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## CONCEPTION OF LOCAL CARBON MARKETS CONNECTING FARMERS AND COMPANIES: SOCIO-ECONOMIC OUTLINES OF INNOVATIVE DEVICES

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### Introduction

Various public devices promote the implementation and maintenance of hedgerows: within the framework of the agri-environmental contractualisation of the common agricultural policy (CAP), or planting support programmes run by local authorities, for example. In a context of the rise of "market-based policies", voluntary carbon markets appear as a possible way of valuing environmental carbon storage services. However, agriculture makes a modest contribution to the offer of compensation projects: 22% of the actors surveyed by Tronquet (2017) say they compensate through agricultural projects, while 38% of the respondents would like to do so.

In the West of France, one of the important levers of carbon storage is the maintenance of hedges. Indeed, ADEME has identified hedgerows as one of the various ways to mitigate greenhouse gas emissions, particularly through carbon storage, in addition to other ecosystem services, including the fight against erosion, the regulation of water flows and the improvement of biodiversity and landscape quality. This importance is increased in the greater west of France, particularly in the Pays de la Loire and Brittany areas where hedge rates are high (ADEME, 2015). These arguments on the importance of hedges for carbon storage are also supported by some work on hedgerows, which has shown that the carbon stocks in soils observed in the vicinity of a hedge are higher than those observed in cultivated plots (Follain et al., 2007; Lacoste et al., 2015). Three reasons were given: (1) carbon inputs from the hedge's perennial vegetation are greater than for annual crops, whose biomass is often partly exported; (2) deep mineral soil horizons below the hedge have a significant organic matter content related to significant biological activity over the entire root depth of the trees; (3) in situations subject to erosion, hedges can limit soil and carbon losses associated with eroded particles. Recent research measured the storage potential of hedges in the specific context of West of France (Pays de la Loire and Brittany). It confirms the estimations previously proposed by Pellerin et al. (2013) around 0,5 t eqCO<sub>2</sub>/100ml/year for mixt hedgerows (in aerial, roots and soil compartments). This level of storage varies a lot with the composition of hedges, the age of hedges and the level of initial carbon stock in soil (Viaud and Gautier, 2019).

But, despite previous public and local policies to maintain the hedgerow, the linear of hedges decreases. The challenge of this study is therefore to find new ways to promote the maintenance and creation of hedges by farmers. Our project, therefore, examines the conditions for the development of voluntary local carbon markets as a new way to enhance hedges maintenance and to mitigate climate change<sup>1</sup>.

### 1. Carbon markets: singular devices in agroecological transition

<sup>1</sup> This research has been conducted in Carbocage project (2016-2020) led by Chambre d'agriculture des Pays de la Loire and financed by ADEME

**Commenté [U1]:** Perhaps a definition of ADEME is needed here

**Commenté [U2]:** Check that verbal conjugation

**Commenté [U3]:** Do you mean Ton?

**Commenté [U4]:** Check the units. "ml" of what?

**Commenté [U5]:** Respect to when?

**Commenté [U6]:** Perhaps that reference mach better in a acknowledgment section at the end of the paper

**Mis en forme :** Anglais (États-Unis)

Our project thus begins with an ambition to renew the way to enhance hedgerows in rural territories of West of France. But this ambition is far from new. As McCollin (2000) recalls it, concern regarding hedgerows maintenance arised in the early part of twentieth century: following the american dustbowl episode, the focus of early conservation measures was often the soil (and microclimate effect of hedges considered as shelters). Biodiversity started to become a key issue supported by conservationnnists in the 1970s. Meanwhile a variety of arguments wHere discussed like visual amenities of hedgerows, and more recently agronomic, zootechnic and economic effects regarding grass and crop production or animal welfare. The role of hedgerows in carbon storage appears as a new argument. If the concern for climate mitigation emerged at the end of the last century, the identification of maintainance of hedgerows as a relevant lever for this fight is more recent-- in France, the publication of an INRA study in 2013 on effect of agricultural practices on climate mitigation have been a starting point. The authors estimate that the development of hedges on the agricultural land could allow 1.2 MteqCO2 to be stored by 2030 in France, placing this measure at the 10th rank of the 26 measures studied (Pellerin and Bamière, 2013).

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At the same time, public devices concerning the hedgerows management issue have evolved. Until the 1990s, in France as in other European countries, the State delegates to landowners and farmers the management of rural areas (McCollin, 2000; Thareau and Billaud, 2014). In the 1990s, Europe and States legiferate on environmental issues, particularly through the institution of the first agri-environmental measures. In France, the 2000s are a period of reinforcement of the role of local communities in the animation of territorialized environmental projects (Thareau and Fabry, 2013). It was at this time that the first territorial climate projects emerged (2004). In 2009, the State instituted the pivotal role of large local authorities in local environmental policies: it extended their area of competency in the field of climate and biodiversity (Bertrand, 2013). However, local authorities have not yet integrated carbon offsetting into their policies to fight climate change (ADEME 2016).

In this contexte, carbon markets appear as unique mechanism in agriculture, particularly because they are a market-based instrument that mobilize private corporate investment, based on a process of marketing an environmental good, in a political landscape dominated by a contractual logic between the State or Europe and farmers (AEMC for maintaining the hedgerows), public investment (planting subsidies from local communities), or coercitive policies to protect hedgerows (urban planning).

The literature on the determinants of the adoption of environmental innovations in the agricultural sector is quite rich. A large part concerns Agri-Environmental Measures of CAP (AEM) or public subsidies devices. They demonstrate that farmers' willingness to participate in agri-environmental programs varies according to attributes such as the duration of the contract, time spend on non-operational aspects, the level of payment, technical assistance, flexibility in relation to the requirements of the measure and flexibility as to the area to be included in the project (Ruto et Garrod, 2009; Espinosa-Goded et al., 2010; Christensen et al., 2011; Siebert et al., 2006). The involvement of companies in an environmental scheme, have been studied in relation corporate social responsibility (CSR) measures. Organizational factors do interfere with companies' commitment: size of the company, age, sector of activity, degree of innovation. Individual factors (gender, age, sensitivity and emotional commitment of the manager) are also decisive for adhering to a CSR policy (Cabagnols et Le Bas 2006; Labelle et St-pierre 2010; Spence et al 2007; Gherib, 2006). Some authors interpret companies commitment in sustainable development or CSR devices as an attempt to enhance their image and

gain more competitive advantages (Cabagnols, 2006). Others seem to act for ethical reasons, environmental image or to anticipate future regulations (Chenost et al, 2010).

Some research explore more innovative devices and question the effects of devices configurations on involvement of stakeholders. It concerns different kinds of payment for ecosystem services. They show that some conditions of devices do influence stakeholder involvement : the strong involvement of an intermediary, trustfull and with relationships to the farming community (Mariola, 2012). Schirpke et al. (2017) show that to succeed, these devices should benefit from public support, and involve human ressources to conduct a participatory process. This processes should be inclusive for all types of stakeholders, permit to understand stakeholders values and objectives, identify local dynamics, and eventually, produce trust. Lockie (2013) underlines that the success of devices like cap and trade regimes in GHG emissions supposes to establish the legitimacy of the device : it relies on a clear understanding of the ecosystem services in question as well as a transparent, robust and broadly accepted institutional and regulatory framework for monitoring, trading.

This review underlines the role of contract or device attributes in the involvment of stakeholders. Our project focuses on a proposition of voluntary carbon markets. Such carbon markets based on agriculture are not yet established in France, and therefore, the commitment of companies, farmers and local authorities remains uncertain. Our research aims to specify the outlines of such devices to favour stakeholders involvment.

## 2. Method

Our article will focus on the preferences of stakeholders - farmers, companies and local authorities - regarding the object and conditions of participation in a carbon market. For this, we conducted in 2018 and 2019 a survey of 88 actors in 3 territories of Western France (22 companies and 45 farmers and 21 local authorities) to measure and explain their preferences. The results of this survey were consolidated with 3 focus groups mobilizing businesses, local representatives and farmers.

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### 2.1. Measuring relative preferences for an innovative scheme

To allow respondents to project themselves into little-known carbon market schemes whose declination for hedgerow storage did not exist, we chosed : i) to provide informations on carbon storage through hedges and carbon market schemes before and during the interview; and ii) to propose device scenarios and test respondents' preferences for possible alternatives.

Three different questionnaires were designed and submitted to the three categories of actors. Each questionnaire was structured in four sections: (1) the characteristics of the respondent and the entity (farm, company, community), their relationship to the environment and climate systems, (2) their knowledge of hedges and the carbon market, (3) their preferences towards different possible systems, evaluated on the basis of a set of cards based on the Discrete Choice Experiment (DCE)<sup>2</sup> method, and finally (4) the reasons for their preferences on different attributes of the system. The first three themes were mainly addressed through closed questions, the fourth was mainly addressed through open questions.

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<sup>2</sup> A method introduced by Louvière (1983) in environmental economics to assess the value of a property through its attributes or characteristics.

Several analytical methods were used to process the data collected. They consist of statistical analyses of quantitative and qualitative data (AFCM, discrete choice methods) and qualitative analyses of responses to open-ended questions.

## 2.2. A reasoned sampling of actors concerned by the bocage or the climate

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The sampling aimed to test the possibility of setting up a market and its potential characteristics, even if the results concerned a population a priori more inclined to engage in it. We, therefore, constructed a reasoned sampling based on two criteria for farmers (belonging to the study areas and prior participation in bocage or agri-environmental projects), two criteria for companies (link to the target territories, and commitment to a diagnosis or carbon offset approach), and two criteria for local authorities (link to the target territories and field of activity: agriculture, climate energy or environment). We sought to favour respondents who had initiated climate or agro-environmental initiatives in these three categories of actors.

**Table 1:** Distribution of the sample by study area

Territories	Farmers	Companies	Local Authorities
Pays des Mauges	18	9	4
Pays du Roi Morvan	16	2	5
Pays de la Vallée de la Sarthe	10	1	3
Outside territories	1	10	9
<b>Total</b>	<b>45</b>	<b>22</b>	<b>21</b>

The farmers surveyed are mainly men (91%), aged around 50 years old and with levels of education between long secondary school and higher education. Farms have an average area (UAA) of 107 ha. A third of the respondents have obtained organic certification and more than 77% of them have already participated in other environmental schemes (AEM, tree planting program etc.). This sample therefore corresponds to farms larger than the average in Western France (about 65 ha in Brittany and Pays de la Loire in 2017), and farmers more involved in environmental schemes (about 8% of farms are AB certified in these same regions in 2017).

The sample of companies is dominated by men (68%), relatively young (41% are under 40 years of age) and high levels of education (Master degree represent 68% of the respondents). The companies surveyed are divided between SMEs (nearly 41% or 9/22), FTEs (36%) and large companies (22%). There are no microenterprises with less than 10 employees. This sample therefore over-represents medium to large companies at the expense of companies with less than 10 employees. Indeed, at the national level, 96% of companies, excluding financial activities and insurance, are microenterprises, while large companies represent less than 1% of them (Insee, 2017). More than 80% of the

companies surveyed say they have carried out a diagnosis of their greenhouse gas emissions and undertaken actions to reduce their carbon footprint.

The sample of local authorities is composed of 10 elected officials and 11 agents. They are in charge of energy, sustainable development or climate issues (33% of them) or involved in agricultural and agri-food issues (33%). They are elected or agents of the intermunicipalities of the survey areas, of the municipalities, or for a third of them, of other communities (nearby agglomerations, departmental councils). They are mainly men (71%). The levels of education are generally high since the Master degree represent more than half of the sample. More than 60% of the local authorities surveyed did not carry out a greenhouse gas (GHG) emissions diagnosis, but 60% of the local authorities carried out a bocage diagnosis, which illustrates the interest shown in bocage hedges.

### 2.3. Survey areas characterized by the density of hedges, the pre-existence of hedgerow projects and the importance of livestock farming.

The three territories surveyed are included in the two regions of Brittany and Pays de Loire. These territories were chosen for their determination on energy and climate transition issues, which is reflected in the fact that these three have set up a Climate local Policy, but also for their longstanding work on bocage and carbon storage. Agriculture is very important in these three rural territories with important production capacities. Production is generally oriented towards livestock (mainly dairy farming), poultry and pig farming (Table 2).

**Table 2:** Summary of the characteristics of the studied territories

Territories	Pays des Mauges	Pays du Roi Morvan	Pays de la Vallée de la Sarthe
Number of residents	121 000	26 500	78 000
Surface Area (km <sup>2</sup> )	1 315	763	1 104
UAA (utilized agricultural area) in ha	141 5980	43 801	413 900
Hedgerows linear (km) ( in 2011)	10 343	4 314	5 098
production orientation	Livestock farming	Livestock farming	Livestock farming
Policies in place	-Circular economy - Territorial Climate-Air-Energy Plan, initiated in 2003 -PAT (territorial food program)	- Territorial Climate-Air-Energy Plan initiated in 2010 - Hedges plantation programs (2003-2006 and 2011-2013)	- Territorial Climate-Air-Energy Plan initiated in 2009 - CEP (Shared Energy Advisor)

## 3. Results

### 3.1. High commitment linked with different views of local carbon markets

The first challenge of our survey was to measure the interest of the actors in a local and voluntary carbon market scheme. Although we had chosen respondents a priori concerned with maintaining the bocage or with the climate issue, which would tend to increase interest in our proposal, on the other hand, these respondents were very often already invested in bocage or climate systems (more than three-quarters of them). It was therefore far from certain that they would be interested in testing a new type of mechanism.

After describing the issues and main features of a local carbon market around hedges, we asked them: *"Would you be willing to engage in this type of scheme?"*. Nearly 80% of respondents want to get involved, regardless of the type of actor involved.

The motivations of the actors to commit themselves describe the meaning they give to such a system. Local authorities see this scheme as a way **to extend their action for the bocage**. The multiple advantages of the scheme, particularly in terms of ecosystem services (preservation of biodiversity and landscape quality, and therefore quality of life), appear to be decisive in their commitment. Local authorities also underline the importance of these schemes for the appropriation of climate and environmental issues by the actors, in order to generate added value on the territory. These respondents more often project themselves as intermediaries on the market, only a third imagine themselves as intermediaries and buyers of carbon credits. For companies, engaging in a carbon offset market allows them to **be part of a virtuous environmental approach and to establish their territorial anchorage**, in addition to economic interests and positive spinoffs in terms of the company's image. Farmers mainly see it as **an opportunity to better remunerate hedge maintenance**, which many already do, some are also motivated by environmental and climate ambition, by the possibility of increasing their social recognition, and to improve their hedge management. The actors hesitant or unwilling to engage in this scheme mainly say they lack information on the scheme (cost, relevance, interests, actors involved) in order to be able to give their opinion.

### **3.2. A shared ambition to combine different environmental benefits: carbon storage, biodiversity, water quality, landscapes.**

The object of the transaction in these voluntary markets would of course be carbon sequestration. However, the definition of this object can be clarified according to different dimensions, including the consideration of environmental co-benefits and the introduction in the contract of requirements on the practical modalities that contribute to qualify this carbon sequestration.

We have chosen to measure the actors' preferences for the different qualities of carbon credits through three indicators:

- **The affiliation to environmental co-benefits** was measured by assessing the preferences of actors between two types of hedges: the pluristrates (or mixed) hedge presented as a hedge that moderately stores carbon, but generates multiple environmental co-benefits (biodiversity, landscape, water purification, erosion control) and the coppice hedge presented as a hedge that stores more carbon but generates fewer environmental co-benefits.
- **The duration of farmers' commitments (5, 15 or 30 years),**
- **The proportion of hedgerow linear engaged by the farmer:** either all the hedges present on the farm, or part of his hedgerow linear, with the possibility of modulating them (moving, pulling up, replanting)

Our survey shows a strong preference, from all types of actors, for hedges with environmental co-benefits. 71% of respondents say they prefer this modality when only 11% say they prefer coppice hedges. This preference is supported by the statistical treatment of the DCE (Discrete Choice Experiment). For all types of respondents, this preference is explained by the perceived importance of other environmental issues: biodiversity in particular for companies, water in particular for local authorities, esthetics and biodiversity for farmers. This preference for pluristrates hedges is also linked to the desire to maintain existing types of hedges on farms or in the area, to pursue previous hedgerow projects or policies (communities, farmers). Finally, farmers are interested in the economic co-benefits associated with the pluristrates hedge: wood production and valorization, especially in lumber.

Preferences are more heterogeneous with regard to the duration of the engagement and the linear to be engaged. A small majority of respondents prefer a 15-year commitment period, with very mixed responses for the linears. We can thus distinguish four types of representations of the desirable transaction object in the contractualization.

- **All the linear in pluristrates:** The aim here is to support the creation or improvement of pluristrate hedges, over 15-year contracts that cover the entire linear of farmers' hedges. This contract is in line with previous projects and practices. For these respondents, it is a question of proposing a contract that is consistent with the ambition of storage in the medium or long term, with the hedge maintenance cycles. The commitment of the entire linear is a guarantee of maintaining the bocage (for local authorities) and securing the scheme (for companies), which fear that farmers will continue to pull up the trees. Farmers consider that it is coherent and interesting to think globally about the management of hedges on their farm, and that the commitment of the entire linear is a guarantee of administrative simplicity.

- **Flexibility in pluristrates:** here too, it is a question of giving priority to the creation or improvement of pluristrate hedges, but this time the respondents prefer 5 or 15 year contracts and give priority to the possibility for farmers to hire only part of their hedgerow linear or to be able to move the committed hedges. The aim is to enable farmers to commit themselves in stages, to test the scheme, but also to adapt it to changes in their farm, by allowing adjustments to the contractualised hedgerow linear and by maintaining a certain freedom to manage their entire hedgerow linear. This is the preferred contract for all players. However, companies highlight the importance of implementing precise control of linear developments.

- **Strong commitment regardless of the type of hedges:** respondents who prefer a long contract tend to prefer a total commitment of the hedgerow linear as well. Farmers who prefer these contracts also want to create new hedges and not just improve or manage existing ones. Respondents think it would be desirable to propose a highly engaging scheme to strengthen its credibility (companies, local authorities) and its impact in the fight against climate change. Farmers also underline that they do not plan to remove hedges, with or without contractualization. Finally, some mentioned the environmental challenge of maintaining ecological continuity, which justifies the use of all hedgerow linear.

- **Partial coppice:** this fourth type of contract is the only one that favours coppice hedges, over commitment periods of 5 or 15 years and for an engagement of only part of the linear. For these respondents, the challenge of rapidly storing carbon is a priority and justifies supporting the most efficient hedges in this respect. For farmers,

it is also the contract that appears to be the most profitable. In any case, the flexibility of the linear system used makes it possible to adapt to the challenges facing farms, but also to other measures to fight climate change that could be developed, such as land exchange.

For the three variables tested, the level of indecision (cumulative non-response and "don't know" responses) is high, particularly for the sub-population of local authorities. Respondents explain that they do not feel competent to arbitrate, or that they consider that farmers should be given the choice to adapt as best they can to their situations. It also concerns respondents who are not interested in the scheme (farmers, local authorities).

**Tab 3:** Preferences for contract types according to the actors surveyed

	Farmers		Local authorities		Companies		Total	
	Eff.	% Obs.	Eff.	% Obs.	Eff.	% Obs.	Eff.	% Obs.
All the linear in pluristrates	16	36%	2	10%	3	14%	21	24%
Flexibility in pluristrates	15	34%	10	50%	8	36%	33	38%
Strong commitment regardless of the type of hedges	6	14%	1	5%	4	18%	11	13%
Partial coppice	2	5%	2	10%	4	18%	8	9%
Undecided	5	11%	5	25%	3	14%	13	15%
Total	44	100%	20	100%	22	100%	86	

p-value = 0,13 ; Khl2 = 12,41 ; ddl = 8,00

These preferences are different according to the types of actors (Tab3). In particular, it should be noted that companies preferences are more dispersed than for the other categories and that more community respondents are willing to give farmers some flexibility.

### 3.3. Four types of vision of the good socio-economic outlines of the device

We hypothesized that the conditions under which the voluntary carbon market mechanism was organized influenced the actors' desire to engage in it and their willingness to pay or receive. We therefore asked the various respondents to tell us their opinions on a set of possible characteristics of the devices: the nature of the intermediate actor within the market and the methods of control, but also traceability (in a "traced" market, buyers identify carbon as coming from a group of farmers in a given area, and in return, these farmers know their buyers and each of the stakeholders), the possibility of benefiting from technical support, the nature of carbon credit certification and finally the way the price is constructed (indexed to another carbon market, at hedge maintenance cost or not indexed).

Respondents generally agree on the interest of implementing a traced market. 71% prefer this modality compared to only 8% who prefer an untraced market. Local authorities and companies underline the importance of traceability in **creating links between buyers and sellers**, facilitating the monitoring and control of the action and making it possible to communicate with employees or customers of companies, by directly involving farmers. For farmers, this facilitates local **recognition of their commitment to the climate**. Some farmers prefer an untracked market. In this case, they consider that traceability is unnecessary since, on the contrary, the aggregation of carbon credits at regional or national level makes it possible to simplify the scheme, reduce transaction costs or facilitate access to the market.

For the other characteristics, the preferences appear more contrasted, we distinguish four desirable mechanism profiles :

- **Local development system.** The voluntary market would strongly involve a local organization as a central actor in its governance. Control could mobilise buyers and sellers through a participatory guarantee system. As the aim of the scheme is to support better management of hedges, it seems important here that there be technical support and that the price paid to farmers be indexed to the costs of maintaining the hedge.
- **OTC contracts between companies and farmers in a light and inexpensive system.** To implement a local carbon market, it must be simplified. Systematically, these respondents prefer the lightest forms of governance (no certification, no technical support), the preference is oriented towards a direct contractualization between companies and farmers and for this a linkage by a private intermediary is appropriate.
- **National aggregated environmental public policy scheme.** The local anchoring of the market and its traceability are of little importance to these respondents. The focus is on ensuring the implementation of reliable and credible storage practices, including certification and technical control. The State appears to be the right intermediary for this mechanism.
- **A local supply traced within the international carbon market.** For these respondents, the voluntary carbon markets resulting from hedges must be able to integrate into international markets. To do this, the price must be indexed to international prices. Nevertheless, companies want to be able to buy locally and farmers want to rely on a local collective and make their area and region benefit from the scheme. Finally, these respondents are concerned about the credibility of the system: for this, they prefer a control that doubles the photo-interpretation of a technician's visit, they are committed to setting up a reliable and serious certification system (international or national).

**Table 4:** Preferences of the different types of actors for the types of schemes

Acteur	Farmers		Local Authorities		Companies		Total	
	Eff.	% Obs.	Eff.	% Obs.	Eff.	% Obs.	Eff.	% Obs.
Local development system	15	34%	16	80%	8	36%	39	45%
OTC contracts	8	18%	4	20%	8	36%	20	23%
local supply within the international carbon market	10	23%	0	0%	5	23%	15	17%
National public policy scheme	11	25%	0	0%	1	5%	12	14%
Total	44	100%	20	100%	22	100%	86	

p-value = < 0,01 ; Khi2 = 21,70 ; ddl = 6,00

The stakeholders' preferences for these different types of schemes are very much shared, particularly for companies and farmers (Table 4).

#### 4. Discussion - conclusion

Our research aimed to test the opportunity to implement voluntary carbon markets to support the maintenance of hedges, in a context where a diversity of bocage support systems already exist (at national and local scales). It then aimed to clarify the form that these contracts could take.

#### **4.1. A market involving a set of environmental services**

The first significant result is that the actors surveyed are mostly interested in this type of measure. They prefer to enter a market that values mixed hedges. This result should be considered with caution as it concerns a statement of prospective intent and is based on a selected sample of respondents concerned by our object. Nevertheless, this result is confirmed by the analysis of the Choice experiment associated with this survey, which succeeds in identifying a potential price range for trading carbon credits from hedgerows; then by the results of the three focus groups organised in the territories, which mobilised actors declaring ready to commit themselves to the establishment of local carbon markets.

The interest in this new device is based on a diversity of motivations (technical, economic, environmental and social), which reflect the differences in the points of view of the stakeholders interviewed. However, for the majority of them, the scheme should promote hedges that produce a diversity of ecosystem services (ecological, landscape, water-related), even if this means limiting the efficiency of the service in terms of carbon storage. This reflects a desire to integrate this device into the continuity of prior commitments (local authority policies, agricultural practices). Stakeholders thus participate in a form of erasure of the climate object in the face of the ambition of environmental coherence, which constitutes a way of managing environmental injunctions experienced as sometimes contradictory by actors (Thareau et al., 2014). Stakeholders, and in particular farmers, also participate in strengthening inertia in local action, which is traditionally observed in public policy analysis (Bertrand, 2013). It should be noted that it is among the companies that we meet the most actors concerned about the climate efficiency of the scheme, even if it means transforming local landscapes and practices. Less rooted in agri-environmental schemes, companies can be drivers of transformations in local practices.

#### **4.2. A variability of preferences related to contract**

Our results distinguish four types of preferences regarding the object of the contract. The contract preferred by all types of actors is flexible (in terms of duration of engagement and linear hedges engaged), this result is in line with the literature on farmers' engagement in agri-environmental schemes (Ruto and Garrod, 2009; Espinosa-Goded et al., 2010; Christensen et al., 2011). We assumed that preferences for short and flexible contracts would be more asserted by farmers than by buyers or local authorities. However, we observe the opposite: farmers more than other types of actors prefer binding contracts, companies and especially local authorities prefer more flexible contracts. The farmers' point of view is explained on the one hand by the fact that the majority of them have already developed important hedgerow linears, the scheme would make it possible to finance pre-existing practices; on the other hand they wish to ensure the credibility and robustness of the market via the terms of the contract while limiting the administrative complexity of the scheme (this ambition of administrative simplicity is in accordance with the literature). On the other hand, companies and local authorities see the scheme as a lever to engage new farmers in the implementation of hedgerows, they then prefer to propose conditions of engagement that allow them to test the market to facilitate the enrollment of the greatest number and to increase the effectiveness of

the scheme. From their point of view, the credibility of the market must be ensured by the attributes of the device.

#### 4.3. A variability of preferences related to device

Our research identifies four forms of devices that are desirable from the respondents' perspective. Except for local authorities who largely prefer a "local development system" type, where they would play a decisive role in the governance of the device, the other actors have more fragmented preferences. They are partly linked to the experience of the actors: farmers are more interested than others in devices characterised by high intermediation that provides technical support and robust public certification of the effectiveness of the environmental service. These attributes of the devices resemble the AEMs largely mobilized by these farmers. Companies prefer market driven or OTC contractual mechanisms which are easily integrated into their business practices. The compatibility of the device with the system of values and practices, with the experiences of the actors, helps to explain their preferences (Gherib, 2006; Spence et al, 2007)

What is at stake in the arbitrations carried out by the respondents is ***the way in which trust between the parties and the credibility of the device are organised***: via a direct and local link in local and over the counter development schemes, or via national or international institutions in the international and national market schemes. What is also at stake is ***the efficiency and cost of the scheme***. Some respondents prefer limit these costs and mainly pay for the ecosystem service itself, whereas others believe that the success of the device will rely on a consistent investment on governance tasks, which could be partly supported by public investment via local authorities budget. Finally, the respondents' preferences also reflect visions of the ***system's anchoring in political strategies at different scales***: at the level of companies only (willingly), in the context of territorial projects (local development) or finally in relation to national policies, thought out or not in the context of the COP (national mechanism and international market). This anchoring contributes to the legibility and recognition expected, particularly from farmers.

Surprisingly, the ambition to found new connections between farmers and enterprises in a local and communitarian device seems more affirmed by companies than by farmers. For companies, it is motivated by the ambition to control the implementation of storage measures, to be able to report, in particular to their employees, on the company's action for the territory and sometimes, finally, by the desire to strengthen commercial relationships with their suppliers (Tronquet et al., 2017).

#### 4.4. Inertia and renewal of transitional arrangements towards agro-ecology

Starting from a singular proposition of evolution of the modes of valorization of the environmental services, this research thus points a certain inertia of the preferences of the farmers and of the local authorities (on the object and the modalities of the device). In this proposed scheme, companies are new players. With them, two major challenges are affirmed: the desire to anchor the system in the territories via direct links between buyers and sellers, the ambition of measurable climate efficiency. These ambitions are factors for renewal and social innovation in a context of a profusion of agri-environmental measures to maintain the bocage. These local carbon markets could make it possible to create mixed workspaces on the evolution of agricultural models and practices, which

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mobilize new stakeholders (companies), and which seem to be able to contribute to improving knowledge and recognition of the role of farmers in their territories.

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