Towards collective action in ecosystem services governance: the recognition of social interdependencies in three collective agri-environmental initiatives in Quebec.

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ABSTRACT

Governing ecosystem services entails the recognition of mutual and interdependent relations between different actors (i.e. beneficiaries, providers and intermediaries) in relation to each other and the living world. Appreciating these social interdependencies requires understanding ecosystem services as commons, generated at the entanglement of social and biophysical relationships and requiring collective action mechanisms. The objective of this article is to study the processes by which social interdependencies are recognized, and how these processes shape the emergence of collective action in three agri-environmental initiatives in Quebec (Canada). These concern a local program of payment for ecosystem service, an integrated watershed management project, and a political coordination process among 16 rural municipalities. Through a qualitative analysis of observations, semi-structured interviews, and field visits with relevant stakeholders, this study outlines the processes involved in the recognition of social

interdependencies beyond already established actions, and sometimes at the margins of the formalized agri-environmental initiative. While the three examples do not appear to be collective actions yet, they result in an increase in social capital, which serves as a crucial intermediary step towards achieving cooperation. Our results show that this emergent cooperation is based on constant (re)negotiation and adaptation, whereby intermediaries (e.g. agronomists, environmental coordinators, NGOs) play a key role by reinforcing existing social networks or opening opportunities for new social linkages. Finally, our results show that the social links and the institutions that encourage the collective recognition of social interdependencies are continuously co-constructed by actors and influenced by existing power asymmetries through processes of institutional bricolage.

KEYWORDS

Collective action, ecosystem services governance, institutional bricolage, social interdependencies, power relations, agriculture, Quebec.

1. INTRODUCTION

Ecosystem services (ESs), defined as the benefits that humans receive from ecosystems, directly or indirectly support human survival and well-being (Harrington et al., 2010). Agro-ecosystems provide a variety of ESs that influence land productivity for the provision of food, fiber, and fuel as well as other intangible benefits such as water supply, soil conservation, climate change mitigation, aesthetic landscapes, and wildlife habitat, among others (Zhang et al., 2007; Power, 2010; Garbach et al., 2017). The provision and maintenance of these agricultural ecosystem services (AESs) require high levels of coordination of land use practices at the landscape level (Stallman, 2011; Rival & Muradian, 2013). In the intensive and privatized agricultural landscapes of North America, the farm is a private firm generating private goods that are both rival and excludable. Yet, while private property regimes for land use are the norm, the majority of AESs are non-excludable goods. For instance, pollination, soil quality,

water, pest or climate regulation act more like common-pool resources or perfect public goods (Farley & Costanza, 2010; Muradian & Rival, 2012; Barnaud & Antona, 2014).

The non-excludable character of most AESs implies that collective action is required for improving both how AES are socially conceptualized and understood in a given context as well as their delivery and provision (Muradian et al., 2013; Duraiappah et al., 2014; Miyanaga & Shimada, 2018). AESs are therefore considered as collective outcomes "coproduced" by the agricultural landscape, underpinned by social relationships and interdependencies between individuals, producers and beneficiaries and between the living and non-living environment (Barnaud & Antona, 2014; Barnaud et al., 2018). Co-production here refers to the entanglement of social and biophysical processes that "produce" ecosystem services, as emergent ecological (biophysical) relations and socio-cultural ones (Barnaud & Antona, 2014) This implies the need for institutional spaces that acknowledge socio-ecological interdependencies around AESs as well as the development of a system of rules, norms and social conventions that allow for their pooling together (McGinnis, 2011; Ostrom et al., 2012).

For such collective action to emerge, there must be good communication, strong legacies of trusting relations and frequent exchanges between actors, as well as well-established social networks that reinforce the recognition of social interdependencies (Dietz et al., 2003; Muradian & Rival, 2012). In other words, actors (providers, beneficiaries and intermediaries) must be conscious that they are mutually dependent on each other to solve a given socio-ecological issue, as their management actions are interlinked and have an impact on the quality and quantity of AESs. Moreover, the development of mutual confidence among actors can generate social obligations and a reciprocal feeling of trust which are central features of social capital, and contribute to the development of cooperation (Westerink et al., 2017; Pretty & Smith, 2004) According to the literature on collective action around AESs, actors are more likely to engage in a collective action process if they are aware of such interconnectivity

(Barnaud et al. 2018). Therefore, the recognition of social interdependencies is an important step in the process leading to the emergence of collective action around AESs. It is to this social process that we want to pay closer attention, more specifically to how it takes place in collective strategies around AESs.

Few studies analyze the institutional and social processes involved in the collective acknowledgement of social interdependencies around AESs and how they create the conditions for collective action to take place (Ravnborg & Westermann, 2002; Pelenc et al., 2015; de Vries et al., 2019). Understanding this process involves revealing the interactions between farmers, public sector and civil society involved in approaches to improve the governance of ESs (Ricart et al., 2019), as well as the perception of mutually dependent relationships between humans and non-human natures (Barnaud et al., 2018; Himes & Muraca, 2018). Moreover, collective action is often presented as a technical or managerial approach, following specific rules for managing common pool resources (Dietz et al., 2003). In practice, their implementation follows a more socially complex trajectory influenced by institutional dynamics and power structures (Cleaver & Whaley, 2018).

In this work, we aim to answer the following research question: how does the recognition of social interdependencies occur and how does this process shape collective action for the provision of ESs in agricultural settings? To answer these questions, we examine three agri-environmental initiatives in Quebec (Canada): a local payment for ecosystem services initiative, an integrated watershed management project, and a political roundtable process among 16 rural municipalities. In the following sections, we present the methods of our qualitative analysis, including the analytical framework mobilized to study the process of recognition of social interdependencies. We then detail the results, weaving together elements of the framework with insights from the case studies. Finally, we discuss the conclusions and

implications of our research for the design of policies that foster collective action around AESs.

2. METHODS

2.1. Analytical framework

To answer our research question, we combine two analytical frameworks. First, the framework proposed by Barnaud et al. (2018) allows us to describe and identify social interdependencies as a main element in the collective management of AESs. Second, from a critical institutional perspective, we understand the recognition of social interdependencies as a process of "institutional bricolage," and we examine the influence of power dynamics in the development of collective initiatives (Cleaver, 2002, 2007; Franks & Cleaver, 2007)

Even if some literature recommends encouraging coordination and cooperation in the management of AESs (e.g. Steingröver et al., 2010; Westerink et al., 2015, 2017), few studies offer an analytical framework for the study of collective action around AESs. Barnaud et al. (2018) propose a framework that accounts for the complexity of ecological processes, social interrelations and institutions involved in collective management of AESs. The authors adopt a critical but constructive approach to ESs, suggesting that these benefits can translate socio-ecological interdependencies while acknowledging the risks of commodifying nature when defining or interpreting ESs.

According to Barnaud et al. (2018), collective action around AESs is interpreted as a **"***Voluntary process of cooperation among various stakeholders, users and managers addressing a common ESs management problem in a given territory."* This process aims to include all stakeholders associated with ESs generation and potentially affected by management decisions. Collective action defined as such requires social learning, trust, collective and mutual understanding, as well as negotiation and conflict

resolution. The recognition of the mutual dependency between actors (social interdependencies) is key for the implementation of cooperation of various stakeholders at the landscape level. ESs here are key elements that facilitate the identification of interdependencies with non-human nature. These relations might not be explicit or visible. For instance, a change in land management practices to reduce erosion at the farm level will not only affect the quality of soil on the farm, but also increase the ecological benefits at the watershed level, improving water quality for those who depend on the ESs. Without the common recognition of such co-benefits, there might not be social reciprocity links or obligations to be involved in collectively addressing ecological problems (Barnaud et al. 2018). Interdependencies can also be asymmetrical relations, when the benefits (ecological benefits downstream) involve costs or losses for the producer of ESs (cost of adopting or changing ecological practices). In both situations, an asymmetrical or mutually beneficial interdependency, actors rely on each other for the achievement of collective well-being.

In order to identify social interdependencies, one must define the action arena (i.e. the social space), the social roles played by actors (i.e. providers, beneficiaries, or intermediaries), the kinds of social (inter)dependencies between providers and beneficiaries, as well as their dimensions, including the cognitive framing of interdependencies, levels of organization, institutions involved, and the power asymmetries that influence the collective action process (Table 1).

175 Table 1: Elements of collective action in agro-ecosystems adapted from Barnaud et al. (2018)

Elements	**Characteristics**
Action arena	The social space where participants interact around a subset of ESs (watershed, region, municipality)
Socio-ecological interdependencies related to ecosystem service or disservice	Visible or invisible relations between humans and non-human nature that influence well-being (ESs) Changes in the quality of ESs affect the interlinked stakeholders. The recognition of these interdependencies affects awareness, motivation, and capability to engage in collective action
Social role	
Beneficiaries or co-beneficiaries	Those who potentially or actually benefit from the ESs. Ex: those with access to the ecosystem (farmers) or external users such as tourists, conservationists, neighbours, politicians, governments.
Providers or co-providers	Those whose actions on the agro-ecosystems contribute to the co-production, degradation, preservation or management of ESs. Ex: Farmers and landowners
Intermediaries	Those who interact with the ESs providers and beneficiaries and can influence the decision-making process. Ex: Decision/rule makers, facilitators of negotiations, informants, advisors, etc.
Social interdependencies between actors	
Between beneficiaries	The relation of a group with common interests around the provision of ESs. This relation can also be conflicted between beneficiaries interested in antagonist services (ex. tradeoff between water quality and agricultural production).
Between providers	The mutual benefits of a coordinated action between land managers. Sometimes these benefits can be a source of conflict (divergent land management interest). Their recognition depends on the presence of institutions.
Beneficiaries-providers	Asymmetrical relation as ESs beneficiaries depends on the action of providers, but providers are not necessarily dependent on beneficiaries' actions. Potential source of conflict due to diverging interests.
Dimensions of social interdependencies	
Cognitive framing of interdependencies	Stakeholder representations and recognition of socio-ecological and social interdependencies around key ESs; these include the perception of farmers on what ESs are and the relation of their actions with the state and quality of ESs.

Levels of organization	This refers to the levels of management of the ESs, as well as the potential mismatch between the levels of management and ecological process and patterns (spatial and temporal dynamics).
Institutions	The existing formal and informal rules governing social interdependencies, regulating the provisions of ESs. These include the multi-level governance of collective action and the institutional context that favours (or not) coordination.
Power Relations	Presence of mechanisms influencing how stakeholders are able to assert their interest on specific issues relating to ESs management, influencing the overall outcome. Ex: collective processes dominated by powerful stakeholders resulting in inequitable outcomes.

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Barnaud et al. (2018) present a detailed description of the types and dimensions of social interdependencies, such as the cognitive framing of interdependencies, the levels of organization, institutions and power relations, main elements to achieve collective action in agricultural settings. However, this descriptive framework provides less emphasis on the social process involved in the recognition of social independencies, and the creation of collective institutional spaces that reinforce such process. We therefore combine literature on Critical Institutionalism, which aims to reveal institutional complexity, and the ways in which institutions are "bricolaged" in everyday situations. We consider both frameworks compatible as they focus on the role of institutions and integrate the implication of power relations in shaping collective action.

According to Cleaver and Whaley (2018, p 1.), the Critical Institutionalism (CI) school conceives institutions as the result of a process of bricolage "*where those involved piece together new arrangements from resources at hand.*" CI pays attention to the interplays between structure and agency, reflecting upon the interactions between formalized institutional frameworks and "*the multiple ways in which individuals use their capacities or personal powers to act in meaningful ways"* (Cleaver and Whaley 2018, p. 5). CI sheds light on how governance arrangements are conceived as a dynamic relation shaping political objectives, the social and cultural context and the biophysical landscape in which such arrangements are themselves shaped (Cleaver and Whaley 2018). From this perspective, resource governance systems are socially constructed, where the social reality is historically and geographically situated and emerges from past and present social interactions between members of society lubricated by uneven relations of power.

We understand power dynamics as related to the command of societal resources (Giddens, 1984; Franks & Cleaver, 2007). Resources are conceived as all the means by which human interactions are constructed and can be either allocative (material) or

206 authoritative (non-material). *Allocative* resources refer to the raw materials, means of
207 production, produced goods, whereas *authoritative* resources include organization of
208 social time and space, decision-making mechanisms, opportunities for self-
209 development, relationships between people (Giddens, 1984; Franks & Cleaver, 2007).
210 It is through the uneven ability of actors to command authoritative or allocative
211 resources that power is exercised and particular environmental management
212 mechanisms, such as collective action, are enabled or constrained. In sum, we
213 understand the process towards collective action as the interaction of a constellation of
214 formal and informal institutions that are brought into particular configurations by
215 asymmetrical power relations, which enable or constrain the recognition of social
216 interdependencies. Figure 1 summarizes the framework we have developed to analyse
217 the processes involved in the recognition of social interdependencies underlying AESs
218 dynamics in a collective action situation. The resulting framework emphasises the role
219 of power relations (command of allocative and authoritative resources) and the
220 emergence of formal and informal institutions through processes of institutional
221 bricolage.
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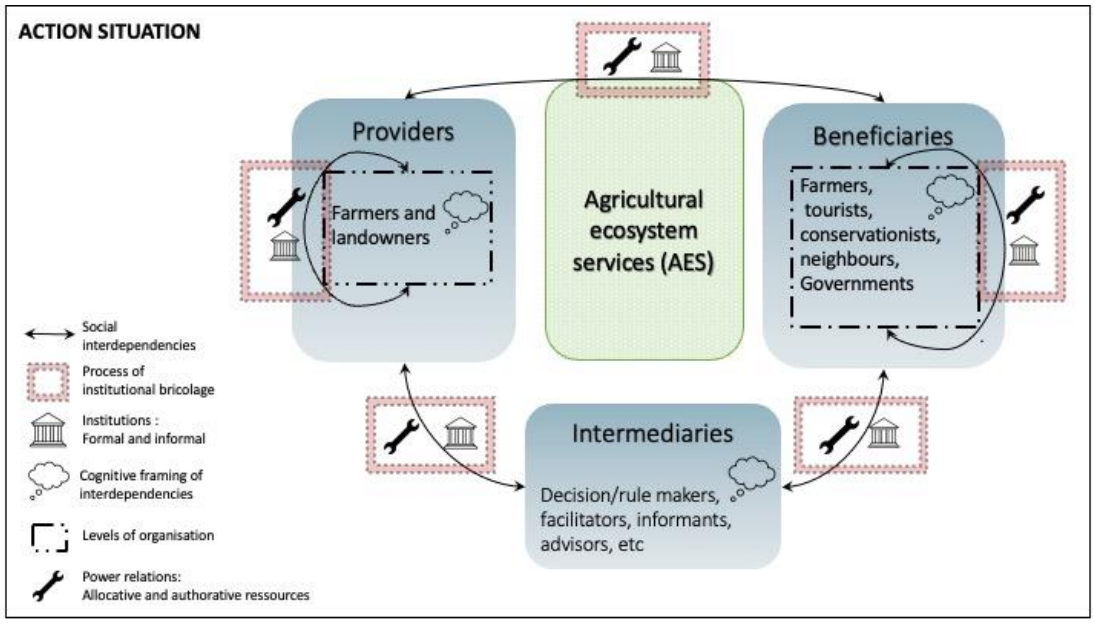

Figure 1: Framework for the analysis of the processes involved in recognizing social interdependencies in agro-ecosystems. This is developed from the collective action framework around AESs (Barnaud et al. 2018) and the theory of institutional bricolage (Cleaver 2007; Frank and Cleaver, 2007).

2.2.Study region

This work adopts a descriptive and interpretative case study approach (Odell, 2001). The case study approach is used for in-depth analysis of one or multiple cases (i.e. collective actions around AES) circumscribed spatially and temporally according to their significance in relation to a research problem (Creswell & Poth, 2016). In order to analyze the social phenomena implied in the recognition of interdependencies around AES, we first describe and detail three emergent collective action cases around AESs. These cases have not been previously studied in the literature. Secondly, we adopted an interpretive approach, which allows up to apply emerging theories in critical institutionalism to be carried out in ESs management. This combination of the descriptive and interpretative approach makes it possible to compare new initiatives situated in the Southern region of Quebec and to develop theoretical contributions drawing from empirical experiences.

Quebec's agriculture has undergone a trend of intensification and specialization, especially in southern Quebec, where most agricultural land is situated (Lehner et al., 2014; Parcerisas & Dupras, 2018). This trend is the result of technological and production changes during the 20th century, characterized by the replacement of pasture and traditional cereals by industrial-scale production of corn and soybean destined primarily for animal feed (Morisset & Couture, 2010). This landscape change led to serious environmental impacts such as biodiversity and habitat loss, soil erosion, and an increase in nutrient runoff affecting water quality in rural areas (Jeswiet & Hermsen, 2015; Terrado et al., 2015). The most intensified landscapes are situated in the Montérégie and the Centre-du-Québec administrative regions. The Montérégie comprises 6,880 farms, mainly of cereal and animal production (hogs and dairy), and composes 35% of the total agricultural production of Quebec (UPA, 2019). The Centre-du-Quebec comprises 3,300 farms, mainly of animal production (hog, dairy and poultry) and has around 11% of Quebec's farm land (UPA, 2019).

It is important to note that in southern Quebec there is a limited adoption of individual agri-environmental practices, despite the existing policies, suggesting that farmers require other specific types of motivation beyond just environmental concerns (Sager, 2004; Dagenais, 2016; Hénault-Ethier et al., 2019). Consequently, farmers' unions, watershed organizations and regional authorities have developed collective initiatives to increase the adoption of agri-environmental practices. We selected three collective-action initiatives to analyse the emergence of social-interdepencies around AESs.

The three initiatives aim to interlink providers and beneficiaries in the provision of AESs, through a direct payment to farmers (ALUS), the provision of advisor services and subsidies (Lake Boivin) and political coordination (MRC-Nicolet Yamaska). These examples were selected as they are new and emergent collective initiatives involving various stakeholders and presenting different governance structures and institutions. Figure 4.1 geographically situates each initiative.

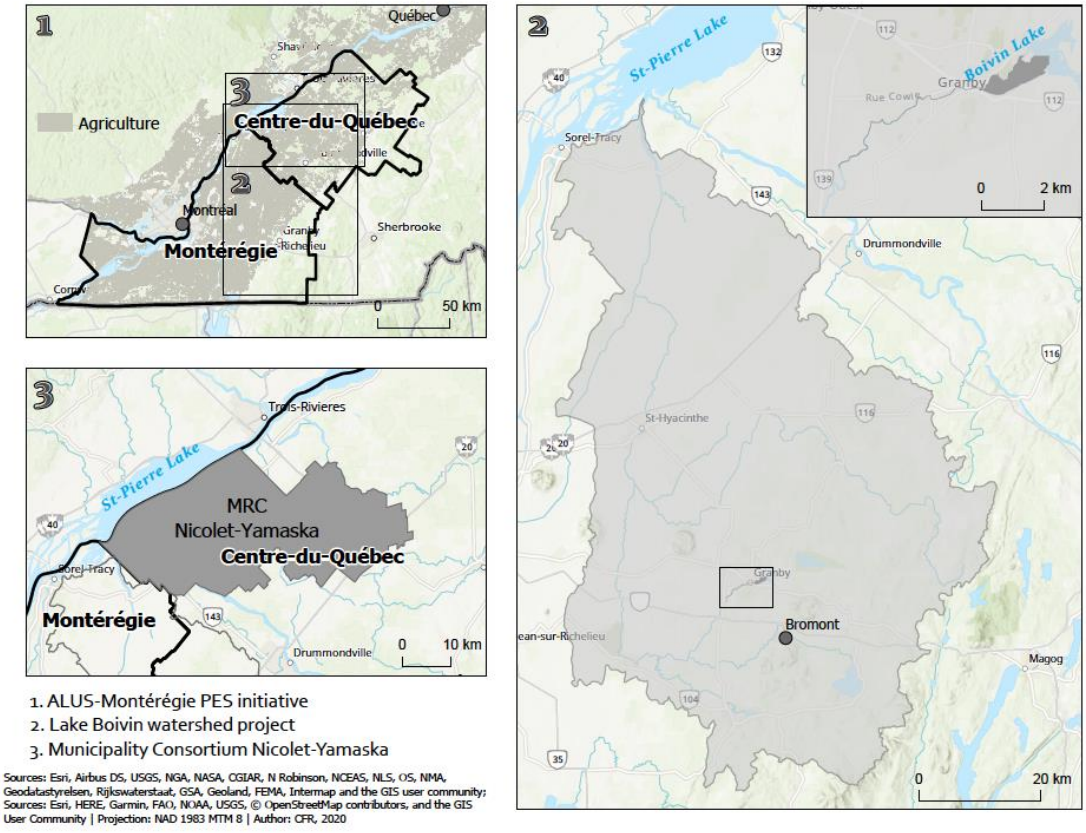

Figure 2: Region of study and geographical extend of the selected collective initiatives in Quebec.

2.2.1. ALUS – PESs initiative.

The Alternative Land Use Services (ALUS) payment for ecosystem services program operates in six Canadian provinces and aims to increase the provision of AESs by farmers. This program was launched in the Montérégie region in 2016 as the first-ever private PESs program in Quebec. ALUS is an NGO that receives financial support from the W. Garfield Weston Foundation, a private Canadian family foundation which directs a significant proportion of its philanthropic mandate to fund projects in nature conservation. The Quebec version of ALUS was established as a partnership between

ALUS Canada and the Federation of Agricultural Producers of the Montérégie (henceforth UPA[1]-Montérégie) which represents 11,000 farmers. The aim of the program is to encourage the provision of AESs by offering farmers a 5-year payment for the adoption of best management practices (riparian buffers, reforestation of wetlands, multifunctional hedges, windbreaks, flower meadows, or hedges for pollinators) to improve air, water quality, and biodiversity conservation. ALUS is collectively managed by the UPA-Montérégie with a partnership advisory committee (PAC) comprised of producers, agricultural stakeholders, environmental and watershed organizations (ALUS Canada, 2020). The targeted AESs, the rules of the program, and the accepted project are defined by the PAC, jointly with the UPA Montérégie, and ALUS Canada. Here is where coordination and cooperative action occurs. ALUS is presented as a "community-to-community-developed" program where each chapter determines "its own priorities while upholding a shared set of national principles" (ALUS Canada, 2020). The initiative started as a pilot project with 7 producers participating in the first phase, 15 additional producers joined the program in 2017–2018, and 21 new producers in 2018-2019.

2.2.2. Lake Boivin Watershed Project.

This project aims to increase the adoption of better land management practices to reduce environmental risks in an agricultural watershed. More important, it aims to increase the quality of drinking water for the city of Granby, situated downstream of the Lake Boivin watershed, a sub-basin of the Yamaska River. This project was developed by the watershed organization of the Yamaska River (henceforth OBV[2]-Yamaska) aiming to coordinate agri-environmental action in the watershed in

[1] UPA is an acronym for *Union des producteurs agricoles* (Agricultural producers union). The UPA is the only certified farmers' union in Quebec, and it is structured around regional federations.

[2] OBV is an acronym for *organisme de basin versant* (watershed organization) in French.

partnership with agricultural producers, city councils and other stakeholders. The Lake Boivin watershed includes 132 farms composed mainly of livestock producers (OBV Yamaska, 2018). The Lake Boivin watershed project included two phases. This first was a recognition phase (2017–2018) of the state of AESs in the watershed with funding from the Ministry of Agriculture of Quebec (through the Prime-Vert program), with matching funds from the city of Granby, a city with a population over 60,000, and the Haut-Yamaska regional municipal council. This phase involved a partnership between OBV Yamaska and the IRDA (Research and Development Institute for the Environment). The second phase is a knowledge-transmission phase (2019–2021) recently financed by the Ministry, aiming to mobilize producers to adopt best management practices in the basin through the support of extension services coupled with governmental subsidies.

2.2.3. Municipality Consortium- Nicolet–Yamaska.

The third initiative is the development plan of agricultural zones in the Municipal county of Nicolet-Yamaska (henceforth MRC Nicolet-Yamaska) adopted in 2017. In this plan, 16 municipalities voluntary engaged to identify and develop collective solutions to agri-environmental issues aiming to enhance water quality in Lake Saint-Pierre, an UNESCO Biosphere Reserve and RAMSAR site. Their common political goal was to encourage, support and stimulate sustainable agriculture and encourage ecological restoration in agricultural lands (Bissonnette & Dupras, 2018). As a response to political pressure from municipal and agricultural actors, the MRC Nicolet-Yamaska wanted to change the image of the region and to coordinate actions at the landscape level through a consortium of agricultural municipalities. To do so, they created a coordination committee to consider agri-environmental issues with representatives of different municipalities, advisors, the farmers' union, and watershed organizations. This committee first involved a consultation process to identify and

document alternatives to collectively promote the improvement of agri-environmental practices in the municipality (Bissonnette & Dupras, 2018).

2.3.Semi-structured interviews

The descriptive and interpretative case study approach allows the use of multiple data collection and analysis methods (Avenier & Thomas, 2015). As a main data collection method, we conducted semi-structured interviews with 44 stakeholders involved in agri-environmental land management programs in Southern and Central Quebec between December 2017 and January 2019. Following the theoretical framework, interview questions covered themes such as the presence of programs for the management of AESs; the functioning of incentives for collective action (role of intermediaries, producer outreach, farmer's participation); the history and process of emergence of such projects (political steps, questions of power, influence of different intermediaries); the institutional context of their implementation (levels of organization, institutions, relations between actors); the perception of participants towards the initiative; and their motivation and interest to engage in collective action around AESs. The interview guide is presented in annex one, as supplementary material. This data was completed by technical document analysis.

The recruitment of the respondents was initially conducted through targeted phone calls and emails. We first targeted the managing organization of each initiative such as the UPA-Montérégie for the ALUS program, the OBV Yamaska for the Lake Boivin project and the MRC Nicolet-Yamaska for their new agricultural policies. These first interviews served as pilots to adapt the interview questions to each case study and to identify the main stakeholders involved in each initiative. With the help of the managing organization, we recruited farmers and intermediaries involved closely in the development of such collective initiatives. Table 2 details the total number of participants. The numbers of participants for each category and each case study was

contingent upon the type and number of stakeholders involved in each initiative. For instance, ALUS and Lake Boivin have a lower number stakeholders involved closely in the management and outreach, compared to the Nicolet-Yamaska MRC.

The average length of interviews were of 60 minutes. The recruitment was stopped when the discussion reached saturation in terms of identifying the social processes involved in the emergence of collective action. Saturation was reached relatively quickly, partly due to the limited number of actors involved in each case. Moreover, field visits and participatory observations including farmers' meetings (3), stakeholder meetings involving local governments and environmental organizations (2), information sessions (2), and on farm demonstrations (1) were performed. These observations were key to contextualize each collective agri-environmental project, the role of stakeholders, and to observe and identify potential power asymmetries between actors.

Table 2: Interviewed stakeholders according to each collective initiative in southern Quebec.

Actors	**ALUS**	**Lake Boivin**	**MRC Nicolet-Yamaska**
Farmers	4	3	4
Agronomists and support services	3	2	3
Municipal and regional representatives	1		5
Farmers' union: representatives and staff	3	2	3
Watershed organizations	1	3	3
Environmental and development NGO	0	2	3
Total	12	12	21

2.4.Content analysis

Interviews and fieldwork notes were transcribed and qualitatively coded using the NVivo 12 software. Interviews were coded by the first two authors (double coding) and

391 thematic categories were discussed with the research team. The data were coded
392 according to the interdependencies framework (Barnaud et al. 2018) to describe each
393 initiative (see Table 1) focusing on the role of actors, the social interdependencies they
394 identified, and the main dimensions of those social interdependencies. Secondly, we
395 developed and applied a coding grid (Table 3) focusing on the emergent elements that
396 played a role in the process of recognition of social interdependencies, such as new
397 collective institutional spaces, the presence of power relations, the role of
398 intermediaries, and the political process involved. This last coding grid helped both to
399 organize the data and to theorize the social processes involved in the collective
400 recognition of interdependencies.
401
402 Table 3: Coding grid on the themes around the collective recognition of
403 interdependencies.

Overarching themes	**Categories**	**Subthemes**
Collective institutional spaces	Actors' awareness	common problems; mutual dependency; common interests
	New relations among actors	with neighbors; with advisors; reciprocity; trust; collective pride.
	Unusual and new collective spaces	Meetings; farm activities; discussions next to tractors; committees
Power relations	Influential actors	Farmers' associations; funding agencies; elected officials (political will)
	Resources	lack of financial resources; decision-making powers; legislative power; organisational power
Intermediaries	Social links	Trust; connections to funding; connections with the community
	Outreach	individual requests; mapping of producers
	Accompaniment	Knowledge transmission, access to programs (incentives)
Political process	Level of governance	Municipalities and local officials; MRC initiative, the role of the government; role of the facilitator/organization; farmers' autonomy
	History of collective action	Previous motivations of actors; previous initiatives

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3. RESULTS

3.1. Recognizing social interdependencies

Our analysis illustrates how each of the cases aims at balancing asymmetrical relations between producers and beneficiaries by generating mutual benefits derived from collective action around AESs. These mutual benefits are the main social interdependencies fostered by the projects. During the interviews and meetings, participants emphasized that such co-benefits and mutual interest, sometimes explicit, sometimes tacit, serve as their main motivations for engaging in these projects. We therefore focused our analysis on the process of recognizing social interdependencies around the perceived mutual benefits. These relations of mutual benefit are just a selection of the many relations around AESs. We acknowledge that asymmetrical relations might continue to exist (benefits for one group can be a nuisance for others). Such interdependencies, influenced by uneven power relations, were referred to during discussions as relations that need to be balanced and transformed through payments, advisor support, or political coordination. The ways by which actors navigate asymmetries of power through the introduction of new institutions or the modification of existing ones illustrates the means by which bricolage takes place in response to everyday social interdependencies. Table 4 summarizes the type of actors involved, the social interdependencies witnessed, as well as their dimensions.

431 Table 4: Social roles, social interdependencies and dimensions of three collective action initiatives in Southern Quebec

		ALUS -Montérégie	Lake Boivin watershed project	MRC Nicolet-Yamaska
Action arena		Montérégie region	Lake Boivin watershed	MRC Nicolet-Yamaska
Targeted ecosystem services		Water quality ·biodiversity ·carbon sequestration ·landscape quality	Control soil erosion ·water quality	Landscape quality ·water quality
Social roles	**Beneficiaries**	Farmers ·rural communities in Montérégie ·citizens of nearby municipalities	Farmers ·rural communities in the watershed ·nearby municipalities (Granby)	Municipalities in the MRC ·farmers ·users of the watersheds (Lake Saint-Pierre)
	Providers	Enrolled farmers in Montérégie	Farmers in the watershed	Farmers and land owners of the targeted municipalities
	Intermediaries	·Regional Farmers Union (UPA-Montérégie) ·ALUS coordinators ·farm advisors ·ALUS Canada ·watershed organizations (COVABAR, OBV Missisquoi) ·Agricultural Ministry (MAPAQ) ·Rural municipalities (Saint-Jean-sur-Richelieu), private partners (Soleno)	·Watershed organizations-OBV Yamaska ·Farm advisors ·Agricultural Ministry ·Rural municipalities (Granby) ·Research Centre (INRA) ·Farmers Union (UPA) ·biodiversity conservation groups.	·MRC Nicolet Yamaska (16 municipalities) ·Farm advisors ·Farmers Union (UPA) ·Research consultants (Eco-2Urb), watershed organizations (OBV), community leaders.
Social Interdependencies (mutual benefits identified by actors)	**Beneficiaries–beneficiaries**	Improvement of water quality and decrease of the cost of "cleaning the river."	Improve drinking water quality for Granby. Improve landscape aesthetics.	Improve the environmental image in the region.
	Providers-Providers	Shared desire to project a positive image as a farmer (collective pride)	Share interest in establishing links with farm advisors and governments to increase sources of funding	Project a positive image of farmers and set up incentive mechanisms to improve practices

	Beneficiaries–providers	·Balancing asymmetrical relations through payment for ESs. ·Dependence on advisory and incentives to be connected. ·Increase social recognition of the role of farmers in the protection of ESs.	Balancing asymmetrical relations through advisor support and potential subsidies.	Balancing asymmetrical relations through the coordination of a political process. The outcomes have not yet to be implemented.
Dimensions of social interdependencies	**Cognitive framing of interdependence**	·Increasing common knowledge on the state of the region and on agricultural practices and benefits from ESs through workshops, farm visits, farmers' meeting and exchanges. ·Intermediaries play an important role in mobilizing farmers and knowledge transmission.	There is an increase in awareness of the state of ESs through research. Farm advisors and the OBV play an important role– reaching out to farmers (knowledge transmission) Intermediaries link actors in the watershed through stakeholder roundtables and knowledge mobilization activities.	Increasing knowledge and awareness among stakeholders on governance strategies of ESs through research and spaces of discussion.
	Levels of organization	·The program is managed at the regional level. ·This region covers 10 main watersheds (water services) ·Political decisions are taken at the province level, MRC level and municipal (institutional mismatch)	·The project is managed at the watershed level (ecological level for the water service). ·Political decisions are taken at the municipal and provincial level (institutional mismatch)	·The initiative is managed at the MRC level involving 16 municipalities, and a main watershed (Yamaska and Lake St Pierre). ·Some political decisions can be made at the MRC level, but most take place at the provincial level (institutional mismatch.)
	Institutions	·Formal: PESs contracts, UPA organization, Partnership advisory committee (PAC.)	·Formal: Lake Boivin project, Agri-environmental	·Formal: the Development plan for the agricultural areas of the MRC (PDZA), the

		·Informal: collective action days (planting), norms of trust between farmers, coordinators and advisors, new spaces for discussion.	diagnostic tools (PAA), MAPAQ subsidies contracts ·Informal: new spaces for discussions (roundtables) and developing trust relations between advisors and farmers	municipalities involved and their rules. ·Informal: Local working group on agri-environmental issues, citizens and farmers for the environment of Sainte-Monique (village), networks of municipal political leaders.
	Power relations	·The UPA and ALUS Canada delimit rules of participation. ·Uncertain sources of funding. ·Intermediaries are the main source of knowledge and of mobilization efforts. Pre-existing relationships between intermediaries and farmers influence adoption. ·Upwardly mobile "first-movers" or champions are more likely to adopt ALUS than average farmers. ·External market pressures continue to influence land use decisions.	·The main source of funding is governments, influencing outcomes, aim, and duration of the project. ·Intermediaries are the main sources of knowledge and mobilization efforts. Pre-existing relationships between intermediaries and farmers influence adoption. ·External market pressures continue to influence land use decisions.	·Elected mayors at roundtables can shape the outcomes as it is part of a political strategy. ·Advisors have less political power but have more knowledge of the region. ·Sources of funding are unknown. ·External market pressures continue to influence land-use decisions

Our analyses focused on the processes by which awareness and acknowledgement of the detailed social interdependencies is developed (cognitive framing of interdependencies) in each strategy. Overall our results show that such recognition occurs through the generation of social capital through 1) new social links among actors promoted by intermediaries, 2) political process of consultation and negotiation and 3) the emergence of new institutional spaces sometimes at the margin of each initiative.

3.1.1. Intermediaries as social catalyzers

The relations between providers (farmers) and intermediaries are key in increasing awareness of the interdependencies around the provision of AESs. Respondent farmers mentioned relying on intermediaries "*knocking at their door*" to be involved in the ALUS-PESs and Lake Boivin programs, and to learn more about the offered land management practices. Respondents also identified a need for "*a human follow-up*" as one farmer stated during an interview, referring to the necessity to be accompanied by someone capable of listening to their concerns, and in making connections between on-farm needs, agronomic tools and actions at the farm level. In the case of ALUS, the knowledge transmission from farm advisors, the efforts of the UPA-Montérégie coordinators, and the organization of open farm days were also mentioned by stakeholders as being key to engage in land use change. As one of the ALUS-PESs coordinators stated.

"*After the open farm day, we had neighbours who contacted us and we are starting ALUS projects on their lands now. This is a typical example of when we do an activity and farmers see the outcomes, it motivates them to participate. We often get calls from producers that have not worked with us yet asking for more information about ALUS"*– Agri-environmental coordinator.

These new and sometimes invisible interactions show that participation to collective strategies rely on the development of social capital and relations between providers of AESs, or between providers and intermediaries. In the case of ALUS, these links go beyond the PESs governance structure and contract, and recognize the connectivity between actors at the landscape level in the management of AESs.

"*Municipalities and regional counties want to join ALUS; they need to do it. People understand that there is a benefit in doing this. There are more and more actors involved,*

ALUS mobilizes them and it is gaining momentum. It goes beyond the conservation community as it becomes a social project"–Agri-environmental coordinator.

We therefore observe the creation of new social links and connections at different levels of organization beyond the established governance of this project. In the case of Lake Boivin project, respondents additionally stressed the importance of developing links between participant producers, farm advisors and the watershed organization to develop awareness of the state of AESs and the actions that can be taken collectively in the region. After a land use recognition phase, producers in the Lake Boivin were directly contacted by advisors to share environmental solutions and to complete a diagnostic and action-based tool to increase best management practices on the farm. Through knowledge transmission and social discussion, the project increased the number of farmers developing agri-environmental action plans. This was not an easy task for advisors, especially in reaching out to farmers and communicating the aims of the project. Initially, farmers were reluctant to share information or meet with the advisors from the watershed organization:

"*At first, I did not understand why they were calling me, and why we were doing this. I already have an advisor I said […] But, then, I realized I did not know much about the agri-environmental services or programs in the region, it was the first time I learn about all this*" Farmer 2.

"*The one-on-one meeting changes everything. If you just give the information on a piece of paper, it won't stick. But when we are one-on-one, we talk about their problem and we tell them that everyone has the same problem as him, and then we realize we can do something to make a change in the region*." Farm advisor.

These insights illustrate the importance of developing links of trust between intermediaries and providers. Intermediaries act as catalyzers for the recognition of social interdependencies through informal exchange and trust building between them and providers of ESs, increasing awareness around the collective and social nature of soil and water problems, not necessarily specific to a single farm.

In the case of the ALUS-PESs initiative, it is important to mention that the program is still in a development state, representing only a small minority of farmers in the Montérégie region. Consequently, the social or ecological impact of the program is as of now difficult

to evaluate. However, based on our observations, it is possible that the future of the program relies more on the strengthening of social capital than on the payment itself.

3.1.2. Political process

The initiative of the municipal county (MRC) Nicolet-Yamaska differs from the ALUS-PESs and Lake Boivin cases, as the collective recognition of interdependencies and the process of coordination itself emerges from a political process. In the region, influential agri-environmental stakeholders such as the local farmers' union, watershed organizations, members of conservation initiatives and agronomists from local non-profit organizations had historically tried to unite by pooling resources together and better coordinating actions for the provision of AESs. At first, stakeholders created an informal structure that relied upon the willingness of local participants to invest time in an attempt to coordinate agri-environmental efforts. Some farmers had also demonstrated leadership in developing agri-environment cooperatives. Despite repeated attempts, specific initiatives were led by a single organization and there was little monitoring, integration capacity, nor any attempts to scale up efforts in the area. As a consequence, the involved stakeholders called upon the MRC of Nicolet-Yamaska to demand better coordination of agri-environmental initiatives. As mentioned by one influential actor engaged during this process:

"*It's been a long time since we are talking about doing something to better join forces to improve the effectiveness of our actions on agri-environmental issues. Some of us have been trying to meet regularly to discuss possible actions, but it seems to always fall short, it's not because of a lack of will, that's for sure, but we would need a real structure and perhaps paid staff to organize us*."- Municipal mayor.

Change in the governance context with new directorships in the MRC, along with renewed pressure from vocal mayors from local municipalities provided the impetus to determine common political goals. This was established in the MRC's agricultural development plan aiming to encourage, support and stimulate sustainable agriculture and encourage ecological restoration on agricultural lands. This political step was crucial to begin recognizing socio-ecological interdependencies at the landscape level for the provision of AESs. The MRC consequently formed a coordination agri-environmental committee that

in the summer of 2018 hired an external consulting firm mandated to design a participative roadmap to coordinate environmental actions at the MRC scale. After reviewing potential initiatives and assessing the social and financial conditions of their implementation, the consultations resulted in the delineation of initiatives that could eventually improve the level of cooperation among actors.

Respondents mentioned that not everyone agreed that the leadership should be exercised by the MRC. This sentiment was particularly shared by members of the farming community who had been involved for many years in agri-environmental initiatives. They believed that the farming community should be provided with more resources and autonomy to deal with environmental issues.

"*We, farmers, don't necessarily agree on what we should do, but many of us have been doing a lot to improve water quality or reduce erosion, and we don't feel like any of these efforts have been recognized or compensated. We are willing to keep participating in new initiatives, but we don't want to feel like everything's our fault that we are the bad guys*."
– Union leader

As stated by this union leader, providers of ESs feel that the recognition of social interdependence, the link between their ecological-oriented land use practices and the social value of such practices, needs to be further developed in the region. They furthermore perceived that particular political initiatives such as the consultation process offer an important way to increase the social recognition of their efforts. The consultation process revealed that actions carried out by actors (e.g. farmers, agronomists, watershed organizations) in the MRC as a whole would benefit from better cooperation to improve the complementarity between the interventions and the achievement of both socially and ecologically compatible outcomes.

3.1.3. New institutions and spaces

In the three cases, we observed the emergence of new institutions and spaces that recognize that actors rely on each other for agri-environmental innovation, and farmers among themselves for the provision of AESs at the landscape level. In the case of the MRC

Nicolet-Yamaska, we observe a formalization of institutional spaces fueled by the political will of influential actors. The political process described created new institutions such as the "agricultural development plan" and formal spaces for political action (e.g. the agri-environmental committee), with the MRC aiming to structure the coordination of the provision of AESs in the region. Participants also identified that efforts to raise awareness and disseminate information should continue, particularly with regards to the adoption of practices that could improve the quality of water and the health of soils, as well as the enhancement of forest and agroforestry systems. The continuity of the MRC-supported agri-environmental coordination committee and other coordination efforts will depend on the political cohesion between stakeholders, the identification of coordinated actions with the support of agri-environmental intermediaries, and collective efforts to realize such actions.

In the case of *ALUS-PESs*, informal spaces were formed at the margins of the more formalized institutionalized actions of the program. For instance, ALUS organizes member meetings as luncheons and festive gatherings to recognize the efforts of enrolled farmers while handing out their annual payment. During these meetings, farmers share their experience and their motivations for being a member of the ALUS Montérégie community. While these opportunities to speak and share experience is not a mandatory practice of the program, but it has become a recurrent and important moment of collective pride, not only in sharing experience but also in showcasing proactive efforts towards agri-environmental best practice and as a communication experience for regional media to report these experiences in local newspapers. As farmers stated during one annual meeting.

"*It is encouraging to have people who accompany you, and the implementation team is really good too, it motives me to continue to act with others. For instance, all the support we got during the planting of the hedgerow, from the school and neighbours, it showed that we are a community*."–Farmer 1

The producer in question was proud to mention that his reforestation project obtained unexpected help from students from a nearby high school in what became an informal "planting day." This event combined with informal sharing habits results in the recognition

of mutual benefits of actions that encourage the provision of AESs, a process that relies on the strengthening of social capital by the project.

In the Lake Boivin case, the OBV held workshops with producers and stakeholders to present the results of the modelling of agricultural land use on the watershed, the state of the collectively selected ESs (soil and water quality), and potential approaches and solutions available to farmers. Respondents stated that these meetings were important spaces to discuss issues around water management and to foster renewed relationships between actors in the watershed. Respondents claimed that such exchange spaces involving research outputs and discussion with farmers contributed to increasing collective pride with some farmers claiming to have "*seen their farm on the map*" as well as the overall contribution of agricultural land to the health of the watershed.

Moreover, respondents in ALUS-PESs and Lake Boivin stated that informal meetings "*next to the tractors*" offered opportunities to talk about land and environmental issues ways that did not involve putting farmers on the spot. These informal meetings also offered the space to discuss longer-term concerns over who will take up farming in subsequent generations. Farmers acknowledged the lack of collective spaces to informally discuss any agri-environmental problem:

"*We don't have a lot of room for this. We have local producer meeting but we only talk about production or economic issues. Sometimes the agri-environmental clubs do some activities, but it is only for their members*" Farmer 3- Lake Boivin.

In response to this need, in the summer of 2018, a stakeholder roundtable was established to collectively discuss and organize around ecological problems in the Lake Boivin watershed, together with local municipalities and environmental organizations. This project aims in the following years to continue creating spaces to discuss with farmers (now around 40), and to develop custom-made approaches for each participant involving access to agri-environmental subsidies. Through increasing access to subsides and knowledge transmission activities, the Lake Boivin project aimed to increase mutually beneficial

relations between providers and beneficiaries, valorizing collective efforts of farmers to improve AESs.

3.2.Power relations

In the case studies, we observed power asymmetries based both in terms of access to allocative resources (e.g. time and funding) as well to authoritative resources (e.g. political arenas for decision-making, organizations). During the interviews, intermediaries involved in the ALUS and Lake Boivin projects discussed the continuous lack of financing (allocative resources), and their dependence on external resources to continue the development of the collective projects. This systemic dependency on external funding slowed down the collective process and generated uncertainties for the future of cooperation. As stated by the following actors,

"*The money that we get from the government for the first phase was not enough. We did not lose a lot of money, but we had to cut the budget allocated to the meetings with producers. The follow-up phase has been accepted, we are really happy, but stressed as we need to plan it well so we do not penalize the producers*." – Manager – Lake Boivin watershed project

"*We spend a lot of time talking with the farmers, and then we don't count the number of hours, and at the end it goes beyond our rates. But we know that this helps so much in the project, makes things move forward by earning their trust*" Farm advisor - ALUS

These intermediaries showcase how their dependence on external resources gives power to the authorities and funding agencies in determining the rules for exactly how mechanisms to collectively manage AESs should be implemented in practice. The stress and uncertainty caused by short-term funding illustrates the ways by which governments or private organizations exert power, as the result of short-term allocative decisions influencing the strategies of actors implementing projects on the ground, often with minimal resources at their disposal. This power asymmetry implies that intermediaries are not able to rely on assured, long-term financial resources to promote activities that encourage and solidify sustainable social relations in the long term.

In the case of MRC Nicolet-Yamaska, the development of new coordinated actions is based on a common political aim shaped through a from the process of policy bricolage. Here, we can observe that political pressure and negotiation led to the adaptation of the regional development strategy that created a unique formal space assembling local governments, farmers and intermediaries, and reflecting evolving stakeholders' aims and interests. This space is currently conceived as key for cooperation around AESs in the region. However, despite being a product of collective pressure, this adapted development strategy for the MRC relies mainly on the political will of the regional council. We thus witness a tangible political asymmetry between elected officials that have more authoritative resources in the form of decision-making power and political influence and farmers or agri-environmental councilors when it comes to orienting political decisions at the regional level. Changes in the configuration of the council (e.g. representatives of 16 municipalities) or political and economic instabilities might play a role in the long-term permanence of any further collective action and the recognition of socio-ecological interdependencies at the regional level. In turn, these changing relationships will invariably influence the mutual dependency between actors in the provision of ESs.

A less tangible but influential power relation is the role that the UPA, the primary farmers' union of Quebec, plays in each initiative. Following the producer's law of Quebec, the UPA benefits from a "union monopoly" by being the only entity credited to represent all farmers in Quebec to the provincial government (Morisset & Couture, 2010). Collective involvement and membership among farmers to the UPA in the province are a key feature of Quebec's agricultural governance structure, playing an important role in the protection of supply management, family farms and rural lifestyles (Morisset & Couture, 2010). In recent decades, the UPA has been mainly associated with ensuring the protection of profit generation for Quebec's agribusiness industries. With this powerful "monopoly" status, they can equally act as the veto voice of farmers, expressing supposed unanimous interests and goals of farmers, even as farms and farmers are clearly not homogenous (Dupont, 2009; Morisset & Couture, 2010). Through their authoritative resources (e.g. political status, influence and structure), the UPA is well placed to shape the design of initiatives like ALUS-PESs, in strategic ways to influence farmer involvement in watershed

694 management like the Lake Boivin project, or to influence political decisions in the case of
695 the MRC Nicolet-Yamaska. At the same time, they could potentially impact the outcomes
696 of agri-environmental action at the landscape level in positive ways by serving as the
697 vehicle to mobilize farmers and promote awareness-raising among all producers in a
698 particular region or for the province as a whole.
699
700 However, the UPA has largely exercised its political influence to protect powerful
701 production interests or to claim for compensation for any yields and profits lost, as shown
702 for instance during the free-trade negotiations between Canada and the European Union.
703 The influence of the UPA has also been evident in their opposition to production
704 moratoriums to decrease the environmental pressure from industrial hog farming (Dupont,
705 2009). In other words, if political views or interests of the UPA are in confrontation with
706 those of other stakeholders, for instance for increasing conservation areas on land otherwise
707 meant for intensive production, their role can certainly present a systemic obstacle for
708 genuine collective action. This exercise of power could hamper the emergence of spaces
709 or mechanisms for the recognition of socio-ecological interdependencies, the strengthening
710 of trust relations (social capital), and therefore the emergence of collective action for the
711 managing of agri-environmental landscapes.
712
713 Finally, in the three cases, we observed a lack of political autonomy at the watershed or
714 landscape level since the level of political intervention does not match the ecological scale
715 of the co-production of AESs. Even if new spaces to manage AESs are created, these
716 institutions do not have the authoritative resources to generate legislative, regulatory or
717 coercive mechanisms to exercise any type of collective landscape governance of ESs. In
718 the case of the MRC, even if there exists sufficient political will, the overarching
719 institutions in charge of environmental regulations remain under the legislative power of
720 the provincial government. This institutional mismatch represents a further obstacle for
721 fostering spatially and temporally relevant collective action for agri-environmental
722 landscapes.
723

When we examine how power dynamics shape the mechanisms and institutions involved in recognizing social interdependencies for collective action, we observe that they often go through a process of institutional bricolage (Cleaver, 2002) By this we mean that eventual outcomes for agri-environmental action involve the collective piecing together of strategies shaped by the (in)capacity to exert agency and autonomy in decision-making as embedded in the power relation between actors. Bricolage implies that actors improvise allocative (e.g. financing opportunities), and authoritative resources (e.g. professionalized expertise, government institutions, political discourses) in an everyday context of negotiation and adaptation between the goal of achieving cooperation and in achieving their own interests as beneficiaries, providers or intermediaries. In the documented cases, it is not only the introduction of policy tools for developing collective action that influence the recognition of social interdependencies around ESs, but also the creation of new, formal or informal, socially embedded spaces and strategies shaped by the availability of resources and the exercise of power.

4. DISCUSSION

The collective initiatives described here contribute to illustrating the social processes involved in the recognition of social interdependencies around AESs. Such co-dependent and mutually beneficial relations are acknowledged through the emergence of new institutions and spaces beyond already established actions, and sometimes at the margins of the main initiative. New visible and invisible social interactions are developed according to relations of trust between intermediaries and providers that emerge from informal exchange and political negotiation, resulting in spaces for collectivization around agri-environmental issues. While the three examples do not appear to be collective actions yet; they do result in the reinforcement of the recognition of interdependencies between actors, which according to Barnaud et al. (2018), offers a crucial intermediary step towards achieving collective action.

Our results indicate as well that social interdependencies around AESs might not be well defined by actors at the start of agri-environmental interventions, but instead become co-

constructed through new exchanges and collective practices (Jacoby & Ochs, 1995). Cooperation is based on constant (re)negotiation and adaptation (De Koning & Cleaver, 2012), whereby intermediaries (e.g. agronomists, environmental coordinators, NGOs) play a key role in catalyzing the reinforcement of existing social networks or opening opportunities for new social relations (Bird & Barnes, 2014; Schomers et al., 2015). These new visible and invisible interactions are developed in accordance with growing relations of trust that emerge from both informal exchange and more formal political negotiation. The potential outcome of these interactions results in spaces of collectivization around agri-environmental concern.

To this end, we observed gains in social capital, especially in new relations of trust and ongoing engagement between providers and intermediaries, which did not exist before the initiation of these programs. These conclusions are in line with literature on the ways collective landscape governance can be reinforced by the strengthening of social capital through the development of social networks and the building of reciprocal links of trust (Pretty & Smith, 2004; Van Gossum et al., 2005; Polman & Slangen, 2008; Six et al., 2015; Westerink et al., 2017). Our analysis goes a step further by discussing how the development of social capital for collective action is influenced by uneven power relations, characterized by the control over material and non-material resources (Franks & Cleaver, 2007). To this end, the social processes involved in the recognition of interdependencies are directed through a process of institutional bricolage, whereby social links are continuously (re)constructed by actors, both at the interface of formal and informal institutions, but most importantly under the influence of existing power asymmetries. We argue that analysing how power shapes processes of recognizing social interdependencies, and the development of social capital contributes to studies of ESs governance, complementing the conceptual framework proposed by Barnaud et al. (2018).

Our analysis has focused on the collective recognition of mutual benefits for providers and beneficiaries of ESs, identified as their main motivations to engage in collective provision

of AESs. We acknowledge that the selected and discussed interdependencies do not cover the full range of interlinkages and interdependencies among actors, as such relations might not only be beneficial but also asymmetrical (e.g. benefits for some groups imply less benefit for others) or mutually detrimental. For instance, the economic and social benefits of agri-environmental ESs within commodity crop production (e.g. soy, maize) create economic benefits for those involved in commodity supply chains, but they do less to structurally alter the market-driven imperative to intensify land use in the long-term, resulting in environmental consequences for those in surrounding areas (Kolinjivadi et al., 2020). To this end, we acknowledge the presence of long-term tradeoffs between intensive land uses, focused on increasing food production and yields, and conservation practices to improve the quality of regulation services (water quality, erosion, among others). These dynamics tend to be neglected in studies of collective action initiatives. We therefore offer a caveat in framing collective action too narrowly, only in terms of positive socio-ecological interdependencies, social capital, ESs and negotiation around incentive-based mechanisms while neglecting the overarching drivers of market-driven land-use intensification.

Conflicts between providers and beneficiaries (negative social interdependencies) around land uses might persist and could become a long-term obstacle to the emergence of further collective action. The studied initiatives do not present mechanisms to resolve such land use conflicts or underlying drivers of land-use intensification as they are based on the voluntary participation of actors. Such conflicts must be further taken into account, particularly in terms of how they enable or disable collective production of AESs in the long-term. As such, conflicts, through the framework used in this research (Barnaud et al. 2018) must be apprehended as *normal* in the process of engagement and disengagement in collective action, rather than an anomaly that needs to be technically corrected for. Conflicts can be the outcome of competing demands for resources or distinct framing of responsibilities resulting from negative interdependencies (Ferreyra et al., 2008). Collective action around AESs must therefore be conceptualized as an open-ended process, where conflicts are expected to emerge as potential outcomes. The challenge remains for intermediaries to identify latent conflicts in order to prevent escalation into more

intractable forms of alienation or distrust (Emery et al., 2015 cited by Reed et al. 2018). To this end, the intervention of a neutral mediator can be helpful to reach an agreement, usually by providing negotiated stakeholder-directed solutions, rather than a solution imposed by an outside judge (Reed et al., 2018).

In terms of policy implications, our results illustrate that farmers rely on outreach and social activities as a way to inform themselves and to gain further access to knowledge and conservation opportunities. However, funding sources for collective initiatives do not always cover all costs associated with increasing cooperation (e.g. meetings, forums, follow-ups). Indeed, these transaction costs are not fully considered in the design of projects as they remain difficult to account for and to evaluate in terms of the required labor (e.g. time and effort) exerted by intermediaries (Mills et al., 2011; McCann, 2013). The financial uncertainty leaves little room to maintain long-term confidence in the relationships that emerge, which are crucial for solidifying the recognition of social interdependencies and ultimately collective action for socio-ecological transformation. In order to foster collective action in the generation of ESs, funding sources would need to be sensitive to the hidden costs of sharing and developing awareness on the connectivity between actors, uneven relations of power, conflict emergence and resolution, as well as the resources these efforts would require.

Those who design policy should be aware that the process towards collective action is complex and attention must be paid to situated experiences of policies and programs as they combine with other institutional structures and the ways these experiences are profoundly influenced by power dynamics. For instance, the emergence of informal spaces and exchanges suggests that everyday negotiations and less visible interactions offer the potential to circumvent mistrust and generate connections rooted in care between farmers and farm advisors, subsequently encouraging future cooperation and engagement. As a result, new social interactions become both shaped and limited by the availability of resources, such as time and funding (allocative resources), by broader political narratives and decision-making strategies (authoritatives resources).

CONCLUSION

Our results contribute to the characterization of the social processes involved in the emergence of collective initiatives around AESs. First, the three cases studied reveal that new institutional spaces frame the way social interdependencies are recognized beyond already established actions. Second, relationships of trust (e.g. social capital) is strengthened through new social interactions based on a relation of trust between intermediaries and providers of AESs. Third, such relations are forged through political processes, characterized by formal political negotiation and informal exchange among actors, resulting in spaces of discussion and collectivization around agri-environmental issues. These social processes have the potential to strengthen the recognition of interdependencies between actors, as a crucial intermediary step influencing the potential of collective action. We observe that such social interdependencies around AESs might not be well defined by actors at the beginning of each initiative, but are rather co-defined and co-constructed through continuous negotiation between involved actors. This process of institutional bricolage, influenced by uneven power relations (access to allocative or authoritative resources), will ceaselessly influence the potential development of collective action.

In sum, our work generates insights towards the processes leading to collective action around AESs. We highlight the role of social interactions, political processes and emergent spaces in the development of collective awareness of social interdependencies around the managed AESs. Even if such interactions might be judged as secondary during policy implementation, the very fact that these conversations and exchanges occur "next to the tractors" offers a helpful imaginary of how trust relations and social capital should not be overlooked when determining the success or failure of agri-environmental measures. Collective initiatives around ESs stand to gain from the inclusion of spaces and strategies, where social interconnections are built as crucial pillars for collective action around ESs.

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Bibliography

ALUS Canada. (2020). *Communities*. ALUS Canada. http://alus.ca/home/communities/

Avenier, M.-J., & Thomas, C. (2015). Finding one's way around various methodological guidelines for doing rigorous case studies : A comparison of four epistemological frameworks. *Systemes d'information management*, *20*(1), 61-98.

Barnaud, C. & Antona, M. (2014). Deconstructing ecosystem services : Uncertainties and controversies around a socially constructed concept. *Geoforum*, *56*, 113-123.

Barnaud, C., Corbera, E., Muradian, R., Salliou, N., Sirami, C., Vialatte, A., Choisis, J.-P., Dendoncker, N., Mathevet, R., & Moreau, C. (2018). Ecosystem services, social interdependencies, and collective action. *Ecology and Society*, *23*(1).

Bird, C. & Barnes, J. (2014). Scaling up community activism : The role of intermediaries in collective approaches to community energy. *People, Place & Policy Online*, *8*(3).

Bissonnette, J.-F., & Dupras, J. (2018). *Rapport des consultations réalisées dans le cadre du projet : « Un paysage à cultiver »*. Eco2Urb.

Cleaver, F. (2002). Reinventing Institutions : Bricolage and the Social Embeddedness of Natural Resource Management. *The European Journal of Development Research*, *14*(2), 11-30. https://doi.org/10.1080/714000425

Cleaver, F. (2007). Understanding agency in collective action. *Journal of human development*, *8*(2), 223-244.

Cleaver, F. & Whaley, L. (2018). Understanding process, power, and meaning in adaptive governance. *Ecology and Society*, *23*(2).

Creswell, J. W. & Poth, C. N. (2016). *Qualitative inquiry and research design : Choosing among five approaches*. Sage publications.

Dagenais, G. (2016). *Analyse stratégique de la gouvernance de l'eau en milieu agricole : Normes, acteurs, enjeux, stratégies*.

De Koning, J., & Cleaver, F. (2012). Institutional bricolage in community forestry : An agenda for future research. Dans *Forest-people interfaces* (p. 277-290). Springer.

de Vries, J. R., van der Zee, E., Beunen, R., Kat, R., & Feindt, P. H. (2019). Trusting the People and the System. The Interrelation Between Interpersonal and Institutional Trust in Collective Action for Agri-Environmental Management. *Sustainability*, *11*(24), 7022.

Dietz, T., Ostrom, E. & Stern, P. C. (2003). The struggle to govern the commons.

science, *302*(5652), 1907-1912.
Dupont, D. (2009). *Une BrEve Histoire de l'Agriculture Au Québec : De La ConquEte du Sol A La Mondialisation*. Éditions Fides.
Duraiappah, A. K., Asah, S. T., Brondizio, E. S., Kosoy, N., O'Farrell, P. J., Prieur-Richard, A.-H., Subramanian, S. M., & Takeuchi, K. (2014). Managing the mismatches to provide ecosystem services for human well-being : A conceptual framework for understanding the New Commons. *Current Opinion in Environmental Sustainability*, *7*, 94-100.
Emery, S. B., Mulder, H. A. & Frewer, L. J. (2015). Maximizing the policy impacts of public engagement : A European study. *Science, technology, & human values*, *40*(3), 421-444.
Farley, J. & Costanza, R. (2010). Payments for ecosystem services : From local to global. *Ecological Economics*, *69*(11), 2060-2068.
Ferreyra, C., de Loe, R. C., & Kreutzwiser, R. D. (2008). Imagined communities, contested watersheds : Challenges to integrated water resources management in agricultural areas. *Journal of rural studies*, *24*(3), 304-321.
Franks, T. & Cleaver, F. (2007). Water governance and poverty : A framework for analysis. *Progress in development Studies*, *7*(4), 291-306.
Garbach, K., Milder, J. C., DeClerck, F. A., Montenegro de Wit, M., Driscoll, L., & Gemmill-Herren, B. (2017). Examining multi-functionality for crop yield and ecosystem services in five systems of agroecological intensification. *International Journal of Agricultural Sustainability*, *15*(1), 11-28.
Giddens, A. (1984). *The constitution of society : Outline of the theory of structuration*. Univ of California Press.
Harrington, R., Anton, C., Dawson, T. P., de Bello, F., Feld, C. K., Haslett, J. R., Kluvankova-Oravska, T., Kontogianni, A., Lavorel, S., & Luck, G. W. (2010). Ecosystem services and biodiversity conservation : Concepts and a glossary. *Biodiversity and Conservation*, *19*(10), 2773-2790.
Hénault-Ethier, L., Lucotte, M., Smedbol, É., Gomes, M. P., Maccario, S., Laprise, M. E. L., Perron, R., Larocque, M., Lepage, L., & Juneau, P. (2019). Potential efficiency of grassy or shrub willow buffer strips against nutrient runoff from soybean and corn fields in southern Quebec, Canada. *Journal of Environmental Quality*, *48*(2), 352-361.
Himes, A. & Muraca, B. (2018). Relational values : The key to pluralistic valuation of ecosystem services. *Current opinion in environmental sustainability*, *35*, 1-7.
Jacoby, S. & Ochs, E. (1995). *Co-construction : An introduction*. Taylor & Francis.
Jeswiet, S. & Hermsen, L. (2015). *Agriculture et faune : Une relation d? Interdépendance*. Statistique Canada.
Kolinjivadi, V., Bissonnette, J.-F., Mendez, A. Z., & Dupras, J. (2020). Would you like some fries with your ecosystem services? : McDonaldization and conservation in Prince Edward Island, Canada. *Geoforum*, *111*, 73-82.
Lehner, B., Gombault, C., Mehdi, B., Michaud, A., Beaudin, I., Sottile, M.-F., Blondlot, A., Bernier, D., Bérubé, J., Lauzier, R., & others. (2014). *Increasing agricultural watershed resilience to climate change and land use change using a water master plan : A case study for the Missisquoi Bay*. http://www.ouranos.ca/media/publication/379_RapportLehner2013.pdf

McCann, L. (2013). Transaction costs and environmental policy design. *Ecological Economics*, *88*, 253-262.
McGinnis, M. D. (2011). An introduction to IAD and the language of the Ostrom workshop : A simple guide to a complex framework. *Policy Studies Journal*, *39*(1), 169-183.
Mills, J., Gibbon, D., Ingram, J., Reed, M., Short, C. & Dwyer, J. (2011). Organising collective action for effective environmental management and social learning in Wales. *Journal of Agricultural Education and Extension*, *17*(1), 69-83.
Miyanaga, K. & Shimada, D. (2018). 'The tragedy of the commons' by underuse : Toward a conceptual framework based on ecosystem services and satoyama perspective. *International Journal of the Commons*, *12*(1).
Morisset, M., & Couture, J.-M. (2010). *Politique et Syndicalisme agricoles Au Québec*. Les Presses de l'Universite Laval.
Muradian, R., Arsel, M., Pellegrini, L., Adaman, F., Aguilar, B., Agarwal, B., Corbera, E., Ezzine de Blas, D., Farley, J., Froger, G. & others. (2013). Payments for ecosystem services and the fatal attraction of win-win solutions. *Conservation letters*, *6*(4), 274-279.
Muradian, R. & Rival, L. (2012). Between markets and hierarchies : The challenge of governing ecosystem services. *Ecosystem Services*, *1*(1), 93-100.
OBV Yamaska. (2018). *Caractérisation, portrait et plan d'action du bassin versant du Lac Boivin – rapport phase I, pour le programme Prime-Vert Volet 2.1,* (p. 87). Organisme de bassin versant de la Yamaska.
Odell, J. S. (2001). Case study methods in international political economy. *International studies perspectives*, *2*(2), 161-176.
Ostrom, E., Chang, C., Pennington, M. & Tarko, V. (2012). The Future of the Commons-Beyond Market Failure and Government Regulation. *Institute of Economic Affairs Monographs*.
Parcerisas, L., & Dupras, J. (2018). From mixed farming to intensive agriculture : Energy profiles of agriculture in Quebec, Canada, 1871–2011. *Regional Environmental Change*, *18*(4), 1047-1057.
Pelenc, J., Bazile, D. & Ceruti, C. (2015). Collective capability and collective agency for sustainability : A case study. *Ecological economics*, *118*, 226-239.
Polman, N. B. P., & Slangen, L. H. G. (2008). Institutional design of agri-environmental contracts in the European Union : The role of trust and social capital. *NJAS-Wageningen Journal of Life Sciences*, *55*(4), 413-430.
Power, A. G. (2010). Ecosystem services and agriculture : Tradeoffs and synergies. *Philosophical transactions of the royal society B: biological sciences*, *365*(1554), 2959-2971.
Pretty, J. & Smith, D. (2004). Social Capital in Biodiversity Conservation and Management. *Conservation Biology*, *18*(3), 631-638. https://doi.org/10.1111/j.1523-1739.2004.00126.x
Ravnborg, H. M. & Westermann, O. (2002). Understanding interdependencies : Stakeholder identification and negotiation for collective natural resource management. *Agricultural Systems*, *73*(1), 41-56.
Reed, M. S., Vella, S., Challies, E., De Vente, J., Frewer, L., Hohenwallner-Ries, D., Huber, T., Neumann, R. K., Oughton, E. A. & Sidoli del Ceno, J. (2018). A theory

of participation : What makes stakeholder and public engagement in environmental management work? *Restoration Ecology*, *26*, S7-S17.

Ricart, S., Kirk, N. & Ribas, A. (2019). Ecosystem services and multifunctional agriculture : Unravelling informal stakeholders' perceptions and water governance in three European irrigation systems. *Environmental Policy and Governance*, *29*(1), 23-34. https://doi.org/10.1002/eet.1831

Rival, L. & Muradian, R. (2013). Introduction : Governing the provision of ecosystem services. Dans *Governing the provision of ecosystem services* (p. 1-17). Springer.

Sager, M. (2004). Enquête sur l'application de la Politique de protection des rives, du littoral et des plaines inondables par les municipalités. *Repéré à: http://gaiapresse.ca/documents/enquete26jlt04. pdf*.

Schomers, S., Sattler, C. & Matzdorf, B. (2015). An analytical framework for assessing the potential of intermediaries to improve the performance of payments for ecosystem services. *Land Use Policy*, *42*, 58-70.

Six, B., Zimmeren, E. van, Popa, F. & Frison, C. (2015). Trust and social capital in the design and evolution of institutions for collective action. *International Journal of the Commons*, *9*(1), 151-176. https://doi.org/10.18352/ijc.435

Stallman, H. R. (2011). Ecosystem services in agriculture : Determining suitability for provision by collective management. *Ecological Economics*, *71*, 131-139.

Steingröver, E. G., Geertsema, W., & van Wingerden, W. K. (2010). Designing agricultural landscapes for natural pest control : A transdisciplinary approach in the Hoeksche Waard (The Netherlands). *Landscape Ecology*, *25*(6), 825-838.

Terrado, M., Tauler, R., & Bennett, E. M. (2015). Landscape and local factors influence water purification in the Monteregian agroecosystem in Québec, Canada. *Regional environmental change*, *15*(8), 1743-1755.

UPA. (2019). *L'agriculture en Montérégie*. Fédération de l'UPA Montérégie. http://www.upamonteregie.ca/lagriculture-en-monteregie/

Van Gossum, P., Luyssaert, S., Serbruyns, I., & Mortier, F. (2005). Forest groups as support to private forest owners in developing close-to-nature management. *Forest Policy and Economics*, *7*(4), 589-601.

Westerink, J., Melman, D. C. & Schrijver, R. A. (2015). Scale and self-governance in agri-environment schemes : Experiences with two alternative approaches in the Netherlands. *Journal of Environmental Planning and Management*, *58*(8), 1490-1508.

Westerink, J., Opdam, P., Van Rooij, S. & Steingröver, E. (2017). Landscape services as boundary concept in landscape governance : Building social capital in collaboration and adapting the landscape. *Land Use Policy*, *60*, 408-418.

Zhang, W., Ricketts, T. H., Kremen, C., Carney, K. & Swinton, S. M. (2007). Ecosystem services and dis-services to agriculture. *Ecological economics*, *64*(2), 253-260.

Annex 1: Guide for semi-directed interviews

Questions to intermediaries/ administrators / advisors

Introduction:

- What is your role in your organization?
- How long have you worked in this field?
- How many programs that encourage the production of ecosystem services or the adoption of agro-environmental practices exist in the region?
- Can you describe the functioning of the agro-environmental program (s) available to agricultural producers?
- Are there collective management mechanisms put in place?
- Can you describe the history of the program(s) and the type of actors involved?
- What conservation measures are supported by the program (s)? Why do farmers want to adopt them?
- What is the ultimate objective of the financial assistance or support assigned by the program (s)?
- Is there a long-term vision within the program to improve social and environmental benefits in agriculture compared to what has been favored over the past 30 years in Quebec?

Program rules (institutions):

- What are the criteria for benefiting from the program (s)?
- How are the payments / rewards made? Depending on the adoption of the planned measures?
- Is there a funding cap for adopting practices?
- Do farmers have to seek other financing to cover the costs of the developments?
- How are payments from the program related to expected results?
- Are the payments based on the adoption of certain practices or are they linked to performance?

Actors' role:

- What is the financial contribution of the federal and provincial governments to the program? Who are your funders?
- How are the rules and procedures that ensure the running of the program established?
- What is the difference between the program you manage / support and other initiatives that encourage the production of ecosystem services in the region?

- What do you think are the challenges in setting up agri-environmental initiatives in Quebec? How does the program(s) cope with these challenges?
- How do the programs interact with other government programs (MDDELP; MDDEF; MRCs?)
- How do you interact with the different government actors?
- How do you interact whith farmers in the region?
- What type of collaborations do you establish with the actors involved in the program (s)?
- Do you have any promotional or exchange activities with other stakeholders and participating producers?

Long-term vision :

- In your opinion, how famous is the program (s) in Quebec? Are there strategies to improve visibility or to sensitize farmers to the program (s)?
- If so, can you describe them?
- Do you think the program is attracting interest among farmers? With neighbors and entourage of a participating farmer?
- What are the greatest successes of the program (s)?
- What are the biggest challenges or areas for improvement?

Questions to agricultural producers

Sociodemographic questions:

- What is your main occupation?
- Do you own the land, a tenant, or both?
- Type of production:
    - Cultivated land area (ha):
    - The size of the farm in terms of income:
    - Work off the farm?

History of the farm:

- Can you name any major changes on your operation since you became a producer?
- Have you changed your farming practices in the past (5-10) years? What practices? And how?
- What improvements have you made since you acquired the farm?
- What are your long-term development aspirations; how do you imagine your farm in 10, 20, 30 years?

- What are your biggest challenges?
- Do you have activities on the farm that are not related to production? (Hunting or fishing, direct sale at the farm; tourism?)
- Can you tell me what are the economic factors that influence your crop yields now?

Incentive programs an initiatives:

- Do you participate in agri-environmental programs?
- How did you find out about the program (s)?
- What were your first impressions of this program (s)?
- Do you discuss this with your neighbors / families before participating? What was their advice?
- What are the main reasons for joining the program?
- What measures are encouraged by the program in your field? how are they chosen?
- Did the program give you the necessary funding to make the planned activities or are you going to seek other funding?
- What were your expectations for this program?
- What do you think are the impediments to participating? Did you have any concerns?
- What are, in your opinion, the aspects to be improved in the implementation of the program?
- Do you know of other similar initiatives? Have you subscribed to these?
- Did you receive help to implement the facilities (work with neighbors, agro-advice)?
- Did you receive direct counseling from the program?
- How did you like these tips? Have you incorporated them into your activities?

Perceptions of social relations:

- How are your relations with your neighbors? Do you have a good relationship with them?
- Do you tend to share good practices with each other or talk about them sometimes?
- Could you have done the agri-environmental arrangements while being alone?
- Do you get involved with an agri-environment advisory club? If so, express your expectations of your participation? How have these organizations facilitated (or prevented) your actions?
- What is your opinion of the government in terms of encouraging agri-environmental practices? Are they doing their best to improve conditions for farmers? If so, in what way?
- If not, what are the obstacles, challenges, or shortcomings of the following levels:
    - The municipality:

- The MRC:
- MAPAQ (Ministry of Agriculture, Fisheries and Food):
- The MDDELCC (Ministry of Sustainable Development, Environment and the Fight against Climate Change):
- The MFFP (Ministry of Forests, Wildlife and Parks):
- The OBVs:
- the UPA (Union of agricultural producers)

Ecosystem services and interrelationships:

- What are the expected benefits of the agri-environmental developments that you have installed?
  - At your farm level
  - With regard to your relations with your neighbors
  - For the region
- Who could benefit or appreciate the facilities / practices that you have installed in your operation?
- Regarding the financial compensations granted to you by the program, do you consider these compensations profitable?
- Who decided what types of practices would be made and for what purpose?
- Do you believe that these practices require more or less labor and costs compared to the practices you normally follow in your operation?
- How do they diverge from your existing practices and the values you hold on your land?
- Could you have installed these facilities without financial compensation? Without accompaniment?
- What factors do you think will ensure the continuity of agri-environmental measures once installed?
- On the other hand, what will be the factors that could lead you to abandon the arrangements?