Adoption of environment-friendly agricultural practices with background risk: experimental evidence

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Abstract

Agriculture is one of the economic sectors most exposed to exogenous risks such as climate hazards and price volatility on agricultural markets. Agricultural policies targeting the adoption of environment-friendly but potentially risk-increasing practices cannot ignore this challenge. Farmers have indeed to decide if they take the foreground risk associated with the adoption of environment-friendly practices, while simultaneously facing exogenous background risk beyond their control. Using a theoretical model and a public good experiment, we analyse the adoption of agri-environmental practices and the effect of agri-environmental subsidies in a context where risks are both foreground and background. While most of the literature on background risk focuses on its impact on individual decisions, we analyse the influence of background risk in a context of strategic uncertainty (contribution to a public good). The results highlight the potential synergies between greening the CAP and supporting risk management. We find that background risk discourages the adoption of green practices, although it affects all farmland independently from the farmer's choice of practices (environment friendly or conventional). An incentive payment per hectare of land farmed with green practices increases the adoption of risk-increasing practices but is significantly less effective in the presence of background risk.

JEL codes: C93, D81, Q18, Q12

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1. Introduction

One of the main challenges facing EU agriculture and its common policy post 2020, is to foster the adoption of environment-friendly agricultural practices and sustainable land management (European Commission 2017). To do this, consideration should be given to how to motivate farmers to better manage the environment in an effective and efficient way.

There are multiple barriers to the adoption of environment friendly farming practices. First, a farmer may be reluctant to bear individually the costs of their implementation, since the benefits created will be distributed collectively. For example, the maintenance of hedgerows promotes pollination services or natural regulation by crop auxiliaries in neighbouring farms. To overcome this public good dilemma, incentive schemes have been set up in the EU since the late nineties with the aim of encouraging farmers to adopt practices beneficial for the environment under multiannual contracts. These so-called agri-environmental measures are designed to compensate for the costs faced by farmers when they implement such practices[1].

Second, adopting environment-friendly practices sometimes leads to greater variability in yields and costs (Knapp and Heijden 2018) not easily accepted by risk-averse farmers (Binswanger 1980; Chavas and Holt 1996; Bocquého, Jacquet and Reynaud 2014; Bougherara et al. 2017; Menapace, Colson and Raffaelli 2013; Chèze, David and Martinet 2020). Farmers may choose to avoid the foreground risk of profit variability arising from risk-increasing environment-friendly practices by not engaging in them.

In addition, farmers also face risks beyond their control. Agriculture is one of the economic sectors most exposed to exogenous risks (hereinafter referred to as “background risks”) such as climate change (or climate hazards more generally) (Herberich and List 2012). While farmers can use various strategies to manage the consequences of climate risks on production (e.g. irrigation, resilient crops) and/or revenues (e.g. income diversification, insurance), these strategies do not always allow for all risks to be pooled or shifted (OECD 2009). Part of the risk inevitably remains in the background. As a result, farmers must decide whether they should adopt potentially risk-increasing practices in an already uncertain environment. In other words, they have to decide whether to bear the foreground (endogenous) risks while simultaneously facing one or more immutable background (exogenous) risks. Taking into account the background risk could thus significantly improve our understanding of behaviours in many contexts, including the decision to adopt risky and environment-friendly practices. In this multiple risks context, it is well known that the optimal risk-taking decision on a particular risk is generally not independent of the existence of other risks, even if these risks are independent (Gollier 2001). Whether agents make more or less risky decisions when the riskiness of the environment itself

[1] While, in theory, agri-environmental measures aim at compensating the total costs of implementing environment-friendly practices, it is not always the case in practice. First, because it provides a fixed payment to farmers, calculated on the average costs in a given region. As a result, some farmers, facing higher costs, have no incentive to contract such measures. Second, because additional costs, such as transaction or learning costs, are not always accounted for in the design of the payments. This increases the total costs for farmers, who, in turns, have no incentive to engage in such contracts (Ducos, Dupraz and Bonnieux 2009; Espinosa-Goded, Barreiro-Hurlé and Dupraz 2013). While this is an important barrier to agri-environmental measures adoption, this is not the main focus of our paper. Here, we only consider payments that cover the full costs of implementation.

changes depends on assumptions about preferences (Gollier and Pratt (1996), Eeckhoudt, Gollier and Schlesinger (1996), Diamond (1984), Quiggin (2003)). Therefore, understanding the effect of background risk on risk-taking behaviours remains an empirical question.[2]

While agri-environmental measures aim to offset the full costs of environment-friendly practices implementation, their design does not take these two types of risks (foreground and background risk) into account. Therefore, even with these measures, farmers could still refrain from adopting such practices in order to avoid the variability of profits associated with them in an already uncertain context.

The purpose of this paper is twofold. First, we analyse the importance of background risk on decisions to adopt environmentally sound practices (whether risky or not) in a context of strategic uncertainty. Second, we assess how incentive payments, similar to those proposed under the CAP to promote sustainable agriculture, are effective in triggering the adoption of environment-friendly practices in the presence of foreground and/or background risk.

To do so, we begin by developing a simple theoretical model to study how farmers allocate their land between environment-friendly and conventional practices (a portfolio decision) and how this decision is influenced by the presence of foreground and background risks, as well as a certain incentive payment. In our framework, a producer's individual gain depends both on his or her own contribution to environment-friendly farming and on the total area cultivated with such green practices in the group. These practices are assumed to be more costly and riskier than conventional practices. The marginal return from agriculture is uncertain, regardless of the practices used, due to production, price and policy uncertainties, and this constitutes the background risk. To simplify, we assume that preferences over the random ex-post wealth can be represented by a two-moment utility function (Meyer, 1987). We prove that, under DARA preferences, the game between farmers is with strategic complementarities. As a consequence, there is potentially too little land cultivated with environment-friendly practices compared to the situation where farmers cooperate perfectly. In addition, among other results, we show three main findings: (i) the presence of foreground risk reduces the adoption of environment-friendly practices, (ii) the presence of background risk reduces the adoption of green farming practices but only when they are risky and (iii) the incentive payment increases the adoption of green farming practices in all risks contexts.

In a second step, we conducted a framed lab experiment based on a public good game in order to test the empirical validity of the three results described above. The experiment is contextualized to capture the context of European agriculture and the subject pool consists of future agriculture stakeholders

[2] Laboratory and field experiments have been designed to test whether background risk affects the risk behavior of individuals. Laboratory experiments conducted by Lusk and Coble (2008), Lee (2008) and Beaud and Willinger (2014) concluded that an individual exposed to background risk (whether fair or unfair) would be willing to take fewer foreground risk. With regards to field experiments, Harrison et al. (2007) find that increasing background risk increases risk aversion in the U.S. rare coins market. In contrast, Bchir and Willinger (2013) found that Peruvians living in high-risk areas (due to volcano mudflows) are less risk-averse than those living with lower background risk levels, but their result holds only for low income individuals (no significant results for higher incomes). Herberich and List (2012) carried out an experiment similar to that of Harrison et al. (2007) comparing US farmers and students, but they find no conclusive results regarding the impact of background risk on risk aversion.

(students in agriculture). We observe that adopting green farming practices is indeed less likely when they are risky (as in (i)). We also find that background risk can reduce the willingness to engage in environment-friendly practices with public good properties, but even if there are not risk-increasing (as opposed to the theoretical result (ii)). Moreover, we highlight that a given incentive payment can efficiently increase the adoption of green practices when only one source of risk exists but can fail to do so in the presence of both foreground and background risks (therefore qualifying result (iii)).

Our analysis adds to the sparse literature investigating the production decisions of risk-averse farmers in the presence of multiple risks (Coyle 1999; Isik 2002; Serra et al. 2006; Ridier, Chaib and Roussy 2016; Bontems and Nauges 2019).[3] In particular, we contribute to the literature by analysing the influence of background risk on cooperative decisions, in a context of strategic uncertainty. Most of the literature on background risk is in the field of finance and focuses on its impact on individual portfolio decisions. In strategic context, only the impact of foreground risk has been analysed, in particular in the experimental literature applied to environmental issues based on public good games (Dickinson 1998; Gangadharan and Nemes 2009; Levati, Morone and Fiore 2009; Levati and Morone 2013). We contribute to the literature by testing whether the presence of background risk reduces the voluntary contribution to a public good (with and without foreground risk).

The paper is organized as follows. Section 2 presents the modelling framework, section 3 the experimental design, and section 4 the experimental results. In section 5, we discuss the policy implications and limitations of the study while section 6 concludes.

2. The modelling framework

2.1 The farmer's problem

Each farmer disposes of L_i hectares (exogenous endowment, equal for all players) and has to decide how much of this land is farmed with environment-friendly practices ($g_i \leq L_i$ hectares) or with conventional ones ($L_i - g_i$ hectares). Since green farming benefits the group (through ecosystem services), the individual's payoff depends both on her/his own contribution to green farming (g_i) and on the total area farmed with green practices in the group ($\sum_{i=1}^{n} g_i$).

The net private benefits of agriculture depends on the financial returns (bL_i), minus the costs multiplied by the number of hectares cultivated with each type of practice. The financial returns per hectare b

[3] There are many different risk taxonomies in the agricultural economics literature (see OECD (2009) for a review of the different classifications of agricultural risks). For example, one can distinguish between output and price uncertainty, sometimes including other sources such as technological or policy uncertainty (Moschini and Hennessy 2001). Another useful categorization in dynamic context is that of « non-embedded risks », i.e. risks that are beyond control of the decision maker because all decisions are made initially, versus « embedded risks », i.e. risks that can be influenced by farmers' adaptive behaviour due to sequential decisions (Hardaker, Pandey and Patten 1991; Dorward 1999; Ridier, Chaib and Roussy 2016). While both taxonomies are certainly relevant, we rely here on another one to distinguish between background risk (which is beyond farmers' control and affects all crops) and foreground risk (which only affects crops grown according to environment-friendly practices: Farmers may therefore choose to avoid the foreground risk by not engaging in such practices).

include the price, the yield and the base CAP payment (first pillar), and are assumed to be the same for both types of practices.[4] Environment-friendly practices are assumed to be on average more expensive than conventional practices ($c_g > c_c$), as alternative management strategies can be more labour-intensive and generate learning costs[5].

To account for the public good nature of the services provided by the adoption of environment-friendly practices, our game is similar to a public good game: when one unit of land is environment-friendly farmed, $\beta(g_i + \delta g_{-i})$ points are earned by a farmer in the neighbourhood, where $g_{-i} = \sum_{j \neq i} g_j$ is the sum of other farmers' actions. The parameter $\beta > 0$ is the green land efficiency factor, corresponding to the ecosystem services associated with green practices. The parameter $\delta \geq 0$ is a scaling factor allowing for a differentiated efficiency of personal green land and others' green land. In the limit case where $\delta = 0$, each farmer does not benefit from the actions of others: there is no strategic uncertainty.

The adoption of environment-friendly practices can be supported by an incentive payment scheme: PAY per hectare. The agri-environmental schemes of the rural development policy and the green payment of the first pillar of the CAP can be seen as two examples of instruments that are conditional on the respect of certain environmental standards or practices.

Overall, the payoff function of farmer i is defined as

$$\pi_i = bL_i - c_c(L_i - g_i) - c_g g_i + \beta(g_i + \delta g_{-i}) + PAY g_i$$

It is convenient to rewrite this expression as follows:

$$\pi_i = \varepsilon L_i + a g_i + \beta\delta g_{-i}$$

where $\varepsilon = b - c_c$ and $a = PAY - (c_g - c_c - \beta)$.

The payoff is decomposed into a term εL_i proportional to the size of land devoted to farming, a term $a g_i$ proportional to the land devoted to environment-friendly farming, and finally a term $\beta\delta g_{-i}$ proportional to the land devoted to environmentfriendly farming by neighboring farmers.[6]

The parameter ε is the marginal net benefit of farming which is expressed as the difference between the marginal benefit of farming b and the marginal cost c_c of using conventional practices. The parameter a is the additional marginal net benefit of farming that the farmer can obtain by using environment-friendly practices instead of conventional ones. It is expressed as the difference between

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[4] Indeed, most environmentally friendly practices do not provide access to different prices for the products since they cannot be labelled or certified or are not well-known by the consumers (Bazoche et al. 2013). Moreover, there is no consensus on the impact of environment-friendly practices on yields and yields variability, notably because yield level has many determinants interacting with each other (Lechenet et al. 2017). Finally, CAP direct payments are paid whatever the choice of practices made by a farmer (as long as the land is maintained in good agricultural and environmental conditions and the three greening requirements are fulfilled).

[5] For example, integrated pest management strategies, such as those based on crop diversification and rotations, are time and information/knowledge intensive, compared to pesticide-based pest management strategy as used in conventional agriculture (Guillou et al. 2013; Lefebvre et al. 2017).

6 The game therefore corresponds to an impure public good game because contributions to the public good generate collective benefits, but also provide private benefits (Narloch, Pascual and Drucker 2012; Midler et al. 2015).

the incentive payment PAY and the opportunity cost of g_i which is $c_g - c_c - \beta$. Indeed, the alternative to green farming is to use conventional practices which allows to save some costs $c_g - c_c > 0$ but entails the loss of not enjoying β per unit of land.

2.2 Modelling foreground and background risks

There are two sources of risk, together with the presence of strategic uncertainty due to the public good nature of the game.

First, to account for risks beyond farmers' control, we assume that the marginal benefit b is random with mean $\overline{b}$ and variance v_b. It follows that ε is random with mean $\overline{\varepsilon} = \overline{b} - c_c$ and variance $v_\varepsilon = v_b$. We assume that the parameters are such that $\overline{\varepsilon} > 0$. As a consequence, the payoff component εL_i constitutes a background risk, affecting all the farmland independently from agricultural practices, capturing production uncertainty on yields (for example due to climate hazards), but also price uncertainty and policy uncertainty regarding the size of base CAP payments.

Second, environment-friendly practices entail additional risk due to the cost c_g which is random with mean $\overline{c}_g$ and variance v_g. It follows that a is random with mean $\overline{a} = c_c - \overline{c}_g + \beta + PAY$ and variance $v_a = v_g$. Under uncertainty with respect to c_g, the payoff component $a g_i$ represents the foreground risk.

There is potential correlation between the cost of environment-friendly practices c_g and the benefit b, which translates into a covariance between the background risk ε and the foreground risk a that we denote $\sigma_{a\varepsilon}$. This correlation is positive if the cost of environment-friendly practices implementation depends on those same climatic events that influence yields or prices. It is null if the obstacles to environment-friendly farming (translated into higher costs) are specific to such practices. At this stage, we do not impose specific assumptions on the sign of this correlation in order to fit various settings.

The farmer's decision about how much land should be devoted to farming employing environment-friendly practices can thus be seen as a portfolio decision for an agent owning an initial and certain wealth denoted w_0 and that has preferences over its ex-post final wealth denoted $w_i = w_0 + \pi_i$. Added complexity comes from the fact that the decision is taken in a strategic context (where the game is aggregative (Acemoglu and Jensen 2013) and under the presence of a background risk potentially correlated to the foreground risk.

2.3 The structure of preferences

We assume that preferences over the random ex-post wealth can be represented by a two-parameter utility function $V(\mu, v)$ where μ and v are the expected value and the variance of ex-post wealth, respectively (following Eichner and Wagener (2011) and Bontems and Nauges (2019)[7]).

[7] Coyle (1999), Isik (2002) Serra et al. (2006) and Bontems and Nauges (2019) have also analyzed farmers' production decisions in a mean-variance framework in the context of multiple risks (including background risk for Bontems and Nauges (2019)). Our contribution extends the analysis of production decisions in a risky environment to a public good game context.

The expected ex-post wealth μ is as follows:

$$\mu(g_i, L_i, g_{-i}) = w_0 + \overline{a}g_i + \overline{\varepsilon}L_i + \beta\delta g_{-i}$$

and the variance of the ex-post wealth is written as

$$v(g_i, L_i) = v_a g_i^2 + v_\varepsilon L_i^2 + 2L_i g_i \sigma_{a\varepsilon}.$$

Note that the variance does not depend on the decision of other farmers, while the expected wealth does.

Following Meyer (1987), we assume that V is a C^3 function with

$$V_\mu > 0, V_v < 0, V_{\mu\mu} < 0, V_{\mu v} > 0$$

The assumptions $V_\mu > 0$ and $V_{\mu\mu} < 0$ entails that preferences are characterized by risk aversion. Risk neutrality would correspond to $V_v = 0$. The assumption $V_{\mu v} > 0$ is the analogue of prudence in the expected utility framework. The mean-variance counterpart of the Arrow-Prat measure of absolute risk aversion is the marginal rate α of substitution between μ and v:

$$\alpha(\mu, v) = -\frac{V_v}{V_\mu} > 0.$$

Decreasing absolute risk aversion (DARA) preferences are represented by $\alpha_\mu < 0$ and it means that the marginal willingness to pay for a reduction in variance decreases when expected wealth increases. Also, variance vulnerability is obtained when $\alpha_v > 0$, which indicates that the marginal willingness to pay for a reduction in variance increases when wealth becomes more volatile. Following Eichner (2008), when these two conditions are met, the individual is said to be risk vulnerable. Finally, to ensure second-order conditions in optimization programs, we consider that $V(\mu, v)$ is quasi-concave or equivalently that:

$$\alpha\alpha_\mu + \alpha_v > 0.$$

2.4 Resolution of the farmer's problem

Farmer i maximize $V(\mu, v)$ with respect to g_i that belongs to the compact set $[0, L_i]$ and for given strategies g_{-i} by other farmers:

$$\max_{g_i} U(g_i, g_{-i}, L_i) \equiv V(\mu(g_i, L_i, g_{-i}), v(g_i, L_i))$$

Ignoring corner solutions, the first-order condition for an interior solution defines the best-response function $g_i^r(g_{-i})$ such that:[8]

[8] The assumption of quasi-concavity for $V(\mu, v)$ implies that the second order condition $\partial^2 U/\partial g_i^2 < 0$ holds.

$$\frac{\partial U}{\partial g_i} = V_\mu \frac{\partial \mu}{\partial g_i} + V_v \frac{\partial v}{\partial g_i} = 0$$

or equivalently

$$\frac{\partial \mu}{\partial g_i} = \alpha(\mu, v) \frac{\partial v}{\partial g_i}$$

At equilibrium, the marginal benefit of g_i $\left(\frac{\partial \mu}{\partial g_i} = \overline{a} > 0\right)$ is equalized with its marginal cost $\left(\alpha(\mu, v) \frac{\partial v}{\partial g_i}\right)$. The marginal cost decomposes as the marginal willingness to pay for a reduction in variance times the marginal increase in variance of wealth. Importantly, the best-response decision $g_i^r(g_{-i})$ depends on others' decisions only through the expected wealth μ contained in $\alpha(\mu, v)$.

If both the cost of environment-friendly practices c_g and the marginal benefit b are known with certainty, the wealth function is linear in the decision variable and therefore the equilibrium is a corner solution: $g_i = L_i$ if $\overline{a} > 0$ or $g_i = 0$ if $\overline{a} < 0$. Note that this decision rule under certainty is independent of the other farmers' actions because the wealth function is additive separable between g_i and g_{-i}. Note also that when there is no foreground risk and only a background risk (thus $v_a = \sigma_{a\varepsilon} = 0$), the variance is constant with respect to the decision g_i. Because $\frac{\partial \mu}{\partial g_i} = \overline{a}$, the equilibrium is once again a corner solution with : $g_i = L_i$ if $\overline{a} > 0$ or $g_i = 0$ if $\overline{a} < 0$.

However, in the presence of foreground and background risk, and under DARA preferences, the game is with strategic complementarities between the land use decisions g_i for $i = 1, \ldots$,n (see the proof in the appendix A.2). The intuition is the following: whenever $\delta > 0$, each time the allocation of land to environment-friendly practices by other farmers increases, it brings some additional benefits to the non-stochastic part of wealth for farmer i. Under DARA preferences, being richer entails that farmer i is induced to take more risk and hence to increase land use with environment-friendly practices. The main consequence of strategic complementarities is that there is potentially too low contributions compared to a situation where land allocations are decided upon coordination between farmers. As long as $\delta > 0$, there is underinvestment from each farmer in g_i because it generates a positive externality on others that is not taken into account when each farmer decides unilaterally of its land use allocation.

It is also worth noting that the background risk is fair in the sense that its upscaling always raises the expected wealth. In the appendix A.1, we also characterize conditions under which an upscaling of the background risk never decreases the variance of wealth (a condition to be qualified as a risk) and under which it decreases utility so that it can be denoted as undesirable.

2.5 Theoretical propositions tested in the experiment

The model allows to explore how the land allocation decision between environment-friendly practices and conventional ones is impacted by the presence of foreground and/or background risk, and the existence of an incentive payment. Comparative statics of the model is parsed with details in the appendix A3. In particular, the model allows to draw three propositions, which have been tested in an experiment whose design is detailed in the next section.

Proposition 1: Foreground risk reduces the adoption of environment-friendly practices

Proposition 2: Background risk reduces the adoption of environment-friendly practices, but only when they are risky

Proposition 4: The incentive payment increases adoption of environment-friendly practices in all risk contexts

3. Experimental design

In order to test the empirical validity of the three propositions above, we have conducted a framed lab experiment based on a public good game. We choose a public good game to capture the ecosystem services provided by environment-friendly practices, such as pollination services or biocontrol, providing benefits for the community. Farmers decide how much of their land they would like to farm according to conventional (corresponding to the private account) or to environment-friendly practices (corresponding to the public account).

3.1 Treatments

In order to capture the presence or absence of foreground and background risk, the treatments differ by the volatility of the financial yields and costs.

In the benchmark treatment, we consider the case of non-risky environment-friendly practice and participants know the fixed value of the parameters c_g and b. In the other experimental treatments, we introduce risk on these parameters. In the foreground risk treatment (ForeOnly), participants are informed that c_g can be either $\underline{c_g}$ or $\overline{c_g}$, each with probability ½, corresponding to a risk-increasing practice. In the treatment with background risk only (BackOnly), the financial yield b can be either $\underline{b}$ or $\overline{b}$, each with probability ½ but c_g is known (there is no foreground risk). The fourth treatment (Fore&Back) corresponds to the realistic situation where participants face both foreground and background risk.

All parameters values are available in Table 1. Parameters have been chosen such that the expected profits are equal in all treatments. The background risk affecting financial yields originates from multiple sources of risk, frequently independent of each other and unlikely to cancel each other out. Therefore, we have chosen a volatility greater for the background risk ($Var(b)=25$) than for the foreground risk ($Var(c_g)=4$). While the model allows for correlation between the foreground and background risk, the correlation is set to zero in the experiment. This allows to disentangle the impact of these two sources of risks, while their effects would generally be confounded in observational data.

In order to study the impact of the introduction of an incentive payment to foster the adoption of environment-friendly practices in those different contexts of risk, a within-subject design is chosen: each participant makes two decisions, without and with the payment. It allows to compare individual contributions in a given risk set-up, before and after the implementation of the instrument. We do not control for order effects since we are not interested in the impact of the withdrawal of this support, which would be an unlikely policy scenario.

The parameter has been chosen such that $a = PAY - (c_g - c_c - \beta)$ is negative in the no payment scenario (PAY=0) and positive in the payment scenario. In other words, there is a social dilemma in the absence of incentive payment: participants' best private strategy is not to allocate any land units at all to environment-friendly practices and to instead free-ride on others in order to earn the collective benefits. But the incentive payment solves the social dilemma since it compensates the opportunity cost of contributing to the public good.[9] As shown in section 2.4, in the absence of foreground risk (Benchmark and BackOnly treatments), farmers therefore allocate all their land units towards the environment-friendly farming practices ($g_i=L_i$) in the payment scenario.

In this game, farmers face strategic uncertainty because they don't know whether others will contribute to the public good, even more so without pre-play communication. In all treatments, strategic uncertainty is kept constant by keeping constant group size, anonymity in the group and marginal incentives to contribute to the public good (β and δ) as in Gangadharan and Nemes (2009). In the experiment, we analyse decisions in a group of n=2 players.[10]

Table 1: parameters

Treatments between-subject	Land endowment L_i[11] (hectares)	Financial yield b (points/ hectare)	Cost of conventional practices c_c (points /hectare)	Cost of green practices c_g (points /hectare)	Efficiency factor of the green land $\beta(g_i + \delta g_{-i})$ (points /hectare)	No payment scenario	Payment scenario	Nb of participants

[9] This assumption is realistic since, in the current CAP, the payments associated with agri-environmental contracts are set-up to cover up the opportunity cost of adopting green practices. Concerning the green payment, while its level was not chosen to compensate the opportunity cost of adoption greening requirements, it has been shown that it is higher than the compliance costs for a large majority of farmers (Louhichi et al. 2018).

[10] While in reality the ecosystem services can benefit a larger perimeter where several farmers are operating, we have used the smallest possible group (2) to simplify the experiment. There is much literature on the effect of group size on contributions in public good games. For instance, Isaac et al. (1988) found no difference between groups of 4 and groups of 10 people. To our knowledge, there is no experimental evidence on the differences in the behaviours of individuals interacting in pairs (in a prisoners' dilemma) and in groups of 4 persons.

[11] To reinforce the field context, we attempted to respect the same size as an average farm in the Pays de Loire region since most students come from the area. The average farm size in the area is 79.2 ha (Agreste 2017), so we chose 80 ha in our experiment.

Benchmark $v_a = 0$ $v_\varepsilon = 0$	80	15	4	7	β=2 δ=1	PAY=0	PAY=2	26
ForeOnly $v_a > 0$ $v_\varepsilon = 0$	80	15	4	5 or 9*	β=2 δ=1	PAY=0	PAY=2	29
BackOnly $v_a = 0$ $v_\varepsilon > 0$	80	10 or 20*	4	7	β=2 δ=1	PAY=0	PAY=2	39
Fore&Back $v_a > 0$ $v_\varepsilon > 0$	80	10 or 20*	4	5 or 9*	β=2 δ=1	PAY=0	PAY=2	30

Note: *equally probable

3.2 Experimental procedure

The sample chosen for this experiment is made of full-time students in agriculture (for at least 2 years) of the Pays de la Loire region in France. While lab experiments with university students remain common, a growing number of experiments involve samples of professionals. Gneezy and Imas (2017) review evidence and conclude that it is important to elicit behaviour and preferences with non-standard populations that are closer to the theoretically relevant target population. The potential reasons for behavioural differences are the distribution of social preferences (Carpenter and Seki 2011), familiarity of the subject with the topic (Frechette 2011) and self-selection issue. As mentioned in the results section, the agricultural students we recruited have strong connections with the farming environment, making them closer to stakeholders than other students.

The experiment was run in May 2017 and presented to students during one of their classes after which they had 7 days to complete it on-line, with an exam question dedicated to the experiment. The experiment was programmed with Limesurvey. Participants were randomly assigned by the software to one of the four treatments when they first logged-on.

At the beginning of the survey, participants were asked to read the instructions that explained the different parts of the survey and the monetary incentives. In each part of the survey, they answered questions that tested their understanding of the instructions. Instructions are available in the appendix C.

The survey is divided into five parts. First, before the public good game, we have run two complementary tasks to elicit risk aversion and social preferences. Risk aversion has been shown to have a significant impact on decisions in public good games (Dickinson 1998), as well as in coordination games. Social preferences are also important drivers of contributions in public good games (Fischbacher and Gachter 2010; Balliet, Parks and Joireman 2009).

The first part of the survey aims at eliciting risk attitudes. The game is a lottery-choice task derived from the investment game (Gneezy and Potters 1997; Charness and Gneezy 2010). The higher the number of points invested in the risky asset, the less risk averse is the participant. The relative simplicity of the method makes it a useful instrument for assessing risk preferences in the field (Charness, Gneezy and Imas 2013) and we believe it is also suitable for on-line elicitation.

In the second part, to measure social preferences, we have used the Social Value Orientation (SVO) measure (Murphy, Ackermann and Handgraaf 2011). Participants are asked to participate in a set of dictator games where they have to share some money with an anonymous player. Within the SVO framework, it is assumed that individuals have heterogeneous motivations when evaluating different resource allocations between themselves and another person. As examples, a decision maker may endeavour to maximize her own payoff (individualistic), maximize (competitive) or minimize (inequality averse) the difference between her own and the other person's payoff, or maximize joint payoffs (prosocial).

The public good game is played in the third (no payment) and fourth (with payment) parts of the experiment. Participants do not choose between a public and a private account (as in artefactual public good games), rather they divide their land between ‘‘green farming" and ‘‘conventional farming". We rely on a contextualized experiment because we believe that the experimental context can trigger signals, such as pro-social, pro-environmental or context-specific risk preferences, that have an effect on the decision-making process under study. Environmental factors and the culture in which individuals develop, as well as prior experience shape preferences and have a critical influence on how individuals interact (Gneezy and Imas 2017).

We have chosen a "one-shot" design, which is different from most public goods experiments, where participants make repeated decisions in a single treatment and receive feedback between rounds. It allows an asynchronous experimental design, which lessens the constraint on the number of participants connected at the same time. Moreover, as explained by Goeree et al (2002), the one-shot design mitigates the possibility of reciprocity or strategic attempts to trigger others' reciprocity. Given the focus of the experiment on the impact of risk on the adoption of practices with public good properties, we did not want good or bad experiences with respect to others' contribution to the public good to influence the game.

Before making their decision, participants could see two tables explaining their individual payoff (depending on the number of land units allocated to environment-friendly practices by the participant, as well as the random draw(s)[12]) and the additional group payoff (depending on the total number of land units allocated to environment-friendly practices in their group). They were told that their total payoff is the sum of the individual and the additional group payoff.

In the last part, qualitative and quantitative information was collected from the participants using survey questions. In particular, we asked participants to state what would be the main reason for non-adoption and the main lever likely to favour their adoption if they were a farmer. All participants were invited to answer these questions, whether they adopted these practices or not in the experiment.

Participants were informed that their decisions would affect the size of the earnings they would receive. Points earned in each part (1 to 4) of the game are summed and converted at a known fixed rate into euros (200 points=1 euro). At the end of the experiment, in order to calculate the final earnings, all

[12] In treatments ForeOnly and BackOnly, the table with the individual payoff had 2 lines corresponding to the two possible outcomes of the draw. While in treatment Fore&Back, the table had 4 lines, corresponding to the four different outcomes combining the two draws.

participants were randomly matched in pairs and the computer carried out random draws. A multi-brand gift card was sent to each participant via ordinary mail with a credit corresponding to the winnings in the survey. Final earnings were thus between 9 and 23€, with an average around 16€. It took on average 30 minutes to complete the survey.

4. Experimental results

4.1 Our sample: descriptive statistics

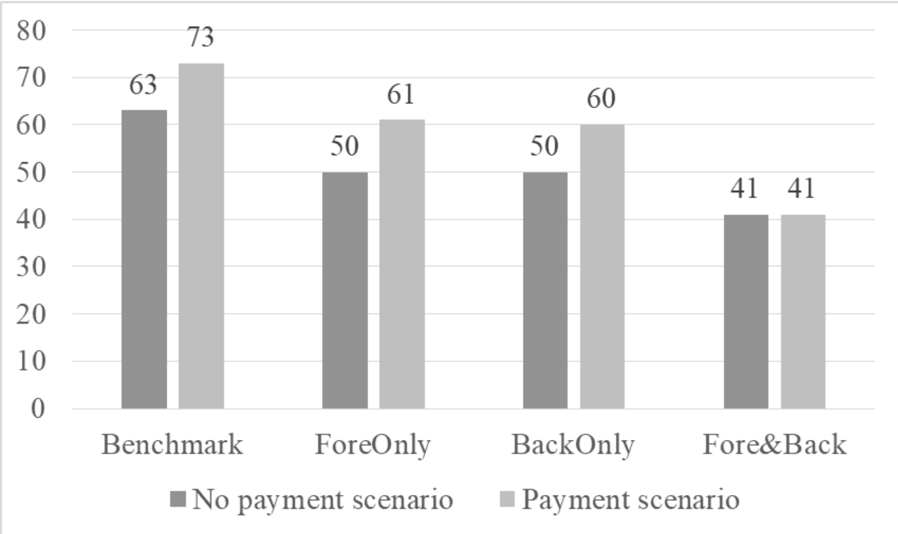
124 agricultural students took part in the experiment. The participants were on average 20 years old and 54% were male. The following numbers indicate that they are concerned with agriculture and can be considered as stakeholders. 58% of them have farmers in their closest family members (parents, siblings or parental siblings). 44% of them spend more than 30 days a year on a farm. 30% of them declare they will be farmers before their thirties, and 40% do not reject this option. Less than one third of the participants already know they do not want to become farmers in the future.

No significant differences were observed in the socio-demographic characteristics, risk aversion and social preferences in the four treatment groups, suggesting that random allocation of participants to the different treatments had the desired effect.

Concerning social preferences, adapting Murphy et al.'s procedure (2011), we classify the participants in two categories: the pro-social players (47%), who aim at maximizing the joint payoff of both players or at minimizing inequalities, and the other players (competitive and individualistic) (53%). With respect to risk aversion, we find that participants are willing to invest 43.4 % of their endowment in the risky option, slightly less than results of previous experiments (Charness and Gneezy 2012). No participants invested all their endowment in the risky asset, they are therefore all risk averse according to this elicitation method. Participants who invested fewer points in the risky asset are considered as more risk averse. Moreover, we checked that our results are not impacted by potential communication between the participants given that six and half days passed between the connection of the first participant and the last one. Indeed, one could argue that experiments conducted on-line lack control compared to lab experiments, in particular because once the experiment has begun, it is more difficult to control information flow about the task (Harrison and List 2004), especially given that participants know each other. To measure whether our results are impacted by this effect, we have verified that the submission date and the time dedicated to answering the survey (mean: 29 minutes, s.d: 16.5) are not significantly different across treatments (Kruskal-Wallis equality-of-populations rank test: Chi2(3)=2.88 and p=0.4105).

On average over all treatment groups, the average number of hectares farmed according to environment-friendly farming is positive and equals to 50.64 ha (over a total of 80 ha). 95% of the participants allocated at least 20 hectares to the green practices in the no payment scenario. Our data thus suggest that most participants depart from payoff-maximization and voluntary contribute to environment-friendly farming, potentially due to their pro-environmental or pro-social preferences. This is consistent with previous experimental literature that has shown that individuals contribute on average more to the public good than predicted by the Nash equilibrium (see for instance Ledyard (1995) for a review on public good games). In our experiment, this is true in all treatments (Figure 1).

Figure 1: Average number of hectares cultivated with environment-friendly practices per treatment



4.2 Discussion of the empirical validity of the theoretical propositions

Results are structured in order to shed light on the empirical validity of the three propositions drawn from the theoretical model. First, we examine the differences across treatments in the number of hectares farmed with environment-friendly practices using nonparametric tests (results are presented in the appendix B). Second, we use an econometrical analysis to find out what motivated decisions. The dependant variable is the number of hectares farmed with environment-friendly practices. We rely on a random effect panel tobit model to account for the nature of the data (the number of hectares are left-censored at zero and right-censored at 80). We use random effects at the subject level to capture the unobserved heterogeneity between participants.[13] The variables are described in Table 2 and the results are shown in Table 3.

Impact of foreground risk on the adoption of green practices (comparison Benchmark-ForeOnly).

In the presence of foreground risk, participants allocated less hectares to the environment-friendly practices than those in the benchmark treatment (variable ForeOnly in Table 3 and non-parametric tests in the appendix B). This result confirms proposition 1 of the theoretical model. It is consistent with the fact that all participants are averse to (foreground) risk according to our elicitation method. We confirm a well-known result in the agricultural empirical literature: risk-increasing environment-friendly practices are less adopted than non-risky practices (Babcock, Fraser and Lekakis 2003; Acs et al. 2009).

[13] The main advantage of using random effects over fixed effects estimations is that it allows for covariates that are constant over time, such as the individual characteristics of the participants (Demidenko 2005).

Impact of background risk on the adoption of green practices (comparison Benchmark-BackOnly and ForeOnly-Fore&Back).

Participants allocated less hectares to the environment-friendly practices in the presence of both foreground and background risks than in the treatment with only foreground risk (variable Fore&Back and ForeOnly in Table 3 and non-parametric tests in the appendix B). This suggests that participants take less risk (by reducing their commitment to risk-increasing environment-friendly practices) in the presence of background risk, as stated by the risk vulnerability conjecture (Eeckhoudt et al. 1996; Gollier and Pratt 1996).[14]

The model predicts that the background risk does not impact the allocation of land to green farming in the absence of foreground risk. However, in the experiment, we observe that, even when environment-friendly practices are not risky, participants allocate less hectares to these practices when there is background risk than when there is none (BackOnly vs. Benchmark). This result cannot be explained by our theoretical model. It suggests that background risk can reduce the willingness to contribute to a public good, a question that remains to be explored both empirically and theoretically.

Proposition 2 is therefore only partially verified: background risk reduces the adoption of environment-friendly practices, whether they are risky or not.

Impact of the incentive payment (comparison “no payment”- “with payment”)

We have introduced interaction terms between the payment variable and the treatment variables in the econometric model to further analyse the impact of the subsidy in the various risk scenarios (PAY*treatment in Table 3). The model predicts that the incentive payment increases adoption of environment-friendly practices in all risk contexts (proposition 4). It is only partially verified with the experimental results: participants allocated significantly more hectares to the environment-friendly practices in the payment scenario than in the absence of incentive payment in all treatments but Fore&Back. Indeed, the interaction term is significant only in Fore&Back (-24.05 ha farmed with environment-friendly practices) and nearly cancels the average impact of the payment (+29.36 ha), leading to a very small impact of the subsidy when both risks are present (+5.31 ha).

Table 2: Summary of the dependant variables used in Table 3

Name of the variable	Description	Statistics
Benchmark ForeOnly BackOnly Fore&Back	**Between-subject treatment variables** 1 if the subject is assigned to the treatment with no risk (Benchmark), foreground risk only (ForeOnly), background risk only (BackOnly) and both types of risks (Fore&Back).	
PAY	**Within-subject treatment variable** 1 if there is an incentive payment, 0 otherwise	

[14] Moreover, according to proposition 3 (see appendix A3), the contribution to environment-friendly practices decreases when the covariance between both risks increases. We could therefore assume that the reduction of the contribution to environment-friendly practices in the treatment Fore&Back would be even more pronounced if the experiment had been designed with positively correlated risks.

PAY * Benchmark (and other treatments)	Interaction term between treatment variables and the payment variable *PAY*	
prosocial	1 if the subject is prosocial according to the social value orientation measure, 0 otherwise	0: 53% 1: 47%
PAY * prosocial	Interaction term between the dummies *prosocial* and *PAY*	
risk aversion	Number of point not invested in the risky asset in the risk aversion elicitation task (between 0 and 500). The lower the number of points invested, the more risk averse is the participant.	mean: 282 sd: 80
install_family	1 if the participant plans to become a farmer and has farmers in his/her family (father, mother, siblings, uncle, ant), 0 otherwise	0: 73% 1: 27%
install_nofamily	1 if the participant plans to become a farmer and has no farmers in his/her family (father, mother, siblings, uncle, ant), 0 otherwise	0: 96% 1: 4%
impact_envt	1 if the subject thinks agricultural practices have a very negative/rather negative/rather positive/very positive impact on the environment, 0 otherwise	Very negative: 9% (reference) Rather negative: 65% Rather positive: 24% Very positive: 2%

Table 3: Results of the regression models (coefficient and statistical significance, random effects panel tobit)

VARIABLES	number of hectares farmed with environment-friendly practices	sigma_u	sigma_e
ForeOnly	-18.47**		
	(8.856)		
BackOnly	-19.87**		
	(8.313)		
Fore&Back	-32.69***		
	(8.772)		
PAY	29.36***		
	(8.418)		
PAY * ForeOnly	-9.489		
	(10.21)		
PAY * BackOnly	-7.603		
	(9.641)		
PAY * Fore&Back	-24.05**		
	(10.02)		
Prosocial	14.68**		
	(5.826)		
PAY * prosocial	-10.95*		
	(6.303)		
risk aversion	-0.0134		
	(0.0326)		
install_nofamily	43.93***		
	(16.12)		
install_family	1.795		
	(5.881)		
impact_envt_negative	-7.686		
	(9.466)		
impact_envt_positive	-6.917		
	(10.64)		
impact_envt_verypositive	-35.86**		
	(17.82)		
Constant	75.85***	20.55***	22.31***
	(14.17)	(2.715)	(1.782)
Observations	248		
Number of id	124		
Rho	0.459	0.083	
Log likelihood	-812.032		
Wald chi2(14)	67.15		
Prob > chi2	0.00		

Note: 10 left-censored observations, 155 uncensored observations, 83 right-censored observations. The regression coefficients are relative to the benchmark treatment and no payment scenario. The Chi2 values provide evidence of the models' explanatory power. Standard errors are in parentheses beneath coefficient estimates. The number of stars indicates the significance level : *** is significant at 1 %, ** is significant at 5 %, * is significant at 10 %.

4.3 Impact of individual variables

Besides treatment effects, the random effect tobit results allow to comment on the impact of other variables collected in the on-line survey. Controlling for these socio-demographic and attitudinal factors in the experiment offers a useful complement to the theoretical model, where the structure of preferences is simplified.

A decision-maker's risk attitude is often considered as essential for explaining and forecasting farm management behavior (Vollmer, Hermann and Mußhoff 2017). However, here, risk aversion as elicited in the simple portfolio investment game does not seem to explain decisions to farm with risky environment-friendly practices (*risk aversion* variable in Table 3), and this is true in all treatments (model with interaction terms not presented here). This result is consistent with Gangadharan and Nemes (2009), who did not find either that elicited risk aversion provides a consistent pattern of behaviour in their public good game with uncertainty. The use of behavioural elicitation method for risk preferences has recently been challenged in the literature. Despite their widespread use in the lab, these methods are unproven for predicting real world farming behaviour (Hellerstein, Higgins and Horowitz 2013). Moreover, several authors have shown that risk preferences are not stable across elicitation methods (Pedroni et al. 2017; Reynaud and Couture 2012; Brunette et al. 2015; Deck et al. 2013; Soane and Chmiel 2005; Crosetto and Filippin 2016; Deck, Lee and Reyes 2014; Weber, Blais and Betz 2002; Dave et al. 2010). In particular, Dave et al. (2010) show that the simplest measure (such as the one we used) have an inferior predictive accuracy. Choosing a lottery-choice measure of risk preferences therefore implies a trade-off between the cognitive burden for the respondents and the predictive performance. We thus cannot disregard the hypothesis that the investment game task we chose provides an unreliable measure of participants' risk aversion.

We observe a significant impact of social value orientation, as defined by Murphy et al. (2011), on decisions: pro-social individuals are more willing to farm with environment-friendly practices than the others. We also observe a negative and significant impact of the interaction term between payment and pro-social individuals, suggesting that the incentive is more effective in changing non-pro-social individual behaviours (as in, for example, Midler et al. 2015). Still, it increases cooperation even among pro-social individuals. Previous studies have documented the impact of farmers' environmental attitude on the adoption of environment-friendly practices and on the acceptance rate of agri-environmental policies (Beedell and Rehman 2000; Vanslembrouck, Huylenbroeck and Verbeke 2002; Willock et al. 1999). Here, we found that participants who think that agricultural practices have a very positive impact on the environment farmed significantly less hectares with environment-friendly practices in the experiment. We think that those answers can reflect a form of disagreement with the experiment postulate that some agricultural practices are not environment-friendly. It could illustrate that some farmers are still not convinced about the need to change practices since they believe conventional practices are not harmful. It could also be that participants perceive the payment instrument as an attempt by the administration to control individual decision (Thomas et al. 2019). The participants with such beliefs are not willing to bear the extra cost and risk of more environment-friendly practices in the experiment.

Plans for the future are important explanatory factors of the agricultural students' decisions in the game. 80% of those who plan to become a farmer but have no farmers in their family declare they are willing to set-up an organic farm (while only 30% of those planning to set-up as a farmer within the family context plan to do so). They are also more likely to farm with environment-friendly practices in the game, compared to those who do not plan to become farmers (variable *install_nofamily* significant). This is not the case for those who plan to set-up within the family context (variable *install_family* not significant). This result is in line with what has been observed in France: new farmers that are not taking over their parents' agricultural holding are more likely to engage in organic farming (Ambiaud 2011).

5. Discussion

We discuss here the contributions and limitations of this study, suggestions for future research and the policy implications of our results.

In order to understand the impact of background risk (such as climate change) on the adoption of environment-friendly practices, often perceived as risk-increasing, we have developed a theoretical model and designed a public good experiment that combined background and foreground risks. To our knowledge, we are the first to study how background risk influences the contributions to a public good game, in particular when it is combined with foreground risk.

Based on a two-moment decision model, we have found that background risk reduces the adoption of risky environment-friendly practices. We have also demonstrated that an incentive payment per hectare of land farmed with environment-friendly practices encourages the adoption of such practices in a risky context with foreground or background risk. Furthermore, an experiment has allowed to test these theoretical propositions, but also to go further: we find that background risk such as climate change can reduce the willingness to engage in environment-friendly practices with public good properties, even if they are not risk-increasing. We also find that an incentive payment designed to solve the social dilemma is not sufficient in the presence of both foreground and background risks: players do not allocate significantly more land to green practices when they receive the payment.

The main limitations of our study are due to the necessary simplification of reality in a model or an experiment. First, the risk setting is over simplified. For example, in the theoretical model, we do not take into account the preferences for skewness and kurtosis, while there is empirical evidence on the importance of downside risk for farmers (Kim et al. 2014; Zuo, Nauges and Wheeler 2015). Moreover, while the model does, the experimental design did not allow to test the impact of the correlation between the foreground and the background risks. Improving the methods used to elicit individual risk preferences could also allow to better distinguish the role of risk aversion and risk vulnerability from the influence of the treatment variables.

Second, in the experiment, the choice of parameters fails to capture the heterogeneity in farming contexts and green agricultural practices. Further research could focus on testing whether our results are robust to a change in the average value and standard deviation of the costs and benefits parameters, which could be chosen in order to better represent a specific green practice and increase the external validity. More experimental sessions would have also allowed to run some sensitivity analysis on the impact of farm size (impacting the size of the background risk) and the impact of the payment size.

Despite these limitations, the results shed light on existing agricultural policies. In the actual European agricultural context, both protecting the environment and managing uncertainties are issues that are gaining importance (European Commission 2017). However, CAP support to sustainable agriculture and risk management are mostly discussed separately so far and targeted by different policy instruments. Our results suggest that instruments aiming at motivating farmers to better manage the environment should take into account not only the risk associated with the adoption of more environment-friendly practices, but also the background risk. Indeed, it is often argued that CAP incentives set-up as a fixed amount per hectare received regardless of the market conditions, such as agri-environmental measures, could improve environment-friendly practices adoption by covering the extra cost and the foregone revenues (including the risk premium). Yet, in our experiment, such fixed payments appeared to be less efficient in the presence of both foreground and background risk. This questions the efficiency of agri-environmental payments, set-up as a fixed subsidy per hectare, in the presence of multiple risk sources such as pest attacks, climate hazards, price volatility and climate change.

One response could be to increase the payment for adoption of environment-friendly practices in highly risky environment. It might make the payments more effective in triggering adoption but it has two limits: first, it might be difficult to do because the amount must comply with the WTO rules and cannot exceed the foreseen costs of changing practices. This rule prevents management authorities to sufficiently increase the payment level to integrate the cost of risk in their payments. Second, it might be less cost-effective than other risk management tools.

In the CAP 2020 proposal, the European Commission proposes to make risk management tools mandatory for all member states (European Commission 2017). These tools, which include insurance, mutual funds, saving accounts, ad-hoc payments and fiscal measures, were already available in the previous CAP under pillar II, but implemented by member states on a voluntary basis. As a result, the share of CAP funds being spent on crisis and prevention measures remained very low (Bardaji and Garrido 2016). Our results suggest that such instruments, which are helping farmers manage background risk, could also impact positively their willingness to adopt green practices. Making them mandatory could thus generate environmental co-benefits, if they are not financed using the agri-environmental instruments funding.

Building bridges between environmental objectives and risk management by proposing risk management tools to farmers that are conditional on the transition towards more sustainable practices could foster the adoption of riskier and more costly green practices while helping farmers maintaining a safe level of income (Huang 2002; Coble et al. 2003). The experience “Fondo Risemina Mais” (Veneto, Italy) is one of the very few experiments in Europe of an agricultural-environmental insurance (PANEurope n.d.). In this program, farmers are offered a crop insurance financed by a mutual fund in case of pest damage to maize, as well as damage due to adverse weather conditions; and in return they agree to comply with good agricultural practices and integrated pest management. The payment is therefore not systematic, but triggered in case of unfavorable local climatic conditions or pest attacks.

To our best knowledge, this scheme has not been evaluated yet. There is scope for an experimental study to analyze the impact of such an instrument on the adoption of environment-friendly practices given the numerous behavioral factors likely to influence the perceived value of such an insurance by farmers (Coble et al. 2003; Chèze et al. 2020). Ignoring these factors may lead to error when predicting participation.

6. Conclusion

The critical impact of uncertainty on the adoption of environment-friendly practices has not fully been explored yet: the analysis has been restricted to the impact of foreground risk. However, while farmers can choose to avoid the uncertainty associated with environment-friendly practices by farming their land with well-established and less risky practices, they are also exposed to background risks beyond their control. Considering climate change is a major source of background risk in the agricultural sector, it is important to take it into account to improve our understanding of farmers' risk taking decisions. Using a theoretical model and a framed lab experiment with 124 French agricultural students based on a public good game, we have analysed the combined impact of foreground and background risk on decisions to adopt environment-friendly practices and evaluated how incentive payments may influence adoption decisions in such a risky environment.

We observe that adopting green farming practices is less likely when they are risky. More interestingly, we show that background risk is also detrimental to the adoption of green farming practices, suggesting that participants are both risk averse and risk vulnerable. While the theoretical literature is silent on this point, we find that background risk can reduce the willingness to engage in environment-friendly practices with public good properties, even if there are not risk-increasing. Moreover, we highlight that a given incentive payment can efficiently increase the adoption of green practices when only one source of risk exist but can fail to do so in the presence of both foreground and background risks. In terms of policy implications, our research demonstrates the limited efficiency of a fixed payment per hectare (such as agri-environmental payment) to encourage the adoption of risky environment-friendly practices in the presence of background risk. More generally, our results suggest the importance of building bridges between environmental objectives and risk management in the CAP, for example by proposing risk management tools to farmers that are conditional on the transition towards more sustainable systems.

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Appendix A: theoretical model

Having laid down the foundations of the model in the text in section 2, we derive the results here. We start by establishing the nature of the background risk in subsection A.1. In A.2, we characterize the nature of the game by showing that there are strategic complementarities between decisions if preferences are DARA. In A.3, we establish a number of comparative statics results.

A.1 The nature of the background risk

Let us first analyze in details the nature of the background risk. To do so, it is convenient to use the size of land L_i for upscaling since the background risk is proportional to it.

First, the background risk is *fair* because upscaling the risk always raises the expected wealth ($\partial\mu/\partial L_i = \bar{\varepsilon} > 0$). Second, this background risk is actually a *risk* only if its upscaling never decreases the variance of the final wealth (alternatively, one could say that the size L_i is risk increasing):

$$\frac{\partial v}{\partial L_i} = 2v_\varepsilon L_i + 2g_i\sigma_{a\varepsilon} \geq 0$$

which happens if and only if the size L_i is large enough for a given choice g_i:

$$L_i \geq -g_i\frac{\sigma_{a\varepsilon}}{v_\varepsilon}$$

Note that if $\sigma_{a\varepsilon} > 0$ (positive correlation between a and ε), this condition is always met and the size L_i is *risk increasing*. On the contrary, when the correlation between the foreground and the background risk is negative, and given that the decision g_i satisfies $g_i \leq L_i$, a sufficient condition for L_i to be risk increasing is that $-\sigma_{a\varepsilon} \leq v_\varepsilon$.

Finally, the background risk is *undesirable* if its upscaling decreases utility U:

$$\frac{\partial U}{\partial L_i} = V_\mu\frac{\partial\mu}{\partial L_i} + V_v\frac{\partial v}{\partial L_i} \leq 0$$

or equivalently:

$$\frac{\partial v}{\partial L_i} \geq \frac{\bar{\varepsilon}}{\alpha}$$

i.e. if and only if L_i is sufficiently risk increasing.

A.2 The nature of the game

To determine the nature of the game between farmers, we need to derive the marginal influence of others´ strategy on farmer's i action. Let us derivate totally the first-order condition w.r.t. g_i and g_{-i} to determine the slope of the best-response function:

$$\left(V_{\mu\mu}\frac{\partial\mu}{\partial g_i}+V_{\mu v}\frac{\partial v}{\partial g_i}\right)\frac{\partial\mu}{\partial g_{-i}}dg_{-i}+\frac{\partial^2 U}{\partial g_i^2}dg_i=0$$

recalling that g_{-i} only intervenes in expected wealth of farmer i (and not in its variance).

It follows that:

$$\frac{dg_i}{dg_{-i}}=-\frac{\frac{\partial\mu}{\partial g_{-i}}}{\frac{\partial^2 U}{\partial g_i^2}}\left(V_{\mu\mu}\frac{\partial\mu}{\partial g_i}+V_{\mu v}\frac{\partial v}{\partial g_i}\right)$$

The sign of the slope is determined by the sign of the term brackets as $\frac{\partial^2 U}{\partial g_i^2}<0$ because of second order condition and $\frac{\partial\mu}{\partial g_{-i}}=\beta\delta\geq 0$. Recall now that $\frac{\partial\mu}{\partial g_i}>0$ and that the first-order condition also imposes that $\frac{\partial v}{\partial g_i}>0$. Furthermore, $V_{\mu\mu}<0$ because of risk aversion and $V_{\mu v}>0$ because of prudence. It follows that, in this case, the sign is a priori ambiguous. Nevertheless we can show that at the equilibrium:

$$V_{\mu\mu}\frac{\partial\mu}{\partial g_i}+V_{\mu v}\frac{\partial v}{\partial g_i}=\left(V_{\mu\mu}\alpha+V_{\mu v}\right)\frac{\partial v}{\partial g_i}$$

and also that:

$$\alpha_\mu=-\frac{V_{\mu\mu}\alpha+V_{\mu v}}{V_\mu}<0\ (DARA)$$

It follows that:

$$V_{\mu\mu}\frac{\partial\mu}{\partial g_i}+V_{\mu v}\frac{\partial v}{\partial g_i}=-\alpha_\mu V_\mu\frac{\partial v}{\partial g_i}>0.$$

Hence, we get:

$$\frac{dg_i}{dg_{-i}}=\beta\delta\alpha_\mu V_\mu\frac{\frac{\partial v}{\partial g_i}}{\frac{\partial^2 U}{\partial g_i^2}}\geq 0$$

and $\frac{dg_i}{dg_{-i}}=0$ when $\delta=0$. In other words, under DARA preferences and when $\delta>0$, the land use game between farmers entails strategic complementarities between the land use decisions g_i for $i=1\ldots n$.

A.3 Comparative statics

In this section, we derive the comparative statics of the equilibrium w.r.t to different parameters. For any parameter p, it suffices to differentiate totally the system of first-order conditions:

$$\frac{\partial U_i(g_i, g_{-i}, p)}{\partial g_i} = 0 \textit{ for any } i = 1 \ldots n$$

and we get:

$$\text{(A1)} \qquad \frac{\partial^2 \mathrm{U_i}}{\partial \mathrm{g_i^2}} \mathrm{dg_i} + \sum_{\mathrm{j \neq i}} \frac{\partial^2 \mathrm{U_i}}{\partial \mathrm{g_i}\, \partial \mathrm{g_j}} \mathrm{dg_j} + \frac{\partial^2 \mathrm{U_i}}{\partial \mathrm{g_i}\, \partial \mathrm{p}} \mathrm{dp} = 0 \text{ for any } \mathrm{i} = 1 \ldots \mathrm{n}$$

Let us compute first the cross-derivative term $\frac{\partial^2 U_i}{\partial g_i \partial p}$. We obtain that:

$$\begin{aligned} \frac{\partial^2 U_i}{\partial g_i \partial p} &= \left(V_{\mu\mu} \frac{\partial \mu}{\partial p} + V_{\mu v} \frac{\partial v}{\partial p}\right) \frac{\partial \mu}{\partial g_i} + \left(V_{\mu v} \frac{\partial \mu}{\partial p} + V_{vv} \frac{\partial v}{\partial p}\right) \frac{\partial v}{\partial g_i} \\ &\quad + V_\mu \frac{\partial^2 \mu}{\partial g_i \partial p} + V_v \frac{\partial^2 v}{\partial g_i \partial p} \end{aligned}$$

Rearranging, this can be rewritten as follows:

$$\begin{aligned} \frac{\partial^2 U_i}{\partial g_i \partial p} &= \left(V_{\mu\mu} \frac{\partial \mu}{\partial g_i} + V_{\mu v} \frac{\partial v}{\partial g_i}\right) \frac{\partial \mu}{\partial p} + \left(V_{\mu v} \frac{\partial \mu}{\partial g_i} + V_{vv} \frac{\partial v}{\partial g_i}\right) \frac{\partial v}{\partial p} \\ &\quad + V_\mu \frac{\partial^2 \mu}{\partial g_i \partial p} + V_v \frac{\partial^2 v}{\partial g_i \partial p} \end{aligned}$$

Now, recall that:

$$\alpha_\mu = -\frac{V_{\mu\mu}\alpha + V_{\mu v}}{V_\mu} < 0 \textit{ (DARA)}$$

and that:

$$\alpha_v = -\frac{V_{\mu v}\alpha + V_{vv}}{V_\mu} > 0 \textit{ (Variance vulnerability)}$$

Replacing, we obtain:

$$\textit{(A2)} \qquad \frac{\partial^2 U_i}{\partial g_i \partial p} = \left(-\frac{\partial v}{\partial g_i} \alpha_\mu V_\mu\right) \frac{\partial \mu}{\partial p} + \left(-\frac{\partial v}{\partial g_i} \alpha_v V_\mu\right) \frac{\partial v}{\partial p} + V_\mu \frac{\partial^2 \mu}{\partial g_i \partial p} + V_v \frac{\partial^2 v}{\partial g_i \partial p}$$

To do the comparative statics, let us specialize the model to two farmers as in the experiment ($n = 2$). In that case, we get from equation (A1), for $i, j = 1,2$ and $j \neq i$:

$$\text{(A3)} \qquad \frac{\partial \mathrm{g_i}}{\partial \mathrm{p}} = \frac{1}{\Delta} \left(\frac{\partial^2 \mathrm{U_i}}{\partial \mathrm{g_i}\, \partial \mathrm{g_j}} \frac{\partial^2 \mathrm{U_j}}{\partial \mathrm{g_j}\, \partial \mathrm{p}} - \frac{\partial^2 \mathrm{U_j}}{\partial \mathrm{g_j^2}} \frac{\partial^2 \mathrm{U_i}}{\partial \mathrm{g_i}\, \partial \mathrm{p}} \right)$$

Where:

$$\Delta = \frac{\partial^2 U_j}{\partial g_j^2} \frac{\partial^2 U_i}{\partial g_i^2} - \frac{\partial^2 U_i}{\partial g_i \partial g_j} \frac{\partial^2 U_j}{\partial g_i \partial g_j} > 0$$

because of the stability of the Nash equilibrium.

Impact of change in variances $\boldsymbol{v_g}$, $\boldsymbol{v_b}$ and covariance $\boldsymbol{\sigma_{a\varepsilon}}$

Consider first a change in variance of the background and foreground risks.

Let us start with the foreground risk variance $v_g = v_a$. Consider equation (A2) for the v_a parameter:

The variance only appears in the second and last terms since it does not affect the expected wealth μ. We have:

$$\frac{\partial v}{\partial v_a} = g_i^2 \; and \; \frac{\partial^2 v}{\partial g_i \partial v_a} = 2g_i.$$

Consequently,

$$\frac{\partial^2 U_i}{\partial g_i \partial v_a} = -\frac{\partial v}{\partial g_i}\alpha_v V_\mu g_i^2 + 2g_i V_v < 0$$

An increase in the foreground risk variance decreases the marginal utility of risk taking g_i.

Now using (A3), we have:

$$\frac{\partial g_i}{\partial v_a} = \frac{1}{\Delta}\left(\frac{\partial^2 U_i}{\partial g_i \partial g_j}\frac{\partial^2 U_j}{\partial g_j \partial v_a} - \frac{\partial^2 U_j}{\partial g_j^2}\frac{\partial^2 U_i}{\partial g_i \partial v_a}\right) < 0$$

once again because of strategic complementarities ($\frac{\partial^2 U_i}{\partial g_i \partial g_j} > 0$) and concavity ($\frac{\partial^2 U_j}{\partial g_j^2} < 0$).

Proposition 1. An increase in the variance of the foreground risk decreases the land allocation choice to environment-friendly and risky practices.

Let us continue with the background risk variance $v_b = v_\varepsilon$. Consider equation (A2) for the v_ε parameter.

The variance only appears in the second and last terms since it does not affect the expected wealth μ. Moreover, we have

$$\frac{\partial v}{\partial v_\varepsilon} = L_i^2 \; and \; \frac{\partial^2 v}{\partial g_i \partial v_\varepsilon} = 0.$$

Consequently, we obtain that

$$\frac{\partial^2 U_i}{\partial g_i \partial v_\varepsilon} = -\frac{\partial v}{\partial g_i}\alpha_v V_\mu L_i^2 < 0$$

An increase in the background risk variance always decreases the marginal utility of risk taking g_i.

Now using (A3), we have

$$\frac{\partial g_i}{\partial v_\varepsilon} = \frac{1}{\Delta}\left(\frac{\partial^2 U_i}{\partial g_i \partial g_j}\frac{\partial^2 U_j}{\partial g_j \partial v_\varepsilon} - \frac{\partial^2 U_j}{\partial g_j^2}\frac{\partial^2 U_i}{\partial g_i \partial v_\varepsilon}\right) < 0$$

because of strategic complementarities ($\frac{\partial^2 U_i}{\partial g_i \partial g_j} > 0$) and concavity ($\frac{\partial^2 U_j}{\partial g_j^2} < 0$).

In the absence of foreground risk ($v_a = 0$), an increase in the variance of the background risk has no impact on g_i.

Proposition 2. An increase in the variance of the background risk decreases the land allocation choice to environment-friendly but only when these practices are risky.

Last, we analyze the impact of the correlation between the background and the foreground risk. Consider equation (A2) for the $\sigma_{a\varepsilon}$ parameter. There, the covariance $\sigma_{a\varepsilon}$ only appears in the second and last terms as it does not affect the expected wealth μ. We have:

$$\frac{\partial v}{\partial \sigma_{a\varepsilon}} = 2L_i g_i \; and \; \frac{\partial^2 v}{\partial g_i \partial \sigma_{a\varepsilon}} = 2L_i.$$

Consequently:

$$\frac{\partial^2 U_i}{\partial g_i \partial \sigma_{a\varepsilon}} = -2\frac{\partial v}{\partial g_i}\alpha_v V_\mu L_i g_i + 2L_i V_v < 0$$

An increase in the covariance decreases the marginal utility of risk taking g_i, whatever the sign of this correlation.

Finally, using (A3), we have:

$$\frac{\partial g_i}{\partial \sigma_{a\varepsilon}} = \frac{1}{\Delta}\left(\frac{\partial^2 U_i}{\partial g_i \partial g_j}\frac{\partial^2 U_j}{\partial g_j \partial \sigma_{a\varepsilon}} - \frac{\partial^2 U_j}{\partial g_j^2}\frac{\partial^2 U_i}{\partial g_i \partial \sigma_{a\varepsilon}}\right) < 0$$

once again because of strategic complementarities ($\frac{\partial^2 U_i}{\partial g_i \partial g_j} > 0$) and concavity ($\frac{\partial^2 U_j}{\partial g_j^2} < 0$).

Proposition 3. A decrease in the covariance between the foreground and the background risks increases the land allocation choice to environment-friendly and risky practices.

The impact of the incentive payment

The parameter PAY affects positively the expected profit only through the mean of a. Consider equation (A2) for the PAY parameter. From the definition of μ and v, we have:

$$\frac{\partial \mu}{\partial PAY} = g_i \; and \; \frac{\partial^2 \mu}{\partial g_i \partial PAY} = 1$$

And:

$$\frac{\partial v}{\partial PAY} = \frac{\partial^2 v}{\partial g_i \partial PAY} = 0.$$

It follows that:

$$\frac{\partial^2 U_i}{\partial g_i \partial PAY} = \left(-\frac{\partial v}{\partial g_i}\alpha_\mu V_\mu\right) g_i + V_\mu > 0.$$

The payment increases the marginal utility of g_i.

Now using (A3), we have

$$\frac{\partial g_i}{\partial PAY} = \frac{1}{\Delta}\left(\frac{\partial^2 U_i}{\partial g_i \partial g_j}\frac{\partial^2 U_j}{\partial g_j \partial PAY} - \frac{\partial^2 U_j}{\partial g_j^2}\frac{\partial^2 U_i}{\partial g_i \partial PAY}\right) > 0$$

because of strategic complementarities ($\frac{\partial^2 U_i}{\partial g_i \partial g_j} > 0$) and concavity ($\frac{\partial^2 U_j}{\partial g_j^2} < 0$).

Proposition 4. An increase in PAY induces each farmer to raise its land use allocation of environment-friendly practices.[15]

The impact of strategic complementarities

The impact of the parameter δ that scales the importance of strategic complementarities can also be evaluated using the above analysis. We have the following result.

Proposition 5. An increase in δ, that is the relative importance of others' actions in individual payoff, leads each farmer to raise its own land use allocation to environment-friendly practices.

From equation (A3), we obtain:

$$\frac{\partial g_i}{\partial \delta} = \frac{1}{\Delta}\left(\frac{\partial^2 U_i}{\partial g_i \partial g_j}\frac{\partial^2 U_j}{\partial g_j \partial \delta} - \frac{\partial^2 U_j}{\partial g_j^2}\frac{\partial^2 U_i}{\partial g_i \partial \delta}\right)$$

and from equation (A2),

$$\frac{\partial^2 U_i}{\partial g_i \partial \delta} = \left(-\frac{\partial v}{\partial g_i}\alpha_\mu V_\mu\right)\beta g_{-i} > 0$$

$$As \quad \frac{\partial \mathrm{v}}{\partial \delta} = \frac{\partial^2 \mu}{\partial \mathrm{g_i} \partial \delta} = \frac{\partial^2 \mathrm{v}}{\partial \mathrm{g_i} \partial \delta} = 0$$

Similarly, $\frac{\partial^2 U_j}{\partial g_j \partial \delta} = \left(-\frac{\partial v}{\partial g_j}\alpha_\mu V_\mu\right)\beta g_{-j} > 0$. It follows that $\frac{\partial g_i}{\partial \delta} > 0$ because of strategic complementarity ($\frac{\partial^2 U_i}{\partial g_i \partial g_j} > 0$) and concavity ($\frac{\partial^2 U_j}{\partial g_j^2} < 0$).

Hence, the bigger the strategic complementarities (and thus strategic uncertainty) the stronger the incentives to adopt environment-friendly practices.

[15] A similar result can be expected with respect to an increase in β, the marginal utility of g.

Appendix B: results of non-parametric tests

We relied on the Wilcoxon rank-sum two-sample test to compare the choices of participants in the four risk settings (between-subject treatments). Results are presented in Table A.

Table A: Results of Wilcoxon two samples tests, with no payment

	ForeOnly	BackOnly	Fore&Back
Benchmark	z = 3.268 Prob>|z|= 0.0011***	z = 3.742 Prob>|z|= 0.0002***	z = 4.553 Prob>|z|= 0.0000***
ForeOnly		z = -0.183 Prob>|z|=0.8551-	z = 1.813 Prob>|z|=0.0698*
BackOnly			z = 2.140 Prob>|z|=0.0324**

The number of stars indicates the significance level : *** is significant at 1 %, ** is significant at 5 %, * is significant at 10 %, - is not significant.

Kruskal-Wallis equality-of-populations rank test (chi-squared = 41.771, prob = 0.0001): we can reject the hypothesis the four samples are from the same population.

In order to analyze the impact of the incentive payment and the way it might influence it differently depending on the risk contexts, we rely on a Wilcoxon matched pair test to compare the choices of participants without and with incentive payment. Results are presented in Table B.

Table B : Average number of hectares farmed with environment-friendly practices and results of Wilcoxon matched pair tests

	Benchmark	ForeOnly	BackOnly	Fore&Back
No payment scenario	63	50	50	41
Payment scenario	73	61	60	41
difference	z = -4.461 Prob>|z|=0.0000 ***	z = -3.691 Prob>|z|=0.0002 ***	z = -3.488 Prob>|z|=0.0005 ***	z = -0.570 Prob>|z|=0.5686 -

Appendix C: instructions (translated from French)

Economic study on agricultural practices

Introduction

Thank you for participating in this survey, which is part of a research project in economics and psychology at the University of Angers. This research is entirely funded by the University of Angers, and it is entirely independent of any political interest or the agricultural profession.
Our aim is to increase understanding of farmers' motivations in various scenarios.
The survey is divided into five parts and takes about 30 minutes to complete.
Each part (from Part 1 to Part 4) consists of:
- explanations
- a comprehension test to check that you have fully understood the explanations
- decisions to be taken. There is no right or wrong answer. We are just seeking to know more about your decision making.

Why should you participate in this survey?
Scientific research
First, your answers will be useful to scientific research regarding agricultural policies. It is essential that studies that are independent of States, European institutions, and agricultural trade unions be conducted on this topic.

Remuneration
Second, as a token of our gratitude, you will receive within a couple of weeks a gift card valid in numerous brands. You can view the list of these brands on the « illicado » site.
The exact amount of the gift card will depend upon your survey answers. You will earn points in each part of the survey, and these points will be converted into euros credited to the gift card, based on the following rate: 200 points = 1 euro.
The gift card amount will be between 1,000 and 6,000 points (hence, between 5 and 30 euros).

Privileged access to the results
Finally, a synthesis of the findings will be emailed to you.
What will the survey data be used for?
The data collected in the survey will be used for scientific purposes only. No data will be given to the State or any other body external to the University. The survey results will be used for one or several scientific publications that will be made available to the general public on the Internet.
The data will be anonymous: your name and address will be used only to send you the gift card; then, they will be erased from our database.
Should you have any questions, please feel free to email us. You will receive an answer within 24 hours, and you will then be able to return to the survey.
The final deadline for your participation in the survey is May 10, 2017. After this date, the survey will no longer be available.

Part 1

In Part 1, you have one decision only to take.
You have 500 points. You may decide to keep these points or to invest them all or some of them.

The investment we offer you is risky: there is a 50/50 chance that the project fails and a 50/50 chance that it succeeds. The computer will run a random draw to decide whether the project is successful or not.

Should the computer draw "success", the points invested are multiplied by 2.5. Hence, you win the points non invested plus 2.5 times the points invested.

Should the computer draw "fail", all the points invested are lost. Hence, your investment is deducted from your original number of points (i.e. 500 points).

First example:
If you decide to invest 400 out of the 500 points.
If the computer draws "success", you win 500 - 400 + 2.5 x 400= 1,100 points
If the computer draws "fail", you lose the points invested, and you are left with 100 points.

Second example:
If you decide to invest 100 out of the 500 points.
If the computer draws "success", you win 500 - 100 + 2.5 x 100=650 points
If the computer draws "fail", you lose the points invested, and you are left with 400 points.

Remember: The points you win in Part 1 will be added to your total of points, then will be converted into euros credited to the gift card, based on the following rate: 200 points = 1 euro.

Comprehension test:
Please answer the following quiz to check you have understood the instructions.
How much are 500 points worth?
Please select one answer only:
- €0.50
- €2.50
- €5

If you decide to invest 250 points, how many points will you receive?
If the project fails, I will receive:
Please select one answer only:
- 0 point
- 250 points
- 875 points

If the project succeeds, I will receive:
Please select one answer only:
- 0 point
- 250 points
- 875 points

Test answers:
500 points are worth €2.50.

If you invest 250 points and the project fails, you will receive 0 point.
If the project succeeds, you will receive 875 points.

Decision
You are now able to make a decision for Part 1.
You can click on "Previous" to read the explanations again.
Remember: 200 points = €1

How much do you wish to invest?
The total must be 500 points.
How many points do you wish to invest?
How many points do you wish to keep?

How many points do you think the other survey participants will invest on average?
Your answer must be 1,000 at the most.
Enter an integer only in this field.

Part 2

In Part 2, you are partnered with another person whom you do not know. This person is randomly selected by the computer from among all the participants to the survey. At no time will you know who the person is, and the person will not know who you are either.

You need to select the number of points you keep for yourself and the number of points you give to this other person. This person will do the same.

Hence, you will receive the points you decided to keep for yourself and the points this other person decided to give you.

Remember: The points you win in Part 2 will be added to your total of points, then will be converted into euros credited to the gift card, based on the following rate: 200 points = 1 euro.

Comprehension test:
Please answer the following quiz to check you have understood the instructions.

If you decide as indicated in the first table and the other person decides as indicated in the second table, how many points are you going to receive?

Your decision:

You keep for yourself	300	350	400	450	500	550	600	650	700
You give the other person	800	700	600	500	400	300	200	100	0
					X				

The other person's decision:

He/she keeps for himself/herself:	300	350	400	450	500	550	600	650	700
He/she gives me	800	700	600	500	400	300	200	100	0
							X		

Please select one answer only:
I will receive 500 points
I will receive 700 points
I will receive 900 points

Answer:

In this case, you will receive 700 points. 500 points you keep for yourself + 200 points the other person decided to give you.

Decision

You are now able to make a decision for Part 2.
You can click on "Previous" to read the explanations again
Remember: 200 points = €1

For each table, which distribution of points do you decide?

Remember that you need to decide on various distributions of points between you and another person. You receive the points you decided to keep for yourself plus the points another person has given you.

The computer draws a number between 1 and 6. This number corresponds to the decision used to calculate your points in Part 2.

Decision 1

You receive	425	425	425	425	425	425	425	425	425
The other person receives	425	390	340	295	250	205	165	120	90

Which distribution do you decide upon? (for yourself; for the other person)
Please select one answer only

Decision 2

You receive	425	435	445	455	465	470	480	490	500
The other person receives	75	80	120	140	165	185	205	230	250

Which distribution do you decide upon? (for yourself; for the other person)
Please select one answer only

Decision 3

You receive:	250	270	295	315	340	360	380	405	425
The other person receives	500	490	480	470	465	455	445	435	425

Which distribution do you decide upon? (for yourself; for the other person)
Please select one answer only

Decision 4

You receive	250	270	295	315	340	360	380	405	425
The other person receives	500	445	395	340	290	235	180	130	75

Which distribution do you decide upon? (for yourself; for the other person)
Please select one answer only

Decision 5

You receive	500	470	440	405	375	345	315	280	250
The other person receives	250	280	315	345	375	405	440	470	500

Which distribution do you decide upon? (for yourself; for the other person)
Please select one answer only

Decision 6

You receive	500	490	480	470	465	455	445	435	425
The other person receives	250	270	295	315	340	360	380	405	425

Which distribution do you decide upon? (for yourself; for the other person)
Please select one answer only

Part 3

This survey part may appear to be rather complicated. Hence, take your time before responding because your gain will depend upon your decision. Remember: The points you win in Part 3 will be added to your total of points, then will be converted into euros credited to the gift card, based on the following rate: 200 points = 1 euro.

You play the role of a farmer who has 80 hectares cultivated in large-scale crops.

The computer will draw another participant in this survey to be your "neighbor". At no time will you know who the person is, and the person will not know who you are either.

There are two possible crop systems: the orange one and the purple one. The purple system is more effective than the orange one to reduce the environmental impact of agricultural production.

You need to select which crop system you wish to use per tract of 20 hectares.

Treatment 1

Your gain (in points) for Part 3 is determined as follows:

Revenue:

Your crops bring you a revenue of 15 points per hectare, regardless of the crop system put in place. The revenue per hectare remains the same.

Observations carried out in the farms that have implemented the purple crop system show that the revenue is the same as that of the orange system.

Production costs:

The production costs with the orange system are 4 points per hectare.

The production costs with the purple system are 7 points per hectare. These costs are higher than those of the orange system because implementation requires more equipment or more work.

Ecosystem services:

Setting up the purple system contributes to the ecosystem services nature provides.

The total number of hectares cultivated with the purple system by you and your neighbor determines the quality of these services provided by nature.

In other words, the purple system generates additional revenue when it is adopted collectively.

The total number of hectares cultivated with the purple system by you and your neighbor will bring you an additional gain (in points) that is equal to twice the cultivated surface. For instance, if both farmers use the purple system to cultivate half their surface, the additional gain is 2 x (40+40) =160 points.

Comprehension test:
Please answer the following quiz to check you have understood the instructions.

My number of points in Part 3 is determined by the crop system I decide to put in place (orange or purple).
Please select one answer only:
True
False

The purple system is less expensive for me if my neighbor also implements it.
Please select one answer only:
True
False

I will receive a revenue of 15 points per hectare regardless of the number of hectares I cultivate with the purple system.
Please select one answer only:
True
False

The sum of the number of hectares cultivated with the orange crop system and of the number of hectares cultivated with the purple crop system determines the additional gain related to the ecosystem services.
Please select one answer only:
True
False

Test answers:
The number of points you obtain in Part 3 is determined by the crop system you decide to set up (orange or purple).
The purple system is not less expensive for you if your neighbor also puts it in place. The cost of the purple system is the same, but you benefit from an additional gain related to the ecosystem services if your neighbor also puts it in place.
You will receive a revenue of 15 points per hectare regardless of the number of hectares you cultivate with the purple system.

The sum of the number of hectares cultivated with the orange crop system and of the number of hectares cultivated with the purple crop system does not determine the additional gain related to the ecosystem services. What determines the additional gain related to the ecosystem services is the sum of the number of hectares cultivated with the purple crop system by you and your neighbor.

Decision
You are now able to make a decision for Part 3.
You can click on "Previous" to read the explanations again
Remember: 200 points = €1

You have no calculations to make. These tables indicate your gain depending upon your decision and the total number of hectares cultivated with the purple system. To obtain your total gain, you need to add your individual gain and the additional gain related to the ecosystem services.

	Your farming operation: number of hectares with the purple crop system				
	0	20	40	60	80
Individual gain (in points)	880	820	760	700	640

	Total number of hectares (you + your neighbor) with the purple crop system								
	0	20	40	60	80	100	120	140	160
Additional gain related to the ecosystem services (in points)	0	40	80	120	160	200	240	280	320

Your decision (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

What do you believe will be your neighbor's decision? (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

Treatment 2

Your gain (in points) for Part 3 is determined as follows:

Revenue:
Your crops bring you a revenue of 15 points per hectare, regardless of the crop system put in place. Observations carried out in the farms that have implemented the purple crop system show that the revenue is the same as that of the orange system.

Production costs:
The orange system production cost is fixed, known, and equal to 4 points per hectare.
In contrast, the purple system production cost is not known in advance. It may increase through adverse events such as unpredictable weather conditions or the onset of diseases.
The computer will randomly determine whether there is an adverse event (a 50/50 chance). The production cost will thus depend upon this random draw. If an adverse event occurs, the cost of the purple system is 9 points per hectare. If no adverse event occurs, the cost of the purple system is 5 points per hectare.

Ecosystem services:
Setting up the purple system contributes to the ecosystem services nature provides.
The total number of hectares cultivated with the purple system by you and your neighbor determines the quality of these services provided by nature.
In other words, the purple system generates additional revenue when it is adopted collectively.
The total number of hectares cultivated with the purple system by you and your neighbor will bring you an additional gain (in points) that is equal to twice the cultivated surface. For instance, if both farmers use the purple system to cultivate half their surface, the additional gain is 2 x (40+40) =160 points.

Comprehension test:
Please answer the following quiz to check you have understood the instructions.

My number of points in Part 3 is determined by the crop system I decide to put in place (orange or purple).
Please select one answer only:
True
False

The purple system is less expensive for me if my neighbor also implements it.
Please select one answer only:
True
False
I will receive a revenue of 15 points per hectare regardless of the number of hectares I cultivate with the purple system.
Please select one answer only:
True
False

The sum of the number of hectares cultivated with the orange crop system and of the number of hectares cultivated with the purple crop system determines the additional gain related to the ecosystem services.
Please select one answer only:
True
False

Test answers:

The number of points you obtain in Part 3 is determined by the crop system you decide to set up (orange or purple).

The purple system is not less expensive for you if your neighbor also puts it in place. The cost of the purple system is the same, but you benefit from an additional gain related to the ecosystem services if your neighbor also puts it in place.

You will receive a revenue of 15 points per hectare regardless of the number of hectares you cultivate with the purple system.

The sum of the number of hectares cultivated with the orange crop system and of the number of hectares cultivated with the purple crop system does not determine the additional gain related to the ecosystem services. What determines the additional gain related to the ecosystem services is the sum of the number of hectares cultivated with the purple crop system by you and your neighbor.

Decision
You are now able to make a decision for Part 3.
You can click on "Previous" to read the explanations again
Remember: 200 points = €1

You have no calculations to make. These tables indicate your gain depending upon your decision and the total number of hectares cultivated with the purple system. To obtain your total gain, you need to add your individual gain and the additional gain related to the ecosystem services.

		Your farming operation: number of hectares with the purple crop system				
		0	20	40	60	80
Individual gain (in points)	No adverse event Cost of the purple system: 5 pts/ha	880	860	840	820	800
	Adverse event: Cost of the purple system: 9 pts/ha	880	780	680	580	480

		Total number of hectares (you + your neighbor) with the purple crop system								
		0	20	40	60	80	100	120	140	160
Additional gain related to the ecosystem		0	40	80	120	160	200	240	280	320

services (in points)										

Your decision (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

What do you believe will be your neighbor's decision? (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

Treatment 3

Your gain (in points) for Part 3 is determined as follows:

Revenue:
Your crops bring you the same revenue per hectare, regardless of the crop system put in place. Observations carried out in the farms that have implemented the purple crop system show that the revenue is the same as that of the orange system.
However, the revenue is not known in advance because it can decrease through adverse events that reduce yield and/or prices on the agricultural markets.
The computer will randomly determine whether there is an adverse event (a 50/50 chance). The revenue per hectare will thus depend upon this draw. If an adverse event occurs, the revenue per hectare is 10 points per hectare. If no adverse event occurs, the revenue per hectare is 20 points per hectare.

Production costs:
The production costs with the orange system are 4 points per hectare.
The production costs with the purple system are 7 points per hectare. These costs are higher than those of the orange system because implementation requires more equipment or more work.

Ecosystem services:
Setting up the purple system contributes to the ecosystem services nature provides.
The total number of hectares cultivated with the purple system by you and your neighbor determines the quality of these services provided by nature.
In other words, the purple system generates additional revenue when it is adopted collectively.
The total number of hectares cultivated with the purple system by you and your neighbor will bring you an additional gain (in points) that is equal to twice the cultivated surface. For instance, if both farmers use the purple system to cultivate half their surface, the additional gain is 2 x (40+40) =160 points.

Comprehension test:
Please answer the following quiz to check you have understood the instructions.

My number of points in Part 3 is determined by the crop system I decide to put in place (orange or purple).
Please select one answer only:
True

False

The purple system is less expensive for me if my neighbor also implements it.
Please select one answer only:
True
False

My revenue depends only upon the number of hectares cultivated with the purple system.
Please select one answer only:
True
False

The sum of the number of hectares cultivated with the orange crop system and of the number of hectares cultivated with the purple crop system determines the additional gain related to the ecosystem services.
Please select one answer only:
True
False

Test answers:

The number of points you obtain in Part 3 is determined by the crop system you decide to set up (orange or purple).

The purple system is not less expensive for you if your neighbor also puts it in place. The cost of the purple system is the same, but you benefit from an additional gain related to the ecosystem services if your neighbor also puts it in place.

Your revenue does not depend only upon the number of hectares cultivated with the purple system since it can decrease through adverse events that reduce yield and/or prices on the agricultural markets.

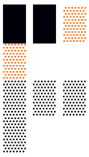
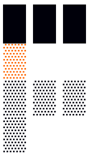
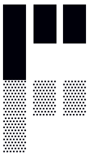
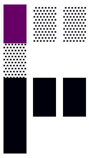
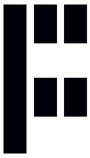
The sum of the number of hectares cultivated with the orange crop system and of the number of hectares cultivated with the purple crop system does not determine the additional gain related to the ecosystem services. What determines the additional gain related to the ecosystem services is the sum of the number of hectares cultivated with the purple crop system by you and your neighbor.

Decision
You are now able to make a decision for Part 3.
You can click on "Previous" to read the explanations again
Remember: 200 points = €1

You have no calculations to make. These tables indicate your gain depending upon your decision and the total number of hectares cultivated with the purple system. To obtain your total gain, you need to add your individual gain and the additional gain related to the ecosystem services.

		Your farming operation: number of hectares with the purple crop system				
		0	20	40	60	80

Individual gain (in points)	No adverse event Revenue: 20 pts/ha	1280	1220	1160	1100	1040
	Adverse event: Revenue: 10 pts/ha	480	420	360	300	240

	Total number of hectares (you + your neighbor) with the purple crop system								
	0 	20 	40 	60 	80 	100 	120 	140 	160 
Additional gain related to the ecosystem services (in points).	0	40	80	120	160	200	240	280	320

Your decision (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

What do you believe will be your neighbor's decision? (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

Treatment 4

Your gain (in points) for Part 3 is determined as follows:

Revenue:
Your crops bring you the same revenue per hectare, regardless of the crop system put in place. Observations carried out in the farms that have implemented the purple crop system show that the revenue is the same as that of the orange system.
However, the revenue is not known in advance because it can decrease through adverse events that reduce yield and/or prices on the agricultural markets.
The computer will randomly determine whether there is an adverse event (a 50/50 chance). The revenue per hectare will thus depend upon this draw. If an adverse event occurs, the revenue per hectare is 10 points per hectare. If no adverse event occurs, the revenue per hectare is 20 points per hectare.

Production costs:
The orange system production cost is fixed, known, and equal to 4 points per hectare.
In contrast, the purple system production cost is not known in advance. It may increase through adverse events such as unpredictable weather conditions or the onset of diseases.
The computer will randomly determine whether there is an adverse event that affects the production costs with the purple system occurs or not (a 50/50 chance). The production cost will thus depend upon this random draw. If an adverse event occurs, the cost of the purple system is 9 points per hectare. If no adverse event occurs, the cost of the purple system is 5 points per hectare.

Ecosystem services:
Setting up the purple system contributes to the ecosystem services nature provides.
The total number of hectares cultivated with the purple system by you and your neighbor determines the quality of these services provided by nature.
In other words, the purple system generates additional revenue when it is adopted collectively.
The total number of hectares cultivated with the purple system by you and your neighbor will bring you an additional gain (in points) that is equal to twice the cultivated surface. For instance, if both farmers use the purple system to cultivate half their surface, the additional gain is 2 x (40+40) =160 points.

Comprehension test:
Please answer the following quiz to check you have understood the instructions.

My number of points in Part 3 is determined by the crop system I decide to put in place (orange or purple).
Please select one answer only:
True
False

The purple system is less expensive for me if my neighbor also implements it.
Please select one answer only:
True
False

My revenue depends only upon the number of hectares cultivated with the purple system.
Please select one answer only:
True / False

The sum of the number of hectares cultivated with the orange crop system and of the number of hectares cultivated with the purple crop system determines the additional gain related to the ecosystem services.
Please select one answer only:
True / False

Test answers:
The number of points you obtain in Part 3 is determined by the crop system you decide to set up (orange or purple).

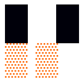
The purple system is not less expensive for you if your neighbor also puts it in place. The cost of the purple system is the same, but you benefit from an additional gain related to the ecosystem services if your neighbor also puts it in place.

Your revenue does not depend only upon the number of hectares cultivated with the purple system since it can decrease through adverse events that reduce yield and/or prices on the agricultural markets.

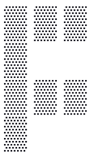
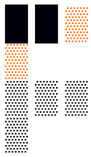
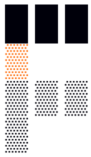
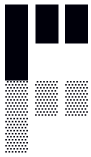
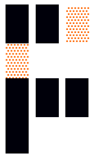
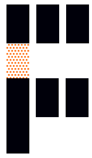
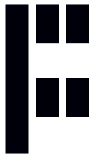
The sum of the number of hectares cultivated with the orange crop system and of the number of hectares cultivated with the purple crop system does not determine the additional gain related to the ecosystem services. What determines the additional gain related to the ecosystem services is the sum of the number of hectares cultivated with the purple crop system by you and your neighbor.

Decision
You are now able to make a decision for Part 3.
You can click on "Previous" to read the explanations again
Remember: 200 points = €1

You have no calculations to make. These tables indicate your gain depending upon your decision and the total number of hectares cultivated with the purple system. To obtain your total gain, you need to add your individual gain and the additional gain related to the ecosystem services.

		Your farming operation: number of hectares with the purple crop system				
		0 	20 	40 	60 	80 
Individual gain (in points)	No adverse event: High revenue: 20 pts/ha Low cost of the purple system: 5 pts/ha	1280	1260	1240	1220	1200
	An adverse event: High revenue: 20 pts/ha High cost of the purple system: 9 pts/ha	1280	1180	1080	980	880
	An adverse event: Low revenue: 10 pts/ha Low cost of the purple system: 5 pts/ha	480	460	440	420	400
	Two adverse events Low revenue: 10 pts/ha High cost of the purple system: 9 pts/ha	480	380	280	180	80

	Total number of hectares (you + your neighbor) with the purple crop system

	0 	20 	40 	60 	80 	100 	120 	140 	160 
Additional gain related to the ecosystem services (in points)	0	40	80	120	160	200	240	280	320

Your decision (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

What do you believe will be your neighbor's decision? (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

5 Part 4

Treatment 1

This part is similar to the previous one. The only difference is that a subsidy has been set up for those farmers who undertake to set up the purple crop system,
Remember: The points you win in Part 4 will be added to your total of points, then will be converted into euros credited to the gift card, based on the following rate: 200 points = 1 euro.

Your gain (in points) for Part 4 is determined as follows:
Revenue, production costs, and the gain related to the ecosystem services are identical to the preceding part.

Revenue:
Your crops bring you a revenue of 15 points per hectare, regardless of the crop system put in place. Observations carried out in the farms that have implemented the purple crop system show that the revenue is the same as that of the orange system.

Production costs:
The production costs with the orange system are 4 points per hectare.
The production costs with the purple system are 7 points per hectare. These costs are higher than those of the orange system because implementation requires more equipment or more work.

Ecosystem services:
Setting up the purple system contributes to the ecosystem services nature provides.

The total number of hectares cultivated with the purple system by you and your neighbor determines the quality of these services provided by nature.
In other words, the purple system generates additional revenue when it is adopted collectively.
The total number of hectares cultivated with the purple system by you and your neighbor will bring you an additional gain (in points) that is equal to twice the cultivated surface. For instance, if both farmers use the purple system to cultivate half their surface, the additional gain is 2 x (40+40) =160 points.

Subsidy:
The subsidy brings you 2 additional points per each hectare you choose to cultivate with the purple crop system.

Comprehension test:
Please answer the following quiz to check you have understood the instructions.

I receive the subsidy only if I cultivate all 80 hectares with the purple system.
Please select one answer only:
True / False

Because of the subsidy, I have the same gain regardless of the type of system I choose.
Please select one answer only:
True / False

Results:

You do not need to cultivate the 80 hectares with the purple system to receive the subsidy. The subsidy amounts to 2 points for each hectare cultivated with the purple crop system.

The gain varies according to the type of system because the production costs are different and the subsidy is paid only for the purple system. The additional gain related to the ecosystem services depends upon your choice but also that of your neighbor.

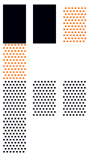
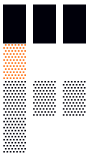
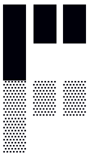
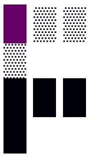
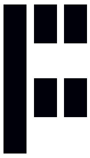
Decision

You are now able to make a decision for Part 4.
You can click on "Previous" to read the explanations again

You have no calculations to make. These tables indicate your gain depending upon your decision and the total number of hectares cultivated with the purple system. To obtain your total gain, you need to add your individual gain and the additional gain related to the ecosystem services. Remember: 200 points = €1

	Your farming operation: number of hectares with the purple crop system				
	0	20	40	60	80

Individual gain (in points)	880	860	840	820	800

	Total number of hectares (you + your neighbor) with the purple crop system								
	0 	20 	40 	60 	80 	100 	120 	140 	160 
Additional gain related to the ecosystem services (in points)	0	40	80	120	160	200	240	280	320

Your decision (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

What do you believe will be your neighbor's decision ? (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

Treatment 2

This part is similar to the preceding one. The only difference is that a subsidy has been set up for those farmers who undertake to set up the purple crop system.
Remember: The points you win in Part 4 will be added to your total of points, then will be converted into euros credited to the gift card, based on the following rate: 200 points = 1 euro.

Your gain (in points) for Part 4 is determined as follows:
Revenue, production costs, and ecosystem services are the same as in the preceding part.

Revenue:
Your crops bring you a revenue of 15 points per hectare, regardless of the crop system put in place.
Observations carried out in the farms that have implemented the purple crop system show that the revenue is the same as that of the orange system.

Production costs:
The orange system production cost is fixed, known, and equal to 4 points per hectare.
In contrast, the purple system production cost is not known in advance. It may increase through adverse events such as unpredictable weather conditions or the onset of diseases.
The computer will randomly determine whether there is an adverse event (a 50/50 chance). The production cost will thus depend upon this random draw. If an adverse event occurs, the cost of the

purple system is 9 points per hectare. If no adverse event occurs, the cost of the purple system is 5 points per hectare.

Ecosystem services:
Setting up the purple system contributes to the ecosystem services nature provides.
The total number of hectares cultivated with the purple system by you and your neighbor determines the quality of these services provided by nature.
In other words, the purple system generates additional revenue when it is adopted collectively.
The total number of hectares cultivated with the purple system by you and your neighbor will bring you an additional gain (in points) that is equal to twice the cultivated surface. For instance, if both farmers use the purple system to cultivate half their surface, the additional gain is 2 x (40+40) =160 points.

Subsidy:
The subsidy brings you 2 additional points per each hectare you choose to cultivate with the purple crop system.

Comprehension test:
Please answer the following quiz to check you have understood the instructions.

I receive the subsidy only if I cultivate all 80 hectares with the purple system.
Please select one answer only:
True / False

Because of the subsidy, I have the same gain regardless of the type of system I choose.
Please select one answer only:
True / False

Results:
You do not need to cultivate the 80 hectares with the purple system to receive the subsidy. The subsidy amounts to 2 points for each hectare cultivated with the purple crop system.

The gain varies according to the type of system because the production costs are different and the subsidy is paid only for the purple system. The additional gain related to the ecosystem services depends upon your choice but also that of your neighbor.

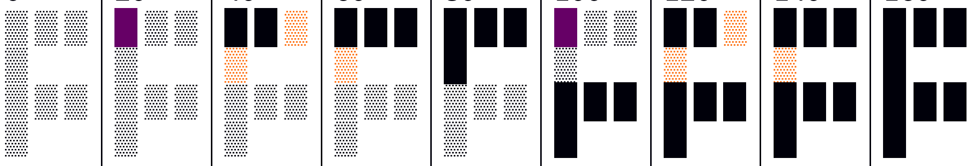
Decision

You are now able to make a decision for Part 4.
You can click on "Previous" to read the explanations again

You have no calculations to make. These tables indicate your gain depending upon your decision and the total number of hectares cultivated with the purple system. To obtain your total gain, you need to add your individual gain and the additional gain related to the ecosystem services. Remember: 200 points = €1

		Your farming operation: number of hectares with the purple crop system				
		0	20	40	60	80

Individual gain (in points)	No adverse event Cost of the purple system: 5 pts/ha	880	900	920	940	960
	Adverse event: Cost of the purple system: 9 pts/ha	880	820	760	700	640

	Total number of hectares (you + your neighbor) with the purple crop system								
	0	20	40	60	80	100	120	140	160
									
Additional gain related to the ecosystem services (in points)	0	40	80	120	160	200	240	280	320

Your decision (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

What do you believe will be your neighbor's decision? (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

Treatment 3

This part is similar to the preceding one. The only difference is that a subsidy has been set up for those farmers who undertake to set up the purple crop system.
Remember: The points you win in Part 4 will be added to your total of points, then will be converted into euros credited to the gift card, based on the following rate: 200 points = 1 euro.

Your gain (in points) for Part 3 is determined as follows:
Revenue, production costs, and ecosystem services are the same as in the preceding part.

Revenue:
Your crops bring you the same revenue per hectare, regardless of the crop system put in place. Observations carried out in the farms that have implemented the purple crop system show that the revenue is the same as that of the orange system.
However, the revenue is not known in advance because it can decrease through adverse events that reduce yield and/or prices on the agricultural markets.

The computer will randomly determine whether there is an adverse event (a 50/50 chance). The revenue per hectare will thus depend upon this draw. If an adverse event occurs, the revenue per hectare is 10 points per hectare. If no adverse event occurs, the revenue per hectare is 20 points per hectare.

Production costs:
The production costs with the orange system are 4 points per hectare.
The production costs with the purple system are 7 points per hectare. These costs are higher than those of the orange system because implementation requires more equipment or more work.

Ecosystem services:
Setting up the purple system contributes to the ecosystem services nature provides.
The total number of hectares cultivated with the purple system by you and your neighbor determines the quality of these services provided by nature.
In other words, the purple system generates additional revenue when it is adopted collectively.
The total number of hectares cultivated with the purple system by you and your neighbor will bring you an additional gain (in points) that is equal to twice the cultivated surface. For instance, if both farmers use the purple system to cultivate half their surface, the additional gain is 2 x (40+40) =160 points.

Subsidy :

The subsidy brings you 2 additional points per each hectare you choose to cultivate with the purple crop system.

Comprehension test:
Please answer the following quiz to check you have understood the instructions.

I receive the subsidy only if I cultivate all 80 hectares with the purple system.
Please select one answer only:
True / False

Because of the subsidy, I have the same gain regardless of the type of system I choose.
Please select one answer only:
True / False

Results:

I do not need to cultivate the 80 hectares with the purple system to receive the subsidy. The subsidy amounts to 2 points <u>for each hectare</u> cultivated with the purple crop system.

The gain varies according to the type of system because the production costs are different and the subsidy is paid only for the purple system. The additional gain related to the ecosystem services depends upon your choice but also that of your neighbor.

Decision

You are now able to make a decision for Part 4.
You can click on "Previous" to read the explanations again

You have no calculations to make. These tables indicate your gain depending upon your decision and the total number of hectares cultivated with the purple system. To obtain your total gain, you need to add your individual gain and the additional gain related to the ecosystem services. Remember: 200 points = €1

		Your farming operation: number of hectares with the purple crop system				
		0	20	40	60	80
Individual gain (in points)	No adverse event Revenue: 20 pts/ha	1280	1260	1240	1220	1200
	Adverse event: Revenue: 10 pts/ha	480	460	440	420	400

	Total number of hectares (you + your neighbor) with the purple crop system								
	0	20	40	60	80	100	120	140	160
Additional gain related to the ecosystem services (in points)	0	40	80	120	160	200	240	280	320

Your decision (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

What do you believe will be your neighbor's decision? (orange system hectares; purple system hectares)

Hectares with the orange crop system	0	20	40	60	80
Hectares with the purple crop system	80	60	40	20	0

Please select one answer only

Treatment 4

This part is similar to the preceding one. The only difference is that a subsidy has been set up for those farmers who undertake to set up the purple crop system.
Remember: The points you win in Part 1 will be added to your total of points, then will be converted into euros credited to the gift card, based on the following rate: 200 points = 1 euro.

Your gain (in points) for Part 4 is determined as follows:

Revenue, production costs, and ecosystem services are the same as in the preceding part.

Revenue:
Your crops bring you the same revenue per hectare, regardless of the crop system put in place. Observations carried out in the farms that have implemented the purple crop system show that the revenue is the same as that of the orange system.
However, the revenue is not known in advance because it can decrease through adverse events that reduce yield and/or prices on the agricultural markets.
The computer will randomly determine whether there is an adverse event (a 50/50 chance). The revenue per hectare will thus depend upon this draw. If an adverse event occurs, the revenue per hectare is 10 points per hectare. If no adverse event occurs, the revenue per hectare is 20 points per hectare.

Production costs:
The orange system production cost is fixed, known, and equal to 4 points per hectare.
In contrast, the purple system production cost is not known in advance. It may increase through adverse events such as unpredictable weather conditions or the onset of diseases.
The computer will randomly determine whether there is an adverse event that affects the production costs with the purple system occurs or not (a 50/50 chance). The production cost will thus depend upon this random draw. If an adverse event occurs, the cost of the purple system is 9 points per hectare. If no adverse event occurs, the cost of the purple system is 5 points per hectare.

Ecosystem services:
Setting up the purple system contributes to the ecosystem services nature provides.
The total number of hectares cultivated with the purple system by you and your neighbor determines the quality of these services provided by nature.
In other words, the purple system generates additional revenue when it is adopted collectively.
The total number of hectares cultivated with the purple system by you and your neighbor will bring you an additional gain (in points) that is equal to twice the cultivated surface. For instance, if both farmers use the purple system to cultivate half their surface, the additional gain is 2 x (40+40) =160 points.

Subsidy :

The subsidy brings you 2 additional points per each hectare you choose to cultivate with the purple crop system.

Comprehension test:
Please answer the following quiz to check you have understood the instructions.

I receive the subsidy only if I cultivate all 80 hectares with the purple system.
Please select one answer only:
True / False
Because of the subsidy, I have the same gain regardless of the type of system I choose.
Please select one answer only:
True / False

Results:

I do not need to cultivate the 80 hectares with the purple system to receive the subsidy. The subsidy amounts to 2 points <u>for each hectare</u> cultivated with the purple crop system.

The gain varies according to the type of system because the production costs are different and the subsidy is paid only for the purple system. The additional gain related to the ecosystem services depends upon your choice but also that of your neighbor.

Decision

You are now able to make a decision for Part 4.
You can click on "Previous" to read the explanations again

You have no calculations to make. These tables indicate your gain depending upon your decision and the total number of hectares cultivated with the purple system. To obtain your total gain, you need to add your individual gain and the additional gain related to the ecosystem services. Remember: 200 points = €1

		Your farming operation: number of hectares with the purple crop system				
		0	20	40	60	80
Individual gain (in points)	No adverse event: High revenue: 20 pts/ha Low cost of the purple system: 5 pts/ha	1280	1300	1320	1340	1360
	An adverse event: High revenue: 20 pts/ha High cost of the purple system : 9 pts/ha	1280	1220	1160	1100	1040
	An adverse event: Low revenue: 10 pts/ha Low cost of the purple system: 5 pts/ha	480	500	520	540	560
	Two adverse events Low revenue: 10 pts/ha High cost of the purple system: 9 pts/ha	480	420	360	300	240

	Total number of hectares (you + your neighbor) with the purple crop system								
	0	20	40	60	80	100	120	140	160

Additional gain related to the ecosystem services (in points).	0	40	80	120	160	200	240	280	320

Your decision (orange system hectares; purple system hectares)

Hectares cultivated with the orange crop system	0	20	40	60	80
Hectares cultivated with the purple crop system	80	60	40	20	0

Please select one answer only

What do you believe will be your neighbor's decision? (orange system hectares; purple system hectares)

Hectares cultivated with the orange crop system	0	20	40	60	80
Hectares cultivated with the purple crop system	80	60	40	20	0

Please select one answer only

6 Part 5

Finally, we would like to have more information about you.
Gender
Please select one answer only:
Masculine
Feminine

Year of birth
Only numbers may be entered in this field.

Are there any farmers in your family (father, mother, brother, sister, uncle, aunt)?
Please select one answer only:
Yes / No

How many days per year do you spend on a farm?
Please select one answer only:
More than 60 days a year
Between 31 and 60 days a year
Between 5 and 30 days a year
Less than 5 days a year

We would like to know what you think about setting up a crop system similar to the purple system that improves the environmental impact of agricultural production.
Imagine that you are a farmer.

What would prevent you from testing such a system on your farm? Give the main reason.
Please select one answer only:
I fear reduced crop yields, hence reduced income
This means acquiring additional information and skills
I would like to sell my production at a higher price specifying that its environmental impact is reduced, but I fear I may not find markets.
It requires excessive investments.
None of the above

In contrast, what would help you adopt such a system? Give the main reason.
Please select one answer only:
Technical assistance
Financial assistance to invest in the necessary equipment or training
Financial assistance to take out insurance to cover a drop in income
Higher subsidies to make up for the loss of earnings
Joining a group of farmers who collectively undertake this venture
None of the above

Do you think that it is the responsibility of farmers to protect the environment?
Please select one answer only:
strongly disagree
tend to disagree
tend to agree
strongly agree

Do you think that the impact of agricultural practices on the environment is rather negative or positive?
Please select one answer only:
very negative
rather negative
rather positive
very positive

Are you considering becoming a farmer?
Please select one answer only:
Yes, as soon as I've finished school
Yes, within the next 10 years
Never
I don't know

What would be the core farming activity?
Answer this question only if the following conditions apply: The answer was 'Yes, as soon as I've finished school' or 'Yes, within the next 10 years' to the question Are you considering becoming a farmer?
Please select one answer only:
Cattle for milk only
Cattle for meat and a mix milk-meat
Intensive farming (e.g. pigs, poultry)
Field crops
Market gardening, horticulture and fruit
Viticulture
Other productions

Do you think yours will be a certified organic farm?
Please select one answer only:
Yes / No

Do you think you could join a group of farmers (e.g. CUMA, GDA, CIVAM, GAEC, cooperative) outside an agricultural union?

Please select one answer only:
Yes / No

We cannot tell you your gain immediately because it depends upon the decisions made by another participant and random draws. Once we have the answers given by the participant you were partnered with by random draw, you will receive an email recapping your decisions and your gain for each part, and the final amount that will be credited to your gift card.

Do you wish to receive your gift card?
Please select one answer only:
Yes / No

Do you wish to receive the survey results by email?
Please select one answer only:
Yes / No

Do you wish to take part in other surveys of this type that might be set up by the University of Angers?
Please select one answer only:
Yes / No

Surname:
First name:
Address:
Telephone (optional):
Email address:

The survey is finished. Thank you for your answers.
We are available to answer any question or comment by email.