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Preserving peri-urban land through biodiversity offsets: Between market transactions and planning regulations

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Abstract: Competition for land use is a severe problem in peri-urban areas where available land is scarce and is also Biodiversity offset targeted for different purposes such as construction, local food systems, recreational areas, and biodiversity Planning offsets. In this context, mitigation policies can be considered like innovative planning regulations, in order to neutralize land development impacts and sustain ecosystem restoration and conservation. The policies may lead to the production of biodiversity offsets, which are secured pieces of land where ecological restoration is carried out as a way to compensate for impacts. In this way, biodiversity offsets appear to be a viable option to maintaining natural areas in peri-urban areas in the long run. This article examines the different ways to deal with land availability and access to offset sites through the analysis of land strategies developed by public and private intermediary actors involved in the implementation of mitigation policies, and the consequences on the ecological quality of offsets. Based on a sociological survey of 20 case studies and 95 interviews conducted in 2019–2021 in six French regions, the article identifies three situations that rely on different balances between market transactions and planning: (i) private intermediaries and municipalities who coordinate to offer land solutions to developers; (ii) access to land for biodiversity offsets stems from private land transactions which can lead to temporary mobilization of land and thus to ecologically precarious solutions; (iii) attempts by municipalities to include offsets in planning policies. Finally, if municipalities do not intervene to identify and set aside dedicated land, biodiversity offsets will remain temporary and limited in their capacity to conserve biodiversity.

1. Introduction

Mitigation policies have been developed since the 1970 s to act as innovative planning regulations to neutralize land development impacts and sustain ecosystem restoration and conservation. They are increasingly adopted worldwide by public regulators as a pre-condition for the administrative authorization of land development projects (Koh et al., 2019). Within these policies, biodiversity offsets refer to the last part of a so-called “mitigation hierarchy” that defines a three-step process for economic developers during the design and implementation of projects: first, the design of the project is required to “avoid” major environmental impacts (reflecting notably on the geographical location of the project and the type of ecosystems being impacted); second, to “reduce or minimize” impacts that are unavoidable (mainly through the optimization of construction activities in regards to their impacts on ecosystems); lastly, to “offset” residual impacts (Bull et al., 2016; Maron et al., 2016). The final step entails securing land and enhancing its ecological quality through ecological restoration and management operations near the impacted land. In countries like the USA and Germany, offset implementation is mostly carried out with the use of a credit system: public or private biodiversity entrepreneurs identify large sites where ecological restoration can be carried out and converted into biodiversity credits. These “environmental intangibles” (Chiappello and Engels, 2021) that can then be sold to land developers whose projects impact the same ecosystem locally. This type of mechanism is acknowledged for its ability to mutualize compensation liabilities of several projects on one large site, which leads to robust ecological solutions (Barral, 2020; Wende et al., 2018). However, it has barely been

developed in France: compensation liabilities are mostly handled on a case-by-case basis, leading to patchy mitigation (Weissgerber et al., 2019).

The mitigation hierarchy was introduced in France in environmental regulations in 1976 (within the *Loi sur la Protection de la Nature*), but it was only implemented in the 2000 s to comply with the European directives on birds and habitats in 2007 (Quétier et al., 2014). There, the national regulations state that the mitigation hierarchy ought to be implemented both throughout the design of territorial planning documents (referred to here as “land planning”) and for each development project, through its administrative permit process. This means that ahead of development, land planning ought to identify and secure relevant areas for future biodiversity offset liability so as to reflect on the geographical location of potential offsets ahead of impacts, and to ensure ecological coherence and connectivity. In practice, mitigation policies are barely integrated into land planning; they are mainly applied to land development projects on a case-by-case basis. For each project, economic developers are required to demonstrate how design and construction take the mitigation hierarchy into account as a condition of its administrative permit. This means that planning regulations merely play a role in terms of zoning: they classify land into different categories (natural areas/farmland/constructible zone) at the municipality level, which frames the potential location of offset sites (on non-constructible land) (Bigard et al., 2020). Therefore, for each project, economic developers face the need to search for land in the surrounding areas of impacted ecosystems, to secure it, and to ensure its ecological restoration in the long term. In other words, the implementation of mitigation policies is highly dependent on how land developers manage to position themselves on the local land market. However, in some cases, municipalities intend to anticipate future biodiversity offset needs, identify potential sites and organize pre-negotiations with land owners, so as to constitute a “pooling” of land that developers can use to implement compensation measures (Tarabon et al., 2021). In both cases, however, land developers still need to buy or lease land, that is to say to carry out transactions on the land market, secure one or several sites and organize ecological restoration¹. This means that French mitigation policies are highly dependent on land market as their efficiency is tied to land access: their implementation and the related offset of impacts are dependent on land availability, i.e access to land property or land use through leasing. This is particularly acute in peri-urban settings where land markets are tense and competition for land use change has intensified in recent decades, especially with the relocation of food systems and the social demand for better ecosystem services management.

As access to land is carried out specifically for each project, on a case-by-case basis, mitigation policies are implemented in an ad hoc manner, granting a lot of flexibility to the local set of actors (Gardner, 2013). Economic developers mainly subcontract the mitigation activities they are meant to carry out, and implementation of biodiversity offsets involves two types of intermediaries who facilitate land access. On one hand, local municipalities can act as significant land owners (Kan-Balivet, 2013) and give land access for offset requirements. Moreover, they are key stakeholders since they bear responsibility for, and also develop their own, territorial political projects; they

¹ In France, there is one “Site Naturel de Compensation” similar to the US conservation banking system, located in the South of France, and facing important profitability issues. As it is a minor option, it remains out of the scope of this paper.

are also responsible for staying compliant with the transversal policies of regulation of land consumption at the national level. On the other hand, with the effective enforcement of biodiversity offsets, a number of private intermediaries have surfaced in the past decade. We will refer to these professional organizations as “private land intermediaries” in this article, even though their activities not only focus on land access but also include ecological management. They carry out key activities such as identifying land plots, assessing the ecological state and potential of the plots, securement (through purchase or easement), and ecological restoration tasks. As they mediate land negotiations with private and public land owners, they act as key stakeholders for mitigation policies.

However, while land is a key critical dimension of mitigation policy implementation, the related literature has not yet addressed the issue of land access. Based on the French case, this article examines the following questions: how do public and private land intermediaries identify sites and organize land access for mitigation policies in peri-urban settings? To what extent can the upstream integration of offset requirements in planning regulations facilitate access to land? How do the different situations influence the ecological quality of offsets? Building on the French mitigation policy case, this article aims to highlight more generally the issue of site identification and access to land as a key issue for biodiversity offset quality. Through this objective, the article speaks more broadly of the constraining role of land access in conservation policies. While a case-by-case implementation such as the French policy critically reveals the difficulties of such a fragmented approach to biodiversity conservation, similar patterns may be at stake in other institutional settings for further types of offset instruments. This article is also an opportunity to shed light on land issues since they also influence how other countries implement biodiversity offsets.

In this article, we first outline the blind spots in the existing scholarship on biodiversity offset and explain our conceptual framework: we focus on the role of public and private intermediaries to explore the factors that underlie access to land to mitigate impacts on biodiversity, and the related quality of offsets. Second, we describe data production, based on a large empirical investigation of biodiversity offset implementation projects in French peri-urban settings. Third, we analyze three land access situations in peri-urban settings, insisting on the difficulties faced by economic developers and the anticipation and pooling strategies carried out by land intermediaries as well as public municipalities. Fourth, we discuss the implications of peri-urban land market pressure on public/private dynamics as well as on ecological outcomes.

2. State of the art and analytical framework

The purpose of this literature review is to point out a research gap related to access to land for biodiversity offsets in peri-urban settings. First, access to land has been understudied in biodiversity offset literature whereas it appears to be a critical dimension of their implementation, notably in areas where land markets are tense. Second, studies on land preservation in peri-urban settings tends to focus on agricultural land despite the fact that biodiversity offset can also be a relevant conservation instrument in these settings. While some articles identify discrepancies between impact and offset location, there is still a need to understand what social and economic processes lead to site identification and access to land. To fill this research gap, the article builds on an analytical framework centered on the study of land market intermediaries and on the interplay between upstream planning orientations and direct transactions on the land market, which sustains access to land for economic developers, with direct consequences on the quality of biodiversity offsets.

2.1. Biodiversity offsets in practice: Land and peri-urban settings as blind spots in the literature

In the past decades, biodiversity offsets have been a popular type of conservation instrument that has gained momentum worldwide. They are considered hybrid instruments that build on environmental regulations, as

well as market dynamics, to reach ecological objectives (Vaissiere and Levelrel, 2015). Their founding principle is that economic incentives are more likely to foster behavioral change than regulatory enforcement, and it is argued that such instruments allow for flexible implementation that can adapt regulations to the actual situation of each actor (Lockie, 2013; Muradian and Rival, 2012). They aim at building economic transactions through valuation of natural resources and ecosystems benefits, as well as that of negative externalities. Their establishment opens up participation in environmental policies to new categories of stakeholders like economic developers, which has a direct impact on the social organization of land management at the local level. While there has been a considerable amount of literature produced that focuses on the incentivization of private actors to produce goods within environmental policies (e.g. Grabosky, 1995; Gunningham and Sinclair, 2019; Penca, 2013; Salzman and Ruhl, 2006), little attention has been paid to the land use in such regulations (Filoche, 2017).

2.1.1 Land as a critical resource in biodiversity offsetting

While issues of ecological equivalence and the production of ecological additionality through biodiversity offsets are widely discussed in the ecological literature (Bull et al., 2016; Maron et al., 2012; Moilanen and Kotiaho, 2018), land issues that underlie the implementation of offsets are less addressed. We conducted a search query on ScienceDirect with the key words “biodiversity offset + land” as well as “mitigation + land” in the title and abstracts², and found that there have only been 10 papers published on the subject matter. Yet the geographical location of offsets is a key aspect of their ecological coherence (Womble and Doyle, 2012). According to policy requirements of the mitigation hierarchy, offset sites should be located in the vicinity of impacts, so as to maintain ecological functioning of the area. To some extent, economics and geography scholars have questioned the social equity that stems from the loss or gain of ecological services (Griffiths et al., 2019; Martínez-Paz et al., 2021): they insist on the fact that individual welfare gains and losses depend on the distance of individuals from the damage and offset sites (Gastineau et al., 2021). In practice, the choice of their location is driven by land availability and price rather than ecological grounds (Quétier et al., 2014; Sonter et al., 2020). Because economic developers are eager to access cheap land, offsets in peri-urban settings are likely to be located away from development sites, in less densely populated areas where land prices are lower (Salzman and Ruhl, 2006; zu Ermgassen et al., 2020). Land costs and location constraints are key to grasping the implementation of offsets and to highlighting the conditions under which mitigation policies can be rendered optimal (Gastineau et al., 2021). These issues are particularly acute both in countries where biodiversity offset policies still operate on a case-by-case basis like in France, and in peri-urban areas where conflicts over the use of space are strong (Torre et al., 2016). While scholars have paid attention to the location of biodiversity offsets and reflected on the social and ecological consequences, access to land is a related issue that has not come under much scrutiny.

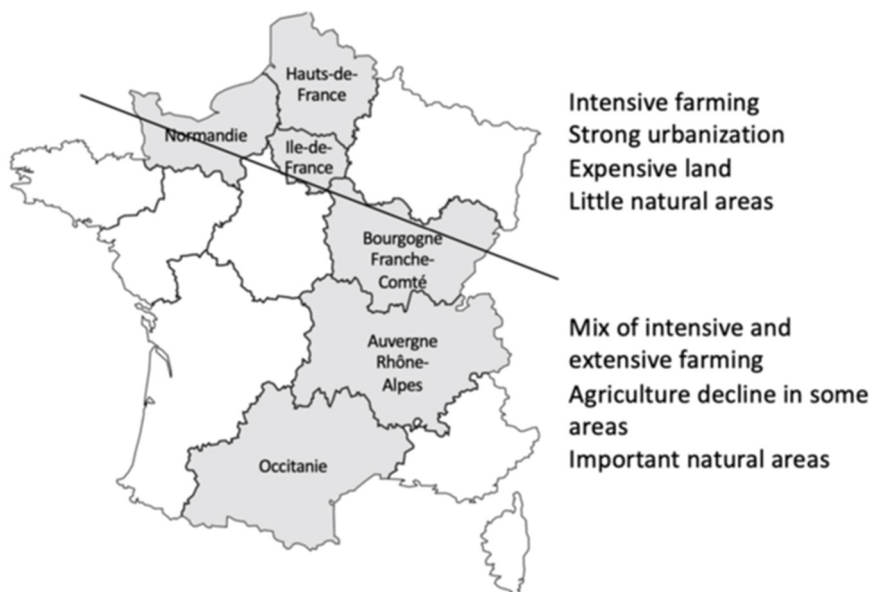
2.1.2 Strong focus on farmland preservation in peri-urban settings

Within peri-urban settings, land use change issues have mainly been examined in relation to local food system development. A search on ScienceDirect with the keywords “biodiversity + offset + peri urban” yields 371 articles³, approximately 10 times fewer articles than a search using the keywords “farm land + peri urban” shows 3469 articles.

In terms of content, biodiversity offset studies in peri-urban settings focus on two dimensions: 1) perception of biodiversity offsets; 2) meta-evaluation of policies. However, the implementation of biodiversity offsets and its regulation remains out of the scope of study.

On the contrary, the query reveals that local food systems and farmland preservation have attracted scholarly attention from the fields of human geography, with a focus on land governance changes that have occurred due to the increasing social demand for local supply. Recent literature shows interest in the social and political mechanisms put in place to ensure farmland

² The query was conducted on June 7th, 2022. ³ Query carried out on June 7th, 2022.



preservation in peri-urban settings (Soulard et al., 2018), insisting on the role of agricultural actors, the power relations at stake (Perrin and Baysse-Lainé, 2020), and the limits of such policies (Bousbaine, 2017; Kassis et al., 2021). The existing literature also insists on the alignment between land planning policies and development in the local food system as a central issue (Jarrige and Perrin, 2017). Indeed, these authors describe how the development of local agriculture requires a renewed governance of land use, integrating sectoral constraints, norms and rules into the planning process. The authors insist on the influence of planning policies and municipalities to advance local food systems, thus questioning the mere role of voluntary land transactions for their enforcement. Their reflection on the intertwining of market transactions and planning regulations is key to advancing our analytical framework.

operationalization of their environmental obligations. They play a key role as they directly act on the land market, and they identify, access and secure land on behalf of economic developers or by following a more integrative strategy at the planning level.

Building on the sociology of market intermediaries (Bessy, Chauvin,

Table 1
Fieldwork period and number of case studies per region.

Regions	Fieldwork period	Development projects	Planning initiatives
Occitanie	November 2019 (1 week)	5	2
Bourgogne Franche Comt'e	November 2019 (3 days); November 2020 (1 week)	3	
Auvergne Rhone Alpes ^	November 2019 (1 week); January 2020 (3 days)	2	1
Normandie	February 2021 (1 week)	2	
Ile-de-France	Sporadic interviews in 2019– 2021 and main field period in February 2021	1	1
Hauts-de- France	Several day-sessions in 2020 (mostly zoom interviews due to pandemic conditions)	2	

Source: authors).

2.2 Analytical framework: land intermediaries between planning and market

The article focuses on land securement strategies developed by locally-involved stakeholders in the implementation of the mitigation hierarchy and of the consequent offset requirements, to question how land planning and the land market influence access to land for biodiversity offsets. As explained in the

Fig. 1. Six regional contexts for the implementation of offset biodiversity in France (introduction, economic developers subcontract offsetting activities. Site identification and access to land can be intermediated by public (i.e municipalities) or private intermediaries. The aim is to analyze how the stakeholders deal with land resources in this compensatory policy context, whether via land markets or direct ownership, and how planning regulation ahead of offset implementation can influence the outcome of the policy, through the facilitation of site identification, access to land and securement.

2.2.1 A focus on land intermediaries

Due to the key role that they play in access to land, these actors are the focus of the analytical framework. From a theoretical point of view, we consider that all actors involved in the implementation of biodiversity offset policies, (i.e land developers, municipalities, private intermediaries, land owners and bureaucrats) who are in charge of the administrative process, are interrelated within a loosely-coupled system of power relations. All of them are involved in offset implementation according to their related interests and with specific resources. Within this social system, the emphasis is set on public and private intermediaries because each of them play a specific role in access to land. The role of municipalities is twofold. Firstly, they are key actors in terms of planning; the municipalities are the institutional scale where land zoning is carried out, and offset pooling can be launched. Secondly, they are also landowners who can make land available for developers. For the past two decades, private intermediaries, on the other hand, have evolved to assist landowners in the

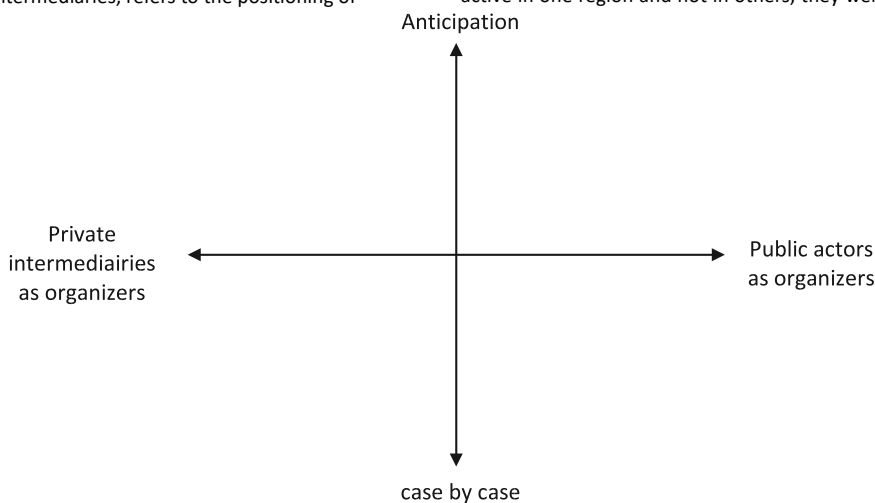
2013), we consider that public and private intermediaries gain power from the specific position they have in the social system, because they control a key resource, namely land. This power is related to the possibility of defining the rules of exchanges, as well as the ecological measures that constitute offsets. More specifically, different backgrounds of intermediaries lead to very different situations of biodiversity offset implementation (Barral and Guillet, 2022): intermediaries have different interests since some of them are historical

agricultural organizations and may be willing to limit offset implementation on farm land; other intermediaries are environmental NGOs aiming for robust conservation. Regarding public intermediaries, they may or may not be willing to anticipate future offset needs and to integrate mitigation requirements in planning documents.

In other words, we assume that intermediaries have a direct influence on a number of parameters that explain the (poor or high) quality of biodiversity offsets.

2.2.2 The influence of land intermediaries on the quality of offsets

The analytical framework addresses the role of intermediaries and mitigation anticipation on the quality of biodiversity offsets. The first analytical factor, the role of intermediaries, refers to the positioning of



municipalities and private intermediaries as organizers of access to land and offset implementation. The second factor refers to the level of offset anticipation, ranging from integration in land planning to mere access to land on a case-by-case basis.

We consider that both of these factors have a direct influence on the quality of offsets, defined as ecological additionality and length of conservation securement (Lockie, 2013; Muradian and Rival, 2012). First, pre-identification of sites set the ground for a greater additionality of offsets, while access to land on a case-by-case basis leads to more uncertain outcomes in terms of the ecological potential of sites. Secondly, depending on their interests and resources, intermediaries are likely to promote different offset types.

The following diagram shows the two axes that structure the analysis of biodiversity offset projects in peri-urban settings.

3 .Material and method

Between 2019 and 2021, 20 biodiversity offset implementation projects were analyzed with a case-study-based qualitative investigation that took place in six French regions (Table 1). The investigation includes two levels of data production. First, informational interviews were conducted at the regional scale to grasp the overall land and urbanization dynamics and to identify relevant empirical situations in light of the framework. Based on these outcomes, the second part of the investigation involved the case studies themselves (Flyvbjerg, 2006; George and Bennett, 2005), that comprised 95 interviews, document analysis and observation. This led to (i) 16 case studies on biodiversity offsets that are directly related to specific development projects; (ii) four case studies of municipalities seeking to integrate biodiversity offsets in land planning. The analysis focused on projects that are located in urbanized, peri-urban and rural areas, which are detailed in the following sections. The interviews, which lasted between one and two hours, were conducted in three ways: in the interviewees' offices, during field visits, or by videoconference (due to the pandemic).

2.3 Establishing the regional context related to land dynamics

The investigation was conducted in six French regions in order to study the contrasted settings in regards to urban demography, farming economy and land availability. This first step mainly consisted in interviews with regional and institutional stakeholders. In addition, we conducted desk research and analyzed websites and institutional documentation analysis in order to grasp the regional context concerning agricultural, planning and conservation issues. The identification of regional stakeholders was based on two approaches. First, stakeholders who take an official position on biodiversity offsetting were considered. For example, stakeholders who organize conferences, distribute good practice guides, or offer services. Even though some institutions are active in one region and not in others, they were interviewed in all regions in

order to capture the different territorial configurations. The second approach is bottom-up: the stakeholders who are directly involved in study cases are generally field operators. In parallel, we consulted the regional management offices of the corresponding institutions, where the range of stakeholders we interviewed were mainly environmental administrations and institutions with competence in land (SAFER) and agriculture (Chambers of Agriculture), as well as biodiversity offset intermediaries (associations, consultancy firms, consular organizations, natural area managers, lawyers). The stakeholders were asked to explain why they had or had not chosen to become active in implementing biodiversity offsets, and also if it was a new activity or simply a continuation to enhance their skill set. The aim was also to understand what resources were mobilized to position themselves in this land and environmental services market. The accumulation of responses by region and the interregional comparison helped us to characterize the territorialization of the biodiversity offsetting policy and to analyze its implementation in particular contexts.

The Occitanie region presents important ecological issues which are threatened by a strong urbanization that is linked to its growing population. Bourgogne Franche-Comte and Auvergne Rh^one-Alpes are ^ two regions where urbanization is concentrated around large and medium-size cities, where land has a high agronomic value. Further from cities are areas with more depreciated farm land. Normandy is characterized by a low demographic dynamic and also spread urbanization, as well as intensive agricultural systems. Both Ile de France and Hauts de France present a tension between extensive urbanization and soils of high agronomic value supporting an intensive culture system. These different agricultural and urban contexts lead to a more or less acute tension in terms of land use and land transactions. Regions with extensive farming allow for the possibility to implement offsets far away from peri-urban areas if needed, whereas in highly productive regions, securing land remains more problematic as unproductive land is very scarce. The implementation of biodiversity offsets therefore appears to be heterogeneous from one region to another; it is reinforced by the influence of agricultural unions that compete for the institutionalization of regional norms to avoid access to farmland for biodiversity offsets. In sum, access to land is harsher in the upper northern region of France (see Fig. 1) than in the southern region.

3.1 Analyzing land strategies through case studies of biodiversity offset implementation

The second level of the survey consisted of an in-depth analysis of 20 case studies across the six regions presented above. First, in order to vary the urbanization gradient, one to four development projects were studied per region. The support of regional environmental administrations allowed us to select case studies according to the following criteria: projects representative of local practices without legal irregularities, and projects involving various actors and using different land transfer modalities. They were located in peri-urban settings of large cities, and medium-sized towns and villages in rural areas (Table 2). Interviews were conducted with all the stakeholders involved in the selected projects and were aimed at analyzing their resources and interests, the agreements reached between them, the factors that influence these agreements, and ultimately the type of biodiversity offsets produced. These include: economic developers, land intermediaries, land owners and offset managers (including farmers). The semi-structured interviews were first analyzed in order to trace the history of each case study by cross-checking the Table 2

16 case studies of development projects located in peri-urban areas of large cities, medium-sized cities and villages in rural areas.

Regions	Large cities	Medium-size cities	Small cities in rural area
Occitanie	2	3	
Bourgogne Franche Comté			3
Auvergne Rhone Alpes		1	2
Normandy		1	1
Ile-de-France			1
Hauts-de-France		1	1

such operations. This third dimension of the survey was dealt with opportunistically in the six regions, by devoting a part of the interview to possible pooling operations that the interviewee may have already had knowledge of. Four cases were identified. Then, when the interviewees were directly involved, the interviews were focused on these pooling operations. These direct sources of information were supplemented by desk research and attendance dedicated to conferences and workshops.

After the completion of data production, all interviews were transcribed and analyzed manually. The criteria of analysis have been established iteratively during fieldwork, and have been progressively refined in the course of interviews, transcription and analysis. They include: the type of intermediary, land access strategies, the type of transactions and legal arrangements for securing land, the length of securement, the type of offset measure, and ecological additionality. Regional overviews were produced as a result, as well as the analysis of different intermediaries' specificities with regards to their activities and strategies. Comparative-case analysis also allowed for an exploration of land access strategies and the refinement of the above-presented typical situations.

4. Results

All study cases were analyzed in light of the analytical framework. Among the four theoretical situations presented in Section 2.2.2, three had empirical evidence. Cases studies allowed for the refinement of all situations, namely coordinated support, private arrangements, and local planning. After highlighting how land plays out as a constraint for land developers, each situation is laid out in the following subsections.

interviews that have all been transcribed. The interviews were then analyzed in a transversal way and classified by emerging themes (i.e., farmers' refusal to release land, the duration of offset measures, etc.). This approach was carried out at the regional level, then at a larger scale involving the whole corpus of case studies.

Second, in each region, attention was paid to the initiatives that were made by local authorities and aimed at anticipating future offset needs and integrating them into land planning documents. Here we refer to these operations as "pooling operations". This approach follows a survey of initiatives aimed at planning the mitigation hierarchy carried out in 2018–2019 by Ollivier et al. (2020) and which includes 14 operations in France, to evaluate the ecological improvements that a planning approach could offer. In our study, the challenge was to understand the factors that led to the emergence of pooling operations, the stakeholders who develop and promote them as well as the partners involved, and the possible levers and hindrances encountered in the implementation of

3.2 Access to land as a major hindrance for biodiversity offsets in peri-urban areas

Peri-urban areas are sites of fierce competition for land, as cities extend and related infrastructural development directly impacts the price of land available for construction, while maintaining agricultural land, particularly in areas with high agronomic value, and conserving natural areas are requirements for the quality of life and the ecological state of territories. Economic developers directly deal with this tension through access to land: it is a first challenge for development projects and even more so when it comes to fulfilling biodiversity offset obligations. Although biodiversity offsetting regulations require compensation sites to be previously identified and secured for project permits to be released, projects are in practice authorized with approximately one third of the offset sites being settled (Weissgerber et al., 2019). While permitting authorities are usually aware that offset duties are on average too large to be addressed fully without delaying both administrative processes and development activities, they only compel economic developers to identify and secure part of the total area to deliver permits. This means that as long as a portion of the requested area is not committed, the project is blocked, which leads to strong constraints for economic developers on the work schedule and budget. In two study cases, one located in the vicinity of a large city (Occitanie) and the other in the peri-urban area of a medium-sized city (Auvergne-Rhone Alpes), the project authorization has been delayed by two years due to standoffs related to land availability and the willingness of landowners to sell their land. As an economic developer involved in a Joint Development Zone Business Park states:

"We would have been able to submit the file at the beginning of April, but the [environmental administration] requires that we have identified at least part of the biodiversity offset sites. We set up committees with [all land intermediaries and municipalities] around the table, but it's blocked. There are farming families, large landowners. But nobody offers any solution" (Economic developer, 2019).

To cope with land constraints, economic developers face several options that are not mutually exclusive. First, as mentioned ahead, they seek to reduce the size of their mitigation liability by negotiating with the environmental administration. As a matter of fact, in peri-urban areas, ratios between ecological impacts and gains are lower than in rural areas. An economic developer expresses his hopes about such a possibility:

"We have secured almost half of the surface requested for biodiversity offsets. We have a meeting with the administration soon, so we hope that this will be enough for them and that we can drop the rest." (Economic developer, 2019)

Secondly, economic developers may approach municipalities to obtain direct support. The latter thus often plays a role of public land provider. Lastly, private land intermediaries can overcome these difficulties because they have

specific tools to pre-identify land and facilitate timely transactions, as economic developers subcontract with professional organizations to identify land, draw up the specifications for biodiversity offsets and organize their implementation. These organizations can be historical land development actors, such as agricultural organizations or nature conservation NGOs, with an extensive knowledge of local land dynamics. Depending on their own mission and their working networks, these intermediaries develop different strategies for land solutions, in which the ecological issue is more or less a selection criterion. Empirically, the investigation revealed three main situations regarding access to land for biodiversity offsets.

4.1 Coordinated support

In peri-urban areas, the municipality plays the role of the public land provider and therefore spearheads development projects. The municipality is therefore willing to assist economic developers in complying with environmental obligations so that projects can be built without any pushback. In the Bourgogne Franche-Comte or Occitanie regions, municipalities or local public development institutions make their land available. More precisely, they sell plots to developers at a low price. Implementation of biodiversity offsets therefore relies on specific land availability, that of public land, whose access is facilitated as owners have a direct interest.

The management of the site is usually entrusted to a nature conservation NGO who is accountable for implementing and monitoring offsets. This situation favors specific land intermediaries such as the Conservatoire d'Espaces Naturels (CEN), which has built its reputation on its ecological management skills. The CEN is also a relevant partner for the developer because of its legitimacy in the eyes of the state services, which guarantees a good assessment of the project throughout the administrative procedure.

The CEN then negotiates its participation based on the condition that conservation is ensured in the long term. Land is generally entrusted to this organization through the transfer of private property or 99 year- long leases, while economic developers are responsible for financing offsets implementation and monitoring costs.

Being generally involved locally in several projects, the CEN can try to bring together offsets in the same area with a high degree of ecological coherence. The support of municipalities gives the CEN the possibility to negotiate acquisition of adjacent plots for developers who have requested them. Because of the association's ecological legitimacy and proximity to the players in the area (it is largely subsidized by regional public funds), it is granted public spaces by municipalities concerned with facilitating development, while still maintaining the ecological quality of the area. In 2 of the 16 cases, biodiversity offsets happened in the same area. This approach leads to relevant outcomes in terms of ecological coherence and length of securement. Additionality is more fluctuating as sites aren't chosen for their ecological potential but for their availability.

4.2 Private arrangements

The second situation only involves private land intermediaries. These intermediaries don't own land directly, but rather make their expertise available to build arrangements that lead to the provision of land. They include both non-profit organizations historically active in the field of land and agriculture, and conservation-oriented organizations. Economic developers therefore deal with intermediaries with little or no involvement from municipalities. This situation appears in two land contexts and leads to two contrasting implementations of biodiversity offsets.

The first situation relates to areas where the land use tension is weaker and where land transfers are possible, in the peri-urban areas of rural towns or medium-sized cities, and in regions with low or negative demographic dynamics (Bourgogne Franche-Comte or Normandy). Intermediaries carry out land prospection on private land, and to a minor extent on public land. They

help economic developers identify land for acquisition or easement, on a project-by-project basis.

When artificialization rates are high enough to ensure a certain level of contracts with economic developers, intermediaries carry out anticipated land surveys in order to be able to provide timely answers to economic developers' needs. CdC Biodiversité³ is one of these: it is a financial institution whose mission is to produce economic tools for sustainable development and biodiversity conservation, and which has developed a prospecting approach called "Biodiversity Territory Projects". CdC Biodiversité is a pioneer in the development of biodiversity offsets in France, and seeks to offer robust conservation. Because its offer is more expensive than others, it represents a smaller market share than that of other intermediaries addressed in the article. Nevertheless, CdC Biodiversité benefits from a financial foundation that allows it to develop land prospecting activities in areas that are subject to future development such as in the suburbs of Paris, in Ile de France. This early prospecting enables a land solution proposal to be made quickly when economic developers prepare an environmental assessment. As a member of the CdC Biodiversité highlights:

"In region Ile-de-France, we have developed "Biodiversity Territory Projects". This is a CdC Biodiversité product: we have already made a list of sites available for offsets, on which we have prepared management scenario" (CdC Biodiversité, 2019).

Another regional intermediary is known to develop a land prospecting strategy: SAFER, a public/private organization whose historical mission is to regulate farm land markets and whose main activity today is to monitor farmland transfers. SAFER takes advantage of its land institution status, in particular its capacity to watch and exhibit control over land sales and to play a key role in mitigation policy. In Ile-de-France and Hauts de France, SAFER has joined forces with an environmental consultancy firm to offer a service which combines land and ecological expertise:

"For example, we know that there will be a project in 5–10 years, we put the sector under surveillance, so we can already have a good knowledge of the prices that are being charged. If there is land that is being sold, and going to be taken out of agricultural use, we can offer it for pre-emption for biodiversity offsets. We can already start to prepare the discussion with the stakeholders to enable compensation" (SAFER, 2019).

In areas where pressure on agricultural land is high, SAFER tends to hinder or even withdraw from mitigation policies so as to avoid more offsets on farmland.

These land prospecting strategies allow intermediaries to be well positioned when a project is launched in the prospective area and to be selected as intermediaries by developers. However, identifying land does not always mean that it will be secured in the long run. Private landowners are often reluctant to sell their land, especially in areas where land pressure may drive prices higher in the future. For this reason, most offsets identified and implemented through these anticipated land strategies are secured through temporary easements (5–30 years).

Whether land identification and securement are carried out through anticipatory prospection or on a project-by-project basis, leaving the implementation of biodiversity offsets to private arrangements and transactions on the local land markets leads to mixed outcomes. Transactions may be hard to carry out, limited to short- or medium-term leases, or very expensive. For this reason, some municipalities also intend to integrate identification of potential sites for future biodiversity offset needs at the planning level.

³ Caisse des dépôts et des consignations (CdC) with a specific subsidiary working on biodiversity economic tools.

4.3. Local upstream pooling strategies and offset planning

The third situation is the case of municipalities who want to integrate biodiversity offsets in planning ahead of development projects. Field research revealed four occurrences of this type of situation, all of which took place in large cities or highly populated areas. Regulators who defended this type of endeavor within municipalities were motivated by the possibility of enhancing both economic development and conservation as well as managing the risk of administrative blocking.

Two out of these four cases were led by public establishments of inter-municipal cooperation, i.e. large cities, and their respective agglomerations, that carry out the planning:

- Metropolitan Lyon, which encompasses 59 municipalities, is currently using a conservation plan for an agricultural bird species called *Œdicnème* to implement an integrated biodiversity offsetting program.
- Metropolitan Nîmes, which counts 39 municipalities, has been working on the integration of mitigation hierarchy in planning regulations since 2017.

The other two cases, which started in 2015 and are also larger in scale, are among the first planning initiatives to be launched in France. They include:

- an initiative led by the Yvelines department (i.e the administrative level below regions) in Ile-de-France;
- an initiative led by the Occitanie region.

These projects stem from the perception of potential difficulties related to mitigation policies in these dense peri-urban settings. The case of Nîmes Métropole is particularly significant in that regard: *“When the Biodiversity Law was voted in 2016, with increased requirements on the mitigation hierarchy, Nîmes Métropole understood that there would be severe hindrance related to its implementation, so the urban planning agency was mandated to carry out a forecast. The results came out in 2017 [1990ha of urbanization by 2030, including 1000ha potentially requiring offsets]and we realized these numbers were impossible to reach. We have proposed a new draft that would reduce land consumption by 2/3, but it has not yet been voted on”* (project manager in Metropolitan Nîmes, 2019).

This demonstrates how an anticipation of future blockages stimulates both a collective reflection on future construction, as well as an anticipation of offsets needs at the planning level. Public technical services carry out this collective thinking, and then seek out assistance from local land intermediaries, environmental consultants and public scientists to work on the forecasts, since they lack these skills internally. In practice, technical services aim to carry out an inventory of development projects planned in pre-established territorial plans and then map them out in order to figure out the types of land and habitats that will likely be impacted. They cross-reference this information with ecological maps to highlight where the highest stakes are in terms of ecological value, which enable extrapolations of future local needs in terms of offsets areas. Depending on the type of projects, municipalities might not always be able to act on the level of impacted areas, especially when development projects are large infrastructures that are state-owned. In a department that neighbors Paris, Yvelines, a project manager says:

“We are hosting two large development operations piloted by the state which generates more than 170 ha of urbanized land per year.

We began the first stages of the diagnosis of the territory in 2013, and we estimate a need for compensation of 200 ha per year between 2015 and 2020” (Yvelines project manager, 2018).

Once future offset needs have been estimated, technical services engage in ecological and cartographic work to identify areas that could be potentially set aside for offsets. In each of the four cases, this spatial projection exercise reveals that offsets objectives are impossible to reach, as land stocks are lower than future needs. A member of the Occitanie technical office presenting a map explains how they identify land:

“In urbanized areas, we cannot even make a 1:1 ratio [i.e offsetting one hectare of impacts with one hectare of offset]. Everything in red is already too late. Everything in white is very tight. However, we estimate that to find 10 ha, we need a land envelope of 100 ha, otherwise we know that we won't find an area where we have access to land and which meets the ecological criteria,” (Technical office member, Occitanie, 2018).

This means that to be able to secure 10 ha for future needs, members of the technical office have pre-identified 100 potential hectares of land through their mapping exercise, and have then conducted field surveys to assess which plots are relevant from an ecological point of view. This doesn't directly lead to the securement of land for future biodiversity offsets; negotiations still need to take place on private land.

Due to these obstacles, public municipalities and departmental organizations have abandoned their initial plans. The project undertaken by Metropolitan Nîmes was the most ambitious because the municipality aimed to create a dedicated land institution to ensure compensation needs. While this project has been abandoned, the local authorities are still trying to play a central role in the coordination of the land dynamics. A Metropolitan Nîmes project manager commented in 2019, “We are trying to bring together, in a technical committee, the SAFER, the urban planning agency, the chamber of agriculture, state services, department and region dedicated services, to talk together about the mitigation hierarchy strategy. Because everyone is trying to create landed property by forecasting an increase in land pressure.” (Nîmes Métropole project manager, 2019).

In Occitanie, the challenge was to integrate a mapping of avoidance and offset measures into the regional sustainable development plan, so that they could be transcribed into the planning documents at municipality levels. However, this approach was not sustained politically when it came time to implement it into municipal planning documents. In 2018, a Director of the Planning and Use Department of the Occitanie region said: *“Perhaps we were unwise at the beginning of the study, we thought we could go and do this, but we have to admit that there is too much political resistance. Local politicians favor construction and development.”*

Ultimately, attempts made by the territorial authorities to plan biodiversity offsets came up against a tense land market. All in all, although municipalities are involved in land prospecting, the planning process eventually comes to a halt when there is a need to formalize and secure land for ecological purposes.

5. Discussion

5.1 The many facets of offset implementation and quality

Analyzing the implementation of biodiversity offsets in peri-rural areas reveals the key role of intermediaries who build on their ecological and land expertise to assist land developers. While it is known that private intermediaries are systematically contracted by economic developers to meet their environmental obligations, the investigation shows that they also play a key role in helping municipalities who are looking to plan offsetting at the territorial level. We identify three situations that have different effects on the quality of the biodiversity offsets, as summarized in [Table 3](#).

5.1.1 Relative power of private intermediaries

In the coordinated support situation, municipalities offer sites that are relatively unbuildable. Therefore, what drives access to land is its availability, and not its ecological potential, which leads to variable additionality. In addition, intermediaries are mostly conservation-oriented, which leads to long-term securement.

The second situation (private arrangements) takes place in territories where development pressure is high and municipalities stand back. Intermediaries there implement anticipatory strategies to be able to respond to the developer's demand. Therefore, the quality of biodiversity offsetting is highly influenced by the intermediaries' interest. Their ability to identify land grants them power in the subcontracting relationship, and allows them to impose their interests and supersede some initial requirements. Consequently,

ecological additionality and the length of land securement can range from poor to very robust. Some intermediaries position themselves as producers of high-quality ecological services, who can reinforce regulatory governance (Owen, 2021). In contrast, agricultural intermediaries negotiate their participation on

Table 3
Synthesis of the three models of biodiversity offsetting in peri-urban areas and effect on its quality.

	Role of organizer and degree of anticipation	Consequences for the quality of biodiversity offsets
Coordinated support	Municipalities as a facilitator Intermediaries as operators Case by case basis	Long term securement and variable additionality
Private arrangements	Municipalities standing back Intermediaries as organizer and operators Need to anticipate	The quality of the offset is highly dependent of the approach advocated by the intermediary: Low to high additionality; short term to long term measures, no systematic securement
Pooling strategies	Municipalities as organizers Anticipation and velleity to plan Intermediaries as operators	Identification of relevant sites for high ecological additionality Failed intents of long-term securement

securement, land tenure security, as well as surfaces and ecological characteristics, all of which are important conditions for successful offsetting (Bull et al., 2013). This heterogeneity is linked to the flexibility of mitigation policies in a context of scarce land availability, that intermediaries are only partially able to ease. This has also been observed in other countries and undermines the achievement of mitigation policies (Bull et al., 2015; zu Ermgassen et al., 2020).

Although previous research has demonstrated the influence of intermediaries on reducing the transaction and implementation costs of biodiversity offsets (Coggan et al., 2013), this article shows how this can be counterbalanced by land market dynamics. However, as offset prices are indexed on land prices and are therefore high in peri-urban settings, economic developers may try to reduce costs through a limitation in time of offset securement and management. In the absence of a strict standard, the length of securement is negotiated with the public authorities. Finally, in areas where no there isn't any landowner who is willing to sell or lease, projects may get blocked. In this type of tense situation, intermediaries do not have any leverage and generally rely on local authorities.

5.1.2 Limits of planning policies

The last situation, namely pooling initiatives, relates to cases where municipalities attempt to anticipate and organize future offsetting needs so as to plan territorial development in line with environmental obligations. Here, the intermediaries are mandated to conduct ecological surveys in order to assure the ecological relevancy of anticipated offsets.

Blockages are recurrent in peri-urban areas in the context of growing conflicts over land use (Torre et al., 2016) and are prompting a growing number of local authorities to engage in upstream biodiversity offset planning (Ollivier et al., 2020). These initiatives also stem from changing regulations: the 2001 European Directive on Strategic Environmental Assessment requires local authorities to enforce the mitigation hierarchy at the scale of planning documents following. It is backed up by ecological studies that highlight the relevance of landscape-based propositions (Bigard et al., 2020): scholars have demonstrated potential conservation benefits which stem from the combination of landscape-level conservation planning and offset location selection procedures (Grimm and Koppel, 2019; Kujala et al., 2015; Moilanen, 2012; Sabatier et al., 2014).

The planning approaches developed in Section 4.3 and analyzed by Ollivier et al. (2020) reveal that municipalities face several difficulties for which they do not seem to be prepared. The first one is the capacity to find a balance between the development and securement of natural zones in the peri-urban area: most of the time, biodiversity offset ends up being located far from

the condition that there is no purchase of agricultural land, but rather short-term securement through leasing.

Thus, in cases where no land is made available, all types of intermediaries provide services, leading to a strong heterogeneity in biodiversity offset implementation in terms of prices, length of land urbanization zones, on more accessible and cheaper sites, which usually undermines ecological outcomes (Maseyk et al., 2021). Ecological planning involves an analysis of the environment and extensive mapping to locate ecological connectivity (Tarabon et al., 2020, 2021). In most cases, local authorities refrain from assigning avoidance and offset objectives to specific areas, generally because elected officials back off when it comes to limiting future economic development possibilities. This shows the aversion of elected representatives to support anything that could limit opportunities for future development (Desage and Gu'éranger, 2011; Melot, 2016). Biodiversity offset planning fails because the prevailing logic of peri-urban territories is to provide a leeway for future development. Moreover, the land is privately owned and the owners generally wish to keep it for uses other than offsets.

Previous studies have highlighted that pressure on natural and semi-natural sites is a function of the distance to urban centers and the dynamics of artificialization within peri-urban settings. This article shows that the status of land, and notably the presence of public land, is also a key element in understanding land preservation and the ecological quality of peri-urban areas. While the constitution of public land reserves is a strong path to regulate land use, the issue is barely touched upon in scientific debates (Wende et al., 2020). However, this orientation requires strong political support and even the commitment of private citizens (Perrin, 2013).

5.2 Biodiversity offsets in the interplay between land market and planning regulations

This analysis reveals the limited capacity of mitigation policies to preserve agricultural and natural areas in the urbanization process. Hence it brings forward some nuance to the theoretical perspective of ecological modernization, according to which market mechanisms are an efficient means to reach environmental objectives, whereas state action is reduced to a regulatory ambition (Mol and Spaargaren, 2000). The empirical study highlights its limits when it comes to land, a key factor in environmental policies, which is limited in volume and invites fierce competition.

While land developers and private intermediaries ought to access land through market mechanisms so as to cope with mitigation regulations, this appears to be the most critical element of policy implementation. This is mainly due to the resistance of private landowners, who are not necessarily willing to save the land for future and potentially more profitable uses, as public owners are more likely to engage in conservation actions. When there isn't any public land available, the role of intermediaries ultimately consists in exploiting land margins, at low value or under contractual terms, that do not prevent future urbanization. Intermediaries therefore operate in unstable and changing settings, and mitigation policies barely have the capacity to maintain lands for the ecological quality of peri-urban areas in the long run.

Faced with tense land markets, public actors try to take back control of these policies through anticipatory actions. This leads to a discussion of conclusions put forward in Coggan et al. (2013) on the withdrawal of public intermediaries in facilitating implementation. Other scholars have insisted on the role of anticipated policy actions in facilitating the emergence and development of economic transactions: "By fostering a more favorable trading environment and seeding emerging markets, early action policies and incentives may also provide important learning opportunities for market participants, lower search and other transaction costs, and help to improve long-term business decision making while reducing economic risks" (Galik and Olander, 2018). Currently in France, the National Biodiversity Agency carries out an inventory of sites with a high additionality potential, which amounts to land prospection that could be mobilized for future compensation needs. In particular, it concerns uncultivated land and public land, with the aim to expand the perimeter of local land markets and facilitate a case-by-case prospection.

The case of biodiversity offset implementation in peri-urban areas shows that planning actors have the theoretical ability to facilitate the enforcement of the instrument. The municipalities have the main planning power and can take different directions according to local political priorities. Melot and Bransieq (2016) highlight that municipalities adopt the rhetoric of sustainable development in planning documents, but establish implementation rules that perpetuate strong urbanization. Conversely, Baysse-Lain'e (2020) shows the capacity of municipalities to develop peri-urban agriculture through the construction of stable local configurations that allow access to the land resource. This shows that land market-dependent instruments may be more likely to succeed in identifying and protecting land when strong political support is gained at the local level. Such mechanisms can lead to robust conservation but are often circumvented. As much as land availability, local political forces appear as a critical aspect of mitigation success.

6. Conclusion

The maintenance of natural and agricultural space for biodiversity conservation is subject to land pressure, which is particularly acute in peri-urban areas. The issues of access to land and securement are therefore a decisive aspect of the instrument but are rarely addressed in the literature. The paper questions the links between land market transactions and planning regulations in the implementation of biodiversity offsets, and highlights the key role of intermediaries in this process.

Based on the analysis of 20 case studies, the article shows that municipalities are important providers of land in order to facilitate biodiversity compensation and thus the development of their territory. However, the land market is often tense, which leads to the involvement of private intermediaries who develop land prospecting services and propose solutions for implementing offsets that are more or less anticipated and sustainable. This study therefore shows that biodiversity offset policies are tied to a land market that is partly framed by territorial planning; to a large extent, their implementation relies on the ecological and land expertise of private intermediaries, and is therefore highly dependent on the overall interests of intermediaries. As public certification is not required, any type of intermediary can provide expertise to land developers, be they conservation-oriented or not.

Finally, although the involvement of intermediaries is key for the implementation of the policy, their interventions are easily limited either by the lack of land resources or by political hindrances. With high land pressure, such as in peri-urban areas of medium-sized and large cities, more land securement through planning is needed. The implementation of ecologically robust biodiversity offsets requires a thorough articulation of ecological and land expertise provided by intermediaries with the anticipation of land needs in relation to future development projects. The main challenge remains in the hands of local authorities, whose elected officials are reluctant to exclude land from potential future urbanization.

Data Availability

The data that has been used is confidential.

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References

Barral, S., 2020. Conservation, finance, bureaucrats: managing time and space in the production of environmental intangibles. *J. Cult. Econ.* 1–15. <https://doi.org/10.1080/17530350.2020.1846593>.

Barral, S., Guillet, F., 2022. Nature's time, procedural time. *Temporality conflicts in environmental law. Droit et Socie't'e* 111 (2).

Baysse-Lain'e, A., 2020. Une g'eographie relationnelle de l'accès au foncier agricole en France. *L'Esace Geogr.* 49 (3), 193–212.

Bessy, Christian, Chauvin, Pierre-Marie, 2013. The power of market intermediaries: From information to valuation process. *Valuat. Stud.* 1 (1), 83–117.

Bigard, C., Thiriet, P., Pioch, S., Thompson, J.D., 2020. Strategic landscape-scale planning to improve mitigation hierarchy implementation: an empirical case study in Mediterranean France. *Land Use Policy* 90, 104286.

Bousbaine, A., 2017. What can agricultural land use planning contribute to food production and food policy. *Int. J. Avian Wildl. Biol.* 2.

Bull, J., Hardy, M., Moilanen, A., Gordon, A., 2015. Categories of flexibility in biodiversity offsetting, and their implications for conservation. *Biol. Conserv.* 192, 522–532.

Bull, J.W., Suttle, K.B., Gordon, A., Singh, N.J., Milner-Gulland, E., 2013. Biodiversity offsets in theory and practice. *Oryx* 47 (3), 369–380.

Bull, J.W., Gordon, A., Watson, J.E., Maron, M., 2016. Seeking convergence on the key concepts in 'no net loss' policy. *J. Appl. Ecol.* 53 (6), 1686–1693.

Chiapello, E., Engels, A., 2021. The fabrication of environmental intangibles as a questionable response to environmental problems. *J. Cult. Econ.* 1–16.

Coggan, A., Buitelaar, E., Whitten, S.M., Bennett, J., 2013. Intermediaries in environmental offset markets: actions and incentives. *Land Use Policy* 32, 145–154.

Desage, F., & Gu'éranger, D. (2011). *La politique confisquée: Sociologie des r' eformes et des institutions intercommunales*. Editions du Croquant.

Filoché, G., 2017. Playing musical chairs with land use obligations: market-based instruments and environmental public policies in Brazil. *Land Use Policy* 63, 20–29.

Flyvbjerg, B., 2006. Five misunderstandings about case-study research. *Qual. Inq.* 12 (2), 219–245. <https://doi.org/10.1177/1077800405284363>.

Galik, C.S., Olander, L.P., 2018. Facilitating markets and mitigation: a systematic review of early-action incentives in the US. *Land Use Policy* 72, 1–11.

Gardner, T.A., 2013. Biodiversity offsets and the challenge of achieving no net loss. *Conserv. Biol.* 27, 1254–1264.

Gastineau, P., Mossay, P., Taugourdeau, E., 2021. Ecological compensation: how much and where? *Ecol. Econ.* 190, 107191 <https://doi.org/10.1016/j.ecolecon.2021.107191>.

George, A.L., Bennett, A., 2005. *Case Studies and Theory Development in the Social Sciences*. MIT Press.

Grabosky, P.N., 1995. Using non-governmental resources to foster regulatory compliance. *Governance* 8 (4), 527–550.

Griffiths, V.F., Sheremet, O., Hanley, N., Baker, J., Bull, J.W., Milner-Gulland, E.J., 2019. Local people's preferences for biodiversity offsets to achieve 'no net loss' for economic developments. *Biol. Conserv.* 236, 162–170. <https://doi.org/10.1016/j.biocon.2019.05.049>.

Grimm, M., Koppel, J., 2019. Biodiversity offset program design and implementation. *Sustainability* 11 (24), 6903.

Gunningham, N., Sinclair, D., 2019. *Regulatory pluralism: Designing policy mixes for environmental protection*. Environmental Law. Routledge, pp. 463–490.

Jarrige, F., Perrin, C., 2017. Innovations for agriculture in urban areas ? The example of an agriparc. *Rev. d'Economie Reg. Urbain* 3, 537–562.

Kan-Balivet, B., 2013. La mobilisation du foncier public en faveur du logement. *Droit Et. Ville* 75 (1), 173–185.

Kassis, G., Bertrand, N., Pecqueur, B., 2021. Rethinking the place of agricultural land preservation for the development of food systems in planning of peri-urban areas: Insights from two French municipalities. *J. Rural Stud.* 86, 366–375.

Koh, N.S., Hahn, T., Boonstra, W.J., 2019. How much of a market is involved in a biodiversity offset ? A typology of biodiversity offset policies. *J. Environ. Manag.* 232, 679–691. <https://doi.org/10.1016/j.jenvman.2018.11.080>.

Kujala, H., Whitehead, A.L., Morris, W.K., Wintle, B.A., 2015. Towards strategic offsetting of biodiversity loss using spatial prioritization concepts and tools: a case study on mining impacts in Australia. *Biol. Conserv.* 192, 513–521.

Lockie, S., 2013. Market instruments, ecosystem services, and property rights: assumptions and conditions for sustained social and ecological benefits. *Land Use Policy* 31, 90–98.

Maron, M., Hobbs, R.J., Moilanen, A., Matthews, J.W., Christie, K., Gardner, T.A., Keith, D.A., Lindenmayer, D.B., McAlpine, C.A., 2012. Faustian bargains ? Restoration realities in the context of biodiversity offset policies. *Biol. Conserv.* 155, 141–148.

Maron, M., Ives, C.D., Kujala, H., Bull, J.W., Maseyk, F.J., Bekessy, S., Gordon, A., Watson, J.E., Lentini, P.E., Gibbons, P., 2016. Taming a wicked problem: resolving controversies in biodiversity offsetting. *BioScience* 66 (6), 489–498.

Martínez-Paz, J.M., Albaladejo-García, J.A., Barreiro-Hurle, J., Pleite, F.M.-C., Perni, A., 2021. Spatial effects in the socioeconomic valuation of peri-urban ecosystems restoration. *Land Use Policy* 105, 105426.

Maseyk, F.J., Maron, M., Gordon, A., Bull, J.W., Evans, M.C., 2021. Improving averted loss estimates for better biodiversity outcomes from offset exchanges. *Oryx* 55 (3), 393–403.

Melot, R., 2016. politiques locaux et registres de justification. In: *Revue française de sociologie*, 57. R'eglementer la ville p'eriurbaine, Choix, pp. 711–734.

Melot, R., Bransieq, M., 2016. Regles ` d'urbanisme et choix politique: Les observations de l'Etat sur les projets locaux. *Rev. d'Economie Reg. Urbain* 4, 76 7–798.

Moilanen, A., 2012. Planning impact avoidance and biodiversity offsetting using software for spatial conservation prioritisation. *Wildl. Res.* 40 (2), 153–162.

Moilanen, A., Kotiaho, J.S., 2018. Fifteen operationally important decisions in the planning of biodiversity offsets. *Biol. Conserv.* 227, 112–120. <https://doi.org/10.1016/j.biocon.2018.09.002>.

Mol, A.P., Spaargaren, G., 2000. Ecological modernisation theory in debate: a review. *Environ. Polit.* 9 (1), 17–49.

- Muradian, R., Rival, L., 2012. Between markets and hierarchies: the challenge of governing ecosystem services. *Ecosyst. Serv.* 1 (1), 93–100.
- Ollivier, C., Spiegelberger, T., Gaucherand, S., 2020. La territorialisation de la séquence ERC: quels enjeux liés au changement d'échelle spatiale? *Sci. Eau Territ.* 31 (1), 50–55.
- Owen, D., 2021. Private facilitators of public regulation: a study of the environmental consulting industry. *Regul. Gov.* 15 (1), 226–242.
- Penca, J., 2013. Marketing the market: the ideology of market mechanisms for biodiversity conservation. *Transnatl. Environ. Law* 2 (2), 235–257.
- Perrin, C., 2013. Regulation of farmland conversion on the urban fringe: from land-use planning to food strategies. Insight into two case studies in Provence and Tuscany. *Int. Plan. Stud.* 18 (1), 21–36.
- Perrin, C., Baysse-Laine, A., 2020. Governing the coexistence of agricultural models: French cities allocating farmlands to support agroecology and short food chains on urban fringes. *Rev. Agric., Food Environ. Stud.* 101 (2), 261–286.
- Quétier, F., Regnery, B., Levrel, H., 2014. No net loss of biodiversity or paper offsets? A critical review of the French no net loss policy. *Environ. Sci. Policy* 38, 120–131. <https://doi.org/10.1016/j.envsci.2013.11.009>.
- Sabatier, R., Doyen, L., Tichit, M., 2014. Heterogeneity and the trade-off between ecological and productive functions of agro-landscapes: A model of cattle–bird interactions in a grassland agroecosystem. *Agric. Syst.* 126, 38–49.
- Salzman, J., Ruhl, J., 2006. No Net Loss: Instrument Choice in Wetlands Protection. Moving to markets in environmental regulation: twenty years of experience. Oxford University Press, Oxford, UK.
- Sonter, L.J., Simmonds, J.S., Watson, J.E., Jones, J.P., Kiesecker, J.M., Costa, H.M., Bennun, L., Edwards, S., Grantham, H.S., Griffiths, V.F., 2020. Local conditions and policy design determine whether ecological compensation can achieve No Net Loss goals. *Nat. Commun.* 11 (1), 1–11.
- Soulard, C.-T., Valette, E., Perrin, C., Abrantes, P.C., Anthopoulos, T., Benjaballah, O., Bouchemal, S., Dugué, P., Amrani, M.E., Lardon, S., 2018. Peri-urban agro-ecosystems in the Mediterranean: Diversity, dynamics, and drivers. *Reg. Environ. Change* 18 (3), 651–662.
- Tarabon, S., Dutoit, T., Isselin-Nondedeu, F., 2021. Pooling biodiversity offsets to improve habitat connectivity and species conservation. *J. Environ. Manag.* 277, 111425.
- Torre, A., Kirat, T., Melot, R., Pham, H.V., 2016. Les conflits d'usage et de voisinage de l'espace. Bilan d'un programme de recherche pluridisciplinaire. *L'Information Géographique* 80 (4), 8–29.
- Vaissière, A.-C., Levrel, H., 2015. Biodiversity offset markets: what are they really? An empirical approach to wetland mitigation banking. *Ecol. Econ.* 110, 81–88.
- Weissgerber, M., Roturier, S., Julliard, R., Guillet, F., 2019. Biodiversity offsetting: certainty of the net loss but uncertainty of the net gain. *Biol. Conserv.* 237, 200–208.
- Wende, W., Tucker, G.-M., Quétier, F., Rayment, M., Darbi, M., 2018. Biodiversity offsets: European perspectives on no net loss of biodiversity and ecosystem services. Springer.
- Wende, W., Walz, U., Stein, C., 2020. Evaluating municipal landscape plans and their influence on selected aspects of landscape development—An empirical study from Germany. *Land Use Policy* 99, 104855.
- Womble, P., Doyle, M., 2012. The geography of trading ecosystem services: a case study of wetland and stream compensatory mitigation markets. *Harv. Environ. L. Rev.* 36, 229. zu Ermgassen, S.E., Maron, M., Corlet Walker, C.M., Gordon, A., Simmonds, J.S., Strange, N., Robertson, M., Bull, J.W., 2020. The hidden biodiversity risks of increasing flexibility in biodiversity offset trades. *Biol. Conserv.* 252, 108861. <https://doi.org/10.1016/j.biocon.2020.108861>.