People prefer arable fields and flower strips with continuous soil cover and diversified vegetation

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Research

People prefer arable fields and flower strips with continuous soil cover and diversified vegetation

Lola Serée [1,2], *Sophie Legras* [3], *François Chiron* [2], *Muriel Valantin-Morison* [1] *and Antoine Gardarin* [1]

ABSTRACT. Agriculture is a key driver of the dynamics and transformation of rural landscapes in Western Europe. However, little is known about the influence of cropping techniques on visual perceptions of the aesthetic and ecological value of agricultural fields. We used an online survey to investigate the preferences of French residents for fields of contrasting appearances due to different cropping systems. Participants were shown photographs taken at four periods of field management (i.e., fallow period, seedbed preparation, recommencement of plant growth after winter, and end of the cycle crop), either alone or in combination with temporal sequences typical of organic, conservation, and conventional cropping systems. The perception of flower strips across the seasons was also evaluated according to three levels of diversity and two management options (with and without summer mowing). Agricultural fields with high degrees of soil cover (e.g., presence of a cover crop, narrow inter-rows) and diversified vegetation (e.g., intercrop, weeds) were perceived as more aesthetic and favorable for biodiversity. The temporal sequences reflecting visual appearances of cropped fields under conservation agriculture were considered more aesthetically appealing and favorable to biodiversity than those for organic or conventional agriculture. Participants ranked wildflower strip sequences in descending order of plant species diversity. Within diversity levels, strips not mown in summer were preferred over those mown in summer for both aesthetic and biodiversity preservation value. These results could provide the basis of a design for payments for environmental services, including the socio-cultural services provided by agroecological cropping systems.

Key Words: *aesthetic value, cultural service, landscape seasonality, photo survey*

INTRODUCTION

Agroecosystems benefit from ecosystem services essential to crop production (e.g., nutrient cycling, biotic regulation), but they also provide services in terms of their aesthetic appearance and soil conservation (Zhang et al. 2007). Agroecosystems occupy 40% of the land in the European Union territory (World Bank 2021) and have considerable potential to provide cultural services because they are perceived as aesthetic landscapes and sites of cultural preservation (Vanslembrouck et al. 2005). Cultural services can be defined as the "modalities of living that people participate in, that constitute and reflect the values and histories people share, the material and symbolic practices they engage in, and the places they inhabit" (Fish et al. 2016). They encompass themes such as spirituality, cultural heritage, education, leisure activities, social relations, and aesthetic values. Several studies have recently compared different agricultural landscapes by varying, for example, the presence of livestock or agroecological infrastructures, such as flower strips, hedges, and copses (Junge et al. 2011, van Zanten et al. 2016). Landscape changes due to agroecological transitions were perceived positively by the local population and were considered to provide more regulatory ecosystem services while retaining similar levels of productivity to conventional landscapes. However, the influence of agricultural management on cultural services at field scale requires further exploration.

Agricultural techniques modify the appearance of agroecosystems through the management of cultivated biomass (e.g., crops in place, presence of cover crops, residue management), soil preparation before crop sowing (tillage or no-tillage systems), and weed management (more or fewer weeds in fields). The understanding of this production of landscapes by agriculture and the cultural services it provides cannot be separated from the analysis of the role of the diversity in existing cropping systems, such as organic farming or conservation agriculture. We define a cropping system as the combination of a temporal succession of crops and the cropping techniques used to manage each crop applied to a field (Sebillotte 1990). The temporal succession of cropping techniques, coupled with the dynamics of vegetation within fields or in the field margin, modifies the visual aspect of cropped fields throughout the year, depending on the cropping system used. For example, in organic farming, weed management is based essentially on moldboard ploughing, disturbing the soil, and repeated use of the stale seedbed technique (Bond and Grundy 2001), preventing the establishment of cover crops and leaving the soil bare between consecutive main cash crops. Conversely, in conservation agriculture, a no-tillage system, weeds are generally managed by a combination of the systematic establishment of cover crops, the use of total herbicides, and the diversification of crop species over time and space (Kassam et al. 2019). All of these techniques influence the visual appearance of the field over the course of the year, and may be perceived by local residents as positive (weeds in organic fields, permanent crop cover in conservation agriculture) or negative (ploughing in organic farming, chemical destruction of a cover crop in conservation agriculture). To the best of our knowledge, no previous study has compared different cropping systems at field scale and analyzed their perception throughout the seasons (but see Junge et al. 2015 for a study at landscape scale). Local residents may express different levels of preference for the same photo presented alone or as part of a timeline. Thus, assessments of possible trade-offs between the aesthetic perception of cropping systems over the entire cropping season are required.

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In addition to their aesthetic value, cropping systems affect biodiversity (McLaughlin and Mineau 1995). Biodiversity is intrinsically important in itself, but it also delivers and sustains a wide range of benefits that contribute to the well-being and livelihoods of human populations (Christie et al. 2012). In the minds of most people, elements with more biodiversity usually have a lower impact by man (low input management). Agricultural areas are not generally thought of as habitats for biodiversity, and when they are mentioned, it is generally only through meadows, which are considered "natural" (Cormier et al. 2012). Meadows, but also hedges and trees, have a higher biodiversity (Cormier et al. 2012), and furthermore, are perceived as more "natural" (perceived naturalness; e.g., Tveit et al. 2006, Ode et al. 2009). The assessment of aesthetic value is therefore not independent of the assessment of biodiversity, as each of these assessments can affect the other. It is important to assess the extent to which these two values are associated if we are to understand the motivations of local residents with respect to biodiversity conservation.

In open-field landscapes, wildflower strips serve as a lever for promoting biodiversity and supporting regulation services (Wratten et al. 2012). In addition to these direct services, the species composition and structure of flower strips (architecture, flowers of different colors) and their management may also affect perception of their aesthetic value and their value for biodiversity preservation. For instance, the aesthetic value of meadows is perceived to be higher at the flowering stage (Junge et al. 2015), with species richness seen as a positive feature (Lindemann-Matthies et al. 2010a). Mown meadows and stages during which bare soil is visible receive the lowest preference ratings (Junge et al. 2015). We would therefore expect species-rich unmowed wildflower strips to be perceived as more aesthetically pleasing and favorable for biodiversity.

In the face of the global biodiversity crisis, the way that local residents perceive biodiversity in arable fields may have a particularly important impact on the implementation of biodiversity policies (Soini and Aakkula 2007). We therefore need to determine whether agricultural landscapes can be simultaneously aesthetically appealing and perceived as more favorable for biodiversity and, if so, which agricultural landscapes are perceived most favorably. This knowledge should help to increase public support for ecologically motivated landscape change (Gobster et al. 2007).

The objectives of this study were to evaluate how contrasting cropping systems, through their effects on the visual appearance of fields and wildflower strips, affected perceptions of the aesthetic and biodiversity conservation value of arable crop fields among inhabitants of the Paris basin. This region is dominated by annual arable crops (Agreste 2020). Within the framework of the agroecological transition, we analyzed the perception of organic farming and conservation agriculture relative to conventional cropping systems. We also studied the perception of flower strips, which are widely recommended and implemented in agri-environmental schemes as a means of supporting wildlife.

We aimed to determine: (1) the extent to which the visual appearance of a field, which depends on the cropping system, affected the perception of aesthetic and biodiversity value among residents at particular times; (2) whether combining a series of photographs covering the entire cropping season into a temporal sequence could identify trade-offs between preferred and non-preferred photos, modulating individual preferences; and (3) the extent to which plant species diversity and the mowing of flower strips influenced residents' perception of the aesthetic and biodiversity value of the fields.

METHODS

General principles of the questionnaire

We designed an online survey to evaluate participants' perception of the aesthetic and biodiversity value of cropped fields and wildflower strips on the basis of their visual appearance. The questionnaire consisted of a combination of questions and photographs. Local residents had to compare and rank photographs of different agricultural fields or wildflower strips in different seasons. The photographs of fields or flower strips were taken close-up to hide differences in background elements that might otherwise bias the respondents' assessment (e.g., topography, distant wooded elements). No information was provided about the cropping system employed in the photographed fields (e.g., organic or conventional farming) to ensure that the respondents analyzed only visual information. A first version of the questionnaire was tested with 10 agricultural and environmental experts. After critical discussions about its comprehensiveness, the questionnaire was refined before its completion by a panel of respondents from the general population.

Identification of the main combinations of cropping techniques affecting the visual aboveground appearance of the field crop

Cropping techniques and visual aboveground appearance

We compared the effects of three cropping systems: organic, conservation, and conventional agriculture. Within each category, we also compared the effect of different techniques (see below) affecting the visual appearance of the fields. We chose four periods during which these cropping systems influence the visual appearance of fields and, consequently, the way in which they may be perceived. The periods chosen were: (1) the summer fallow period between two main cash crops, defined here as the period extending from the harvest of the last crop until the sowing of the next crop; (2) soil preparation, just before the sowing of the crop (late August for oilseed rape or autumn for wheat); (3) the re-emergence of vegetation after winter (in February/March); and (4) the end of the crop cycle (in June). For each period, we selected photographs clearly differentiating between cropping systems and the effects of different techniques employed within each type of cropping system (e.g., tillage, species intercrops; Table 1; see photographs in Table A1.1). Our choices were based on recent descriptions of arable cropping systems in the northern half of France (Derrouch et al. 2020, Yvoz et al. 2020). These individual photographs were then combined into series recreating the temporal changes in appearance of fields representative of cropping systems found in the study area (temporal sequence, Table 1).

Conservation agriculture cropping systems maximize vegetation cover of the soil through multispecies cover crops, which may be

Table 1. Visual characteristics (in italics) resulting from the effects of the techniques used in the different cropping systems studied on the aboveground visual appearance of the field during four key periods of crop growth.

Cropping system	Fallow period	Seedbed preparation	Recommencement of growth after the winter	End of crop cycle	Temporal sequence
Organic	No cover crop *Bare soil with some weeds*	Ploughing *Inversion of horizons*	Main crop grown alone *Crop sown with wide inter-row spacing to enable mechanical weeding, presence of weeds possible*	*No weeds*	Org1 Organic - without weeds
				Presence of unsightly weeds (Senecio vulgaris, Sonchus asper)	Org2 Organic - unsightly weeds
				Presence of attractive weeds (Matricaria spp., Papaver spp.)	Org3 Organic - attractive weeds
Conservation	Cover crop *Soil covered*	No tillage - chemical destruction of the cover crop *Orange vegetation*	Main crop grown alone *Numerous crop residues at the surface (straw), presence of weeds possible*	*No weeds*	Cons1 Conservation - without weed
				Presence of unsightly weeds (Senecio vulgaris, Sonchus asper)	Cons2 Conservation - unsightly weeds
				Presence of attractive weeds (Matricaria spp., Papaver spp.)	Cons3 Conservation - attractive weeds
			Main crop grown with an intercropped species *Dense cover, associated plants*	*No weeds, intercrop species visible*	Cons4 Conservation - intercrop
Conventional	No cover crop *Bare soil with some weeds*	Stubble ploughing *Fine soil, some residues*	Main crop grown alone *No weeds, dense crop cover*	*No weeds*	Conv1 Conventional

grown as intercrops and are generally subsequently chemically destroyed (Derrouch et al. 2020). We designed four temporal sequences in which a cover crop was systematically present, with two levels of cash crop diversity (sole crop or intercrop), and three levels of weed type within the "sole crop" category. Weeds were (1) absent, (2) pretty, or (3) not particularly attractive (Table 1).

In organic farming, there is no cover crop during the fallow period, which facilitates mechanical weeding. We chose photographs of fields with a sole crop, sown with a large interrow for mechanical weeding. Three sequences were designed, differing in terms of the presence or absence of weeds and their type, as in conservation agriculture (Table 1).

In conventional cropping systems, the techniques used lead to more uniform, dense, and weed-free fields, with the appearance of the cash crop grown alone. We therefore designed a single temporal sequence with no cover crop followed by a dense and homogeneous crop cover and no weeds.

We thus designed a total of eight temporal photograph sequences corresponding to these three cropping systems, which were evaluated by each respondent (Table 1).

Weeds are generally more abundant in organic farming (Muneret et al. 2018) and conservation agriculture (Buhler et al. 1994, Chauhan et al. 2012) than in conventional cropping systems. This is why we did not ask respondents to evaluate images with weeds in conventional cropping system sequences. By analyzing only representative combinations of field appearance, we followed a systemic approach. Taking into account the fact that some techniques are strongly interrelated, we did not test all possible combinations of techniques. Furthermore, because our aim was to evaluate the effects of the techniques in different crops (but not to compare crops), we did not provide any image with oilseed rape in flower, so that the two sets of images (wheat and oilseed rape) remained comparable.

The temporal sequences were based on the two main crops found in the study area: winter wheat and winter oilseed rape (in 2019, 42% of the agricultural area was under winter wheat and 12% was under oilseed rape; Agreste 2020). Half of the respondents evaluated photographs of winter wheat crops, and the other half evaluated photographs of winter oilseed rape crops.

Management of wildflower strips

We analyzed the effects of (1) plant species richness in perennial wildflower strips, and (2) the mowing of vegetation on participants' perception of aesthetic and biodiversity value. We selected photographs of wildflower strips with three levels of species richness (low, medium, and high) combined with two modes of mowing (summer mowing or no mowing; Table 2), resulting in six temporal sequences for comparison (see photograph timelines in Table A1.2).

Evaluation of individual photographs

The respondents were first asked to rank a series of photographs for each of the four study periods: (1) from the photograph they

Table 2. Level of diversity in flower strips and with regard to modes of mowing per diversity level, with the resulting visual characteristics (in italics) over the course of the year.

Diversity level (number of species)	Summer mowing	Vegetation in autumn	Temporal sequence
Low	Yes	*In regrowth*	M1
Mostly grasses	*No flowers, low vegetation*		
	No	*Senescent*	NM1
	No flowers, uniform colors and vegetation structure		
Medium	Yes	*In regrowth*	M2
Mixture of grasses and dicotyledonous plants	*No flowers, low vegetation*		
	No	*Senescent*	NM2
	Presence of flowers, but little heterogeneity		
High	Yes	*In regrowth*	M3
Mostly dicotyledonous plants	*No flowers, low vegetation*		
	No	*Senescent*	NM3
	Presence of flowers, vegetation with strong morphological and color contrasts		

found the most aesthetically pleasing to the photograph they found the least aesthetically pleasing, and then (2) from the most to least favorable for biodiversity. As shown in Table 1, two photographs were submitted for evaluation for the fallow period, three for seedbed preparation, five for the recommencement of growth after winter, and four were presented for the crop at the end of the cycle. Each set of photographs was presented to respondents in a random order to prevent an order effect bias (Gibson et al. 2014).

We investigated the determinants of photograph preferences by proposing a list of keywords to be associated with the photographs ranked first and last for each of the four periods. Participants could select up to five keywords per photograph. For aesthetic quality, 15 keywords were chosen on the basis of indicators used in previous studies to convey different concepts relating to landscape aesthetics (see Table A1.3 for the definitions of concepts and selected indicators). We also added three neutral words (orange, green, and brown) on the basis of colors known to influence aesthetic perceptions (Tveit et al. 2006, Ode et al. 2008). For the perception of biodiversity value, we chose 22 keywords relating to mechanisms by which agriculture has been reported to affect biodiversity (Benton et al. 2003, Griffiths et al. 2008), such as the presence of resources, shelters, or habitat structure and the maintenance or disturbance of fields (Table A1.4).

Evaluation of temporal sequences

We assessed whether the combination of photographs in a temporal sequence altered participants' perception of the photographs relative to the presentation of individual photographs. Participants were asked to rank the eight cropping system temporal sequences and the six flower strip sequences in descending order of preference, from the most to the least aesthetically pleasing and then, on the same temporal sequences, from the most favorable to the least favorable for biodiversity.

Socio-demographic and behavioral measures

The perception of beauty has a subjective aspect and could vary according to the experience of each respondent, together with educational level, age, and sex (Häfner et al. 2018). We investigated the extent to which this influenced our results by asking respondents to give their age, sex, main place of residence during childhood (urban, suburban, rural), level of education, socio-professional category, and postal code. We also asked respondents how often they visited areas with cultivated fields in the course of a year and we used a series of 11 statements to measure their attachment to nature (connectedness to nature scale [CNS], Mayer and Frantz 2004) to detect possible "pro-environmentalist" behaviors (New Ecological Paradigm [NEP], Dunlap et al. 2000) and to assess their general perception of agriculture (Wachenheim and Rathge 2000) on a Likert scale, from 1 (strongly disagree) to 5 (strongly agree; see Table A1.5 for detailed statements).

Panel description

The target population corresponded to people living in the Paris basin area (in the administrative regions of Yvelines, Essonne, Eure, Eure-et-Loir and Loiret), where the photos taken reflect the rural landscapes encountered.

The questionnaire was administered online during one week in December 2020 by the Kantar survey institute (https://www.kantar.com). It was distributed until 500 responses were reached. The panel had an even distribution of sexes (48% women and 52% men) and age groups. Half of the respondents had a general, technological, or professional baccalaureate or a 1st cycle university diploma. Half of the respondents were retired or office workers. The characteristics of the panel surveyed (percentage per age groups, education level, socio-professional categories, place of residence during childhood, frequency of visits to the agricultural landscape by administrative area of residence [department], and total) are detailed in the Table A1.6. The table also includes actual values for the region surveyed to ensure the validity of the sample. The most notable differences relate to an over-representation of retirees and people holding a 1st cycle university diploma, and an under-representation of people with no diploma. However, overall, the sample is quite representative of the actual population of the five surveyed departments. In total, respondents had a mean score of 3.4/5 (± 0.7) on the NEP scale, 3.8/5 (± 0.7) on the CNS scale, and 3.1 (± 0.6) on the general perception of agriculture.

Data analysis

Classification of individual photos for each period, to determine cropping technique preferences in terms of perceived aesthetic and biodiversity value

We determined which cropping techniques were preferred by calculating the frequency of first choice for each photo in each period. On this basis, we ranked the photographs in decreasing order of preference separately for aesthetic and biodiversity value perception. We projected the cloud of associated keywords (package "wordcloud"; Fellows and Ian 2018) to visualize the criteria behind the choices made: the larger the word in the word cloud, the more frequently it was selected by participants.

Classification of temporal sequences to determine cropping techniques and wildflower preferences across the year in terms of the perception of aesthetic and biodiversity value

We determined the order of preference for "cropping system" or "flower strip" temporal sequences by calculating the sum of ranks for each temporal sequence and then ranking the temporal sequences, from the lowest value of the sum of ranks (= most often ranked first and therefore preferred), to the highest value of sum of ranks (= most often ranked last and therefore least preferred). This analysis was performed separately for oilseed rape and wheat temporal sequences and for the temporal sequences for both crops pooled together. Separate analyses were performed for the perception of aesthetic and biodiversity value.

Comparison of ranks between individual photographs and temporal sequences for cropping techniques

We searched for possible trade-offs between preferences for cropping techniques at a given time (individual photographs) and the combination of techniques used over the cropping season (temporal sequences of photographs) by comparing the observed ranks of sequences with the expected ranks (i.e., theoretical) calculated on the basis of preferences for individual photographs. For each respondent and each temporal sequence, we summed the ranks of each of the four individual photographs when assessed separately. The sequences were then ranked according to this final score (sum of the four ranks) to determine the ranking of the sequences expected on the basis of preferences for individual photos. This ranking was compared with the observed ranking of the sequence in cumulative link models (adapted for ordinal-scale observations), for ordinal logistic regression with the "clm" function ("ordinal" package; Christensen and Christensen 2015). The temporal sequences (eight levels), type of ranking (observed or expected), and their first-order interaction were included as explanatory variables. Post-hoc tests for paired comparisons were then performed with the "lsmeans" function ("lsmeans" package; Lenth and Lenth 2018) to identify significant differences between the observed and expected rankings of temporal sequences.

Socio-demographic effects

We assessed the influence of respondents' characteristics on their preferences for photographs using cumulative link models and ordinal logistic regression analyses with the "clm" function ("ordinal" package; Christensen and Christensen 2015) for each preferred individual photograph and for each temporal sequence. We included the following variables: sex, age, frequency of visits to agricultural landscapes, place of residence during childhood, highest level of education completed, socio-professional category, and crop (oilseed rape or wheat). The scores obtained for the CNS, NEP, and general perception of agriculture were included as fixed variables. Each subset of questions for the CNS, NEP, or agricultural perception were averaged for each respondent. When questions were formulated negatively, they were reversed to ensure that an increasing score denoted a greater link with nature. We kept the CNS and NEP scales separate, as they are not correlated (cor = 0.31; $t = 7.15$; df = 498; $p < 10^{-4}$).

ANOVA was performed with RVAideMemoire packages (Hervé 2021) to evaluate the global effects of socio-demographic factors (p-value threshold = 0.05) in the CLM model, followed by post-hoc tests for pairwise comparisons with the "lsmeans" function. All analyses were carried out with R version 3.5.2 (2018-12-20).

RESULTS

Preferences for individual photographs of agricultural fields for each period, with associated keywords

The photographs preferred by respondents for each of the four periods were ranked in the same order for the perception of aesthetic value and for perceived value for biodiversity, for both crop species considered (wheat and oilseed rape).

For the fallow period, the photograph showing a cover crop was much more frequently preferred than the photograph with no cover crop. For seedbed preparation, the photograph representing a chemically weeded cover crop, with orange vegetation (corresponding to frequent practice in conservation agriculture), was considered more aesthetically pleasing and biodiversity friendly than the photographs taken after soil tillage. For the period in which the vegetation re-started growing after winter, the preferred photograph was that of a typical conventional system, with dense vegetation, no residues, and no weeds. However, for biodiversity value, this photograph was ranked second overall (proportion of first choice = 36%) after that with weeds (41%; Table A1.8). At the end of the crop cycle, the most frequently preferred photograph was that of a field containing attractive flowering weeds (*Papaver rhoeas*; Fig. 1).

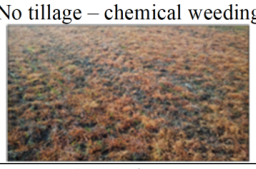
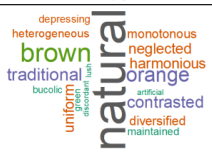
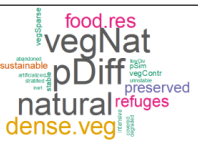
The photographs preferred in terms of aesthetic value for the fallow period or vegetative growth in early spring were associated mostly strongly with the keyword *green* and, to a lesser extent, with the keywords *natural*, *lush*, *harmonious*, and *maintained*. For seedbed preparation, the photograph considered most aesthetically pleasing, that with the chemically weeded cover crop, was associated principally with the following keywords: *natural*, *brown*, *orange*, and *traditional*.

For the end of the cycle, the photograph of the field containing flowering weeds was most frequently associated with the following adjectives: *natural*, *harmonious*, *bucolic*, and *diverse* (Fig. 1 and Table A1.7).

For the perception of biodiversity, the photographs of agricultural fields considered more favorable to biodiversity were generally associated with the following keywords: *dense vegetation*, *natural vegetation*, *food resources*, and *refuges* (Fig. 1 and Table A1.7).

Overall, socio-demographic factors had little effect on the ranking of photographs for either aesthetic preferences or perceived

Fig. 1. The most and least preferred photographs for each period during the crop growing season for the perception of aesthetic and biodiversity value. A word cloud of the keywords associated with the most preferred photo is provided. The size of the word is based on how frequently the word was chosen. Only results for photographs taken in oilseed rape are shown here (see Table A1.8 for the results for wheat). Food.res = presence of food resources; Dense.veg = dense vegetation; natural = close to a natural state; pDiff = different plants; pSim = similar plants; vegNat = natural vegetation; vegContr = controlled vegetation; vegSparse = sparse vegetation, fewDiv = little diversified.

	Perception	Fallow period	Seedbed preparation	Early growth period	End of crop cycle
Preferred photograph	Aesthetic	Presence of a cover crop	No tillage – chemical weeding	Dense seeding – no weeds	Attractive weeds (poppies)
					
	Biodiversity	Same picture	Same picture	Same picture	Same picture
Proportion of first choices	Aesthetic	89%	56%	49%	65%
	Biodiversity	86%	73%	54%	64%
Keywords associated with the preferred photograph	Aesthetic				
	Biodiversity				
Least preferred photograph	Aesthetic	No cover crop	Ploughing	No intercrop – residues at soil surface	No weeds
					
	Biodiversity	Same picture	Same picture	Same picture	Same picture
Proportion of first choices	Aesthetic	11%	18%	6%	4%
	Biodiversity	14%	11%	6%	3%

biodiversity value. One of the most relevant results was the higher probability of the photograph of a cover crop during the fallow period being preferred by respondents with a higher score on the "agricultural perception" scale, whereas none of the other photographs were related to scores on any of the three scales relating to natural, ecological, and agricultural perception (Table A1.9).

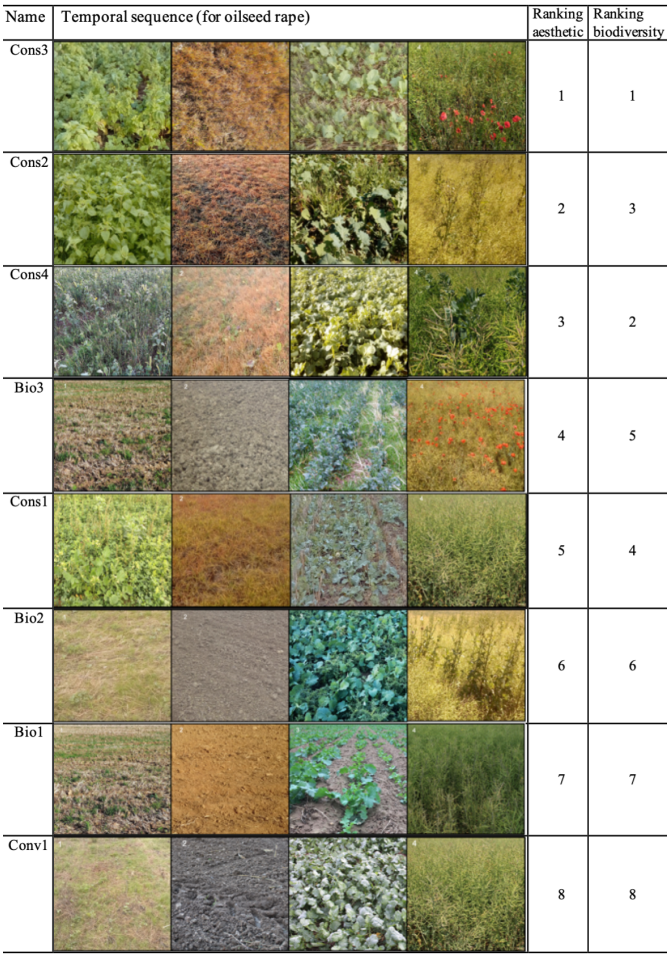
Classification of temporal sequences representing changes over time in the visual appearance of fields, and differences from the classification of individual photos

Respondents were asked to rank eight temporal successions of photos representing contrasting cropping systems. The three temporal sequences of cropping systems considered most aesthetically appealing and favorable to biodiversity were those typical of conservation agriculture. By contrast, the temporal sequence typical of a conventional cropping system was ranked last for the perception of both aesthetic and biodiversity value. The temporal sequence for a conservation agriculture cropping system field, with attractive weeds at the end of the cycle, was considered more aesthetically pleasing and more favorable to biodiversity than the sequence with unsightly weeds and the sequence with intercrops (Figs. 2 and 3).

These observed rankings were compared with the rankings expected from the evaluation of individual photos. For each temporal sequence, the mean observed and expected ranks differed significantly for all temporal sequences except for Org2 for aesthetic appreciation and for Cons1 for the perception of biodiversity value (Fig. 1). Considering all temporal sequences together, the expected and observed rankings of temporal sequences were quite consistent for the evaluation of aesthetic value. Exceptions were observed, however, for the temporal sequence representing a conventional cropping system (Conv1), which ranked three places lower than expected, and the temporal sequence in conservation agriculture without weeds (Cons1), which ranked three places higher than expected (Table A1.11).

The expected and observed rankings of temporal sequences for the perception of biodiversity value differed more than those for aesthetic value. The temporal sequences for conservation agriculture with unsightly weeds (Cons2) and without weeds (Cons1) ranked three places higher than expected, whereas those representing a conventional cropping system (Conv1) ranked four places lower (Table A1.11).

Fig. 2. Classification of temporal sequences presenting contrasting visual appearances of the fields typical of the cropping system concerned, throughout the year. The sequences are ranked from the most to the least preferred in terms of aesthetic value and perceived value for biodiversity. See Table A1.10 for the temporal sequences for wheat.



The ranking of temporal sequences for perceived aesthetic value depended mostly on the type of crop, socio-professional category, and on their attachment to nature (Table A1.12). There was considerable scattering, but we report here the main results. Attachment to nature, measured either via CNS or NEP scores, increases the ranking of the conservation agriculture sequence with an intercrop (Cons4) and with attractive weeds (Cons3). People from higher level intellectual professions and retired people ranked the conservation agriculture sequence with an intercrop (Cons4) higher than laborers. Office workers ranked the organic farming sequence with attractive weeds higher than people from intermediate professions (Org3). However, given the over-representation of retirees and office workers in our sample (see Table A1.6), these results should be taken with caution.

In terms of perceived biodiversity value, the ranking of Cons4 and Org3 increased with ecological awareness (NEP scale values) but decreased for the organic farming sequence without weeds (Org1, Table A1.12).

Finally, women ranked the conservation agriculture sequence with attractive weeds (Cons3), both aesthetically and ecologically, higher than men did.

Classification of the temporal sequences representing wildflower strips over the seasons

Respondents ranked the wildflower strip sequences in descending order of plant species diversity. Within each level of diversity, the strip not mown in summer was preferred over the strip mown in summer. The ranking was the same for perceived aesthetic and biodiversity value (Table A1.2).

For aesthetic value, people with a high degree of connection to nature (CNS scale) showed a lower preference for sequences of mown wildflower strips (M2). Respondents with high levels of ecological awareness (NEP scale) ranked sequences with a high plant diversity higher (NM3). Perceived biodiversity value was mostly dependent on age (Table A1.13).

DISCUSSION

In general, fields and temporal sequences with a higher degree of soil cover were systematically perceived as more aesthetically pleasing and favorable for biodiversity. The presence of flowering weeds in individual photos was also appreciated. Wildflower strips with a higher plant richness and without mowing during the summer were perceived as more aesthetically appealing and favorable for biodiversity.

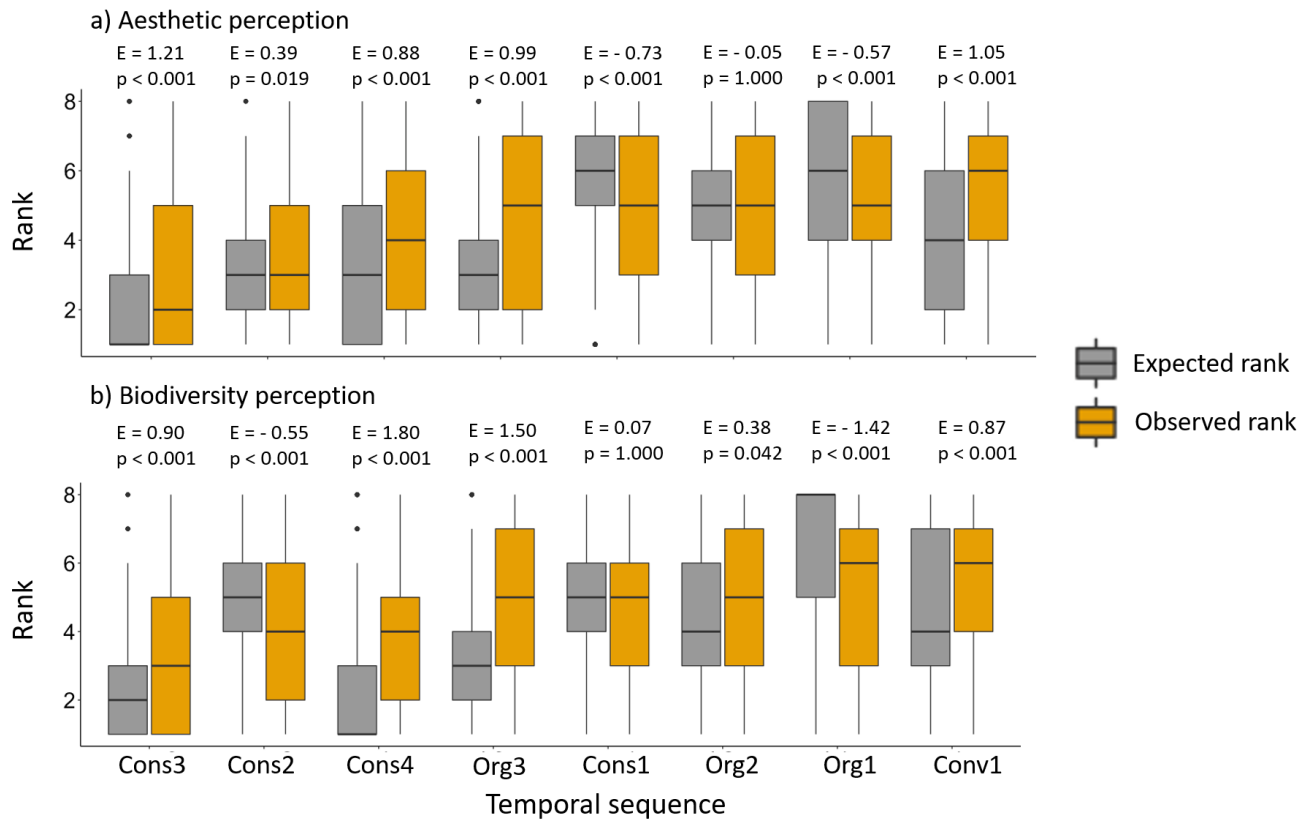
The vegetation cover of soil and the presence of flowers in fields are key elements in the aesthetic appreciation of agricultural fields

Soil cover (i.e., the presence of a cover crop, fields with dense crops, and narrow inter-rows) and the presence of attractive flowering weeds at the end of the crop cycle were the two elements that appeared to determine the aesthetic appreciation of agricultural fields at particular time points. However, the presence of weeds, associated in a temporal sequence with the absence of a cover crop and tillage during seedbed preparation, was considered less aesthetically pleasing (e.g., Org3 temporal sequence) than the intercrop of attractive weeds with higher levels of soil cover in previous periods. A previous study has also shown that a greenish-brown appearance (e.g. crops early in the year, a mown meadow, or stages where bare soil was visible) received the lowest preference ratings (Junge et al. 2015). In our case study, this suggests a trade-off favoring soil cover throughout the season rather than flowers at a given time.

In addition, the increase in visual complexity that follows from an increase in species richness, as well as the presence of more colorful flowers (such as yellow, white, or purple patches), may account for the higher ranking of more diversified fields (Cons1 temporal sequence ranking lower aesthetically than Org3) for aesthetic value at the temporal scale (Lindemann-Matthies et al. 2010b, Junge et al. 2015, Schüpbach et al. 2021).

Finally, a dense and homogeneous crop at the end of winter, which was perceived positively in individual photographs, was judged to be less aesthetic than expected when integrated into a temporal sequence with low soil cover and no weeds during other periods typical of conventional management in the study region.

Fig. 3. Expected and observed rankings for each cropping system temporal sequence for (a) perceived aesthetic value and (b) perceived biodiversity value. See Table 1 for the detailed code of temporal sequences. E=estimate.



Consistent with a previous finding that non-farmers generally dislike monoculture (Soini and Aakkula 2007), we also found that respondents disliked homogeneous successions of the visual appearance of fields over time (i.e., without cover crop, intercrop, or weeds).

Moreover, the adjective "green" was frequently associated with the preferred photographs for aesthetic value. This adjective was generally selected to describe photos without tillage or bare soil. In an experiment conducted at the Botanical Garden of the University of Zurich, 152 randomly selected visitors were asked to create a description of their own "dream" meadow by combining different species. Only one third of the plants were in flower and they often included "grasses," indicating that people like diverse meadows composed of a green matrix interspersed with colorful flowers (Lindemann-Matthies and Bose 2007). In contrast to our online panel reflecting an adult population, the respondents of the latter experiment had a priori an interest in plants since they were interviewed at a botanical garden.

Our work at field scale is consistent with findings of other studies conducted at agricultural landscape scale. In particular, Boeraeve et al. (2020; in Belgium in 2016) and Gao et al. (2014; in Missouri, Texas, and Pennsylvania, USA, in 2011) suggest that conventional landscapes and intensive monoculture scenarios, respectively, are less valued than agroecological landscapes. In our study, at the field scale, the conventional temporal sequence had a worse ranking than organic or conservation temporal sequence, probably because of a more homogeneous visual succession. Indeed, Stobbelaar et al. (2004) highlight that organic farming contributes more than conventional farms to the phenology of the landscape (i.e., the contributions made by farms to the succession of colors and shapes during the seasons), to some extent because of a greater diversity of species and habitats giving a greater expression to the seasons.

A limitation of our design is, however, that respondents evaluated a single temporal sequence for conventional fields, without weeds or soil cover, before and after two main crops, which is restrictive even if this reflects the standard in northern France. Also, for simplicity, we chose to evaluate the same combinations of techniques for the two crops even though some may be more appropriate for one crop but not for another. For instance, cover crops are frequently used before a wheat crop in conservation agriculture but less frequently before oilseed rape.

The vegetation cover of soil and the presence of flowers in fields are also key elements in the perception of biodiversity value

Consistent with published findings, photographs and temporal sequences with a cover crop or intercrop were considered more favorable for biodiversity (de Pedro et al. 2020), as were photographs and temporal sequences including weeds that could provide arthropods with resources and shelter (Norris and Kogan 2000).

Respondents preferred vegetation cover treated with total herbicide over fields with bare soil in terms of perceived biodiversity. This result was unexpected because the renewal of the authorization to use glyphosate in EU has stirred a lot of discussions and debates in particular among citizens in European countries (Kudsk and Mathiassen 2020). Thus, it could have been expected such images to be negatively appreciated. This suggests that people may have an opinion about aspects of agricultural management without being able to recognize the consequences in real agricultural fields.

In addition, the preferred photograph for the seedbed preparation period was the chemically weeded cover, which was strongly associated with the adjective "natural." "Natural" is something that belongs to or comes from nature, and which is not influenced by or a product of a human practice. In the absence of knowledge about the practice generating this visual appearance (yellow-orange vegetation), the respondents considered it to be "natural," which reflects their lack of knowledge of agriculture or an aversion to bare soil. This finding suggests that people's aesthetic preferences, when it comes to seedbed preparation, are associated with no-tillage systems, which are currently put forward as favorable for protecting soil fauna, in particular earthworms (Plaas et al. 2019).

Perception of the aesthetic and biodiversity value of different wildflower strips across seasons

Respondents preferred the most diverse (in shape and color) and unmown wildflower strip. This finding is consistent with previous studies showing the importance of the presence of flowers and species diversity, but also of structural diversity (defined by the height of the plants and the shape of the leaves) for aesthetic appreciation (Lindemann-Matthies and Bose 2007, Junge et al. 2015). Environments that are species rich throughout the year can be conducive to a sense of well-being and increase aesthetic appreciation (Fuller et al. 2007, Lindemann-Matthies et al. 2010b), thereby contributing to the provision of cultural ecosystem services. This finding is also consistent with our current results, where in-field plant diversity (weeds or intercrop), at the end of the crop cycle or at the temporal sequence scale, was most valued.

In terms of strip management, respondents ranked flower strips similarly for aesthetic quality and biodiversity value. This assessment is consistent with general ecological knowledge of the positive role of plant diversity on ecosystem functioning (Isbell et al. 2018), and with the known effect of summer mowing in semi-natural habitats. Indeed, mowing in summer presents risks for the fauna using the wildflower strips as refuges (e.g., during hot weather, disturbances in the field) and greatly decreases the nectar resources available to many insects at a time when crops have already flowered and been harvested, leaving agricultural landscapes poor in resources (e.g., the case of pollinators; Timberlake et al. 2021). Decreases in mowing intensity increase the abundance of wildflowers and of the insects visiting these flowers in suburban public parks (Garbuzov et al. 2015). The results of our survey suggest that biodiversity-friendly measures are on average appreciated by residents, even though our analysis did not capture the heterogeneity of preferences within the population.

Our results were only weakly affected by socio-demographic variables. The aesthetic ranking of wildflower strips depended on NEP and CNS scores. This highlights that attachment to nature and "pro-environmentalist" behaviors influence the perception of agroecological infrastructures. Even if they have a limited knowledge about agricultural practices, people with a high CNS score had a greater preference for unmown strips and those with a high NEP score had a greater preference for more diversified flower strips. The perception of biodiversity value depended mostly on the age of respondents and may reflect their experience; young respondents were more likely than their elders to value mown flower strips with little diversity than mown flower strips with high diversity.

APPLICATION, MANAGEMENT, AND CONCLUSION

Organic farming is generally held to be more virtuous than conventional farming in public opinion (Tscharntke et al. 2021), but without the public having any clear knowledge of the techniques employed in such cropping systems. Our original results indicate that temporal sequences of photos typical of conservation agriculture were considered the most aesthetically appealing and favorable to biodiversity. These results could be taken into account to enrich multicriteria assessments (e.g., Chabert et al. 2020) of the services and impacts of different forms of agriculture.

The presence of a cover crop, with high levels of soil cover by vegetation throughout the year and diversity (in terms of species, shape, and color) together with the presence of flowers seem to be the most relevant criteria for evaluating the aesthetic potential of fields cropped by diverse techniques and wildflower strips. This finding is in line with European Commission objectives (e.g., prevention of soil degradation, protection of biodiversity), which propose several practices to achieve aesthetic and biodiversity objectives through buffer strips and management practices without pesticides, and through the use of mixed cropping or conservation agriculture (European Commission 2021). Perennial wildflower strips also could be used in no-treatment zones in France, where pesticide application is forbidden within 20 m of human dwellings. Given the close proximity of these areas to the local residents, they could be useful sites for recreating links between humans and nature and between society and the agricultural world. Although flower strips and field management were evaluated separately here, it could be worthwhile to assess if the presence of a flower strip modifies the perception of field management.

Our results also demonstrate that farmers who do not necessarily benefit from payments dedicated to organic farming, or from the organic market, can produce cultural services beneficial to society, without any economic return from their practices. Payments for environmental services could be used as an economic tool to remunerate farmers for actions that contribute to, restore, or maintain ecosystems from which society derives benefits, including landscape aesthetic value and biodiversity protection (Engel et al. 2008, Börner et al. 2017). Although in some cases payments for environmental services could be detrimental to already existing motivations of farmers to deploy conservation agriculture (de Snoo et al. 2013), financial instruments constitute only one factor among others explaining farmers' adoption of

environmentally friendly practices (de Snoo et al. 2013, Dessart et al. 2019). Our results therefore provide useful first elements toward the design of payments for environmental services to include socio-cultural services provided by agroecological cropping systems. They call for further research on the actual willingness to pay citizens for cultural services provided by agriculture.

Author Contributions:

LS, AG, SL, and FC conceived the ideas and designed the methodology; LS collected and analyzed the data; LS wrote the first draft of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

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Data Availability:

Data are available upon request via email from lolaseree@hotmail.fr or antoine.gardarin@inrae.fr.

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People prefer arable fields and flower strips with continuous soil cover and diversified vegetation

A1.1: Photographs evaluated by the participants for wheat and oilseed rape crops during the four periods of the cropping season studied.

Key period	Wheat	Oilseed rape
Fallow period		
		
Seedbed preparation		
		
		
Recommencement of vegetation growth after winter		
		
		

		
		
End of the crop cycle		
		
		
		

A1.2: Ranking of temporal sequences presenting contrasting visual appearances of wildflower strips and their management across the seasons. Identical rankings were obtained for perceived aesthetic quality and perceived value for biodiversity.

Rank	Wildflower strips	Diversity	Management
1 *NM3*		High	Non-mown
2 *M3*		High	Mown
3 *NM2*		Medium	Non-mown
4 *M2*		Medium	Mown
5 *NM1*		Low	Non-mown
6 *M1*		Low	Mown

A1.3: Definitions of the concepts used to characterise perceived aesthetic value and the list of the associated keywords proposed to the respondents in our study.

Concept	Definition	Keywords with positive connotations	Keywords with negative connotations
Coherence	Coherence is a harmonious arrangement of landscape composition, such as a unity of landscape colour and texture (Stamps 2004)	Harmonious Uniform	Discordant Monotonous
Disturbance	Disturbance refers to the lack of contextual fit and coherence in a landscape (Ode, Tveit, and Fry 2008).		
Stewardship	Stewardship refers to the sense of order and care present in the landscape, reflecting active and attentive management (Ode, Tveit, and Fry 2008)	Maintained	Neglected
Naturalness	Naturalness describes the perception of proximity to a preconceived natural state (Ode, Tveit, and Fry 2008). It reflects the degree of wilderness or a setting in which the impact of human activities is minimal (Rosley, Lamit, and Rahman 2013)	Natural-looking	Artificial
Complexity	Complexity is the diversity and richness of landscape elements and features and the interpenetration of patterns in the landscape (Ode, Tveit, and Fry 2008)	Diversified Lush	Heterogeneous Contrasted
Historicity	Historicity describes the degree of historical continuity and richness present in the landscape. Historical continuity is reflected in the visual presence of different temporal layers, while historical richness focuses on the quantity and diversity of cultural elements (Ode, Tveit, and Fry 2008)	Traditional Bucolic	Depressing

Note: Some concepts overlap and influence each other, such as the notion of disturbance, which overlaps with the notion of consistency. We do not, therefore, differentiate between these concepts here. The concepts of openness, legibility and mystery were not studied here, because they were not considered relevant at our scale of study (the field).

A1.4: Concepts used to characterize the perception of value for biodiversity and the list of associated keywords proposed to the respondents in our study.

Concept	Keywords
Presence of resource	Presence of food resources
Shelters or habitat structure	Presence of refuges
	Dense vegetation
	Different plants
	Similar plants
	Stratified/tiered
	Covered
	Sparse vegetation
	Little diversified
Maintenance or disturbance	Close to a natural state
	Abandoned
	Artificialised
	Inert
	Living
	Natural vegetation
	Controlled vegetation
	Polluted
	Degraded
	Preserved
	Stable
	Unstable
	Sustainable
	Intensive

A1.5: Statements proposed to measure the attachment of the respondents to nature (Connectedness to Nature Scale) on a Likert scale, to detect possible 'pro-environmentalist' behaviours (New Ecological Paradigm) and to assess the general perception of agriculture.

Related to	Statement
Connectedness to Nature Scale	I am part of nature and I feel close to it (Mayer and Frantz 2004)
Connectedness to Nature Scale	I never feel a personal connection to things in my natural environment like trees, wildlife, or the view on the horizon (Mayer and Frantz 2004)
Connectedness to Nature Scale	My personal welfare is dependent on the welfare of the natural world (Mayer and Frantz 2004)
Connectedness to Nature Scale	I recognize and appreciate the intelligence of other living organisms (Mayer and Frantz 2004)
New Ecological Paradigm	The so-called “ecological crisis” facing humankind has been greatly exaggerated (Dunlap et al. 2000)
New Ecological Paradigm	Humans will eventually learn enough about how nature works to be able to control it (Dunlap et al. 2000)
New Ecological Paradigm	We are approaching the limit of the number of people the earth can support (Dunlap et al. 2000)
General perception of agriculture	I think that agriculture is harmful to the natural world, the environment (Wachenheim and Rathge 2000)
General perception of agriculture	Agriculture has the right to modify the natural environment to meet our needs by producing food (Wachenheim and Rathge 2000)
General perception of agriculture	Farmers have a positive impact on the local economy in my area (Wachenheim and Rathge 2000)
General perception of agriculture	Agriculture produces nuisances (noise, odours, public health problems etc.) that should be more regulated as residential areas move closer to agricultural areas (Wachenheim and Rathge 2000)

Note: The Connectedness to Nature Scale measures the emotional attachment of individuals to the natural world. Scores on this scale have been shown to be an important predictor of ecological behaviour or subjective well-being (Mayer & Frantz, 2004). The New Ecological Paradigm Scale focuses on beliefs about humanity's ability to disrupt the balance of nature, the existence of limits to the growth of human societies, and humanity's right to dominate the rest of nature; it was revised by Dunlap et al. (2000).

A1.6: Characteristics of the panel surveyed. Percentage (%) of men and women, age groups, education level and socio-professional categories by administrative area of residence (*department*). Numbers in parentheses refer to the values of the actual administrative areas, for comparison purposes. Age repartition is calculated for population over 18. Sex, highest level of education completed and socio-professional category are computed for population over 15, due to data availability.

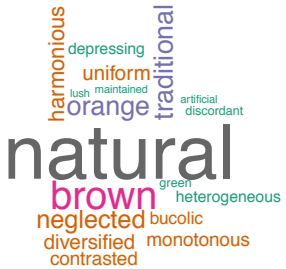
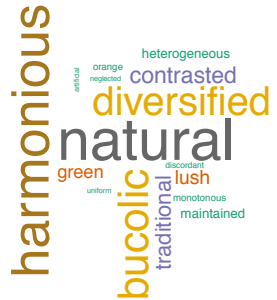
	Administrative area (columns)	Yvelines	Essonne	Eure-et-Loir	Loiret	Eure	Mean
Sex	Female	49 (52)	56 (57)	45 (52)	54 (52)	51 (52)	48 (53)
	Male	51 (48)	44 (43)	55 (48)	46 (48)	49 (48)	52 (47)
Age (years)	18-29	16 (17)	21 (20)	16 (15)	16 (17)	13 (15)	17 (17)
	30-39	18 (17)	13 (17)	14 (16)	18 (16)	18 (16)	16 (17)
	40-49	16 (19)	19 (19)	16(17)	16 (17)	18 (19)	17 (18)
	50-59	18 (17)	16 (17)	25 (17)	19 (17)	4 (17)	17 (17)
	>60	32 (29)	31 (27)	30 (35)	31 (34)	47 (33)	33 (30)
Highest level of education completed	Primary school certificate, no diploma	4 (16)	2 (19)	5 (25)	6 (23)	5 (25)	4 (20)
	General certificate of secondary education	4 (5)	2 (6)	11 (6)	9 (6)	9 (6)	6 (5)
	CAP, BEP or diploma of same level	7 (18)	20 (21)	20 (29)	18 (27)	20 (29)	16 (23)
	General, technological or professional baccalaureate or equivalent	23 (16)	21 (18)	27 (17)	22 (17)	29 (17)	23 (17)
	1st cycle university diploma, BTS, DUT, or equivalent, level BAC +2	32 (13)	28 (13)	16 (11)	29 (11)	20 (11)	27 (12)
	2nd university cycle diploma, BAC +5	17 (12)	18 (11)	11 (7)	12 (8)	16 (7)	16 (10)
	3rd university cycle diploma, doctorate	13 (21)	9 (14)	9 (6)	3 (8)	0 (6)	8 (13)
Socioprofessional category	Farmer	0 (0)	0 (0)	0 (1)	0 (1)	0 (1)	0 (0)
	Craftsman, merchant or business owner	4 (3)	1 (3)	2 (4)	3 (4)	0 (4)	2 (4)
	Executive and higher intellectual profession	19 (23)	15 (16)	7 (9)	12 (8)	4 (8)	13 (16)
	Intermediate profession	14 (19)	13 (19)	16 (18)	8 (17)	18 (17)	13 (19)
	Office worker	25 (16)	31 (18)	30 (19)	23 (18)	9 (18)	25 (18)
	Labourer	4 (8)	3 (10)	7 (16)	9 (18)	11 (18)	6 (12)
	Retired	22 (5)	24 (5)	32 (8)	32 (8)	44 (8)	28 (6)
	No professional activity	12 (27)	14 (27)	7 (25)	12 (27)	15 (27)	13 (27)
Place of residence during childhood	Peri-urban area	34	44	16	25	15	31
	Rural area	25	23	55	46	55	36
	Urban area	41	33	30	29	31	34
Frequency of visits to the agricultural landscape	Very rarely or never	22	17	27	21	27	21
	A few times a year	24	31	20	21	25	25
	Once or twice a month	25	17	20	21	7	19
	Once a week	14	27	18	22	16	21
	Several times a week	15	8	14	15	24	14

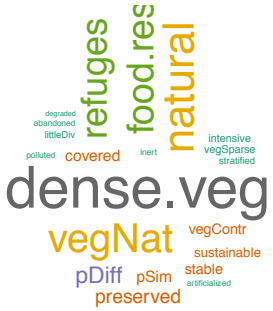
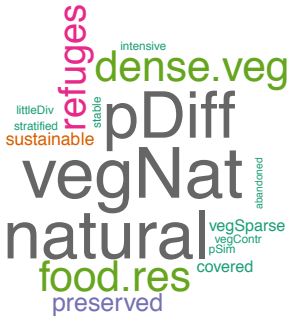
Source: INSEE RP2019.

A1.7: Number of times an adjective was associated with each preferred individual photograph, by time period in the crop cycle. Results are given for the five most frequently chosen adjectives.

Perception	Key period	Preferred photograph	Oilseed rape	Wheat
Aesthetic	Fallow period	Presence of cover crop	Green (141) Lush (94) Maintained (74) Natural (67) Harmonious (59)	Green (142) Natural (75) Lush (74) Harmonious (48) Maintained (35)
	Seedbed preparation	No tillage – chemical weeding	Natural (56) Brown (33) Orange (29) Contrasted (24) Traditional (16)	Natural (79) Brown (35) Traditional (21) Orange (20) Neglected (18)
	New growth of vegetation after winter	Dense seeding – no weeds	Green (74) Lush (62) Maintained (47) Harmonious (31) Natural (27)	Green (80) Harmonious (40) Maintained (37) Natural (30) Lush (28)
	End of cycle crop	Attractive weeds (poppies)	Natural (66) Harmonious (61) Bucolic (50) Diversified (38) Contrasted (16)	Natural (107) Harmonious (93) Bucolic (73) Diversified (70) Contrasted (34)
Biodiversity	Fallow period	Presence of cover crop	Dense vegetation (123) Food resources (87) Refuges (61) Natural vegetation (54) Close to natural state (50)	Dense vegetation (103) Close to natural state (74) Natural vegetation (65) Food resources (61) Refuges (59)
	Seedbed preparation	No tillage – chemical weeding	Close to natural state (74) Natural vegetation (60) Food resources (32) Abandoned (30) Sparse vegetation (28)	Close to natural state (68) Natural vegetation (55) Refuges (42) Sparse vegetation (31) Food resources (25)
	New growth after the winter	Dense sowing – no weeds	Dense vegetation (73) Food resources (60) Natural vegetation (38) Refuges (37) Similar plants (27)	Dense vegetation (40) Close to natural state (28) Natural vegetation (20) Refuges (20) Food resources (17)
	End of cycle crop	Attractive weeds (poppies)	Natural vegetation (55) Close to natural state (49) Different plants (46) Dense vegetation (36) Food resources (26)	Different plants (107) Natural vegetation (90) Close to natural state (86) Dense vegetation (62) Food resources (49)

A1.8: Most preferred photograph for each key period during the crop growing season for the perception of aesthetic and biological value for wheat crops. A word cloud of the keywords associated with the most preferred photograph is provided, in which word size depends on the frequency with which the word was chosen.
Words: Food.res = presence of food resources; Dense.veg = dense vegetation; natural = close to a natural state; pDiff = different plants; pSim = similar plants; vegNat = natural vegetation; vegContr = controlled vegetation; vegSparse = sparse vegetation, littleDiv = little diversified

	Perception	Fallow period	Seedbed preparation	New growth in spring	End of cycle crop
Preferred photograph	Aesthetic	Presence of cover crop 	No tillage – chemical weeding 	Dense seeding – no weeds 	Flowering weeds (poppies) 
	Biodiversity	Same	Same	Weeds 	Same
Proportion of first choices	Aesthetic	93%	64%	47%	80%
	Biodiversity	89%	80%	41%	81%
Key words associated with the preferred photograph	Aesthetic				

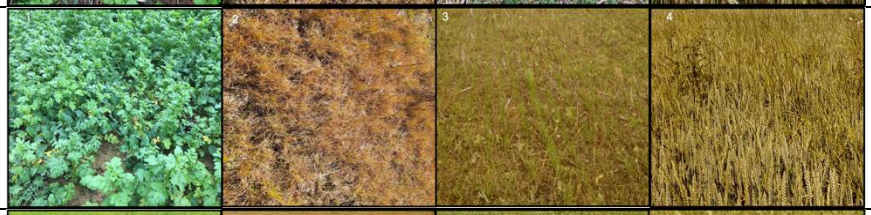
Biodiversity				

A1.9: ANOVA evaluating the effects of sociodemographic factors on the ranking of individual photographs for aesthetic preferences and perceived biodiversity value, for each key period.

	Slope	LR Chisq	Df	*P*-value	Slope	LR Chisq	Df	P-value
Perceived aesthetic value for the preferred individual photograph					Perceived value for biodiversity of the preferred individual photograph			
Fallow period								
Sex		12.36	1	<0.001***		1.92	1	0.166
Contrast female vs. male: 1.29; p<0.001								
Age		7.23	4	0.124		7.09	4	0.131
Frequency of visits to the agricultural landscape		7.42	4	0.115		5.51	4	0.239
Place of residence during childhood		0.69	2	0.707		2.97	2	0.227
Highest level of education completed		4.23	6	0.646		10.49	6	0.105
Socioprofessional category		8.21	6	0.223		12.61	6	0.049*
Area of residence		4.83	4	0.305		3.94	4	0.434
Connectedness to Nature Scale score		2.04	1	0.153		1.82	1	0.178
New Ecological Paradigm score		0.48	1	0.486		0.02	1	0.875
General Perception of Agriculture score	(+)	2.78	1	0.095	(+)	3.66	1	0.056
Seedbed preparation								
Sex		0.10	1	0.752		0.97	1	0.324
Age		11.13	4	0.025*		2.46	4	0.652
Contrast 30-39 vs. >60: -1.29; p=0.037								
Frequency of visits to the agricultural landscape		0.89	4	0.926		5.18	4	0.270
Place of residence during childhood		2.24	2	0.326		3.53	2	0.171
Highest level of education completed		9.05	6	0.171		17.03	6	0.009**
Contrast no diploma vs. BAC+5: -1.68; p=0.082 *Certificate of secondary education vs.BAC+5 :* *-1.42 ; p=0.098*								
Socioprofessional category		4.36	6	0.628		6.35	6	0.385
Area of residence		7.61	4	0.107		3.13	4	0.537
Connectedness to Nature Scale score		1.51	1	0.220		2.36	1	0.124
New Ecological Paradigm score		0.12	1	0.732		2.45	1	0.118
General Perception of Agriculture score		0.01	1	0.898	(+)	4.19	1	0.041*
Recommencement of vegetation growth after winter								
Sex		0.60	1	0.441		0.90	1	0.344

Age	3.99	4	0.407	14.95	4	0.005**
Contrast 18-29 vs. 40-49: -0.96; p=0.024						
40-49 vs. 50-59: 0.95; p=0.013						
Frequency of visits to the agricultural landscape	0.65	4	0.957	1.90	4	0.754
Place of residence during childhood	0.08	2	0.959	0.47	2	0.789
Highest level of education completed	6.17	6	0.404	14.99	6	0.020*
Socioprofessional category	5.96	6	0.428	2.60	6	0.857
Area of residence	0.39	4	0.983	3.27	4	0.514
Connectedness to Nature Scale score	0.24	1	0.622	0.25	1	0.620
New Ecological Paradigm score	0.56	1	0.455	0.01	1	0.905
General Perception of Agriculture score	0.35	1	0.557	0.02	1	0.898
Crop	1.47	1	0.225	11.96	1	<0.001***
Contrast wheat vs. oilseed rape: -0.61; p<0.001						
End of the crop cycle						
Sex	3.43	1	0.064	10.39	1	0.001**
Contrast female vs. male: 0.66; p=0.001						
Age	7.44	4	0.114	7.35	4	0.119
Frequency of visits to the agricultural landscape	5.59	4	0.232	2.04	4	0.728
Place of residence during childhood	0.33	2	0.848	0.97	2	0.616
Highest level of education completed	2.82	6	0.831	4.77	6	0.574
Socioprofessional category	9.92	6	0.128	2.95	6	0.815
Area of residence	6.86	4	0.143	2.34	4	0.673
Connectedness to Nature Scale score	0.01	1	0.923	1.10	1	0.295
New Ecological Paradigm score	0.19	1	0.661	0.02	1	0.879
General Perception of Agriculture score	1.34	1	0.248	3.39	1	0.066
Crop	43.61	1	<0.001***	61.71	1	<0.001***
Contrast wheat vs. oilseed rape: 1.35; p<0.001						

A1.10: Classification of temporal sequences presenting contrasting visual appearances of the fields typical of the various types of cropping system during the course of the year. The sequences are ranked from the most to the least preferred in terms of aesthetic value and from the most to the least favourable for biodiversity. W= wheat crop sequences, O= oilseed rape crop sequences and G= general rank for both crops considered together.

Name	Temporal sequence (for wheat)	Ranking, aesthetic			Ranking, biodiversity		
		G	O	W	G	O	W
Cons3		1	1	1	1	1	1
Cons2		2	2	2	3	2	3
Cons4		3	3	3	2	3	2
Bio3		4	5	4	5	6	4
Cons1		5	6	5	4	5	5
Bio2		6	4	8	6	4	7
Bio1		7	7	6	7	7	8

Conv1		8	8	7	8	8	6

A1.11: Observed and expected (based on the evaluation of each individual photograph) rankings of temporal sequences of field appearance, in terms of aesthetic preferences and perceived value for biodiversity. The difference in rank between the observed and expected rankings is indicated by an arrow in the 'observed-expected rank' column. A positive value (upward arrow) indicates that the temporal sequence was perceived as more aesthetically pleasing or more favourable to biodiversity than expected based on evaluations of individual photographs, whereas a negative value (downward arrow) indicates that the temporal sequence was perceived as of lower aesthetic quality or less favourable to biodiversity than expected.

Perception	Rank	Observed ranking	Expected ranking	Observed-expected rank
Aesthetic	1	Conservation – flowering weeds (Cons3)	Conservation – flowering weeds (Cons3)	➡ 0
	2	Conservation – other weeds (Cons2)	Conservation – other weeds (Cons2)	➡ 0
	3	Conservation - intercrop (Cons4)	Organic - flowering weeds (Org3)	➡ 0
	4	Organic - flowering weeds (Org3)	Conservation - intercrop (Cons4)	➡ 0
	5	Conservation – without weeds (Cons1)	Conventional (Conv1)	⬆ +3
	6	Organic – other weeds (Org2)	Organic – other weeds (Org2)	➡ 0
	7	Organic – without weeds (Org1)	Organic – without weeds (Org1)	➡ 0
	8	Conventional (Conv1)	Conservation – without weeds (Cons1)	⬇ -3
Biodiversity	1	Conservation – flowering weeds (Cons3)	Conservation - intercrop (Cons4)	⬆ +1
	2	Conservation - intercrop (Cons4)	Conservation – flowering weeds (Cons3)	⬇ −1
	3	Conservation – other weeds (Cons2)	Organic – flowering weeds (Org3)	⬆ +3
	4	Conservation – without weeds (Cons1)	Conventional (Conv1)	⬆ +3
	5	Organic – flowering weeds (Org3)	Organic – other weeds (Org2)	⬇ -2
	6	Organic – other weeds (Org2)	Conservation – other weeds (Cons2)	⬇ -1
	7	Organic – without weeds (Org1)	Conservation – without weeds (Cons1)	⬆ +1
	8	Conventional (Conv1)	Organic – without weeds (Org1)	⬇ -4

A1.12: Effects of sociodemographic factors on the rank of the temporal sequences for each cropping system for aesthetic quality and perceived value for biodiversity (only the results for significant variables are shown).

	ANOVA				Contrasts				
	Variables	Slope	Chisq	*P*	Modality	Estimate	SE	z.ratio	*P*
Aesthetic	**Conservation - intercrop (Cons4)**								
	Connectedness to Nature Scale score	(+)	6.74	0.009***					
	Socioprofessional category		15.92	0.014	Executive and higher intellectual professions vs. labourers	1.29	0.43	2.99	0.044*
					Office workers vs. labourers	1.17	0.38	3.06	0.036*
					Labourers vs. retired	-1.56	0.46	-3.38	0.013*
	Organic – without weeds (Org1)								
	-				-				
	Organic –unsightly weeds (Org2)								
	Crop		25.91	<0.001***	Wheat vs. oilseed rape	-0.83	0.17	-5.05	<0.001***
	Organic - attractive weeds (Org3)								
	Socioprofessional category		17.75	0.007**	Office worker vs. intermediate profession	0.85	0.28	3.02	0.041*
	Crop		5.12	0.024*	Wheat vs. oilseed rape	0.38	0.17	2.26	0.024*
	Conventional (Conv1)								
	Crop		5.09	0.024*	Wheat vs. oilseed rape	0.37	0.16	2.25	0.024*
	Conservation – without weeds (Cons1)								
	-				-				
	Conservation – unsightly weeds (Cons2)								
	Area of residence		11.20	0.024*	Eure vs. Eure-et-Loir	1.11	0.37	2.97	0.025*
					Eure-et-Loir vs. Loiret	-0.99	0.33	-2.98	0.024*
	Crop		5.74	0.017*	Wheat vs. oilseed rape	-0.40	0.17	-2.39	0.017*
	Conservation – Attractive weeds (Cons3)								
	Sex		4.77	0.029*	Female vs. male	0.37	0.17	2.18	0.029*
	New Ecological Paradigm score	(+)	5.68	0.017*					
Biodiversity	**Conservation - intercrop (Cons4)**								
	New Ecological Paradigm score	(+)	5.66	0.017*					
	Organic – without weeds (Org1)								
	New Ecological Paradigm score	(-)	9.87	0.002**					

Organic – unsightly weeds (Org2)								
-								
Organic - attractive weeds (Org3)								
Area of residence		11.42	0.022*	Eure vs. Loiret	0.96	0.31	3.16	0.014*
				Eure vs. Yvelines	0.86	0.31	2.78	0.044*
New Ecological Paradigm score	(+)	5.24	0.022*					
Conventional (Conv1)								
Crop		19.04	<0.001***	Wheat vs. oilseed rape	0.72	0.17	4.34	<0.001***
Conservation – without weeds (Cons1)								
Place of residence during childhood		7.49	0.024*	Peri-urban area vs. urban area	-0.51	0.21	-2.48	0.035*
Area of residence		11.93	0.018*	Loiret vs. Yvelines	0.68	0.24	2.84	0.036*
Conservation – unsightly weeds (Cons2)								
Crop		10.01	0.002**	Wheat vs. oilseed rape	-0.52	0.17	-3.15	0.002**
Conservation – attractive weeds (Cons3)								
Sex		5.69	0.017*	Women vs. men	0.41	0.17	2.38	0.017*

A1.13: Effects of sociodemographic factors on the rank of each wildflower strip temporal sequence for perceived aesthetic quality and value for biodiversity (only the results of significant variables are shown).

	ANOVA				Contrasts				
Aesthetic	Variables	Slope	Chisq	P	Modality	Estimate	SE	z.ratio	P
	Low diversity and mown (M1)								
	Age		15.28	0.004**	18-29 vs. 50-59	1.05	0.31	3.43	0.006**
					18-29 vs. >60	1.18	0.38	3.09	0.017*
	Medium diversity and mown (M2)								
	Sex		6.57	0.010*	–Female vs. male	-0.44	0.17	-2.56	0.011*
	Connectedness to Nature Scale score	(-)	6.66	0.010**					
	High diversity and mown (M3)								
	Sex		8.30	0.004**	–Female vs. male	0.51	0.18	2.87	0.004**
	General Perception of Agriculture score	(-)	4.10	0.030*					
	Low diversity and not mown (NM1)								
	Highest level of education completed		17.34	0.008**	General certificate of secondary education vs. 3rd cycle	1.42	0.45	3.16	0.026*
	Connectedness to Nature Scale score	(+)	4.38	0.036*					
	New Ecological Paradigm score	(-)	5.02	0.025*					
	Medium diversity and not mown (NM2)								
	-								
	High diversity and not mown (NM3)								
	Sex		10.53	0.001**	–Female vs. male	0.64	0.20	3.23	0.001***
	New Ecological Paradigm score	(+)	8.53	0.003**					
Biodiversity	**Low diversity and mown (M1)**								

Age		16.65	0.002**	18-29 vs. 50-59 18-29 vs. >60 30-39 vs. 50-59	1.09 1.09 0.87	0.32 0.38 0.31	3.42 2.85 2.78	0.006** 0.035* 0.043*
Medium diversity and mown (M2)								
Area of residence		13.56	0.009**	Eure-Et-Loir vs. Loiret	1.21	0.34	3.58	0.003**
High diversity and mown (M3)								
Age		14.99	0.005**	18-29 vs. 30-39 18-29 vs. 40-49 18-29 vs. 50-59	-0.85 -0.90 -1.07	0.30 0.29 0.31	-2.83 -3.05 -3.50	0.038* 0.019* 0.004**
Low diversity and not mown (NM1)								
Frequency of visits to the agricultural landscape		11.71	0.020*	Few times a year vs. Several times a week	0.83	0.27	3.10	0.017*
Medium diversity and not mown (NM2)								
-								
High diversity and not mown (NM3)								
Age		10.61	0.031*	30-39 vs. 40-49	-0.87	0.31	-2.79	0.042*
New Ecological Paradigm score	(+)	5.69	0.017*					

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