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Title: Perceptions of vegetation succession following agricultural abandonment in the Massif Central region (France)

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Abstract. Agricultural abandonment followed by vegetation succession is a major land use and land cover (LULC) change in Europe. Such a dynamic has critical consequences on biodiversity and ecosystem services (ES) and disservices (EDS). Understanding the way local stakeholders perceive succession and its effects is crucial for sound landscape planning. This study addresses these issues in part of the Massif Central region (France) where multiple LULC changes have occurred in the last decades, including abandonment. We aimed at identifying stakeholders' perceptions and their drivers regarding old fields, and the subsequent post-agricultural vegetation stages from open shrublands to forests. We conducted 29 semi-structured interviews focused on LULC changes with three stakeholder groups: local decision-makers, land managers, and farmers. The terminology used to refer to old fields and the ES and EDS associated with them were recorded, and a thematic analysis was carried out. The results revealed a wide range of words and expressions used to refer to old fields, and inconsistencies between terminology and vegetation stages. The ES and EDS associated to old

fields varied between stakeholder groups and were mainly regulating and cultural. The thematic analysis demonstrated that old fields can be considered as a degradation compared to traditional agriculture and as a loss of human control on vegetation, but also as natural ecosystems persisting in the face of other LULC changes – essentially urbanization and intensification. These findings show that land planning decisions need to consider abandonment in relation to other LULC changes and to the plurality of perceptions of old fields.

Key words: LULC changes, agricultural abandonment, vegetation succession, ecosystem services, stakeholders' perceptions

1. Introduction

The main land use and land cover (LULC) changes in Europe in the last decades have been agricultural abandonment, urbanization, and agricultural intensification (Gerard et al., 2010; van Vliet et al., 2015). Farmland abandonment appears as an important trend (Chazdon et al., 2020); estimations indicate that 150 million hectares have been abandoned worldwide between 1700 and 1992 (Ramankutty & Foley, 1999) and around 60 million hectares between 2003 and 2019 (Potapov et al., 2022). In mountainous regions of Europe, this phenomenon may concern up to 99% of the lands (Lasanta et al., 2017). Land abandonment is expected to continue, with some 5.6 million hectares expected to be abandoned by 2030 (3.6% of 2015 agricultural zones) (Perpiña Castillo et al., 2021). The particularly concerned areas usually present steep slopes, difficult accessibility and low productivity (Kolecka et al., 2017; Levers et al., 2018; Cervera et al., 2019), although abandonment also occurs in other places than marginal areas (Hatna & Bakker, 2011). These changes have severe effects on biodiversity and ecosystem services (ES) (Stoate et al., 2009; Jepsen et al., 2015; Ustaoglu & Collier, 2018).

Vegetation succession following abandonment under temperate climates leads to old fields that present different succession stages up to an ultimate mature forest stage (Cramer & Hobbs, 2007). The delay up to the mature stage varies according to pedoclimatic conditions that determine the succession rate (Lepart & Escarré, 1983; García-Ruiz & Lana-Renault, 2011). All along the post-agricultural succession, plant succession induces changes in biodiversity (Harmer et al., 2001; Regos et al., 2016), ES and ecosystem disservices (EDS) (García-Ruiz & Lana-Renault, 2011; Yahdjian et al., 2017). ES are defined as the benefits delivered by ecosystems to humans (Millennium Ecosystem Assessment, 2005) and EDS designate the harmful and negative inputs from ecosystems (Lyytimaki & Sipila, 2009; von Döhren & Haase, 2015; Blanco et al., 2020). The impacts of post-agricultural succession-related changes can thus be positive, negative, or variable (Ustaoglu & Collier, 2018). They include an increased carbon stock along with the succession stages (Foote & Grogan, 2010), modified hydrology with depleted water resources (García-Ruiz & Lana-Renault, 2011), reduced soil loss (Foucher et al., 2019), and landscape modification, e.g. larger forest patches (Sitzia et al., 2010; Camarretta et al., 2018). Changes in the structure of habitats associated to land abandonment may have variable effects on biodiversity. For example, the larger forest patches can result in increased or decreased biodiversity depending on the species composition (Lasanta et al., 2015). In the literature, the effects of agricultural abandonment are either presented as an opportunity, e.g. for wilder and more natural spaces (Navarro & Pereira, 2012) or as detrimental, e.g. as a loss of cultural landscapes (Plieninger et al., 2006). The evaluation of abandonment effects appear to be driven by regional agricultural history through the choice of the reference state (Queiroz et al., 2014). These authors showed that the cultivated state is the reference state in Eurasia, and this explains why negative effects of abandonment are mostly detected, while positive effects are detected in the Americas, where the reference state is mature forests.

The variability of the evaluation of abandonment consequences obviously needs to be considered to elaborate landscape management strategies. Landscape management consists of actions accompanying social, economic and environmental changes so as to improve landscape quality and sustainability (Council of Europe, 2000; Aretano et al., 2013). Understanding stakeholders and taking their perceptions of landscape into account is necessary to reach this objective (Ban et al., 2013; Mascia et al., 2003). Sustainable management ensures that natural resources are used based on the needs of humans at present without compromising the needs of humans in the future (WCED, 1987; UN, 1992; Termorshuizen & Opdam, 2009); this aim requires identifying stakeholders' needs (Casado-Arzuaga et al., 2013; Cáceres et al., 2015). Cultural insights also need to be considered to minimize the risk of management failure (Nassauer, 1997; Brummer et al., 2017), in particular regarding stakeholders conducting activities on the landscape, e.g. farmers (Schenk et al., 2007; Zagaria et al., 2017). Yet, conflicts about management decisions may arise, e.g. because of diverging conservation perspectives (Vila Subirós et al., 2016), or because ecosystem attributes and functions are perceived as providing benefits by some stakeholders and nuisances by others (Vaz et al., 2017), or because national and local management policies differ (Afroz et al., 2016). Education and compromise may be necessary to handle these conflicts (González et al., 2017; Eloy et al., 2019). Their implementation requires understanding the stances of the different stakeholders, and identifying the ES and EDS important to them (Chan et al., 2012; Felipe-Lucia et al., 2015; Garrido et al., 2017).

From a social point of view, the diverse consequences of agricultural abandonment on ES and EDS goes along with a diversity of stakeholders' perceptions of the phenomenon itself and of the resulting old fields (Benjamin et al., 2007; Ruskule et al., 2013; Stelling, 2017; van der Zanden et al., 2018). For instance, when studying a region of Portugal, Van der Zanden et al. (2018) found an overall negative perception of abandonment. However, experts (land

managers, National Park employees, researchers) were less negative toward successional changes of agricultural lands than local inhabitants more concerned about tradition.

Old fields are diverse, especially regarding their vegetation density and composition (Harmer et al., 2001; Martín-Alcón et al., 2015). We expected such differences to influence stakeholders' perceptions of these ecosystems, as showed for tree density (Gómez-Limón & Fernández, 1999), succession stages (Benjamin et al., 2007), and afforestation types (edge, continuous, mosaic, linear) (Ruskule et al., 2013).

As both the perception of agricultural abandonment and its drivers may strongly vary, they need to be studied together for well-designed land management decisions to be taken. We addressed this question in a study area in the Massif Central region of France, situated near the region's major city of Clermont-Ferrand. The area is characterized by a mix of low mountains and alluvial plain covered by intensive croplands. It is both peri-urban and rural, and to our knowledge, only few studies have addressed the perceptions of abandonment in this context.

Stakeholders' perceptions of land abandonment were gathered using semi-structured interviews focused on LULC. Three stakeholder groups were interviewed: land managers, local decision-makers, and farmers specialized in fruit growing. We expected abandonment and the subsequent vegetation development to be identified as a major change by all interviewees, and the different stakeholder groups to show different perceptions of the succession stages, in relation with their professional skills and their role in communities. To characterize these perceptions, we questioned the interviewees about the ES, EDS and biodiversity they associated to old fields. In parallel, this exploratory study also allowed us to spot other potential factors structuring perceptions of land abandonment.

2. Materials and methods

2.1. Study area

The study area covered 166 km², with a minimum altitude of 321 m a.s.l. and a maximum altitude of 1025 m a.s.l (figure 1). It included 16 municipalities, all part of a federation of municipalities called Mond'Arverne, and was bordered by the conurbation of Clermont-Ferrand (approx. 150000 inhabitants) to the north, by the river Allier to the east, and by the Chaîne des Puys mountain range to the west. The human population was multiplied by 2.7 between 1946 and 2019, passing from 9988 to 27389 people.

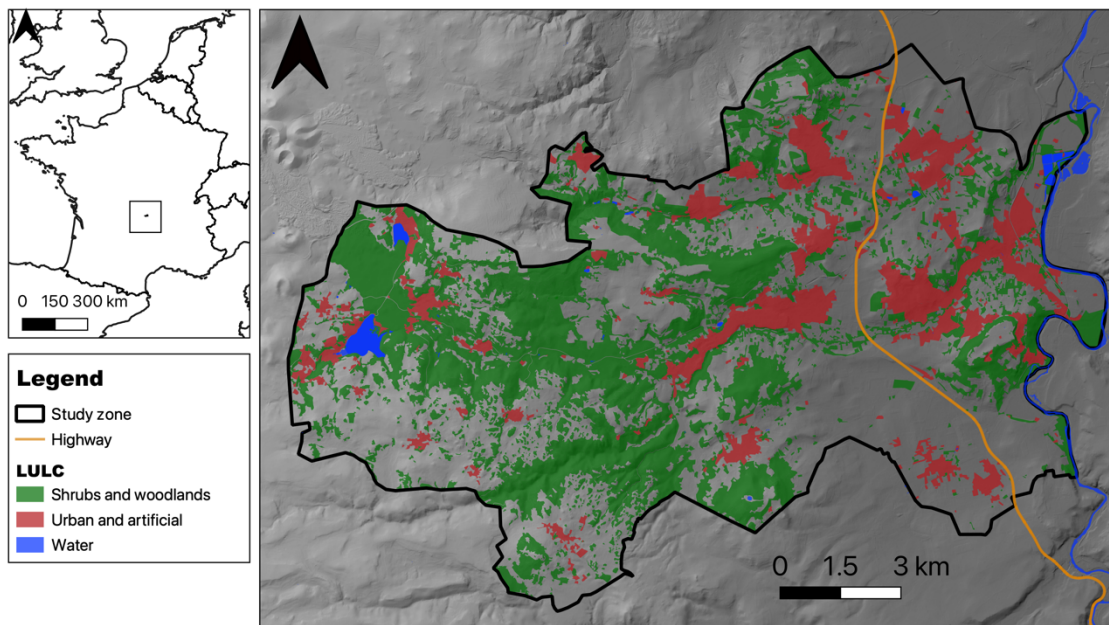


Figure 1. Map of the study area.

The area underwent substantial LULC changes during the last seven decades. Agricultural lands made up for 78% of the area in 1946 and had dropped to 51% in 2019, whereas urban and artificial areas increased from 3% to 13% and areas dominated by ligneous vegetation (shrubs, woodlots, mature forest) from 19% to 34% during the same period (Weissgerber, unpublished). In 1946, the main agricultural activities were arboriculture, viticulture, cattle and sheep farming, and subsistence agriculture. In 2019, crops (cereals, oil seeds) and pasture for cattle represented 51% and 46% of agricultural lands, respectively. During this period the number of farmers decreased in the study area. Available data on population indicate that there

were 488 farmers in 1968 (17% of the working population) and 116 in 2017 (1% of the working population). Tree plantations appeared in the region, but remained scarce in the study area.

2.2. Semi-structured interviews

We conducted 29 semi-structured interviews with stakeholders from the study area (table 1) between February and July 2019. The interviews were conducted in French. To carry out a qualitative assessment, the stakeholders involved in the area were first identified based on their knowledge of the area or their involvement in its management. Two types of stakeholders were singled out: local decision-makers or land managers. Local decision-makers were mayors or members of municipal councils involved in environment and planning. Land managers were employees of institutions or associations participating in land management, either in general terms or focusing on one sector (e.g. agriculture, forest). They can be considered as experts. Two strategies were followed to further select interviewees. Local decision-makers from the 16 municipalities of the study area were invited; nine agreed to be interviewed. For land managers, the first interviews were conducted with employees from identified institutions, and then the snowball method was used to contact new interviewees (Denzin & Lincoln, 2017; Campenhoudt et al., 2017). This method led us to also interview organic fruit growers, who made up a third type of stakeholders. They practice a declining type of agriculture that used to be flourishing, and their activity was largely mentioned in the interviews. The groups of interviewees are presented in table 1.

Local decision-makers		9
Land managers	Areas of expertise	
	Forest	2
	Natural habitats and fauna	7
	Agriculture	3
	Rivers and wetlands	2
General	2	
Farmers (fruits growers)		4
Total		29

Table 1. Number of stakeholders interviewed in each of the three groups. The groups were determined based on the stakeholders' knowledge of and involvement in the territory.

Interviews were organized in two parts (Appendix A). The first part was focused on the ecosystems and the landscape present in the interviewee's zone of interest (their municipality / the areas around their plot / the whole study area). The second part dealt with the past evolution of these ecosystems and landscape, the benefits or nuisances as well as the activities associated with them, and their importance to the stakeholder or their community. The interviews were conducted on the field or with a map that the interviewees could comment on. These were administrative maps with minimal topographic and land-use indications presenting the interviewee's zone of interest. The interviews lasted 37 to 169 minutes, they were recorded and fully transcribed.

Although the groups were made of a limited number of people (four, nine and 16 interviewees for fruit growers, local decision-makers and land managers, respectively), the interviews were long (94 minutes on average) and saturation appeared to be reached when no new terminology, service and disservice was brought up. Moreover, the 'local decision-makers' group gathered people from more than half of the municipalities of the study area, and the 'fruit growers' group gathered more than half of the small number of fruit growers present in the study area.

The interviews were analyzed in three main steps. The first criterion consisted in determining if the interviewees spoke about abandonment and old fields. A lexical analysis (Blanchet & Gotman, 2015) was conducted to identify all the words and expressions used by the stakeholders to refer to the abandoned areas, regardless of their stages. Then, the benefits and nuisances associated with ecosystems and emerging from the lexical analysis were identified. Benefits were summarized, gathered, and classified as ES following the *Common International Classification of Ecosystem Services* (V5.1) (Haines-Young & Potschin, 2018). According to these guidelines, we searched for the contributions of ecosystems to human well-being “in terms of what ecosystems do”. The same procedure was applied for nuisances following Vaz et al. (2017). According to this framework and typology, nuisances were classified as reduced ES or as EDS. This analysis was completed by a thematic analysis (Blanchet & Gotman, 2015) aimed at identifying the potential topics associated with abandonment and old fields by stakeholders. It was conducted focusing on the stakeholders’ arguments regarding their positive and negative perceptions.

3. Results

3.1. Talking about old fields: vocabulary and reality mismatch

The lexical analysis revealed that all the interviewees mentioned old fields. However, five out of 29 only described the presence of old fields and did not mention their increase in the landscape following abandonment over the last decades. For instance, one of the land managers – an expert on natural habitats – mainly reported human activities taking place in the ecosystems but did not speak about the landscape dynamics. Likewise, land managers – expert on river and wetlands – focused on other phenomena (artificialization, channelization, population growth, poisoning, as well as agriculture and forestry intensification).

Old fields were referred to, or described, using one to 16 different words or expressions varying between the interviewees. In total, 31 words and expressions were used, and the most prevalent ones were *forest*, *friche* (a French word close to fallow referring to unused and unclassified vegetation spaces (Derioz, 1994; Benjamin et al., 2007)), *abandoned*, *tree*, *wood*, *nature*, *open*, *vegetation*, *shrubs*, *closed*, and *coppice*. The complete list of French words and their translation in English are available Appendix B. Translation may result in nuances and in meaning being lost.

The association of these words with an ecosystem state was made following a range of criteria including structure, openness, use status, and species presence. In most cases, the interviewees did not easily distinguish between the different stages of succession following abandonment. For example, one land manager explained, “*it’s more going to be areas with shrubs, I don’t know if I should say garrigue, or coppice*” (INT3). The word *nature* in the interviews referred to a diversity of ecosystem types, including old fields. For example, one of the interviewees said, “*{these are natural zones}, some people have plots mown for hay, and there are a lot of coppices and shrubs*” (INT19), and another, “*{nature is what is green on the map} and nature is all around the village*” (INT13).

Cross-analysis of the stakeholders’ descriptions and the areas they described showed that many of these terms intersected with each other (figure 2). A key point was the poor consistency of terminology during the interviews and between interviews (e.g. the word *coppice* may be used several times in an interview to refer to different successional stages), and there was no exact correspondence between an ecosystem succession stage and a given word or expression (e.g. a certain successional stage may be referred to as *friche* by an interviewee and as *wood* by another).

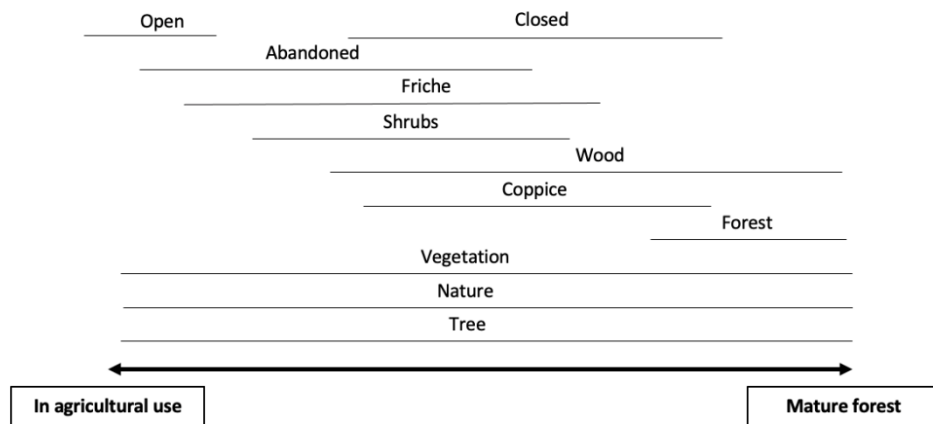


Figure 2. Representation of the main words and expressions used by stakeholders to refer to old fields corresponding to different successional stages from fields under agricultural use up to mature forest.

3.2. Services, disservices and the successional stages delivering them

Nine ES and four EDS or reduced ES delivered by old fields were identified by the interviewees (table 2). They were mainly regulating and cultural ES and EDS. Regulating ES and EDS involved limiting erosion, protecting against unfavorable climate conditions, bringing beneficial organisms, improving water quality, storing carbon, having a positive effect on temperature, bringing pests, increasing fire risk; cultural ES and EDS involved being favorable to recreation, contributing to a pleasant setting, and degrading landscape beauty. The only provisioning ES was wood production. We noted that old fields were associated with little or no activity: “*wooded spaces are a presence, but there are very few activities related to them*” (INT13) and “*nothing, there is nothing {on this plot}, it is friche. People (...) used to cultivate things but it’s over now*” (INT21)

Among the 31 words and expressions used by stakeholders to refer to old fields, only 19 were associated with ES, EDS or biodiversity. In this case, a diversity of associations was suggested (see table 3), and many words and expressions were associated to benefits and nuisances. The words only associated to benefits were *open*, *nature*, and *wild*. Those only associated to

nuisances were *decline*, *mess*, and *jungle*. Erosion limitation, protection against unfavorable climate conditions, carbon storage, and water quality were considered as ES delivered by *friche*, *wood*, *forest*, *nature*, *vegetation*, and *green*. Therefore, it appears that succession had a positive effect on regulating ES in the interviewees' minds. On the contrary, the stakeholders' opinion on the effect of succession on cultural ES and EDS was more nuanced. For instance, landscape aesthetics was considered to be impaired by abandonment except when the plot was termed *open*, *nature* or *green*. Some words and expressions referred to the same successional stage (figure 2), so that a same stage was associated to benefits or nuances depending on how it was called. For example, a same plot qualified as *nature* was associated to benefits, but associated to nuisances if it was qualified as *shrubs*.

	Category	Service or disservice	Quote	CICES code	CICES Descriptor	Local decision-makers	Land managers	Farmers (fruit growers)
Benefits	Provisioning ES	Provision of wood	<i>Recently, there has been energy-wood, we talk about resources in the vicinity which corresponds to these zones, there are coppices that had no great timber value but energy-wood may be an opportunity (INT2)</i>	1.1.1.3	Plant materials used as a source of energy		x	
	Regulation & Maintenance ES	Creation of a protection against erosion and rock fall	<i>In the village some people cleared {vegetation} on a plot, but they should not touch this slope, if you clear you remove what holds it together (INT12)</i>	2.2.1.1	Controlling or preventing soil loss	x		
		Positive effect on the local climate, particularly protection against unfavorable conditions	<i>Having high trees {positively} influences draught, cold, and heat on the plot (INT26)</i>	2.2.1.4	Protecting people from winds			x
		Input of beneficial organisms to orchards	<i>We need forests for our beneficial organisms, such as birds (INT29)</i>	2.2.3.1	Controlling pests and invasive species			x
		Improvement of water quality	<i>Talking about water (...) a forest filters a lot of pollutants and dust (INT14)</i>	2.2.5.1	Controlling the chemical quality of freshwater		x	
		Increase of the carbon stock	<i>What do forests do? They stock carbon. (INT20)</i>	2.2.6.1	Regulating our global climate		x	
		Positive effect on the local climate, particularly temperature	<i>In summer we are very happy to be in the green, it is less hot there (INT19)</i>	2.2.6.2	Regulating the physical quality of air for people	x		x
	Cultural ES	Creation of favorable conditions for recreation	<i>Under the trees, it is very nice to take a walk (...) it is entirely wooded, along the river, it is protected. It is full of paths; many joggers go there (INT12)</i>	3.1.1.1	Using the environment for sport and recreation; using nature to help stay fit	x	x	
		Assimilable to nature and contribution to a pleasant setting	<i>Exceptional settings are ... well did you see the village? The nature is all around (INT13)</i>	3.1.2.4	The beauty of nature	x		
Nuisances	Cultural and aesthetic EDS	Negative effect on the beauty of the landscape	<i>For sure it is nicer to see grasslands, which are clean and well-maintained, rather than coppices everywhere, those close everything (INT4)</i>	/	/	x	x	
	Reduced provisioning ES	Input of pests to orchards	<i>Forests are not a problem, except for a small pest, a weevil that lives in forests and eats flowers, that is annoying (INT25)</i>	/	/			x
	Safety and security EDS	Increase fire risk	<i>If shrubs grow with global warming, there are going to be forest fires or shrubs fires and houses are nearby so it is prompting to reinstall agriculture (INT23)</i>	/	/		x	
	Leisure and recreation EDS	Obstacle to recreation activities	<i>Those gorges are lands that have no value for agriculture; {grazing} is necessary nevertheless for hikers to have an open space to walk (INT25)</i>	/	/		x	

Biodiversity	/	Hosting a valuable biodiversity	<i>Every time we leave friches, these are spaces where biodiversity development is more important, but those spaces need to be connected to hedges and rivers (INT25)</i>	/	/		x	x
	/	Hosting less biodiversity, there is loss	<i>We have remarkable open habitats on those hills, everything is getting closed, {we are losing biodiversity} (INT9)</i>	/	/		x	

Table 2. Ecosystem services and disservices delivered by old fields and effects of old fields development on biodiversity according to the interviewees and depending on the stakeholder group they belonged to.

Nature of ES and EDS Stakeholders' terminology for old fields	Nature of ES and EDS									Effects on biodiversity					
	Provide wood	Protect against erosion	Protect against unfavorable climate conditions	Bring beneficial organisms to orchards	Improve water quality	Increase the carbon stock	Have a positive effect on temperature	Are favorable to recreation	Contribute to a pleasant setting	Have a negative effect on the beauty of the landscape	Bring pests to orchards	Increase fire risk	Constitute an obstacle to recreation activities	Positive effect on biodiversity	Negative effect on biodiversity
Abandoned														x	
Closed										x			x	x	x
Coppice	x									x				x	
Decline										x					x
Forest	x		x	x	x	x		x			x			x	
Friche			x							x		x		x	x
Green								x							
Jungle										x					
Mess										x					
Nature					x			x	x					x	
Open								x	x					x	
Peri-sylvan														x	x
Shrubs											x			x	x
Stand										x					x
Thicket														x	
Tree	x	x	x												
Vegetation		x								x					
Wild														x	
Wood	x	x	x					x	x					x	

Table 3. Ecosystem services, disservices, and associated effects on biodiversity according to the interviewees, and words and expressions used by stakeholders to describe old fields

3.3. Differences between stakeholder groups regarding old field perceptions

The stakeholder groups differed by the words they use to describe old fields and by the ES and EDS they associated to old fields. The number of words used to describe old fields varied largely within groups: local decision-makers used one to 10 words, fruit growers three to 11, and managers two to 16. The peculiarity of some managers was illustrated by their use of very precise terms such as “*fruticé*” to describe old fields (translatable as *peri-sylvan*, see Appendix B). On the contrary, local decision-makers tended to use more general terms such as *vegetation*, *green*, or *nature*.

All groups considered old fields as a source of both ES and EDS, implying positive and negative perceptions. The stakeholder group differed by the ES and EDS they associated to abandoned lands and whether they mentioned biodiversity or not. Most ES and EDS were identified by one stakeholder group only (see table 2); some ES and EDS were mentioned by two groups, but none by all three groups. Regarding EDS, land managers identified more numerous EDS than the other two groups. This group was also occasionally somewhat ambivalent by associating old fields with recreational ES – because wooded spaces are enjoyable to practice outdoor activities – but also with leisure and recreational EDS – because wooded spaces block paths and hinder movement. Ambivalence was present among land managers and also within single interviews except concerning the effects of abandonment on biodiversity: managers either explained that old fields had a positive effect on biodiversity, or that biodiversity was lost because of this change. We did not find such ambivalence among fruit growers and local decision-makers.

3.4. Beyond stakeholder groups: other factors structuring the discourse and explaining perceptions

The thematic analysis and the review of the stakeholders' arguments revealed that four other factors needed to be taken into account to explain old field perceptions by stakeholders. We will not refer to the three stakeholder groups in this section because no difference emerged among them regarding those factors.

(1) Regrets regarding historical agricultural activities that disappeared or declined.

References to traditional activities in the study areas (vineyards, orchards, grazing, and subsistence agriculture) were found in numerous interviews. For instance, one interviewee stated, *“historically, it is a winegrower village, despite what we see. All the parts behind the*

trees used to be hills covered with vines” (INT13). When these activities were mentioned, the interviewees’ positions varied from acknowledgment and regret to wishing for revival or for actively acting on redeveloping these activities, as one local decision-maker said, “*we try to maintain this fruit-growing activity which tends to disappear, and which is characteristic of our surroundings*” (INT19).

(2) A will to control ecosystems’ dynamics. The absence of human interventions generating vegetation succession was considered problematic by some interviewees, whatever their group. They argued in favor of management to maintain vegetation and prevent shrub development. This wish justifies the fact that some villages hire shepherds, whose activity is not profitable enough otherwise. This was set up because “*the presence of sheep limits vegetation growth, {and allows for} a permanent upkeep of the vegetation*” (INT21). The aim here is clearly vegetation upkeep, not the revival of an agricultural activity.

Controlling the ecosystem *via* management and human intervention was also presented as improving the state of the ecosystem, as in the case of open habitats with a manager wanting agriculture back because “*it would be good, and we would make biodiversity*” (INT9); for forests, one interviewee said that “*an unmanaged forest is a forest that gets damaged*” (INT14). Here management adds to the ecosystem and makes it better. Nevertheless, the absence of some kind of control was not a problem for all interviewees. One of them argued against the need to remove vegetation developing freely and asked, “*why would shrubs not have the right to be here?*” (INT17). Unmanaged areas were controversial among the interviewees.

(3) A dislike for urbanization and intensification in the study zone. The stakeholders compared abandonment with other major LULC changes in the area – urbanization and intensification. Regarding urbanization, old fields were considered as more “natural” and their

natural aspect justified their conservation: “*conserving the settings is conserving green and natural zones, which means not building things*” (INT21). The same went for intensively managed lands, considered less valuable than abandoned areas. Rejection of intensification concerned agriculture use as well as forestry: “*here there are no great fields (...) there are uncultivated or abandoned spaces, so they are wilder so to say (...) otherwise it is fields where there are no trees left*” (INT22); “*these are more natural forests because they are not planted, species are more local it is not spruce, Douglas fir or larch*” (INT2). Old fields are appreciated here because they are opposed to urbanization and intensification which are disliked. Moreover, traditional agricultural practices are often presented as better than intensive agriculture because they cause less damage, especially to biodiversity.

(4) Acceptance of old fields because heavy constraints render them unavoidable. The perceptions of old fields are also driven by the recognition that constraints related to topography, landholding, and the socio-economic evolution of the area render them unavoidable.

First, steep slopes render farming and wood extraction difficult. In the steepest areas, the landholding structure also represents a constraint for management because unlike flat zones, it is composed of a multitude of very small plots inappropriate for certain activities. Moreover, the plot owners are often unknown, so that the stakeholders’ actions in favor of farmer establishment are limited: “*we have a very complicated landholding structure (...) a lot of small plots. (...) for instance, on one hectare there are 10 plots, and as many owners, or even more due to inheritance (...) it can be frustrating because we spend time gathering information and, in the end, we do not find all the owners (...) as a result we cannot install an activity*” (INT2). This creates tension and hopelessness, confirmed by a local decision-maker: “*there is a need for State intervention, or at the regional level I don’t know, a need for them to reclaim*

these plots to upkeep them and make them live. But they don't do that, and the land register we have is unbearable" (INT21).

Second, the socio-economic evolution of the area has favored land abandonment, as a result of three main changes: the loss of profitability of historical agriculture (grapevine, fruit, livestock), the development of profitable crops and oil-seed production, and the demographic expansion in the villages and subsequent urbanization. Agricultural abandonment is seen as the byproduct of small-scale agriculture decline and peri-urbanization, which are unstoppable changes. They are seen as inexorable or as necessities for the villages. One interviewee explained the agricultural evolutions of the last decades as follows, "*[nowadays] a machine harvests a field in one day. In the 60s (...) everyone had their small fields and harvested it, but we cannot live like this anymore. It is unfortunate but this is the way it is*" (INT11); and one local decision-maker expressed his opinion regarding ongoing recent urbanization in his village: "*it is very good to open our municipality to new inhabitants because we need to renew the population, it is getting old*" (INT22).

Those four factors intersect with each other, revealing ambivalence in the interviewees' words regarding land abandonment and old fields.

For example, the mayor of a municipality expressed regret about the disappearance of vineyards, but later criticized a land registry reform that tried to protect those vineyards by assigning plots to that sole use: "*It is a wooded area, before that it was a vine zone, with walls, but it was invaded by acacias. We considered making an educational vine plot that schools could visit but we did not have enough money (...) now it is a mess, we can hardly see the small walls anymore. There should be cleaning, removing vegetation (...) but it is a lot of work*" (INT12) and "*Landowners are rebuked if they sell, in the region the rule is to keep the land {for vine} even if we don't use it. We would like to sell those plots for construction, we prefer*

construction to vine. (...) Who is going to plant the vine? So now it is covered with shrubs” (INT12).

Some interviewees also expressed dual expectations about land use, in particular regarding farming, urbanization, and natural zones. This was clear considering the way two interviewees depicted topography, *i.e.* steep slopes, as a constraint: *“I think that topography can be an advantage because it enables us to protect {natural} spaces {from other land uses}. But on the other hand, it is a hindrance to farmer settlement”* (INT13) and *“topography is characteristic, it can be constraining because it is hard to take hold on the hills but conversely, it is what makes the richness of this place and upholds natural zones (...) We talked about it with colleagues, we don’t want to live in the conurbation where there are only buildings”* (INT19).

4. Discussion

The striking point of our findings is the diversity of perceptions of old fields between and within stakeholder groups. Their perceptions can be negative as well as positive (figure 3), and old fields are considered relational to past and present human activities in the area promoted or hindered by physical, socio-economic and land-holding constraints.

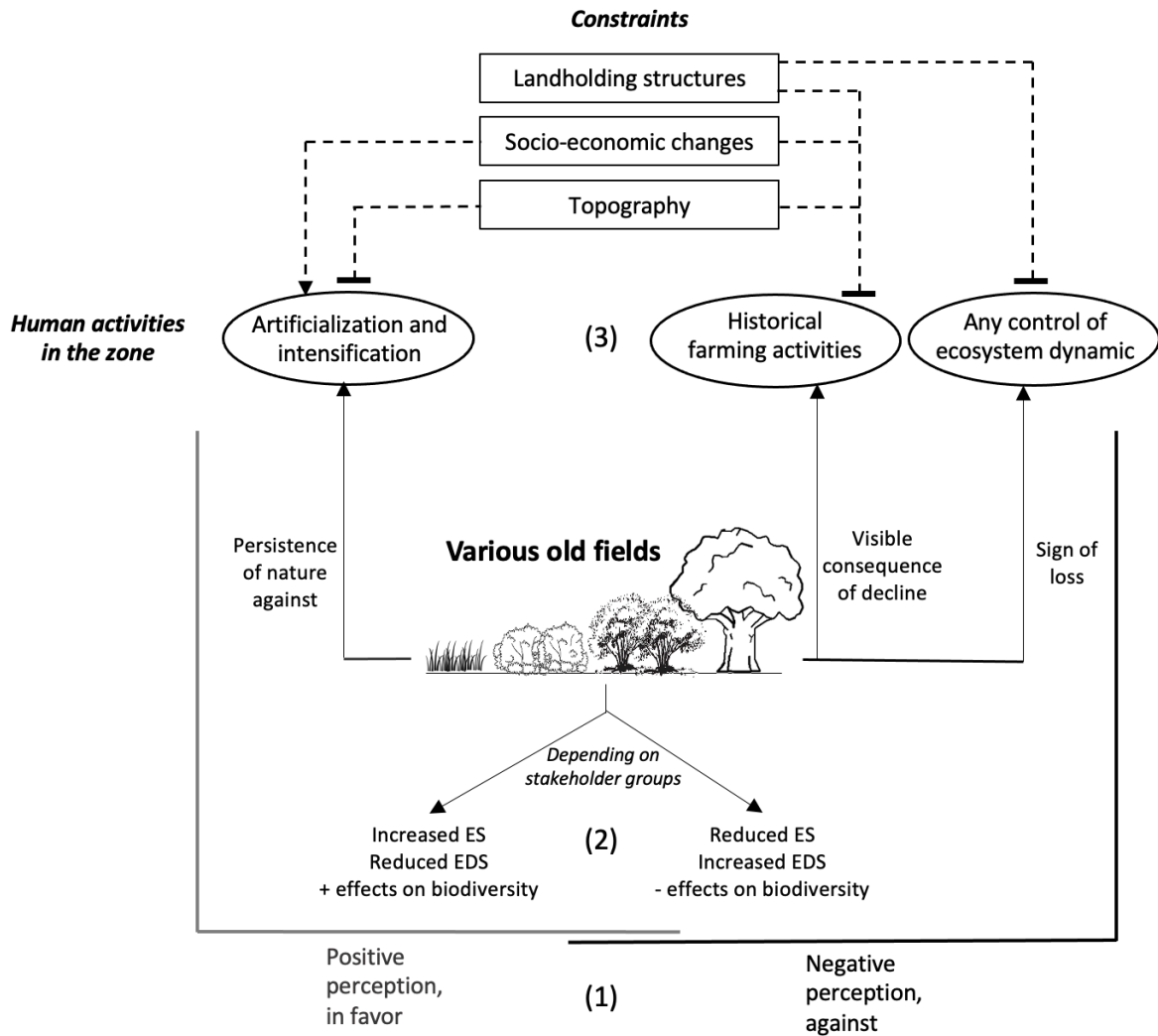


Figure 3. Synthetic diagram of the relationship between (1) the perceptions of the various old fields, (2) ES, EDS and effects on biodiversity, and (3) other drivers of perceptions. Negative and positive perceptions overlap, indicating the diversity of stakeholders' perceptions of old fields and human activities in the area.

4.1. Abandonment is a major LULC change but vegetation stages are hardly distinguished

We hypothesized that agricultural abandonment and vegetation development would be considered as a major LULC change. All stakeholders mentioned old fields in the interviews

and talked about their increase in most cases, validating our hypothesis. This contrasts with the findings of Stelling et al. (2018) in south-eastern Australia, where shrubby regrowth often went unmentioned during interviews about local vegetation although people were surrounded by it. Our results show that old fields and their expansion were well identified in the study area by all interviewees.

In the field, different successional stages could be distinguished by observing plant communities: shrub and tree species abundances increased with the succession (Lepart & Escarré, 1983). Stakeholders accordingly managed to distinguish some stages on the basis of multiple criteria including structure, openness, use status, and the presence of some species. This meets previous findings by Ulrich (1986) showing that aesthetic evaluation of ecosystems is based on complexity, depth, apparent accessibility, and the absence of threat; and Lamb & Pucell (1990) who showed that the key criteria for evaluating naturalness were the absence of human intervention, the presence of trees taller than 30 m, foliage cover, and shrub content. Nevertheless, the different succession stages were not clearly distinguished by the stakeholders' points of view and wordings, as no accurate and consistent terminology was associated to them. In many interviews, a homogenous category of words reflecting the idea of "green and natural zones" were used to designate all old fields whatever their successional stages. Our work thus suggests that few interviewees were able to discriminate between different vegetation stages in the absence of any kind of guidance. Further work is needed to refine the evaluation of old fields by stakeholders either by clarifying the link between their own words and successional stages or by using a method avoiding the uncertainty associated to words, in particular by using pictures. For instance, Ruskule et al. (2012) set up a first phase of identification of afforestation patterns, and then had these patterns evaluated by stakeholders (Ruskule et al., 2013).

4.2. Old fields are perceived as providers of benefits or nuisances depending on the stakeholder group

The interviewees perceived old fields as providers of benefits and nuisances. Benefits indicating increased ES or reduced EDS, while nuisances are related to reduced ES and increased EDS (Vaz et al., 2017). The ES that stakeholders associated with old fields were mainly regulating ES, such as erosion limitation or local climate regulation, while EDS mostly concerned cultural aspects such as aesthetics. The numbers of ES and EDS associated with old fields were rather low (nine and four, respectively). By contrast, stakeholders associated 30 ES and 15 EDS with forested landscapes, 37 ES and 10 EDS with open landscapes and 14 ES and eight EDS with intermediate landscapes in the Mont Lozère region of the Massif central (France) (Moreau, 2019). These differences may first be linked to the importance of nature in people's everyday lives. The Mont Lozère region is more rural than the area we studied, with agriculture and tourism as main activities, so that the various ecosystems at stake are probably more central to people's everyday lives. Second, the diversity of ES/EDS associated to old fields may also differ between the two studies according to the variety of stakeholders and stakeholder groups interviewed. Different stakeholder groups tend to identify different ES and EDS as shown by Cáceres et al. (2015) and Garrido et al. (2017). We interviewed three main stakeholder groups, while Moreau (2019) interviewed a greater diversity of stakeholders.

Our results indicated contrasting ES and EDS associated to old fields among stakeholder groups, mostly according to their activity and expertise. Gómez-Limón and Fernández (1999) found that optimal tree density for farmers in *dehesas* in Spain was lower than the density found desirable by natural habitat managers or recreationists. This contrast was explained by stakeholders' use and interest: a low tree density better fits with cattle grazing for farmers, while higher tree density appears more natural yet accessible landscape for land managers and

recreationists. In our study, local decision-makers also talked about regulating and cultural ES related to their activity, e.g., erosion issues in their village or recreation opportunities for their inhabitants. Concerning EDS, local decision-makers considered that old fields reduce landscape aesthetics. Finally, they did not mention biodiversity, even though they were probably familiar with the term and with the concept, as found by Levé et al. (2019) who surveyed 1,209 French citizens on the concept of biodiversity. It appears that local decision-makers did not link biodiversity with old fields.

Fruit growers also associated old fields with ES and EDS related to their activity (pests, beneficial organisms), and they referred to biodiversity *per se*. Organic farmers have a more holistic perception of biodiversity than other stakeholders do, in relation with their organic practice (Kelemen et al., 2013), and this may explain that they recognized the biodiversity issue associated to old fields.

Some regulating ES (e.g. carbon storage, water quality) or EDS (e.g. fire risk) were associated to old fields only by land managers, who were also the only ones mentioning production services (wood production). The fact that only a few stakeholders mentioned regulating ES was also previously found by Garrido et al. (2017), Moreau (2019) and Blanco et al. (2020), indicating they may be difficult to identify. Raymond et al. (2009) revealed that mapping atmosphere asset values and associated services proved difficult for community representatives, even though they were highly educated. This suggests that the expert knowledge of land managers is specific and appears required to identify regulating ES in particular. Furthermore, managers were the least consensual group in our study when it came to associating old fields to ES/EDS, probably because of their diverse domains of expertise.

4.3. Naturalness as a key concept to understand old field perception

Our results show that the naturalness of ecosystems appears as a relevant concept to understand old field perceptions by stakeholders, alongside ES and EDS. Naturalness characterizes natural spaces in a general way, and includes multiple aspects: biophysical integrity, spontaneity, and spatio-temporal continuity (Guetté et al., 2018). It is impaired by human interventions and allochthonous species (Ridder, 2007). In this study, the words *nature* and *natural* were used to refer to old fields and associated by stakeholders with the absence of human intervention, including management, agriculture, and building.

Many studies have showed that stakeholders associate old fields more than other LULC to diversity and also positively associate them with naturalness; however they reveal that these abandoned zones are concomitantly perceived as “unpleasant”, “untidy”, “a threat”, “of inefficient use”, and even as “a source of shame and sadness” (Benjamin et al., 2007; Ruskule et al., 2013; Stelling, 2017; van der Zanden et al., 2018). Benjamin et al. (2007) showed in particular that, contrary to ecocentric people, anthropocentric or apathetic people (Kaltenborn & Bjerke, 2002) have a negative perception of old fields, possibly because they perceive a low economic gain from old fields and no biological contribution. Similarly, a survey on rewilding established that respondents were *nature-connected users*, *nature controllers*, *nature sympathizers* or *nature lovers*, and that the former two evaluated wilderness and rewilding negatively while the latter two evaluated them positively (Bauer et al. 2009). Our results also showed tension: on the one hand, *nature* and the absence of human intervention were praised, but on the other hand old fields represented loss of control on the ecosystem dynamic and there was hostility toward the absence of management.

4.4. Old field perception is related to other dynamics in the study area

Our results indicate that stakeholders confronted old fields with other LULC. They perceived old fields negatively compared to historical farming activities, *versus* positively compared to intensification and urbanization. Other studies show that the disappearance of traditional agricultural activities is deplored by people, e.g. in Italy (Höchtl et al., 2005) or in Portugal (van der Zanden et al., 2018). Frei et al. (2022) looked at the policy discourses concerning natural forest regrowth in two countries (France and Spain) and found four competing storylines including one advocating for extensive agriculture and one advocating for landscape conservation. Literature data shows that stakeholders express regret concerning specific activities such as the decline of grazing and pastoralism (Palomo-Campesino et al., 2018) or more generally have regrets regarding “tradition and heritage” altogether (Kaur et al., 2004). This can be linked to emotional attachment to cultural landscapes. For example, mountains farmers’ activity in the French Pyrenees is driven by production requirements but also by sentimental attachment to the landscape (Henry, 2013).

A parallel can be drawn with the stakeholders’ relationship with naturalness, in which the absence of management is rejected but at the same time spontaneous nature is appreciated. Our results show that stakeholders expressed selectivity in the management modalities they wished with a gradation: historical agriculture was preferred to old fields, but old fields were preferred to intensification and urbanization. In the southwest of Spain, Quintas-Soriano et al. (2016) listed local people’s arguments in favor or against 4 LULC (greenhouse intensive horticulture, urban intensification, rural abandonment, and protected areas). They found that rural abandonment received the least positive arguments, but ranked the second-to-last for negative arguments, just behind protected areas. So, when people are invited to rank rural abandonment, intensive agriculture and urban intensification, rural abandonment is not approved but it is

significantly less negatively perceived that the two intensive uses. This parallels the fact that stakeholders considered old fields “less bad” than other LULC in our study.

The way stakeholders perceive old fields is also driven by the stakeholders’ capacity to act on them. In our study, slopes, landholding, urbanization pressure and agricultural intensification appeared as major constraints and led stakeholders to do with abandonment. Stelling et al. (2017) drew similar conclusions regarding *Cassinia arcuate* regrowth in Australia: the respondents adopted a “hands off” approach even if they viewed regrowth negatively because keeping it under control is extremely difficult. Therefore, our results suggest that a trade-off between preferred land-uses and feasible land-uses takes place in stakeholders’ minds. Karner et al. (2019) looked at three types of scenarios in five European countries and found the same kind of trade-off: stakeholders preferred land sharing and balanced land use to land sparing, but judged them implausible for political, economic, and aesthetic reasons. For example, land sharing is preferred in Germany, but deemed unrealistic because it would raise the price of agricultural products. In our study area, old fields were thus viewed as independent ecosystems, but also in an interplay with the LULC they replaced and the LULC they could be replaced by.

5. Conclusion

In the Massif Central region of France where this study was conducted, stakeholders belonging to three groups (local decision-makers, land managers and fruit growers) considered that old fields delivered both ES and EDS and had positive and negative effects on biodiversity. These considerations depended on the terminology they used to talk about old fields (e.g. *nature* was associated to ES and *shrubs* to EDS) and on the stakeholder group they belonged to (e.g. provisioning ES delivered by old fields were only identified by land managers) but some mixed

perceptions towards old fields and abandonment were also found within groups and even at the individual scale.

In terms of the generalizations of the results of the present study, the conclusions that have been drawn confirm the different perceptions of old fields depending on stakeholder groups. It stresses the need to interview a multiplicity of stakeholders to fully understand the way LULC changes are considered locally. In our case the range of old field perceptions and their understanding could be further refined by interviewing other stakeholder groups, including farmers other than fruit growers, and by specifying the stakeholders' environmental values.

Results also indicate that vegetation successional stages are hardly distinguished by stakeholders. Measuring or characterizing ES/EDS and the biodiversity effectively present in old fields, depending on the successional stages, would show if perceptions match objective assessment and would also provide determinant data for supporting decisions and actions.

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Accepted Article

List of appendices

1. **Appendix A.** Structure of the interviews
2. **Appendix B.** Complete list of words and expressions used to refer to old fields

Appendix A. Structure of the interviews

Part 1	Can you present yourself? What is your activity?
Part 2	Here is a map of your zone, can you describe it?
Part 3 For each ecosystem cited in part 2	<p>What is that ecosystem? What is it composed of? What are its characteristics?</p> <p>What activities take place in that ecosystem?</p> <p>Is that ecosystem important for you, for your organization, for your municipality?</p> <p>What risk does this ecosystem present? What is done to prevent this / these risks?</p> <p>To whom does this ecosystem belong?</p> <p>How did that ecosystem evolve in the last decades?</p>
Part 4 Supplementary information	<p>What are the specificities of this zone?</p> <p>What do you advise us to look at?</p> <p>Who do you work with?</p>

Appendix B. Complete list of words and expressions used to refer to old fields

	French	English
1	Abandon	Abandoned
2	Accrués	Accrués
3	Arbre	Tree
4	Bois	Wood
5	Bosquet	Grove
6	Broussaille	Shrubs
7	Buisson	Bush
8	Ca part dans tous les sens	Going in every direction
9	Deprise	Decline
10	Envahit	Invaded
11	Espaces verts	Green spaces
12	Fermé	Closed
13	Forêt	Forest
14	Fouillis	Mess
15	Fourrés	Thicket
16	Friche	Friche
17	Frutice	Peri-sylvan
18	Fûtaie	High stand
19	Garrigue	Garrigue
20	Herbe	Grass
21	Jachère	Fallow
22	Jungle	Jungle
23	Lande	Heathland
24	Nature	Nature
25	Ourlet	Herbaceous-shrub ecotone
26	Ouvert	Open
27	Peuplement	Stand
28	Sauvage	Wild
29	Taillis	Coppice
30	Vegetation	Vegetation
31	Verdure	Green