that stakeholders involved in ecological network implementation had contrasting views of the possible pathways for TVB policy implementation. The three archetypal views we distinguished closely resembled the three transition pathways described by Geels and Schot (2007). This framework therefore provided a useful tool for explaining the divergent views of stakeholders involved in putting local policy into practice. A primary difficulty in the implementation of this conservation policy is the coordination of a local, political project involving stakeholders with contrasting viewpoints and methods. These viewpoints are above all related to the positions different stakeholders occupy in the process; they participate as nature protectors, farming representatives or farming or development advisors. Each position is associated with a particular form of experience and knowledge as well as a set of interests for each stakeholder. The writing of the planning document is partially an opportunity to reinforce his/her influence in a context of increasingly regionalised farming and environmental policy.

Our analysis of the local approach to the TVB legislation, combined with research results from ecological surveys and a study of livestock farming in one of the study areas, show that this policy has to deal with high levels of uncertainty. The ecological knowledge used is incomplete and the sociological and technological knowledge is imprecise. In particular, in the context of spatial planning it seems to be difficult to integrate the diverse ways in which individual farms function. Therefore the goal of writing a fixed plan based on a negotiated balance between the interests of professionals and wildlife is unrealistic.

From the discussion it also appears important that ecological continuities of open and wooded habitats be considered independently in both ecological and farming terms, as well as in terms of their linkages and interactions. However, the work carried out by local authorities tends to focus on the wooded network, hardly considering grassland continuity, except as being generally associated with areas of dense hedgerow networks. This is partly due to the choice of legal instrument for policy implementation; it is easier to protect isolated woodland features in a planning document than areas used for production. It may also reflect the difficulties anticipated if farmer actions need to be coordinated in such a way as to increase grassland continuity. Finally, the role of local authorities in enhancing hedgerow networks may be decisive; the upscaling and outscaling processes may rely on the actions of this type of

stakeholder, for example through active promotion of hedgerow creation and coordination of the involvement of farmers, landowners and their neighbours for the definition of management methods. As we have seen, currently stakeholders in charge of writing planning documents seem to opt for a compromise born out of the conflict between nature protection interests on the one hand and defence of the agricultural profession on the other (pathways i and ii in our analysis). This leads, via alternating contributions from each party, to a form of moderation of the initial ecological proposals. This method excludes the possible contribution of those stakeholders who defend agro-ecological innovation.

Could the way in which local stakeholders involved in agricultural development, so far generally excluded from the process, envisage reconfiguration pathways be a model for the development of wooded and grassland continuities? We think not, in as much as, at our study sites, these stakeholders tend to limit their actions to the professional farming sector and the farm scale, neglecting the need for a coordinated spatial organisation of farms if landscape-level policies are to be implemented. Additionally, these stakeholders belong to professional organisations and they risk being limited in their contribution by the need to defend certain groups of farmers who may feel unable to conform to the increases in grassland area and connectivity called for by the ecological network. It also clearly appears that, to succeed in ecological terms, the reconfiguration pathway would need to better integrate ecological propositions during the adaptive process.

This confrontation of the views of stakeholders with the different transition pathways opens up new questions about the interactions between local authorities and stakeholders involved in rural development and farming innovation. Perhaps the goal should no longer be the search for compromises between social groups but rather the reconfiguration of ecological, political and agricultural knowledge.

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