CAN AGGLOMERATION PAYMENTS INDUCE SUSTAINABLE MANAGEMENT OF PEAT SOILS IN SWITZERLAND? – A COMPUTERIZED FRAMED EXPERIMENT

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SUMMARY

Peat soil degradation substantially contributes to national greenhouse gas emissions in many countries. Their preservation is therefore crucial in the achievement of national climate change mitigation goals. However, peat soil degradation is usually a consequence of productive utilization of these soils, and preservation is in conflict with such usage, as it would require to reduce the drainage intensity. Due to the organization of the drainage systems at a community level, regulating the water table requires farmers' cooperation. Agglomeration payments have been proposed by economists as an approach to promote cooperation among land users for the provision of ecosystem services. However, peat soils differ in their nature and state of degradation. This translates into heterogeneity among landowners' opportunity costs for adopting an alternative land use on these soils. We developed a dynamic, computerized, and interactive framed economic experiment to represent the decision situation of Swiss peatland farmers and conducted it with agricultural students. We compare the effects of fixed versus variable agglomeration payment schemes and a baseline without policy on the implementation of a more sustainable land use. We also analyze the impact of social preferences on policy design and effectiveness. We find that both policy options are environmentally effective, but the fixed payment is most effective in incentivizing farmers to adopt the more sustainable land use as compared to a payment scheme following farmers' respective opportunity costs. Risk aversion, social preferences, and farming identity are observed as the most determinant factors in explaining this result. Furthermore, we find that the level of inequality in income distribution is higher with the variable than with the fixed payment scheme, and the variable payment reveals to be less cost-effective in preserving the remaining peat soil layers as compared to the fixed payment.

INTRODUCTION

There are many instances where the effective provision of ecosystem services requires the cooperation of several land users. An example is the implementation of corridors in the agricultural landscape to increase a certain fauna population, or other land use patterns to promote biodiversity. Another is the case where environmental improvement requires a minimum area where an alternative land use practice is implemented (threshold effect). Agglomeration payments which are paid out based on the activities or outcomes of groups of land users - have been proposed as an approach for promoting cooperation in such cases (Drechsler et al., 2007; Parkhurst et al., 2002). Economic experiments have demonstrated the potential of this approach (Banerjee et al., 2015). Yet such past studies assume homogenous land users. However, in practice, land users differ in their opportunity costs of adopting environmentally friendly land use or alternative land use practices. The latter raises additional complexities and questions for the design of effective policies, including the following: Should the agglomeration payment be distributed to land users as equal shares, or in accordance to their differing opportunity costs? How does land user heterogeneity affect their strategic behavior when faced with a potential agglomeration payment?

We address such complexities in this paper. Motivated by the concrete case of peatland degradation in Switzerland, we capture a number of aspects that characterize this case. Adopting more sustainable practices on peat soils requires rewetting the land, which requires farmers' cooperation in common drainage systems. We allow for heterogeneous farmers who differ in the dynamics of how their future production potential in the conventional land use is affected by peat soil degradation. Furthermore, we allow for transfer-payments between farmers. We analyze the resulting dynamics in the adoption of conventional vegetable production versus a more sustainable land use, both with and without agglomeration payments. We examine and compare two types of agglomeration payments: equal per hectare fixed payments and heterogeneous payments aligned to opportunity costs (thus variable). We also analyze how farmers' social preferences affect behavior and outcomes. We first capture essential aspects of the Swiss case in a computerized representation of the farmers' decision situation. We then use it to conduct an economic experiment testing alternative policy scenarios with students of applied agricultural schools in Switzerland who are highly involved in farming activities.

We find that both types of agglomeration payments are effective in promoting the adoption of more sustainable practices, however, the fixed payment is significantly more effective than the one aligned to farmers' opportunity costs. This is not only true for average behavior over all time-periods, but is reinforced when considering the dynamics of farmers' land use decisions over time, which affects soil quality and ecosystem services provision. In the scenario with the differentiated payments, a large part of the players only rewet peat soils after maximizing their farm profit from conventional vegetable production, which results in an exhaustion of the peat soil layer. Contrary, in the fixed payment, the largest part of the players who switch land use do so already early on in the experiment; the major part of the peat soil layer can therefore be preserved. An analysis of players' social preferences and other characteristics helps to explain these results. Under the fixed payment scheme, payment redistribution between group members mainly occurs from farmers with short-term- to farmers with long-term production potential, while it is the other way around under variable (heterogeneous) payments. In the former case, part of the farmers with long production potential make use of their "secure" farming situation to condition their cooperation on a transfer from their group member. In the latter case, social preferences are important and attention is given to the difficult situation of farmers with short production potentials. In addition, we find that the willingness to take risk and the opinion towards cooperative approaches in agricultural management play a role in the fixed payment. In particular, these two factors positively influence the farmers with long production potential to adopt an extensive land use. Finally, we also study how the level of inequality in income distribution between farmers and cost-effectiveness vary between the three scenarios. Using the Gini coefficient, we find that inequality in incomes is higher under the variable payment than under the fixed one; this level increases slightly when considering only the players who adopt an extensive peat soil use. With regards to the preservation of the peat soil layer, we find that the variable payment is less cost-effective than the fixed scheme.

In the next sessions, we first describe the case study, and then the experimental design adopted for this study. We then develop, for each policy scenario, hypotheses on players' behaviors based on their social preferences. Finally, we present the results of the experiment, which are then integrated into a broader policy discussion.

BACKGROUND

Peat soils represent less than 1% of Switzerland's acreage but they have an important role as a pool of carbon (Reiche, 2008). Agricultural production activities associated with drainage and field operations lead to severe forms of degradation of these soils (Xintu, 2009) which are at risk of disappearance today. Subsidence and mineralization result in the reduction of the peat soil layer over time and contribute to greenhouse gas emissions with accompanying losses of soil fertility and ecosystem services. In addition to negative environmental impacts, the loss of the peat layer threatens future agricultural activities. Yet, these soils are not the object of specific management regulations. Rewetting peat soils by stopping drainage is acknowledged as the most effective solution to protect the remaining peat layer and to efficiently reduce greenhouse gas emissions (Lunt et al., 2010; Graves & Morris, 2013). Using the case of Switzerland, this paper aims to identify policy instruments that are effective in promoting a more sustainable management of peat soils in order to prevent their on-going degradation and to protect the remaining peat layer. Interviews with regional experts highlight two core aspects that are seen to be crucial in enabling this change. First, raising the water table and switching to a more extensive land use can only occur if all farmers who depend on the same drainage system agree (on average 10 to 40 farms can depend on a same pumping station in Switzerland). Thus cooperation between farmers is necessary. Second, due to differences in past management and conditions under which it was formed, peat soils are highly variable with respect to both the thickness of the peat layer (i.e. the state of degradation) and the suitability for the current farming activities of the mineral soil layer that is underneath. This leads to differences between farmers in terms of their vulnerability to peat soil degradation and in their future farm profits from the conventional land use (vegetable production). As consequence, farmers' opportunity costs for switching to a more extensive peat soil use differ, which triggers different incentives among farmers for switching land use. The case is further complicated by the fact that opportunity costs vary over time, and that farmers can potentially opt out of a commonly decided land use change by investing in a costly individual drainage system.

Agri-environmental agglomeration payments are potentially promising instruments in fostering a collective decision on raising the water table, as is necessary for sustainable peatland use. Building on the concept of an "agglomeration bonus" defined by Parkhurst et al. (2002), the concept of agglomeration payment was introduced by Drechsler et al. (2010) in the context of habitat pattern creation across farm lands. These payments are used as an incentive for the spatial coordination of conservation areas. An agglomeration payment is based on the joint activities of multiple farmers and is only paid out if farmers commonly undertake a similar activity, while an agglomeration bonus includes a base participation component and a bonus component - the amount of which depends on the number of farmers undertaking the joint activity. Yet this tool might not be a sufficient incentive as seen against the high level profitability of these cultivated peat soils and the limited time available to protect the remaining peat before it is too late. This study addresses the issue of an optimal design for agglomeration payments. We compare two payment scheme scenarios: the effect of a fixed agglomeration payment (P_F) which pays the same amount to each farmer versus a differentiated agglomeration payment (P_V) which mirrors the differences in farmers' opportunity costs; it therefore potentially varies over time. Different payment designs imply different incentives and may lead to different behavioral patterns. We aim to analyze the agglomeration payment design that would be most effective in promoting alternative peat soil use. At a more general level, we aim to test whether agglomeration payments could resolve the complex resource problem at hand.

In this respect, the paper contributes to the literature in several ways. While previous research on peat soils has concentrated on its degradation aspects and on restoration strategies, the present study addressed peat soil management from an agricultural and economic perspective. Moreover, in reference to the need for "real-world experience with agglomeration payments" (Parkhurst & Shogren, 2007), this study contributes by testing agglomeration payments in the context of a dynamic, framed, and interactive computerized experiment, involving participants from the field, and including the option of a variable payment scheme design. Finally, beyond studying participants' decision-making processes under alternative policies, the study links participants' behaviors and cooperation (including the potential cooperation bargaining process) to their socio-economic preferences, and examines how those affect policy design and effectiveness.

EXPERIMENTAL DESIGN

We developed an experiment in form of an interactive computer-game-like representation of farmers' decision situations. It simulates, over time, farmers' decision situations under alternative agglomeration payment schemes promoting a more extensive peat soil use. This tool builds on the "highly visualized framed lab-in-the-field experiment" approach used by Reutemann et al. (2014) in a study about Brazilian cattle rancher's behavior. The core aspects of this experimental concept resides in the framing of the experiment with the actual context-study including the representation of its actual economic data and the time-dependence of the decisions. Contrary to Reutemann et al. (ibid), the experiment presented here includes interactions between players, i.e., a dependency of player's decisions on a group agreement, and a structure which draws on the literature on game theory and behavioral economics (Harrison & List, 2004). The experiment was conducted with agricultural students from regional farmer apprentice schools in Switzerland, whom 87% intend to become farmers.

The structure of the experiment emerges from a compromise between capturing the essence of the issue and making it comparable to other studies to ensure academic rigor and tractability. The experimental session is composed of three parts. The first part is an incentivized Social Value Orientation test (SVO) used to assess players' social preferences (Murphy et al, 2011). The second part of the experiment is the baseline phase (no policy intervention) and the third part is the treatment phase where either the no policy intervention is continued or one of the two agglomeration payments is introduced. A socio-economic survey ends the session.

We describe here the mechanisms of the second and third part of the experiment which tackles farmers' decision-making with respect to their peat soil management practices. A detailed description of the model underlying the experimental design can be found in Appendix A1. The baseline and the treatment phases each consist of ten time-periods. Players are asked to take the role of vegetable producers and are placed into groups of two, which represent the community of farmers depending on a joint drainage system. At each time-period, players face a trade-off between pursuing vegetable production and adopting a peat-soil-preserving, extensive peat soil use that requires rewetting those peat soils.

To reflect farmers' asymmetry, each group consists of two farmers who differ in the type of the underlying mineral layer of their peat soils. H (high) has high quality mineral soils suitable for vegetable production, and therefore a long production potential in the conventional land use (vegetable production). L (low) has low quality mineral soils not suitable for vegetable production, and therefore a short production potential in the conventional land use. This translates into different profit functions for H and L (as shown in Fig. 1). Peat soil degradation does not affect H's farm profit: regardless of the number of time-periods H produces vegetables, his/her farm profit remains constant for this activity. However, peat soil degradation negatively affects L's farm profit which depends on the number of time-periods (n) used previously for farming vegetables. In the scenario where L would produce vegetables for 10 time-periods successively, his/her farm profit would evolve as in Figure 2.

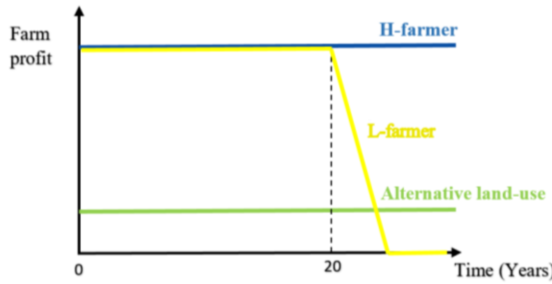

Figure 1: Profit functions of H and L farmers over time

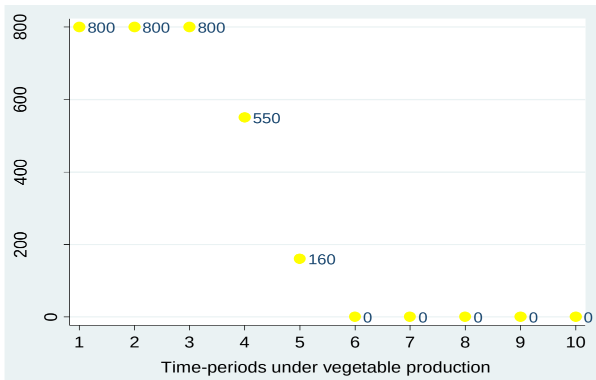

Figure 2: Farm profit of L-farmer when producing vegetables during 10 time-periods successively

From now on we refer to the alternative (peat soil preserving) land use as activity A, and to the conventional land use (vegetable production) as activity B. Activity A can only be conducted if peat soils are rewetted.

The decision situation can be represented by two stages. The first stage is the collective decision over rewetting peat soils. Group members can first anonymously communicate through chat messages in order to coordinate strategies. Then, each member has to cast a binding vote in favor of or against rewetting peat soils for the group. If both farmers vote in favor of rewetting, the drainage system is stopped. If at least one of the members rejects to rewet the peat soils, the land remains drained. The second stage is the individual decision which land use to adopt. If rewetting was rejected, the only option for farmers is to remain in activity B (conventional vegetable farming). If rewetting took place, each farmer can either adopt the sustainable land use (activity A) or install an individual drainage system and continue with vegetable production (activity B).

Our experimental setup also allows for transfer-payments between farmers of a same group. This is implemented as follows. Before voting, each group member can make a binding transfer-payment offer to the other member. The payment is only transferred if and only if both members vote for rewetting peat soil and at the condition that the potential beneficiary adopts activity A, regardless of the choice of the farmer making the offer (cf. Fig 4). Through this possibility of transfer-payment, players can influence the decision situation by negotiating conditions of cooperation within their group.

We implement three treatments. The first treatment repeats the conditions of the baseline phase. The other two treatments represent the introduction of an agglomeration payment to promote the adoption of activity A. Players receive an agglomeration payment (P^L and P^H) if both group members adopt activity A. The payment level is chosen to be slightly higher (2%) than the opportunity costs of the respective farmers; this is necessary to induce farmers' cooperation (Ferraro, 2008; Van Soest, 2013). The fixed agglomeration payment (P_F) is equal for both farmers regardless of the time-period ($P^L = P^H = 770$); it is constant. The variable agglomeration payment (P_V) follows the farmers' opportunity costs from switching to an extensive land use. Here, the payment is constant for H ($P^H = 770$). For L, it evolves according to the number of time-periods used for vegetable farming: when L's farm profit decreases, the payment ($P^L_{n,t}$) that he/she could receive in exchange of adopting an extensive peat soil use decreases by the same proportion (cf. figure 3 below). Thus, as from $n = 3$, the payment that L versus H can receive if both farmers adopt activity A differ.

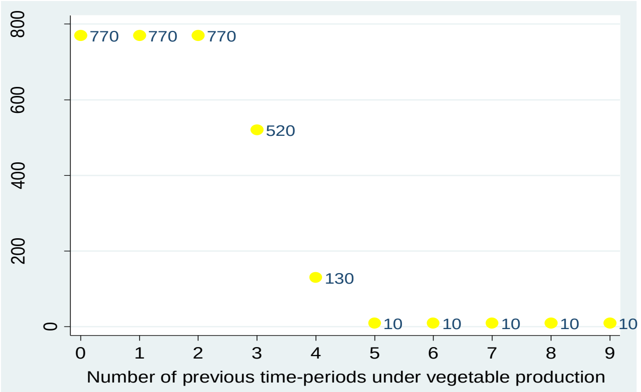

Figure 3: L-farmer's potential payment depending on the number of previous time-periods under vegetable production

There are two different payoff matrices, depending on the outcome of stage 1 (rewetting or no rewetting). Figure 4 corresponds to the case where at least one the group members rejected to rewet peat soils in the first stage-decision. In this case, activity A is not feasible and both players automatically pursue activity B. Figure 5 corresponds to the case where both farmers have voted to rewet peat soil in the first stage and are then directed to the second stage decision (land use choice). Players then need to choose between activity A and B. Parameterization[1] of the payoff matrices is based on expert interviews and secondary data.

The payoff matrices change over time (t) if peat soils are degraded. $\pi^f_{n,t}$ is defined as the farm profit of farmer *f* at time *t*, given a number *n* of previous time-periods with vegetable farming. As explained above and illustrated in figure 2, it is constant for *f*=*H* but declines for *f*=*L* with the number of time-periods under vegetable farming on peat soils. Payoffs also depend on the transfer payments offered by each player. We denote by T^L the transfer payment made by L to H and by T^H the transfer payment made by H to L.

		Farmer H
		Activity B: vegetable farming
Farmer L	Activity B: vegetable farming	$\pi^L_{n,t}$ π^H

Figure 4: First stage decision: players' payoffs at time *t* when peat soils are not rewetted

[1] Payoffs correspond to farm profits from vegetable farming or from the alternative land use. They are calculated based on actual farm profit (from Agridea database and University of Greiswald) as present value of cumulated future farm gross margin over 5 years (with a discount rate of 4%). For easier readability, numbers were rounded up and divided by 1000.

		Farmer H	
		Activity A: extensive peat soil use	Activity B: vegetable farming
Farmer L	Activity A: extensive peat soil use	$40 + P^L_{n,t} - T^L + T^H$ $40 + P^H + T^L - T^H$	$40 + T^H$ $\pi^H - 25 - T^H$
	Activity B: vegetable farming	$\pi^L_{n,t} - 25 - T^L$ $40 + T^L$	$\pi^L_{n,t} - 25$ $\pi^H - 25$

Figure 5: Second stage decision: players' payoffs at time t when peat soils are rewetted; both players voted for rewetting peat soils and moved to this second stage. $P^L_{n,t}$, P^H = agglomeration payment (treatment phase). T^L: transfer payment offer made by L to H, T^H: transfer payment offer made by H to L.

The first stage is essentially a choice on which matrix the players want to be in. Rewetting peat soils or not is the first step-decision which requires cooperation. For the case of rewetting in stage 2, players face a trade-off situation (e.g. "coordination game" or non-dilemma situation) which is determined by the presence of an agglomeration payment and by the time-period players are in.

Five agricultural schools in Switzerland took part in this study. Each one of the two agglomeration payment designs was tested over a sample of 44 groups (i.e. 88 players). Additionally to these two treatments, the baseline was also run as a treatment (where players would experience the decline in profit without the introduction of a payment) in order to ensure comparability between baseline and policy treatments. It was tested over a sample of 39 groups (i.e. 78 students).

BEHAVIORAL PREDICTIONS AND HYPOTHESES

For each scenario, we develop behavioral hypotheses for profit maximizing players. Conventional economic hypotheses on optimal profit-maximizing behavior can be obtained by backward induction. This procedure assumes that "at each decision node, each player will behave optimally, given his or her theory about how the players will behave at nodes farther in the future" (Serrano & Feldman, 2010, 2011). In this study, the two nodes correspond to the first and second stage decisions of a time-period, which are each associated to a payoff matrix. We assume that the player behaves optimally given his/her understanding about how his/her group member would behave, considering first the payoffs of the second-stage decision, and then comparing his/her optimal strategy from this stage to the payoffs of the first-stage decision's matrix. This comparison will then determine the player's vote for rewetting peat soils. Given the dynamic heterogeneity in payoffs, the player's decision at *t* also accounts for the involvement of his/her own and the other member's farm profit in the next time-periods.

Using this method and assuming a profit maximizer player, we identify the optimal action for the decision-making player in the second-stage decision matrix. Having done so, by comparing payoffs of this matrix with payoffs of the first-stage decision matrix, we determine the player's optimal action at the first stage.

However, social preferences are likely to play a role and to induce different outcomes. The SVO test provides a clear categorization of players by their prosocial preferences and distinguishes three main categories. "Individualistic" players are characterized for maximizing their own payoff, "prosocial inequality averse" for minimizing the difference between their own and the other person's payoff, and "Prosocial joint maximizers" by maximizing joint payoffs (Murphy et al., 2011). Therefore, for each scenario, we also draw predictions on how prosocial preferences could generate different behaviors. We stress the fact that these behavioral predictions correspond to the "pure" player type. Player's behaviors are in reality more nuanced. In the results, we categorize players with regards to their prosocial preferences, by analyzing how their behaviors converge towards one of the pure players type's behaviors described below.

- ***Baseline ($P^L = P^H = 0$)***

For *n=0, 1, 2, 3, 4,* each group member would only opt for activity A if he/she would receive a transfer-payment at least equal to 735 (i.e. if 40 – T^L + T^H > $\pi^L_{n,t}$ - 25 - T^L for L or 40 + T^L - T^H > π^H - 25 - T^H for H). In other words, if H chooses either A or B, then L's best response to H is to choose B if T^H is not at least equal to 735. Similarly, if L chooses either A or B, then H's best response to L is to choose B if T^L is not at least equal to 735. However, choosing A (T^H (T^L)) is not profit maximizing: π^H – 25 > π^H - 25 - T^H and $\pi^L_{n,t}$ – 25 > $\pi^L_{n,t}$ - 25 - T^L. In addition, L would only be able to make this transfer during the first three time-periods given his/her profit declines to 550 after three time-periods under activity B. The second-stage decision consists therefore of a non-dilemma situation where both players would pursue activity B (vegetable production) to maximize their payoffs. By comparing the payoffs of this equilibrium to the first-stage decision's payoffs, the strategy maximizing players' profit is to vote against rewetting peat soils (as $\pi^L_{n,t}$ – 25 < $\pi^L_{n,t}$ and π^H – 25 < π^H).

If farmers have ran activity B for 5 time-periods successively (*n=5*), L's incentive varies ($\pi^L_{5,6}$=0). In matrix 2, a profit-maximizer H would still pursue activity B as L cannot make a transfer. However, L would choose A (40 + T^H > - 25). Regardless of the choice of the other player, H's and L's dominant strategies are respectively to choose B and A; [H chooses B; L chooses A] is a dominant strategy equilibrium. With regards to the first-stage decision, profit maximizers H would vote against rewetting as π^H – 25 < π^H, while profit maximizer L players would vote in favor. Because the decision is collective-based and the vote is unanimous, players would pursue activity B. Nevertheless, we stress the fact that [H chooses B; L chooses A] is the strategy with the highest social welfare: 40 + T^H + π^H - 25 - T^H > π^H + $\pi^L_{n,t}$ equiv to: 40 + T^H + 800 - 25 - T^H > 800 + 0.

Social preferences may play a role in the players' decisional process. We developed above behavioral predictions for "individualistic" players. We now develop predictions for the case of "inequality averse" and "joint profit maximizer" players. For *n=0, 1, 2,* equal payoffs in the second-stage decision between players is realized by each of the following strategies: 1) [both conduct activity A], 2) [both conduct activity B], or 3) [H chooses B, L chooses A] with T^H = (775-40)/2 = 367.5 so that farmers' payoffs are both equal to 407.5. The profit maximizing strategy is for both players to pursue activity B. After comparison with the first-stage decision, we assume that "pure" inequality averse players who are also profit maximizers would then vote against rewetting (H's profit = L' profit = 800). In the second-stage decision, maximizing the joint profit is also realized by [both players choose B]. For *n=3, 4,* in matrix 2, equal payoffs can no longer be achieved by [both player pursue activity B]. We expect inequality averse players to converge towards [H chooses B, L chooses A] with T^H = 367.5, given that it is the most profit maximizing strategy for both players. Because payoffs of the first-stage decision's are unequal and transfer-payments are binding on choosing A, that strategy would be preferred. Secondly, maximizing joint profits is only realized if [both choose B]. Prosocial joint maximizer players would then also vote against rewetting peat soils. For *n=5,* equality averse players would again opt for [H chooses B, L chooses A] with T^H = 367.5, and would then vote for rewetting peat soils. Maximizing joint profits is also realized by [H chooses B; L chooses A] (joint profit equal to 775 + 40 = 815).

For this scenario, the main hypothesis is as follows. As long as L's farm profit from activity B is maximum (i.e. equal to 800) and regardless of farmer type and social preferences, farmers would vote against rewetting peat soil; they would pursue activity B (vegetable farming). Once L's farm profit declines and falls below that from activity A (i.e. equal to zero), L has an economic incentive to adopt an extensive land use. However, the transfer payment that L could make to H is insufficient to induce H to vote for rewetting. Given that rewetting peat soil is based on a unanimous agreement, both players would continue with activity B ('non-cooperation'), unless social preferences induce different H behaviors. H-farmers characterized as prosocial may for instance show sympathy with L-farmers' situation by voting for rewetting peat soils in the first-stage decision and then installing their own drainage system. Inequality averse H may furthermore make a transfer to L in order to diminish the payoff inequality. In that case, if case peat soils are rewetted, the dominant equilibrium would be [H pursues activity B; L adopts activity A]. Table 1 summarizes the behavioral predictions for the baseline.

Table 1: Baseline behavioral predictions - summary

	PROSELF		***PROSOCIAL***
Profiles of the group's players	Individualistic	Inequality averse	Joint profit maximizer
1st stage decision	Activity B	-n=0 to n=2: activity B -As from n=3: peat soils rewetted	-n=0 to n=4: activity B -As from n=5: peat soils rewetted
2nd stage decision	Not applicable	-n=0 to n=2: not applicable -As from n=3: H chooses activity B and L chooses activity A (T^H = 367.5)	-n=0 to n=4: not applicable -As from n=5: H chooses activity B and L chooses activity A
Effect on peat soil layer	Exhaustion of the peat	H' peat layer: exhaustion L' peat layer: 3/5 exhaustion →Total peat remaining: 20%	Exhaustion of the peat

- ***Agglomeration payment schemes***

For the two following scenarios, rewetting peat soils or not is the first step-decision which requires cooperation. In stage 2, with the introduction of the agglomeration payment, as long as L's farm profit is positive, players face a "coordination game" similar to the one commonly assumed in the literature on agglomeration payments. It results in two Nash equilibria: [both players adopt activity A] and [both players adopt activity B]. These two equilibria are "Pareto ranked in their payoffs and hence differ in their efficiency properties" (Banerjee et al, 2011). The former is the equilibrium that the policy instrument aims at achieving in order to protect the remaining peat soil layer, hence the "Pareto efficient equilibrium". The latter is the scenario of coordination failure. Cooperation is achieved when both players adopt an extensive land use on peat soils. In our analysis, we use the term '*cooperate'* in this sense: a farmer cooperates if he/she chooses activity A in stage 2 (which implies that both farmers voted for rewetting in stage 1).

- ***Fixed agglomeration payment P_F (P^H = P^L = 770, at any time)***

We use the same principles than for the baseline. We assume that [both conduct activity A] in the second-stage decision. For *n=0, 1, 2, 3, 4,* If H chooses B, then L's best response to H is to also choose B if T^H is not at least equal to 735. Similarly, if L chooses B, then H's best response to L is to also choose B if T^L is not at least equal to 735. If we assume that [both conduct activity B], if H chooses A, then L's best response to H is to choose A, and if H chooses A, then L's best response to H is to choose A. [Both players choose B] and [Both players choose A] are two Nash equilibria; the latter is the social optimum. After comparison with the first-stage decision's payoffs, despite the risk involved by the coordination game, it is more profit maximizing for players to vote for rewetting peat soils. For *n=5*, given that $\pi^L_{4,5}$ = 0, the strategy [Both players choose B] is no longer an equilibrium as L is always better off with activity A, regardless of the choice of H. As consequence, H' risk to vote for rewetting is lower.

Social preferences are also likely to influence behaviors. For *n=0, 1, 2,* equal payoffs between players in the second-stage decision is realized through either [both conduct activity A], [both conduct activity B], or [H chooses B, L chooses A] with T^H = (775-40)/2 = 367.5. The profit maximizing strategy is for both players to choose A (H's payoff = L' payoff = 810). Maximizing joint profits is as well reached by [both choose A]. After payoff comparison, both prosocial profiles would therefore vote for rewetting. As from *n=3*, equal payoffs are only realized by either [both conduct activity A], or [H chooses B, L chooses A] with T^H = 367.5. The profit maximizing strategy is for both players to choose the former, and therefore to rewet peat soils, which is also the prediction for "pure" prosocial joint maximizer players.

The main hypothesis for the fixed treatment is that both farmers have an economic incentive to cooperate, at all time-periods and regardless of the social preferences. However, issues of bargaining power and negotiation process over transfer payments are likely. They are motivated by the fact that the payment is only allocated to each farmer if both jointly adopt activity A. For instance, H-farmers who do not consider the constant payment as fair with regards to the diminishing opportunity costs of L from switching land use, and risk-averse H-farmers (as a coordination game also involves risk) may cooperate under the condition of T^L. Table 2 summarizes the behavioral predictions under this type of agglomeration payment.

Table 2: P_F behavioral predictions - summary

	PROSELF	***PROSOCIAL***	
Profiles of the group's players	Individualistic	Inequality averse	Joint profit maximizer
1st stage decision	As from n=0: Peat soils rewetted	As from n=0: peat soils rewetted	As from n=0: peat soils rewetted
2nd stage decision	H and L choose activity A. (potential T^L as a condition for H to cooperate if H has a strong bargaining power)	Both H and L choose activity A	Both H and L choose activity A
Effect on peat soil layer	Complete preservation of the peat, unless delay in the negotiation process for T^L	Complete preservation of the peat	Complete preservation of the peat

- ***Variable agglomeration payment P_V (P^H = 770, and $P^L_{n,t}$ is time dependent)***

For the profit-maximizer profile, behavioral prediction are identical to the ones described under the previous agglomeration payment. For *n=0, 1, 2, 3, 4*, even considering the decline of L's payment, the second-stage decision is composed of two Nash equilibria and [both choose activity A] is the social optimum. For $\pi^L_{5,t}$ = 0, it is always more profitable for L to vote for A regardless of H's choice. The difference with the previous agglomeration payment (P_F) is likely that, due to L's potential payment decline, L, and in consequence H, would tend to faster coordinate around the social optimum.

Regarding the effect of social preferences on player's behaviors, for *n=0, 1, 2,* the predictions are equivalent to the one made in T_{AC}. For *n=3, 4, 5,* in the second-stage decision, equal payoffs can be realized by [both conduct A] with T^H = (810-560)/2 = 125 if *n=3*, T^H = (810-170)/2 = 330 if *n=4*, and T^H = (810-50)/2 = 380 as from *n=5,* so that farmers payoffs are equal to 685 if *n=3*, 480 if *n=4, and* 420 if *n=5*. The second option to equalize payoffs is the strategy [H chooses B, L chooses A] with T^H = 367.5. Profit maximizing is achieved by choosing the former. Joint profit maximizers would choose it as well as the total welfare for each of these time-periods is the highest. Inequality averse and joint profit maximizers would therefore be in favor of rewetting peat soils.

Under this payment scheme, both farmers have an incentive to cooperate. Given that L's potential payment diminishes with his/her opportunity costs, players characterized as prosocial joint maximizers would tend to cooperate as from the first time-periods (in contrary to P_F where time has no effect on the level of the agri-environmental payment). Again, H-farmers may use their bargaining power to cooperate at the condition of a T^L. Table 3 presents a summary of the behavioral predictions under this type of agglomeration payment.

Table 3: P_V behavioral predictions - summary

	PROSELF	***PROSOCIAL***	
Profiles of the group's players	Individualistic	Inequality averse	Joint profit maximizer
1st stage decision	As from n=0: peat soils rewetted	As from n=0: peat soils rewetted	As from n=0: peat soils rewetted
2nd stage decision	H and L choose activity A. (potential T^L as a condition for H to cooperate if H has a strong bargaining power)	Both H and L choose activity A $T^H = 125$ if $n=3$, $T^H = 330$ if $n=4$, and $T^H = 380$ as from $n=5$	Both H and L choose activity A
Effect on peat soil layer	Complete preservation of the peat, unless delay in the negotiation process for T^L	Complete preservation of the peat	Complete preservation of the peat

In conclusion, without an external intervention (Baseline), the peat soil layer can only be preserved if H-farmers have prosocial inequality averse preferences and therefore vote in favor of rewetting peat soils. However, this situation may not be economically viable for these farmers, given the revenue reduction incurred by either soil degradation or by transfer-payments. With the introduction of the agglomeration payment, both farmers have an economic incentive to cooperate if the other does as well. Under both P_F and P_V, proself and prosocial farmers who aim at maximizing their profit would enable the preservation of the remaining peat soil layer. Again, we expect social preferences as well as other personal characteristics to play a role and to affect and therefore differentiate the level of environmental and cost effectiveness of the two agglomeration payment schemes. One important factor may be related to the use of bargaining power.

RESULTS

We explore the results as follows. We first compare the environmental effectiveness of each treatment[2] by examining the rate of players who cooperate, i.e. adopt activity A[3]. We then examine in each treatment scenario the net transfer-payment offers in order to understand the direction (either T^L or T^H) in which the offers and transfers took place. We also analyze the effect of social preferences[4] and other personal characteristics as well as the communication content between group members and its likely effect on

[2] In this result section, for the baseline, we only consider the outcomes of the treatment "baseline".
[3] We checked that players' behaviors do not significantly vary in the underlying baseline (Phase 2 of the experiment) across the treatment scenarios. Thus, we confirm the randomization of treatments.
[4] The representation of players' social preference types across treatments is provided in appendix A4.

outcomes. Finally, we study the distributional impact of the treatments by computing Gini coefficients, and we also compute the cost effectiveness of the different policy scenarios.

Environmental effectiveness

A crucial proxy for the environmental effectiveness of our policy treatments concerns the rate of players who adopt activity A ('cooperate') in the second-stage decision (matrix). Results of the baseline phase and the two policy treatments are depicted in Fig. 4.

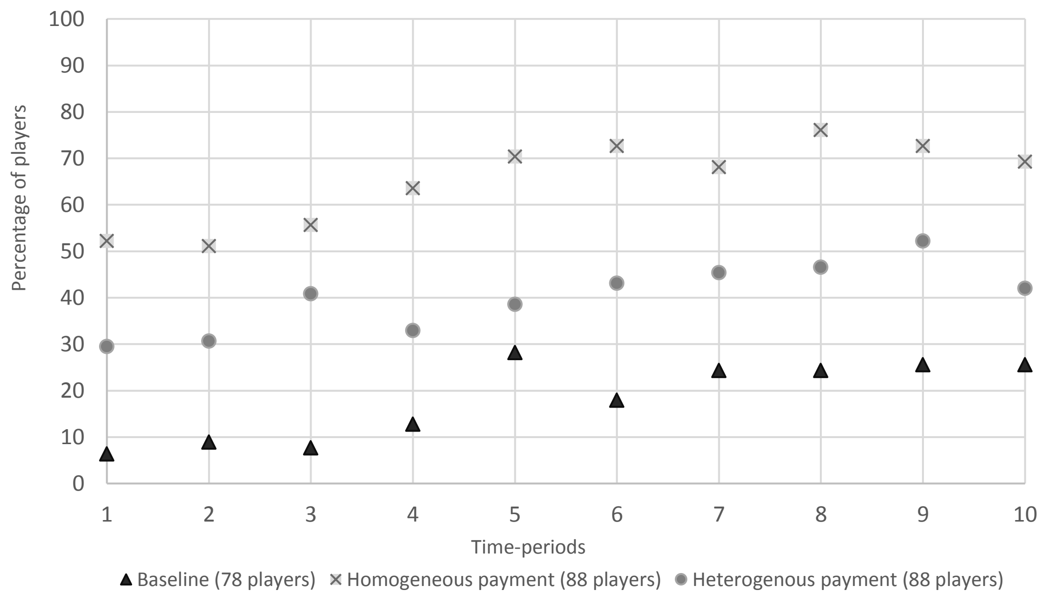

Figure 4: Comparison of the rate of players who cooperate (i.e. adopt activity A) in Baseline versus P_F (homogenous agglomeration payment) and P_V (variable agglomeration payment)

Under both P_F and P_V, the percentage of players who adopt an extensive peat soil use is significantly higher than in the baseline at each time period, apart from P_V in time-periods 5 and 10 (two-proportion z-test at 95 % confidence level). A panel logistic random-effect regression between the players' adoption of an extensive land use and the presence or not of an agglomeration payment confirms this result. The introduction of the payment increases the odds of players to adopt an extensive land use (cf. Table 4, model 1). The effect of the introduction of a payment scheme on the adoption of an extensive land use is about 3 times larger for H- than for L-farmers. This is largely explained by the fact that, in the Baseline, part of the H-farmers tend to pursue activity B while L-farmers tend to adopt activity A. However, in the presence of an agglomeration payment, H-farmers are less likely to adopt an extensive land use than L-farmers. Indeed, H's farm profit is not at risk of decreasing, hence a weaker incentive to adopt activity A.

Comparing the two policy treatments, we find that the percentage of players who adopt activity A at each time-period is significantly higher under P_F than under P_V (two-proportion z-test at 95 % confidence level). A panel logistic random-effect regression of players' adoption of activity A in all time periods confirms that, in P_V, players' odds to adopt an extensive land use (i.e. activity A) reduces to 12% of the value for P_F (see Model 2). Overall, the fixed payment scheme (P_F) appears to be most environmentally effective in the sense of incentivizing land use change.

Table 4: Panel logistic random-effect regression of players' adoption of activity A[5]

	(1)	(2)
Time	1.17*** (0.04)	1.15*** (0.05)
Treatment	114.2*** (81.6)	0.12*** (0.08)
H-Farmer	0.23*** (0.07)	0.69 (0.12)
Treatment*H-farmer	0.33** (0.11)	1.02 (0.22)
Constant	0.15*** (0.06)	1.19 (0.66)
Groups	254	176
Observations	2540	1760

Note: Odds ratio are reported with the significance of their correlation: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. In brackets are the standard errors associated to the odds ratio estimates. Treatment variable: in Model 1: (0 = baseline, 1 = agglomeration payment (P_F or P_V); in model 2: (0=P_F, 1=P_V)

- ***Level of inequality in incomes and cost effectiveness of the policy scheme***

Using the Gini coefficient, we compare the level of inequality in payoff or income between the three scenarios among the players who cooperate (i.e. adopt activity A).[6] We find that in the absence of a payment, the level of inequality is significantly higher than when in the presence of an agglomeration payment: the Gini coefficient is equal to 0.56 (st. dev. 0.27) in the baseline, while it is significantly higher in P_V (0.23 with st. dev 0.12) than in P_F (0.12 with st. dev. 0.05) (two-samples t test, 95% conf. level). In P_V, the level of inequality increases over time (the mean Gini coefficient increases from 0.11 during the first three time-periods to 0.40 during the seven last time-periods). We find that inequality in largely taking place among the L-farmers as, in the absence of cooperation, they see their farm profits and potential payments drop.

The difference in design of these two agglomeration payments leads also to different level of expenditures for a same level of peat preserved. Indeed, if n>3, for a same level of cooperation under the two payment schemes, the total expenditure would be higher under P_F than under P_V. This is why, we compare the cost-effectiveness of the two policy options. For this, we calculate the volume of peat soil preserved for each player at the end of the 10-time-periods. Given that after 5 time-periods under vegetable farming, the peat is exhausted, this volume is a continuous variable taking values from 0 to 5. By summing up over the sample population, we estimate, for each scenario, the total volume of peat which is preserved. In the baseline scenario (78 players), complete preservation of the peat would mean that 78*5 = 390 vol.units are preserved. Under an agglomeration payment (88 players), it would mean that 88*5 = 440 vol.units are preserved. A measure of cost-effectiveness of the policy scheme is obtained by dividing the total volume of peat preserved by the total payments made. If we assume that under both policy schemes, players cooperate as from the first time-period, the maximum total payment which can be made is equal to 88*770*10 =677'600. We find that, although the total payment that could potentially be made under P_F is larger than the one under P_V, the fixed payment P_F appears to be significantly more cost effective than the variable payment P_V (cf. table 5). For a same level of financial funds, a larger volume of peat can be preserved under P_F than under P_V.

[5] To control for group membership, all regression models also include group dummies (not reported).

[6] Using players' round payoffs, we computed the GINI coefficient at each time-period (by only considering the payoffs of the players who adopt activity A) and then computed its average across the ten time-periods.

Table 5: Comparison of the payment schemes' cost-effectiveness

	Baseline	P_F	P_V
Total peat volume preserved along the 10 time-periods, in units	10	199	69
Peat volume preserved in percentage of the total, in %	2.6	45.2	15.7
Total payment spent along the 10 time-periods, in monetary units	-	403'480	208'740
Percentage of the total payment possible, in %	-	59.5	30.8
Cost-effectiveness of the payment scheme: fund spent per peat volume unit preserved	-	2027.5	3025.2

- ***Behavior in the Baseline treatment***

Contrary to standard predictions, some cooperation occurs in the baseline treatment without payment. This happens as L's farm profits start to or threaten to decline: coordination for rewetting peat soils increases from 19% on average up to time-period 5 to 40% as from time-period 5. However, in groups that agree on rewetting, activity A is adopted mainly by L-farmers while most H-farmers revert to activity B.

Interestingly, most of the transfer-payment offers occur from H- to L-farmers, and more specifically from "inequality averse" H-farmer types. The mean net offer increases over time as L's farm profit declines, and is equal to 173 over the last five time-periods. In particular, two H-farmers comply with the prediction of a pure inequality averse player by making a transfer equal to 367, they vote for rewetting peat soil and pursue activity B while their group members L adopt activity A. The communication content of groups which communicate (29) reveals that 24% of groups mention "equitability" of payoffs in their discussions. In some situations this lead to transfers from H without L explicitly requesting such a payment, and in others, L farmers successfully could request a transfer referring to his/her difficult situation. Negative net T^H are only present within the population of proself H-farmers. This matches with the fact that, in part of the groups, H-farmers request a T^L as a condition to rewet.

The results indicate that farmers with long production potential who are characterized as prosocial would likely agree on rewetting peat soils with their neighbor(s) when the latter's farm profit declines, even though this comes at the expense of paying for a personal drainage system. Moreover, inequality averse H-farmers would be willing to work on diminishing inequalities in revenues via payoff redistribution. Nevertheless, this scenario may also generate conflict as another set of the H-farmers tends to take advantage of the L-farmers by conditioning their cooperation on a payment. Despite the adoption of an extensive peat soil use in the late time-periods by a significant proportion of L-farmers and part of the prosocial H-farmers, the peat soil layer is strongly degraded on both farm lands before cooperation emerges. This highlights the importance of a policy instrument to ensure the preservation of the peat soil layer.

- ***Behavior in the fixed payment (P_F)***

In P_F, 60% of the groups coordinate in rewetting peat soils as from the first time-period and continue to do so over time. Within those groups, 90% of the players adopt activity A.

Most of the offers are T^L, and are on average more often made by prosocial L-farmer types. Furthermore, the mean net offer decreases over time (from 107 before to 66 after time-period 3). Based on the communication content, T^L are mainly requested by H-farmers as a condition for cooperation. Also, with regards to the groups which successfully agree on cooperating without discussing over transfer-payments (21 groups), about half of them clearly justify their choice with maximizing each group member's payoff, and 10% with a purpose of payoffs' equitability between group members. To estimate the effective impact of transfer-payment offers on the payment scheme design, we study their representation among the groups who successfully cooperate. A net transfer-payment takes place in 23% of the groups where both players adopt an extensive peat soil use; the mean net H transfer is equal to -67.7. In comparison, among the players who do not successfully cooperate, a net transfer-payment takes place on average in 8.9% of the groups and the average mean of the net H transfer-payment is not significantly different from 0 (mean equal to 38.0, one sample t-test, p-value = 0.64). Therefore, for a certain set of the farmers, the transfer-payments - mainly from L to H-farmers - contribute to the success of their cooperation.

In this treatment, profit maximization appears to be the main driver for players to cooperate as payoffs from activity A are higher with the agglomeration payment. However, a non-negligible part of the H-farmers exploits the fact that the outcome of the first stage decision is based on a unanimous decision and that L-farmers profit will decline if they continue farming vegetables. In this sense, H-farmers have a stronger bargaining power than L-farmers, which they use in order to request TL as a condition to cooperate.

Given the rate of groups (60%) which agree on cooperation as from the first time-periods, this translates into about the same percentage of the peat soil acreage being preserved. For the other part of the groups which either do not reach cooperation within the first time-periods or never reach equilibrium cooperative outcome, the peat soil layer is largely degraded.

- ***Behavior in the variable payment (P_V)***

In P_V, the rate of groups who rewet the peat area (first stage decision) is only significantly higher than the baseline in two time-periods. Across the ten time-periods, the average rate of coordination over rewetting is nevertheless significantly higher in P_v (50.0%) than in Baseline (18.6%) (two-sample test of proportion).Among the groups who rewet peat soils, about 80% of the players adopt an extensive land use, so cooperation in stage 2 is significantly higher than in the baseline.

Interestingly, transfer-payment offers are mainly made by H- to L-farmers; the mean net T^H amounts to about 100. Moreover, most of these T^H are made by the prosocial H-farmer types. Based on the communication content from the chat messages, H-farmers seem to pay attention to the difficult situation of L-farmers (i.e. decreasing farm profit combined with decreasing potential payment) which then results into these positive transfer-payment offers. Overall, among the groups which communicate (40), 40% discuss about possible transfer-payments. At an equivalent rate, this communication deals with either H requesting T^L or L requesting T^H. With regards to the occurrence of transfer-payments, we find that a net transfer-payment takes place in 12% of the groups who successfully cooperate (as compared to 25.9% among the groups which do not successfully cooperate), which is only half as much than in the fixed agglomeration payment treatment. The average mean net H transfer-payment amounts to about 100.

Moreover, we find that part of the players give more priority to activity B (vegetables farming) than to the economic incentive. For instance, one third of the groups who communicate coordinate in rewetting peat soils during the first two to five time-periods but a large part of these players decides to pursue activity B in the second stage. An additional 15% of the groups first agree on cooperating but then reverse to activity B after a few time-periods.

With regards to the potential to preserve the peat soil layer under this payment scheme, we observe that a large part of the players only rewet peat soils after maximizing their farm profit from conventional vegetable production, although their profits would have been higher under the agglomeration payment. This results in an exhaustion of the peat soil layer.

- ***Effect of players' socio-demographic and preference characteristics on their behaviors***

We explore the role of social preferences and other socio-demographic characteristics on players' decisions. Based on the SVO test, table 7 provides the mean SVO angle of players in each treatment; it does not significantly differ across treatments (t test, 95% conf. level).

Table 7: Mean SVO angle in each scenario

	Baseline (78 players)	**P_F (88 players)**	**P_V (88 players)**
Mean SVO angle	25.2 (13.9)	25.1 (15.7)	25.3 (13.8)

The other players' characteristics[7] were collected from the survey conducted at the end of the experimental session (cf. Annex 1). They include the following: care for the environment (Environment), willingness to take risk, general level of patience (Patience), importance of reputation, through care for others' opinion (Reputation), level of knowledge about peat soil degradation in Switzerland, opinion towards success of cooperative approaches in agr.icultural management (Opinion cooperatives), presence of peat soils in parents' farm land (Peat presence), presence of a farm at home (Farm at home), and level of prosociality using the SVO angle (Prosociality).[8]

Our primary interest is to characterize the players who adopt activity A (i.e. a more sustainable land use on peat soils). Conducting a regression analysis where the response variable corresponds to the adoption or not of activity A (cooperation) would imply that the players who conduct activity B include both the players who could not proceed to the second stage-decision (i.e., the players who voted in favor and the one who voted against rewetting) and the players who proceeded but decided to pursue vegetable farming at a cost. The group of players who conduct B is therefore very heterogeneous, which shows the importance of examining each stage-population separately. For this, we provide the regression analyses with dependent variable being = players' vote for rewetting peat soils (i.e. first-stage decision) (see Table 8) and with dependent variable being players' land use choice on rewetted peat soils (i.e. activity A in the second-stage decision) (see Table 10)

[7] Before analyzing the potential effect of players' characteristics on behaviors, we tested for 1) potential effect of the type of treatment on players' survey responses in order to exclude biased variables and 2) for potential correlations between these characteristics one another. With regards to the latter, in the regression analyses and in each scenario, we excluded the variables which were significantly correlated to another variable.

[8] Please see Appendix A2 for detailed description of all measured variables.

Table 8: Panel random-effect logistic regression of players' vote for rewetting peat soils (first-stage)[9]

	VARIABLES	(1) Full sample	(2) P_F and P_v	(3) Baseline	(4) P_F	(5) P_v
Experiment	Time	1.154***	1.119***	1.233***	1.114*	1.121***
		(0.0309)	(0.0360)	(0.0624)	(0.0622)	(0.0440)
	Treatment	17.49***	0.378			
		(9.300)	(0.237)			
	H-farmer	0.0575**	0.0134**	0.502	0.00470*	0.0344
		(0.0696)	(0.0229)	(0.849)	(0.0134)	(0.0719)
Opinions and preferences	Environment	0.988	1.001	0.937	0.917*	1.038
		(0.0208)	(0.0271)	(0.0382)	(0.0476)	(0.0251)
	Willingness to take risk	0.901*	0.839**	1.122	0.857	0.883
		(0.0497)	(0.0673)	(0.120)	(0.128)	(0.0904)
	Patience	1.013	1.004	0.969	1.133	0.943
		(0.0443)	(0.0732)	(0.0677)	(0.148)	(0.0739)
	Reputation	1.131	0.976	2.080**	0.899	0.931
		(0.193)	(0.252)	(0.650)	(0.405)	(0.256)
	Level of knowledge peat	0.842	1.016	0.780	1.837	0.906
	degradation	(0.169)	(0.258)	(0.264)	(1.101)	(0.235)
	Opinion cooperative approaches	1.400**	1.474	1.520	3.544**	1.154
		(0.233)	(0.361)	(0.438)	(1.805)	(0.259)
	SVO angle	1.005	0.993	1.024	0.966	1.020
		(0.0104)	(0.0140)	(0.0204)	(0.0258)	(0.0180)
Farm characteristics	Peat presence	1.034	1.049	0.968	1.151**	1.017
		(0.0365)	(0.0342)	(0.0460)	(0.0743)	(0.0426)
	Farm at home	1.041	1.063	1.741	1.745	0.971
		(0.210)	(0.268)	(0.848)	(0.788)	(0.287)
Interaction terms	Environment*H	1.041	1.040	1.076	1.175***	0.970
		(0.0321)	(0.0411)	(0.0651)	(0.0718)	(0.0457)
	Willingness to take risk*H	1.139	1.376***	0.760	1.535**	1.167
		(0.107)	(0.166)	(0.137)	(0.305)	(0.181)
	Patience*H	1.058	1.187	0.984	1.212	1.212*
		(0.0739)	(0.124)	(0.104)	(0.231)	(0.134)
	Reputation*H	1.110	1.270	0.624	1.069	2.343*
		(0.281)	(0.458)	(0.222)	(0.570)	(1.024)
	Level of knowledge peat	1.258	0.928	1.551	0.761	0.965
	degradation*H	(0.347)	(0.330)	(0.792)	(0.496)	(0.449)
	Opinion cooperative approaches *H	0.827	0.650	1.578	0.151**	0.976
		(0.228)	(0.213)	(0.676)	(0.118)	(0.243)
	SVO angle*H	0.998	1.020	0.954*	1.060*	1.006
		(0.0142)	(0.0194)	(0.0266)	(0.0332)	(0.0239)
	Peat*H	0.924	0.912*	1.115*	0.749***	1.009
		(0.0500)	(0.0489)	(0.0724)	(0.0683)	(0.0543)
	Treatment*H	0.687	0.812			
		(0.296)	(0.327)			
Model	Constant	1.504	14.86**	0.188	19.54	0.998
		(1.382)	(19.58)	(0.280)	(45.05)	(1.627)
	Observations	2,490	1,730	760	870	860
	Groups	249	173	76	87	86
	p-value model	0.00	0.00	0..00	0.04	0.01

Note: Odds ratios are reported. *** p<0.01, ** p<0.05, * p<0.1 In model 1 (full sample), the "treatment" variable takes the value 0 for the baseline and 1 in case of the presence of a payment scheme (P_F or P_v). In Model 2 (P_F and P_v), the treatment variable take the value 0 for P_F and the value 1 for P_v.

We find across all specifications that the likelihood of players to vote for rewetting peat soils increases over time. In fact, time of play is the strongest and most stable predictor overall (Models 1 to 5). In addition, players are more likely to vote for rewetting overall in payment treatments when compared to the baseline (Model 1). Comparing famer-types, H-farmers are generally less likely to vote for rewetting as compared to L-farmers (Models 1 and 2).

When comparing only the payment treatments to each other (Model 2), we confirm our treatment effect that in Pv as compared to P_F, H-farmers are less likely to vote for rewetting as compared to L-farmers,

[9] To control for group membership, all regression models also include group dummies (not reported).

while this effect is particularly pronounced for H-farmers who are more risk loving (see interaction term Willingness to take risk*H-farmer in Model x). In general, the agglomeration payment type generates a risk for farmers to cooperate as the group member could decide to defect in the second-stage decision, which would results in a non-allocation of the payment. This effect makes sense, as on average, it is more risky for H than L farmers to choose cooperation, given that in particular from time period 3 onwards, the profit surplus which can be made by H farmers from cooperation is rather small as compared to the surplus which can be made by L farmers who start to have falling profits over time and thus have much more to gain from cooperation. However, we also observe that, at 90% confidence level, players who are risk-takers are less likely to vote for rewetting peat soils (Models 1 and 2). Most likely, it relates to a second type of risk: if L-farmers focus on maximizing profits from vegetable production during the first time-periods and thus postpone cooperation, they take the risk of seeing their farm profit dropping. The more L-farmers are willing to take risk, the less likely they vote for rewetting during the first time-periods.

Lastly, we consider separate regression for the baseline and the two payment treatments (Models 3, 4, & 5). In the Baseline scenario (Model 3), we find that the odds to vote for rewetting peat soils is multiplied by 2.07 for the players who "care for their reputation". In particular, for the H-farmers, this can be interpreted as players who care about how they would be considered by their group member and other players at a broader level if they would let their group member's profits drop without taking any action.

In the fixed agglomeration payment (Model 4), for these same reasons as in the other models, the odds of H-farmers in voting for rewetting peat soil is significantly reduced as compared to L-farmers. L-farmers have a stronger incentive to cooperate as compared to H-farmers. Furthermore, farmers characterized by a positive opinion towards cooperative approaches in agricultural management are on average more likely to vote for rewetting peat soils; and this effect is significantly stronger from L- than for H-farmers. Last, the farmers who reported to have peat soils in their farm land have a higher likelihood to vote for rewetting, and this effect is significantly stronger for L- than for H- farmers (see interaction term Peat*H).

In the variable agglomeration payment (Model 5), we find that the effects of reputation and patience is significantly stronger for H- than for L-farmers. Beside that, no other predictor appear to influence the voting decision.

Next, Table 9 presents the results from a random-effect panel logistic regression of players' second-stage decision i.e. players who coordinated in rewetting peat soils and adopt activity A. Note that this analysis only includes subjects who reached the second-stage.

Table 9: Panel random-effect logistic regression on players' land use choice[10]

	VARIABLES	(1) Full sample	(2) P_F and P_v	(3) Baseline	(4) P_F	(5) P_v
Experiment	Time	1.027	1.006	**1.254*** **	**1.186***	**0.786***
		(0.0607)	(0.0784)	(0.108)	(0.121)	(0.0988)
	Treatment	**4.128** **	**0.0364*** **			
		(2.959)	(0.0401)			
	H-farmer	0.132	0.00563	3.368	0.203	0.000838
		(0.293)	(0.0187)	(12.30)	(1.016)	(0.00384)
Opinion and preference	Environment	0.984	1.000	0.895	0.992	1.034
		(0.0415)	(0.0456)	(0.0682)	(0.0834)	(0.0652)
	Willingness to take risk	0.918	0.935	1.061	1.021	**0.564** **
		(0.101)	(0.149)	(0.221)	(0.213)	(0.132)
	Patience	**1.202** **	1.179	1.090	1.377	1.170
		(0.110)	(0.163)	(0.148)	(0.278)	(0.216)
	Reputation	**1.786***	1.630	0.685	1.684	**0.187*** **
		(0.553)	(0.650)	(0.328)	(1.286)	(0.0918)
	Level of knowledge peat degradation	0.796	0.533	1.128	1.901	2.119
		(0.330)	(0.298)	(0.705)	(2.217)	(1.454)
	Opinion cooperative approaches	0.753	0.900	1.404	2.699	0.349*
		(0.261)	(0.391)	(0.636)	(2.036)	(0.216)
	SVO angle	1.014	1.006	0.978	0.978	1.001
		(0.0166)	(0.0213)	(0.0321)	(0.0307)	(0.0279)
Farm characteristics	Peat presence	1.061	1.075	0.959	1.078	**1.233*** **
		(0.0518)	(0.0592)	(0.125)	(0.107)	(0.0817)
	Farm at home	1.398	1.332	0.550	0.667	0.409
		(0.517)	(0.626)	(0.435)	(0.570)	(0.269)
Interaction terms	Environment*H	1.005	1.010	1.080	1.069	0.906
		(0.0618)	(0.0725)	(0.107)	(0.118)	(0.0921)
	Willingness to take risk*H	1.184	1.388	0.822	1.503	**2.011** **
		(0.190)	(0.302)	(0.244)	(0.490)	(0.622)
	Patience*H	0.891	1.034	0.991	0.849	1.009
		(0.123)	(0.197)	(0.175)	(0.264)	(0.249)
	Reputation*H	1.180	1.503	0.764	0.305	0.973
		(0.541)	(0.836)	(0.493)	(0.312)	(0.734)
	Level of knowledge peat degradation*H	1.221	1.703	1.032	0.554	0.738
		(0.639)	(1.156)	(0.824)	(0.706)	(0.647)
	Opinion cooperative approaches *H	1.415	0.859	**0.212** **	0.571	3.398
		(0.773)	(0.547)	(0.156)	(0.670)	(2.976)
	SVO angle*H	0.977	1.015	0.967	1.048	1.061
		(0.0223)	(0.0281)	(0.0398)	(0.0449)	(0.0415)
	Peat*H	0.929	0.908		0.888	0.827*
		(0.0654)	(0.0641)		(0.124)	(0.0858)
	Treatment*H	**0.146*** **	1.026			
		(0.101)	(0.729)			
Model	Constant	2.830	9.663	12.82	0.138	6,421**
		(4.250)	(24.66)	(32.44)	(0.477)	(22,617)
	Observations	1,303	1,077	252	644	433
	Groups	232	163	65	85	78
	p-value model	0.00	0.27	0.07	0.35	0.57

Note: Odds ratios are reported. *** p<0.01, ** p<0.05, * p<0.1 In model 1 (full sample), the "treatment" variable takes the value 0 for the baseline and 1 in case of the presence of a payment scheme (P_F or P_v). In model 2 (P_F and P_v), the treatment variable take the value 0 for P_F and the value 1 for P_v.

We find that the introduction of a payment has a significant positive impact on the likelihood of farmers to adopt A (see Model 1) which confirms our main treatment effects. As compared to the previous stage (regressions in Table 9), treatment effects differ depending on farmer-type (see interaction term treatment*H). This means that the introduction of a payment scheme has a significantly stronger impact on L- than on H-farmers with respect to their decision to adopt activity A. In addition, reputation and patience also appear as significant predictors. In Model 2, we only consider the two payment schemes and find no significant predictors of adopting activity A.

[10] To control for group membership, all regression models also include group dummies (not reported).

Next, we consider each treatment scenario separately. In the Baseline, in P_F (Models 3 and 4), time period appears significant. This means that adoption of activity A being more likely across time in both scenarios. In the Baseline (Model 3), also the opinion towards cooperative approaches has a stronger effect on L- than on H-farmers' decision in this stage (see respective interaction term). In P_F, the decision over the land use on rewetted peat soils is not significantly influenced by any other players' characteristics we considered. In P_V, and in contrast to the other treatment, the odds of players to adopt activity A reduces significantly over time. This matches with the finding that, under this payment, a set of the farmers prioritizes vegetable farming over the economic incentive associated to the adoption of an extensive land use. Furthermore, and also in contrary to the first-stage decision (see Table 9), the odds of players to adopt activity A reduces with the level of importance given to reputation (multiplied by 0.187) and with the willingness to take risk, and increases with the presence of peat in own farm land.

DISCUSSION and CONCLUSION

The computerized framed-field experiment, which we executed, helped to gather valuable insights about future farmer's decision-making with respect to peat soil management practices and their response to various agglomeration payment policies. We find that more farmers are willing to implement a more sustainable, extensive land use on peat soils when an agglomeration payment scheme is present, than when this is not the case. Without any policy intervention, only the low-production-potential farmers (L) have an incentive to rewet peat soils in order to pursue an extensive activity once their profit from vegetable production is equal to zero. In terms of environmental effectiveness the agglomeration payment is therefore a promising approach for promoting sustainable peat soil use.

Notably, the policy effect depends strongly on the design of the payment scheme (i.e. variable versus fixed payment), while a fixed agglomeration payment scheme turns out to be more cost and environmental effective than a variable pay to farmers. In addition, a fixed payment scheme leads to less unequal income outcomes (i.e. measured via the GINI coefficient) among farmer groups. More equal group outcomes are partly driven by subjects classified as inequality averse (according to the SVO test classification) who more often offer transfer-payments aiming at equalizing income differences.

Under the fixed agglomeration payment, a large part of the players cooperate and adopt an extensive land use early on in the experiment, and thus preserve their peat soil layer. Under the variable payment, the level of asymmetry between farmers of a same group is larger: in addition of their farm profit from vegetable farming being affected by peat degradation, L-farmers face a decreasing potential payment. A large part of the players do not manage to maintain an equilibrium of cooperation, or delay cooperation, which does not allow the preservation of the peat soil layer. Therefore, for the case of promoting sustainable peat soil use in Switzerland, it would be appropriate to apply the more common approach of fixed payments when designing agglomeration payments. This is promising because variable payments are on average also more difficult to implement as they require prior knowledge of farmers' opportunity costs (i.e. sampling each farm plot to determine the nature of the underlying mineral soil layer and the thickness of the peat soil layer) and the idea is sometimes (falsely) perceived as less equitable and thus may face lower political feasibility.

Moreover, to ensure fast cooperation of the players in order to preserve as much of the peat soil and to prevent delay generated by bargaining processes, the incentive provided by the payment needs to be high. A higher incentive than the one tested in the experiment (which represented 2% more than the opportunity costs from switching to an extensive land use) could enable faster coordination. The speed of coordination between players and the maintenance of cooperation over time is indeed crucial in this context. However, in this particular case, the opportunity costs of switching from vegetable farming to an extensive land use are huge. Given that our goal is to identify a policy option that effectively promotes the adoption of an extensive peat soil use, we assume in this study an "unlimited" budget from the governmental agency allocating the subsidies. In reality, this is likely not the case. Because of budget constraints, the payment may be too low to create a sufficient incentive for farmers to coordinate on rewetting peat soils and then to adopt an extensive land use.

Finally, the enforcement of the policy should account for the farmers' opinions and social preferences which are likely to influence its success. Farmers' risk aversion, opinion towards cooperative approaches, and reputation have been identified as determinant factors.

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REFERENCES

Banerjee, S., Cason, T.N., De Vries, F.P., Hanley, N. (2015) : "Coordination in Agglomeration Bonus Schemes with Transaction Costs and Communication: An Experiment Study", University of St. Andrews, *Discussion papers in Environmental Economics*; Paper 2015-10.

Banerjee, S., De Vries, F.P, Hanley, N., Van Soest, D. (2013): "The Impact of Information Provision on Agglomeration Bonus Performance: An Experimental Study on Local Networks", Stirling Economics Discussion Paper, 2013-09.

Drechsler et al. (2007): "An agglomeration payment for cost-effective biodiversity conservation in spatially structured landscapes", UFZ-Diskussionspapiere, No. 4/2007.

Murphy et al. (2011): "Measuring Social Value Orientation", *Judgment and Decision Making*, Vol. 6, No. 8, December 2011, pp. 771–781.

Ferraro, P.J. (2008): "Asymmetric information and contract designs for payments for environmental services", *Ecological Economics* 65: 810-821.

Harrison, G. & List, J.A. (2004): "Field Experiments", *Journal of Economic Literature Vol. XLII* pp. 1009–1055.

Parkhurst, G.M. et al. (2002): "Agglomeration bonus: an incentive mechanism to reunite fragmented habitat for biodiversity conservation", *Ecological Economics* 41: 305-328.

Parkhurst, G.M. & Shogren, J.F. (2007): "Spatial incentives to coordinate contiguous habitat", *Ecological Economics* 64 (2), 344-355.

Reiche, M. et al. (2008): "Effect of peat quality on microbial greenhouse gas formation in an acidic fen", *Biogeosciences*, 7, 187–198, 2010

Reutemann, T. & Engel, S. 2014. "Return per hectare or per dollar? Opportunity costs of conservation under capital constraints and intensification potential", Working paper, Professorship of Environmental Policy and Economics, ETH Zurich.

Rickenbach, M. et al. (2011): "Cross-boundary cooperation: A mechanism for sustaining ecosystem services from private lands", *Journal of Agricultural and Resource Economics* 66 (4).
Serrano, R., & Feldman, A. M. (vc 2010, 2011): *Lesson 14* Game Theory
Van Soest, D. et al. (2013): "Preference heterogeneity, asymmetric information, and the inevitability of informational rents in environmental subsidy programs", HYPERLINK "http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/10/grantham_vansoest_2015_01_07.pdf" accessed 08.03.2016.
Xintu, L. (2009): "Conditions of peat formation", *Coal, oil shale, natural bitumen, heavy oil and peat*, Vol. 2 (452 pages).

APPENDIX

A1. Experimental design

Each group consists of two extremes cases of farmers *f* who differ in the type of the underlying mineral soil layer of their peat soils, as follows:

f = {*L*, *H*}, with *H* a farmer with high quality mineral soils and therefore a long farm production potential (Blue-farmer in the experiment), and *L* a farmer with low quality mineral soils and therefore a short farm production potential (Yellow-farmer in the experiment). The group composition was changed between the baseline and the treatment phase.

The dynamics of cultivated peat soils are represented by d_t, where d_t≡ drainage at time *t*, defined as:

$$d_t = \begin{Bmatrix} 0, \text{peat soils are drained (current situation)} \\ 1, \text{peat soils are rewetted by stopping drainage (alternative situation)} \end{Bmatrix}, t = \{1, \ldots, 10\}$$

The thickness of the peat soil layer degrades and reduces with drainage. T_t^f is defined as the thickness of the peat soil layer for farmer *f* at time *t*.

$$If\ d_t = \begin{Bmatrix} 0:\ T_{t+1}^f = \alpha T_t^f, with\ 0 < \alpha < 1, \alpha \text{ is a constant which is independant of } f \\ 1:\ T_{t+1}^f = T_t^f \end{Bmatrix}$$

As the peat soil layer reduces with vegetable farming, the underlying mineral soil layer gets closer to the surface. *L* has an underlying mineral soil layer which is not suitable for vegetable production while *H* has one which is suitable for vegetable production. This translates into different profit functions for *L* and *H* (Fig. 1). Peat soil degradation does not affect *H*'s farm profit: regardless of the number of time-periods *H* produces vegetables, his farm profit remains constant for this activity. But peat soil degradation negatively affects *L*'s farm profit which depends on the number of time-periods used previously for farming vegetables.

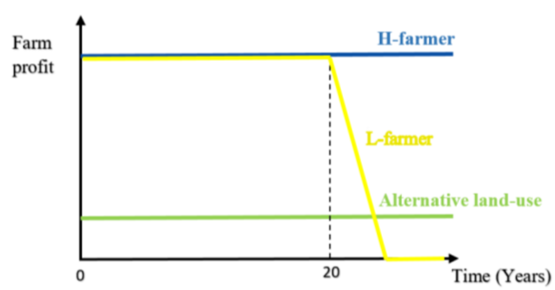

Figure 1: Profit functions of H- and L-farmers over time

$\pi_{n,t}^f$ is defined as the agricultural productivity for vegetable farming of the peat soil layer for farmer *f* at time *t*, given a number *n* of previous time-periods under vegetable farming (n={0,...,9}). It is defined as:

$$If\ d_t = 0: \begin{cases} If\ f = H, \pi^H_{n+1,t+1} = \pi^H_{n,t} \\ \text{(the productivity of H for vegetable farming is independant of n)} \\ If\ f = L: \begin{cases} If\ n = 0,1,2, then\ \pi^L_{n,t} = \pi^H_{n,t} = 800, t = \{1,\dots,10\} \\ If\ n = 3, then\ \pi^L_{n,t} = 550, t = \{4,\dots,10\} \\ If\ n = 4, then\ \pi^L_{n,t} = 160, t = \{5,\dots,10\} \\ If\ n = 5,6,7,8,9, then\ \pi^L_{n,t} = 0, t = \{6,\dots,10\} \end{cases} \end{cases}$$

$$If\ d_t = 1: \pi^f_{n,t+1} = \pi^f_{n,t}$$

The procedure of one time-period is as follows. Group members can first anonymously communicate through chat messages. Each member is invited to vote on rewetting peat soils for the group, or not, i.e. to vote for d_t = 0 or 1. If at least one of the members rejects to rewet peat soils, farmers continue producing vegetables (activity B). If both farmers vote for rewetting (by stopping the drainage), vegetable farming is no longer possible. Farmers are then asked to make a choice between two kinds of agricultural activities: *A)* implementing an extensive land use adapted to high water table (profit equal to 40) or *B)* pursuing vegetable farming by draining back the peat soils with the installation of a personal drainage system (cost equal to 25).

The set of actions a_t^f of the farmer at time *t* is therefore as follows:

$$a_t^f = \begin{cases} If\ d_t = 1: \begin{cases} A: f \text{ adopts an alternative land use on rewetted peat soils} \\ B: f \text{ pursues vegetable farming using a personal drainage system} \\ \text{(cost = 25)} \end{cases} \\ If\ d_t = 0: B: f \text{ automatically pursues vegetable farming on peat soils} \end{cases}$$

- In the baseline, player's payoffs u_t are as follows:

For *H* farmers: $u_t^H(d_t; a_t^H) = \begin{cases} 40\ if\ (d_t; a_t^H) = (1; A) \\ \pi^H_{n,t} - 25 = 775\ if\ (d_t; a_t^H) = (1; B) \\ \pi^H_{n,t} = 800\ if\ (d_t; a_t^H) = (0; B) \end{cases}; t = 1,\dots,10$

For *L* farmers: $u_t^L(d_t; a_t^L) = \begin{cases} 40\ if\ (d_t; a_t^L) = (1; A) \\ \pi^L_{n,t} - 25\ if\ (d_t; a_t^L) = (1; B) \\ \pi^L_{n,t}\ if\ (d_t; a_t^L) = (0; B) \end{cases}; t = 1,\dots,10; n = 0,\dots,9$

- In the treatment phase where we test one type of agglomeration payment, players receive a payment (S) if both group members vote for adopting an extensive land use on rewetted peat soils. Therefore:

If $[(d_t; a_t^L) = (1; A)] \cap [(d_t; a_t^H) = (1; A)]$, then $u_t^L(d_t; a_t^L) = u_t^H(d_t; a_t^H) = 40 + S$

Before voting on stopping the drainage system, each group member is given the option to make a binding transfer-payment offer to the other member. The payment is transferred only if both members vote for rewetting peat soil and at the condition that the potential beneficiary adopts an extensive land use on rewetted peat soils (land use type *A*), regardless of the choice of the farmer making the offer. They are represented in Figure 3 below.

The payoff matrixes at time *t* are as in Figures 2 and 3 below. Payoffs which correspond to farm profits from vegetable farming or from the alternative land use) are calculated based on actual farm profit (from Agridea database and University of Greiswald) as present value of cumulated future farm gross margin over

5 years (with a discount rate equal to 4%). For easier readability, numbers were rounded up and divided by 1000. Players can consult the payoff matrixes all along the experiment as they are displayed on the screen and their content is updated at each time-period based on players' actions.

		Farmer H
		Activity B: vegetable farming
Farmer L	Activity B: vegetable farming	$\pi^{L}_{n,t}$ π^{H}

Figure 3: Players' payoffs at time *t* when peat soils are not rewetted

		Farmer H	
		Activity A: extensive peat soil use	Activity B: vegetable farming
Farmer L	Activity A: extensive peat soil use	$40 + P^{L}_{n,t} - T^{L} + T^{H}$ $40 + P^{H} + T^{L} - T^{H}$	$40 + T^{H}$ $\pi^{H} - 25 - T^{H}$
	Activity B: vegetable farming	$\pi^{L}_{n,t} - 25 - T^{L}$ $40 + T^{L}$	$\pi^{L}_{n,t} - 25$ $\pi^{H} - 25$

Figure 4: Players' payoffs at time t when peat soils are rewetted; both players voted for rewetting peat soils and moved to this second stage-decision. $P^{L}_{n,t}$, P^{H} = agglomeration payment (treatment phase). T^{L}: transfer payment offer made by L to H, T^{H}: transfer payment offer made by H to L.

The effects of fixed (homogenous per hectare) versus variable agglomeration payments are compared. The two agglomeration payment schemes tested in this paper are defined as: P_F: fixed agri-environmental agglomeration payment, equal between L and H farmers regardless of the time-period (equal to 770), and P_V: agri-environmental agglomeration payment which matches the farmers' opportunity costs from switching land use, and can therefore vary. It is constant for H. For L, it evolves according to the number of time-periods used for vegetable farming: when L's farm profit decreases, the payment that he/she could receive in exchange of switching land use on rewetted peat soils decreases by the same proportion. $P^{f}_{n,t}$ is defined as the payment that farmer *f* receives at *t*, given a number *n* of previous time-periods under vegetable farming. It is defined as:

$$If\ f = H, P^{H}_{n+1,t+1} = P^{H}_{n,t} = 770 \text{ (payment constant over time);}$$

$$If\ f = L: \begin{cases} If\ n = 0, 1, 2, then\ P^{L}_{n,t} = P^{H}_{n,t} = 770, t = \{1, \dots, 10\} \\ If\ n = 3, then\ P^{L}_{n,t} = 520, t = \{4, \dots, 10\} \\ If\ n = 4, then\ P^{L}_{n,t} = 130, t = \{5, \dots, 10\} \\ If\ n = 5, 6, 7, 8, 9, then\ P^{L}_{n,t} = 10, t = \{6, \dots, 10\} \end{cases}$$

A2. Representation of players' characteristics across scenarios

Table: Players' characteristics per farmer's type across scenarios

Players' characteristics (on average)	Baseline		P_F		P_V	
Player type	**H**	**L**	**H**	**L**	**H**	**L**
Age	18.8 (2.5)	19.2 (1.4)	20.6 (5.0)	19.9 (2.8)	20.8 (3.7)	20.2 (3.1)
Feedback instructions 0=very clear, 3= very difficult	1.3 (0.8)	1.5 (1.5)	1.2 (0.8)	1.2 (0.7)	1.4 (0.8)	1.5 (0.9)
Farm at home and peat soils (in %)	30.8 2 have peat soils	30.8 2 have peat soils	68 11 have peat soils	70 10 have peat soils	56.8 9 have peat soils	63.6 10 have peat soils
Future plan to be a farmer	54%	79.5%	98%	97.7	97.7	
Level of players' knowledge about degradation of organic soils in CH; 0 = great deal, 3 = nothing	1.3(0.6)	1.2 (0.8)	1.1(0.8)	1.2 (0.5)	1.0 (0.8)	1.1 (0.5)
Opinion on peat soil degradation among the players who have knowledge about the issue; 1= not a problem at all, 4= a very serious problem	2.1 (0.6)	1.9 (0.9)	2.0 (0.8)	2.2 (0.6)	2.1 (0.6)	1.9 (0.9)
Index Altruism Max potential =80, min potential = 0	23.9 (11.08)	25.3 (16.2)	25.4 (13.4)	28.8 (12.4)	22.2 (11.8)	24.6 (12.7)
Index Care for the environment Max potential =44, min potential = 0	22.7 (6.2)	22.9 (7.0)	23.4 (7.1)	22.2 (6.6)	22.9 (6.2)	22.2 (6.2)
Financial risk 0 =avoid financial risk, 10 =willing to take financial risk	3.9 (2.3)	4.4 (2.5)	4.6 (2.1)	4.5 (2.7)	5.0 (2.8)	5.0 (2.2)
Risk 0 = avoid risk, 10=willing to take risk	5.9 (2.0)	6.3 (2.9)	6.6. (2.0)	6.3 (2.3)	7.1 (2.1)	6.8 (2.0)
Time preference (money amount) (outliers excluded)	1189 (1036) (4 outliers)	1146 (1135) (5 outliers)	948 (1074) (3 outliers)	775.7 (841) (1 outlier)	1196 (1372) (3 outliers)	778 (913) (3 outliers)
Impatience 0 = very impatient, 10 = very patient	5.1 (3.0)	4.2 (3.4)	5.06 (2.4)	5.0 (2.6)	5.5. (2.7)	4.8 (2.3)
Care for reputation 1= care a lot, 4 = don't care at all	1.3 (0.9)	1.1 (0.9)	1.34 (0.8)	1.2 (0.6)	1.4 (0.7)	1.4 (0.7)
Environmental scheme preferences Preference for collective participation as compared to individual participation	79.5**%	43.6**%	56.8 %	62.8%	70.4%	63.6%
Opinion towards cooperative approaches in Ag. management; 0=more successful than other approach, 3=not at all	0.95 (0.6)	0.9 (0.6)	0.9 (0.6)	1.1 (0.7)	1.0 (0.7)	1.1 (0.8)

Note: standard deviation); (**): significant difference between H and L farmers at 95% conf. level; Underlined: value significantly different between scenarios at 95% conf. level.

A3. Additional regressions

Table 11: proportional odds panel regression on a 3-factor ranked player's decision variable

	VARIABLES	(1) Full sample	(2) P_F and P_v	(3) Baseline	(4) P_F	(5) P_v
Experiment	Time	**1.140*** **	**1.105** **	**1.269*** **	1.097	**1.118** **
		(0.0395)	(0.0435)	(0.0991)	(0.0725)	(0.0580)
	Treatment	**43.96*** **	**0.202** **			
		(28.32)	(0.133)			
	H-farmer	0.306	0.106	0.882	0.270	0.170
		(0.380)	(0.192)	(1.498)	(0.790)	(0.364)
	Group membership	0.972***	1.000	0.965	0.969	1.024
		(0.00744)	(0.0138)	(0.0231)	(0.0212)	(0.0161)
Opinion and preference	Environment	0.988	1.002	0.919*	1.043	1.003
		(0.0257)	(0.0316)	(0.0428)	(0.0578)	(0.0353)
	Willingness to take risk	0.894	0.897	1.032	**0.687** **	0.966
		(0.0673)	(0.0954)	(0.132)	(0.104)	(0.141)
	Patience	1.037	1.064	0.990	1.107	1.018
		(0.0538)	(0.0803)	(0.0840)	(0.138)	(0.0753)
	Reputation	1.038	1.090	1.664	1.281	0.789
		(0.207)	(0.317)	(0.580)	(0.629)	(0.243)
	Level of knowledge peat degradation	1.106	0.953	0.720	1.085	1.212
		(0.251)	(0.256)	(0.239)	(0.746)	(0.421)
	Opinion cooperative approaches	0.692*	0.600*	1.487	**3.343*** **	1.229

		(1)	(2)	(3)	(4)	(5)
		(0.152)	(0.184)	(0.533)	(1.445)	(0.490)
	SVO angle	1.012	1.000	**1.038***	0.990	1.010
		(0.0116)	(0.0139)	(0.0232)	(0.0264)	(0.0171)
Farm characteristics	Peat presence	0.964	0.995	1.026	1.113	0.992
		(0.0400)	(0.00407)	(0.0673)	(0.0768)	(0.00487)
	Farm at home	1.142	1.203	1.568	1.364	0.842
		(0.280)	(0.325)	(0.774)	(0.614)	(0.327)
Interaction terms	Environment*H	1.028	1.015	1.093	0.998	0.993
		(0.0346)	(0.0425)	(0.0623)	(0.0614)	(0.0600)
	Willingness to take risk*H	1.128	1.188	0.929	**1.950*****	1.080
		(0.0915)	(0.131)	(0.149)	(0.401)	(0.122)
	Patience*H	0.978	0.976	1.007	1.039	1.151
		(0.0754)	(0.109)	(0.105)	(0.202)	(0.144)
	Reputation*H	0.793	0.793	0.764	0.579	1.576
		(0.211)	(0.289)	(0.326)	(0.346)	(0.557)
	Level of knowledge peat degradation*H	0.749	0.891	1.335	1.096	0.966
		(0.203)	(0.285)	(0.694)	(0.741)	(0.498)
	Opinion cooperative approaches *H	1.679	2.156*	0.920	**0.234****	0.674
		(0.590)	(0.880)	(0.589)	(0.134)	(0.324)
	SVO angle*H	0.990	1.008	0.936***	1.027	1.017
		(0.0152)	(0.0190)	(0.0239)	(0.0349)	(0.0241)
	Peat*H	1.024	**1.024****	0.454	**0.798****	1.028
		(0.0561)	(0.0108)	(0.267)	(0.0710)	(0.0221)
	Treatment*H	0.917	1.088			
		(0.204)	(0.217)			
Model	Observations	2,490	1,740	760	870	870
	Groups	251	175	76	87	87

Note: Odds ratios are reported. *** p<0.01, ** p<0.05, * p<0.1 In model 1 (full sample), the "treatment" variable takes the value 0 for the baseline and 1 in case of the presence of a payment scheme (P_F or P_v). In model 2 (P_F and P_v), the treatment variable take the value 0 for P_F and the value 1 for P_v. The standard errors are clustered at the group level.

A4. Social preference types

Table: Representation of social preference types in each scenario, in percentage

		Baseline (78 players)	P_F (88 players)	P_V (88 players)
Proself	Individualistic	39.7	31.8	38.6
Prosocial	Inequality averse	37.2	42.0	23.9
	Joint profit maximizer	6.4	6.8	3.4

Note: the rest of the players was either classified as inconsistent according to the rule of Murphy et al. (2011) or did not reveal any trend towards prosocial joint maximizers or inequality averse profiles. The representation of players' types does not vary significantly across treatment scenarios (proportion test at 95% confidence level).

SUPPLEMENTARY MATERIAL

1. Instructions – Baseline

Part 2 comprises **10 time-periods** of a decision situation.

You are randomly assigned to a group with one other participant. This participant can be any other participant present here today. Any interactions in this study are anonymous.

At the end of the experiment, one time-period will **randomly** be picked from this part and your earning in points from this round will be exchanged into francs (CHF) at a rate of **10 points = 0.25 CHF.**

Before starting Part 2, there will be a learning time-period during which your decisions will not be recorded and will therefore not determine your end payment.

Note that there are no right or wrong answers in your choices and actions; this is only a matter of preferences.

Background:

Peat soils (Torf / organic soils) consist of a first layer of peat and an underneath mineral soil layer (Figure 1). The peat is very good for vegetable production. The peat layer is very rich in organic matter (and thus in carbon) which accumulated in high water level conditions. Since a few decades, the water table (or groundwater) is artificially maintained at a low level by a drainage system in order to enable agricultural activities on peat soils. **Drainage leads to the reduction of the peat soil layer over time**, in particular, because of carbon emissions (Figure 2). The peat soil layer disappears at a rate of about 1cm/year. Once the peat soil layer will be gone, farmers will have to produce on the underneath mineral soil layer. Depending on the location, the quality of this underneath mineral soil layer **varies.**

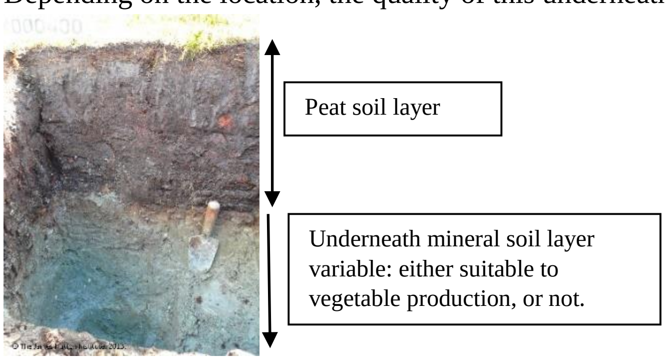

Figure 1: Peat soil profile

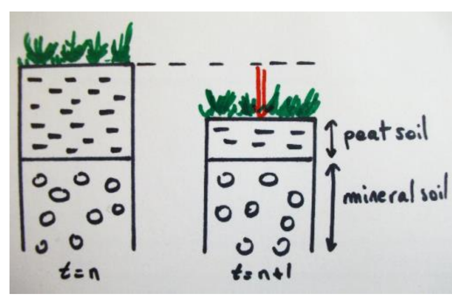

Figure 2: Evolvement of the peat soil profile over time

One of the most effective ways to avoid the loss of peat soils is to rewet them, so to stop the drainage. The drainage systems are regulated at a community level. Therefore stopping the drainage system needs to be decided unanimously. The water table will therefore only be increased if **all farmers** agree on it (**unanimous decision**).

Overview of the experiment:

You will take the **role of a farmer**: you and your group member are vegetable producers. The group you are assigned to will constitute of one **Yellow-farmer** and one **Blue-farmer**. You will be randomly selected to be one or the other and you will keep this profile in all time-periods, and in Part 3.

Yellow and Blue **differ in the type of the underneath mineral soil layer of their peat soils**.

- **Yellow-farmer** has an underneath mineral soil layer which is not suitable for vegetable production. In this case, the use of the peat soil for vegetable production and thus the loss of the peat soil layer will **negatively** affect his/her farm profit.
- **Blue-farmer** has an underneath mineral soil layer which is suitable for vegetable production. This means that regardless of the number of time-periods he/she uses his/her peat soils for vegetable production, the loss of the peat soil layer will not affect his/her farm profit, which will stay **constant**.

Each time-period follows the same pattern: You first need to decide whether to rewet the peat soils of your land or not to do so. They will only be rewetted **if both of you** vote for it.

- If at least one of you rejects to stop the drainage system and thus to increase the water table, you keep producing vegetables. You will be directed to next time-period where you will be asked the same question.
- If **both of you** vote for increasing the water table, peat soils of **both members** are rewetted. You and your group member need then to decide between two types of land use on these rewetted peat soils**:**
    - **A)** Adopting another land use (e.g. crops or livestock adapted to high water level conditions); your farm profit will then be lower than with vegetables or
    - **B)** Pursuing vegetable production by implementing a personal local drainage system on peat soils at a cost to you. You will then be directed to next time-period where you will be asked the same questions.

However, before these choices are made, **Yellow** may offer a binding amount to be transferred by **Yellow** to **Blue** if and only if **Blue** chooses **A. Blue** (at the same time) may offer a binding transfer-payment to be transferred by **Blue** to **Yellow** if and only if **Yellow** chooses **A**.

Note that transfer-payment offers have the effect of changing the total payoffs. Whatever amount you state will be transferred to the other farmer if he/she plays **A**; this money will be transferred regardless of your own choice of land use on rewetted peat soils.

Procedure:

The general procedure of one time-period and the effect of your actions on your profit **for the first time-period** are as follows:

1. Before making a choice in a time-period, you can discuss with your group member via a "chat box window". As you discuss, you can test how a transfer-payment offer to your group member would change your payoffs.

   During this discussion time, you are free to discuss the experiment or other matters (you have about **3 minutes** each time-period). As you exchange messages, please be civic and respectful to one another..

2. After the discussion, each of you can make an offer for a transfer-payment that you would pay to the other player in case he/she chooses option **A**. Whatever offer you make, it is binding. That is, the offered amount will be transferred from you to the other player automatically if the other player chooses option **A**.

3. Both members Yellow and Blue are asked to vote on increasing the water table for their group, or not. There are 2 possible outcomes:

- If at least one of you rejects to increase the water table, the water table is not increased and peat soils are not rewetted. Both members continue with vegetable farming on peat soils. Yellow-farmer's and Blue-farmer's farm profits <u>for this time-period</u> are respectively 800 and 800. No transfer-payments are made in this case because both of you automatically chose vegetable production.

		Blue Farmer
		Does not increase the water table: continues farming vegetables on the peat soils
Yellow Farmer	Does not increase the water table: continues farming vegetables on the peat soils	800 800

- If both of you vote for increasing the water table, peat soils of both members are rewetted. In that case, you need to choose between:
  - **A)** dealing with the high water table and establishing a different land use (your farm profit will then be **40**) and
  - **B)** installing a personal drainage system on your peat soils at your own cost (cost of **25**) and continue producing vegetables. <u>If no transfers are made</u>, the actions' payoffs are as below.

<u>Please note</u> that the yellow numbers represents what the Yellow Farmer gets and the blue numbers represents what the Blue farmer gets. These profits apply if the farmers have taken the corresponding actions, which are read on the left side of the box for the Yellow farmer and on the upper side for the Blue farmer. For instance, if both of you choose to rewet and then choose **A**, that means both of you earn 40. As another example, if both of you choose to rewet and then Yellow Farmer chooses **A** and Blue farmer chooses **B**, Yellow Farmer earns 40 and Blue farmer earns 775.

		Blue Farmer	
		Adopt another land use on rewetted peat soils (A)	Pursue vegetable production (B)
Yellow Farmer	Adopt another land use on rewetted peat soils (A)	40 40	40 800 – 25 = 775
	Pursue vegetable production (B)	800 – 25 = 775 40	800 – 25 = 775 800 – 25 = 775

After all have made their choices, your screen will display your choice and profit for this time-period, as well as the ones of your other group member. **The game then continues to next time-period**.

Evolvement of the farm-profits over the time-periods:

When farming vegetables, the peat soil layer is used and then **<u>irreversibly</u>** reduces.

- This does <u>not</u> affect the profit of Blue-farmer: regardless of the number of time-periods Blue-farmer produces vegetables, his/her farm profit remains **<u>constant</u>** for this activity (800 or 775 (800-25)).
- But peat soil degradation **<u>negatively</u>** affects the farm profit of Yellow-farmer. If Yellow-farmer produces vegetables for 3 time-periods (**successively or not**), at the 4th time-period he/she produces vegetables, Yellow-farmer's farm profit will **decrease** to **550**. If he/she produces vegetables for 1 time-period more, his/her farm profit will decrease to **160**. If he/she produces vegetables for 1 time-period more (i.e. at the 6th time-period that he/she produces vegetables during the experiment), his/her farm profit will then be equal to **0**. This is due to the unsuitability of Yellow-farmer's

underneath mineral soil layer for vegetable production. Concretely, the numbers circled below will decline:

		Blue-Farmer
		Does not increase the water table: continues farming vegetables on the peat soils
Yellow-Farmer	Does not increase the water table: continues farming vegetables on the peat soils	800 800

And if you both agree on increasing the water table, the Yellow-farmer's profits from installing a local drainage system (option **B**), circled below, will be affected too:

		Blue-Farmer	
		Adopt another land use on rewetted peat soils (A)	Installs a local drainage system on rewetted peat soils (B)
Yellow-Farmer	Adopt another land use on rewetted peat soils (A)	40 40	40 800 – 25 = 775
	Installs a local drainage system on rewetted peat soils (B)	800 – 25 = 775 40	800 – 25 = 775 800 – 25 = 775

More precisely, if Yellow-farmer produces vegetables on peat soils during 10 time-periods **successively**, his/her respective farm profit will vary as follows:

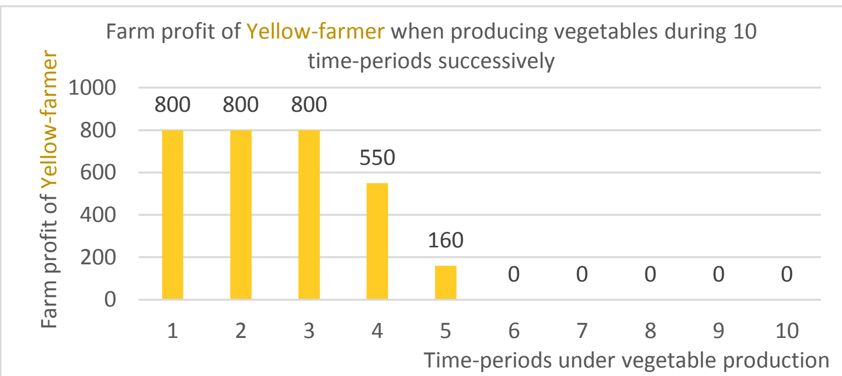

Figure 1

When installing a personal drainage system on the rewetted peat soils (Option **B**), the peat soil is used and thus degrades. Therefore the Yellow-farmer's farm profit will decrease accordingly (the amount indicated in Figure 1 minus the constant cost of 25). The Blue-farmer's farm profit will stay constant (equal to 775) because the use of the peat soil layer for vegetables does not affect Blue's farm profit.

Any time Yellow-farmer or Blue-farmer decide to increase the water table and adopt another land use (Option **A**), their profit will be equal to 40. For Blue-farmer, if he/she then starts farming vegetable again on his/her peat soil, his/her farm profit will then be 800 (or 775 (800-25)). For Yellow-farmer, if he/she then starts farming vegetable again on his/her peat soil, his/her farm profit will depend on the number of time-periods he/she has been farming vegetables previously. This includes the times where the water table was not increased, and the time where Yellow chose option **B**.

NOTE: **Rewetting the peat soils by stopping the drainage is a way to preserve the remaining peat layer; in no way, it allows to recover it. Therefore, it does not allow to recover Yellow's farm profit neither.**

Examples of transfer-payments:

Suppose for example, that Yellow offers to pay **10** to Blue if Blue plays **A**. Then the action's payoffs become (transfer-payments are put in bold in the table):

		Blue Farmer	
		Adopt another land use on rewetted peat soils (A)	Pursue vegetable production (B)
Yellow Farmer	Adopt another land use on rewetted peat soils (A)	40 – **10** = 30 40 + **10** = 50	40 800 – 25 = 775
	Pursue vegetable production (B)	800 – 25 - **10** = 765 40 + **10** = 50	800 – 25 = 775 800 – 25 = 775

As another example, suppose that Blue offers to pay **10** to Yellow if Yellow plays **A**. Then the action's payoffs become:

		Blue Farmer	
		Adopt another land use on rewetted peat soils (A)	Pursue vegetable production (B)
Yellow Farmer	Adopt another land use on rewetted peat soils (A)	40 + **10** = 50 40 – **10** = 30	40 + **10** = 50 800 – 25 – **10** = 765
	Pursue vegetable production (B)	800 – 25 = 775 40	800 – 25 = 775 800 – 25 = 775

Throughout the experiment, you will be able to consult the payoffs obtained in the previous time-periods.