Seasonal scarcity and environmental conservation: Investigating the impact of the hunger season on farmers' decision making in Madagascar

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Abstract: Conservation programs, such as payment for ecosystem service (PES) schemes, must be aligned with preferences of local actors to be successful. Recent research has shown that relative poverty or seasonal scarcity can affect behavioural preferences, which may impact people's willingness to continue to engage in conservation programs. This paper focuses on how seasonal scarcity affects decision-making in the context of a conservation programme used to encourage behaviour change amongst farmers in a rural in a developing country setting. Drawing on a choice experiment and a behavioural preferences module, we examine farmer's preferences to engage in a PES scheme and how it depends on risk and time preferences as well as on social and environmental preferences. By fielding the survey experiment both before and after harvest, and drawing on a sample of around 400 observations, we then study how seasonal scarcity affects preferences and the willingness to engage in a realistic but hypothetical PES scheme. We find that farmers in rural Madagascar are very willing to enrol in the PES scheme and that they risk preferences are significantly affected by shifts in relative scarcity. Other preference measures are stable pre- and post-harvest. Our results complement previous research on the effect of economic fluctuation on risk and time preferences in the context of poor and rural areas, and by integrating the study of scarcity's impact on social and environmental preferences. Our findings suggest that general PES support is not inhibited by seasonal scarcity fluctuations but that the design of PES schemes throughout the harvest cycle should be designed such as to accommodate variable risk preferences.

1.Introduction

The agricultural calendar in developing countries is characterised by important variations in farmers' resource availability and income streams, with periodic successions of shortage and abundance. This intra-annual variability is often experienced within a setting of high levels of poverty. Yet, Payment for Ecosystem Service (PES) schemes need to operate year-round and be attractive to "enough" farmers to achieve their environmental goals. The effects of seasonal variations in resources or income on up-take of PES schemes is thus an important, though often neglected, issue. This paper investigates how such seasonal variations affect the willingness of farmers in a low-income country to enrol in Payment for Ecosystem Service (PES) schemes, through mediating mechanisms of changing time, risk, social and environmental preferences. To this end, we conduct a choice experiment and a behavioural preferences module before and after harvest, collecting about 400 observations from farmers in rural Madagascar. We show that variations in incomes before and after harvest lead to changes in willingness to enrol in a PES scheme, as well as changes in preferences as elicited in our experiment.

We posit that farmers' willingness to participate in PES programmes will depend not just on the payment offered, but more fundamentally on their risk, time, social and environmental preferences. Moreover, we contend that these preferences may vary according to changes in relative poverty or income flows over the course of a year. Work by Dessart et al (2019), amongst others, highlights the wide range of economic and behavioural factors underlying farmers' willingness to adopt more sustainable land use practices. Time, risk, social and environmental preferences are key factors in economic decision-making, particularly among farmers in developing countries (Binswanger, 1980, Yesuf & Bluffstone, 2009, Galarza, 2009). Time preferences can affect a farmer's willingness to sign a PES contract if such a contract changes their expected income profile over time. Similarly, risk

preferences will matter for participation in PES programmes when participation changes the risk associated with future income streams (e.g. by guaranteeing a fixed reward from the PES contract in replacement of uncertain returns from cropping). Environmental preferences can make a difference when farmers care in a non-pecuniary manner about the environmental outcomes of participating in a PES scheme (Kuhfuss et al, 2022), whilst social preferences will be important if a PES scheme has implications for the incomes of a farmer's neighbours or wider social group (Riley et al, 2018).

Studies of time preferences in developing countries find a high level of impatience, which may prevent farmers from making long-term investments (Tanaka et al., 2010, Ashraf et al., 2006, Duflo et al., 2011). Risk aversion has been shown to restrict farmers' willingness to participate in risky but potentially profitable activities such as money lending (Boucher et al., 2008, Jacobson & Petrie, 2009). Risk-aversion has also been identified as a key feature preventing farmers from adopting new profitable technologies (Liu et al., 2008, Dercon & Christiaensen, 2011). Resource scarcity reduces trusting behaviour (Agneman et al., 2023), is positively related to antisocial behaviour (Prediger et al., 2014) and leads to weaker enforcement of sharing (Bartoš 2021). Overall, then, it seems important to assess (i) how changes in income flows over a year are related to poor farmers' risk, time, social and environmental preferences and (ii) how these preferences impact their willingness to participate in a PES scheme which offers payments for changes in farm practices aimed at generating local environmental improvement.

Poverty is often paired with poor decision making. A vast amount of research has provided evidence from both developed and developing countries that poverty leads sometimes to apparently counterproductive behaviour. For example, the poor tend to spend large amounts of money in lotteries (Haisley et al., 2008), their uptake rate of free preventive health care is low (Bertrand et al., 2004) and they frequently borrow at high interest rates (Dobbie & Paige, 2003). What appears to be more present biased decisions and lower self-

control has the potential in turn to feed the vicious cycle of poverty. Indeed, recent evidence further suggests that the psychological impact of being poor exacerbates the poverty trap. Poor people are exposed to stress that negatively affects the way they make decisions, decreases their level of self-control, and prevents them from making long-term plans (Haushofer & Fehr, 2014). Concurrently, poverty is also associated to higher vulnerability, making every decision more impactful on poor's people life and inflicting on them a heavier cognitive burden (Mullainathan & Shafir, 2013).

The link between poverty, impatience and risk aversion has been established in many empirical papers, although, to the best of our knowledge, impacts on social and environmental preferences remain unresearched. Tanaka, Camerer and Nguyen (2010) found that Vietnamese people have higher discount rates than is usually observed in higher income countries. Similar results have been found in the Philippines (Ashraf at., 2006) and Uganda (Clot & Stanton, 2014). Yesuf & Bluffstone (2008) highlighted that discount rates are negatively correlated to wealth among a sample of Ethiopan farmers (measured by land size, capital stock and herd size). When it comes to risk preferences, the relationship is less straightforward and seems to depend largely on the type of risk involved. For example, low-income students appeared to be less risk seeking than students with higher income (Eckel et al 2012). Other authors find that people with fewer resources are more likely to engage in risky behaviour so that they can better meet their needs (Callan et al., 2011; Mishra et al., 2014; Mishra & Novakowski, 2016; Carvalho et al., 2016). Haushofer & Fehr (2014) posit that poverty leads to greater risk aversion since poor people are more liquidity constrained.

In parallel to the effects of absolute poverty, other research demonstrates the effect of relative poverty (i.e. unbalanced cash flows) on risk and time preferences. When seasonal variations impact individual financial resource flows, income fluctuation occurs, and individuals fall alternately into states of relative poverty and relative wealth. In a lab experiment, Haushofer, Schunk and Fehr (2013) found that a reduction in income increases

Swiss students' discount rates compared to a control group. Integrating hyperbolic discounting, a natural field experiment involving US citizens shows that people have more present-biased choices before pay day than after (Carvalho et al., 2016). Di Falco, Veronesi and Yesuf (2011) found that an income loss due to drought in Ethiopia had a significant negative impact on farmers' discount rates, whilst Shujing, Dajun and Yuejun (2021) found famers to be more risk seeking when they find themselves in a situation of resource scarcity.

In this paper, we complement this existing body of research using the context of the predicted uptake of a PES programme in a poor, rural area of Madagascar. Our contributions are to (i) relate changes in seasonal income flows—before and after harvest—to risk and time preferences and to the likely uptake of a PES programme and (ii) to integrate the estimation of these risk and time preferences with estimates of social and environmental preferences, again in the context of PES participation. Shedding light on a broader site of preference and behavioural factors underpinning PES participation is important as millions of small farmers globally are subject to the kinds of income fluctuation we focus on, and since these are often the same kinds of farmers that are targeted as the desired participants in PES programmes. A better understanding of how changes in relative poverty affects time, risk, social and environmental preferences in the context of farmers' willingness to participate in PES schemes may help to better craft successful schemes.

The remainder of this paper is structured as follows. In Section 2, we introduce the local context, while Section 3 introduces our methodological approach and our data. Section 4 reports results while Section 5 concludes.

2. Context

2.1. General context

In many poor rural areas of the world, the "hunger season" is a significant within-year income fluctuation, largely occurring where farmers depend on a single harvest. This hunger season has been shown to substantially alter farmer behaviour, since many lack sufficient access to credit markets to smooth their incomes across time (Le Cotty et al, 2019). As in previous experimental studies (e.g., Spears 2011; Mani et al. 2013), the variation in resources that we use to investigate the effect of relative poverty (and relative wealth) is both temporary and anticipated, although some aspects (such as its length and size) depend on climate conditions and harvest quality, which may vary from year to year. Thus, farmers can expect a hungry season to occur, but are unsure as to its length and magnitude.

We conduct a field study to examine differences in preferences and intended participation in a PES scheme in two extreme conditions: before and after harvest. Individual rice producers in Madagascar have incomes largely based on their harvest, which happens only once a year. The end of the cycle immediately prior to this year's harvest (their hunger season) is a particularly difficult period for many rural households, during which the number of daily meals is often reduced from three to two. This further worsens school failure as children no longer have sufficient caloric intake, associated with an increase in the spread of disease (Belachew et al., 2011; Stoudmann et al., 2019). In contrast, the post-harvest period is characterised by increased expenses relating to various celebrations (traditional festivals, weddings, circumcisions, exhumations…) (Fraslin, 2003).

The last few years have seen a growing interest amongst researchers in studying farmers' preferences towards PES programmes in developing countries (Snilsveit, 2019). At the same time, obtaining field data raises a number of significant challenges in such settings. The standard method for eliciting time preferences - based on multiple price lists - has been criticized because it forces subjects to choose extreme budget allocations, which

may partly explain why these methods yield high estimated individual discount rates (Frederick et al., 2002). For risk preference elicitation, the method based on certainty equivalents has some well-known limitations, such as the propagation of errors. Depending on the nature of the subject pool it is sometimes preferable to rely on a single lottery choice task as proposed by Binswanger (1980) and Eckel & Grossman (2008). More generally, those methods developed in the lab with students as subjects face strong limitations in the field. They are often time-consuming and require a high level of education on the part of respondents.

To overcome these problems, our experimental method develops a single protocol to capture time, risk, social and environmental preferences simultaneously through a stated preference choice experiment (Hanley and Czajkowski, 2019). This contextualised protocol enables the estimation of the relative weights of time, risk, social and environmental preferences in individual choices over participation in a hypothetical but realistic local PES scheme. This choice experiment (CE) is complemented by in-depth survey questions on time, risk and social individual preferences, from the Global Preference Survey (Falk et al., 2022), an experimentally validated module to assess risk, time and social preferences. Finally, we use the New Environmental Paradigm scale as an alternative measure of environmental preferences (Dunlap, 2008). Thus, our protocol allows us to estimate time, risk, social and environmental preferences simultaneously within a context-specific choice experiment, but also allows alternative, more widely-used measurements of each of these 4 preference parameters as a cross-check. We undertake this estimation in 2 samples: one collected during the hunger season, and one after harvest.

2.2. Case study location

The study takes place in 8 villages surrounding Lake Alaotra, Madagascar. The Alaotra-Mangoro region is located in central-Eastern Madagascar, with a total surface area of 33,054

km2, including 350,000 hectares of protected areas. It comprises 5 districts, 3 of which cover the Lac Alaotra basin. Lake Alaotra is the biggest lake of Madagascar, with a surface area of 20,000 ha and an average depth of 2-4 m and is surrounded by 23,000 ha of vegetation dominated by Cyperus madagascariensis and Phragmites communis papyrus. Three critically endangered species are endemic to the Alaotra-Mangoro region: the Alaotra lemur Hapalemur griseus alaotrensis, with a decline rate of 30% (Mutschler et al., 2001), Tachybaptus rufolavatus, which is in danger of extinction, and the Madagascar scaup Aythya innotata. (Wilmé, 1994), The protected area is managed by the Durell Wildlife Conservation Trust since 1996 and the local communities, with the main objective to reduce illegal marsh clearance and restore habitat. Main activities have included planting programme in which 43.3 hectares of marshland, the removal of invasive plants from degraded marshland and educational training to local people. The basin is classified as a RAMSAR site, because of its significant natural resources that are the focus of particular attention.

The development of PES in Madagascar (generally carbon and watershed) benefitted from the decentralisation of natural resources management as well as the strategic position of International NGOs firmly established in Madagascar. Decentralization programs led by the national government and international organizations have been effective in granting increasing autonomy to local institutions in rural areas since the 1990s. Local associations of villagers called 'VOI' (Vondron' Olona Ifototra) have received the responsibility for their communal land with the objective of promoting sustainable land management (Clot et al. 2015).

Direct payments for biodiversity conservation appeared through a program developed by Durrell in 2001, which lasted for 10 years, in four of the NGO's intervention sites in Madagascar, including Lac Alaotra. This initiative is viewed by the World bank and International NGOs as the first Malagasy direct payments for biodiversity conservation.

Payments to communities in this scheme are contingent on both the state of the ecosystem (assessed by the number and affluence of certain species) and on actions that impact the ecosystem (local governance indicators), based on an annual forest transect and governance assessment. Payments are subsequently made to each community based on performance relative to the other communities in the region and the size of each community's forest (Sommerville et al, 2010).

The Alaotra Mangoro area is characterised by rice monoculture farming, and hosts most of Madagascar's rice production, which represents a surface of 120,000 ha (Andrianandrasana et al. 2002). Farmers in the area are therefore highly reliant on the rice harvest. The main rice variety grown in the area is *makalioka* and is harvested between March and June, subject to weather conditions. The lake's wetlands are slowly disappearing due to human activities, partly because of erosion due to cultivation on the mountains' slopes surrounding the lake, but also due to the practice of wetland clearing (bamboo, papyrus and reed cutting) by farmers. This on-going degradation activity threatens the ecosystem by depriving the endemic bamboo lemur of its habitat, as well as leading to a drying out of the wetland. The level of the lake's water is decreasing, threatening the cultivation of rice on the long run.

Durell identifies that a lack of resources during the hunger season were the main drivers of marsh clearance and thus have been working on solutions, which include identifying and planting species to benefit local people lives such as giant bamboo (for building and making fish traps), acacia (fuelwood) and Ravintsara for medicinal properties. They also work on transforming invasive plants (water hyacinth and Salvinia) into organic fertiliser.

Our Choice Experiment (CE) is implemented with the support of Durell and offers hypothetical payments to farmers around the lake who agree to avoid taking actions to further damage the wetland ecosystem. Through our study we test whether voluntary

measures, in the form of PES schemes, could be more accepted by local farmers to prevent marshland clearance.

3. Methods and data

Two groups of rice cultivating farmers from the surroundings of Lake Alaotra were surveyed, one before harvest and the second after harvest, following a between subject design. Enumerators collected data face-to-face with farmers which had been selected from a list provided by village leaders. Respondents from the post-harvest group were selected for having similar characteristics as the pre-harvest group, primarily in terms of the village location, while not having participated to the pre-harvest survey. The alternative strategy, a within subject design (i.e. pre/post sample matching), would have been logistically challenging, as the study site covers areas were cultivated lands and farmers' home are far apart, or accessible only by canoe. Enumerators would not have been able to locate a specific farmer without major disturbance, both for the farmers and for themselves. While not being able to control for within-individual effects, the between-subjects design does not exhibit 'carry over effects' (i.e. practice effect, fatigue effect) or any biases in answers caused by the fact of repeating twice the same questionnaire to the same person (Baltussen et al, 2012). Participants received 10,000 Ariary in exchange of their participation, the equivalent of a day wage.

3.1.   The choice experiment

We used a CE to simulate farmers' participation in a hypothetical but realistic PES policy, designed to reduce environmental pressures, which might be introduced around the lake. This would offer payments to farmers who agree to participate by changing their management of the lake ecosystem (agreeing not to cut reedbeds), thereby improving reedbed ecosystem quality. Since such a scheme does not exist at present, stated preference methods were a preferred alternative to revealed preference approaches. The selection of attributes used describe the alternative PES scheme contracts proposed to farmers was motivated by the objective to encompass all four types of preferences which we have argued above might be relevant for predicting participation in a PES, and which might be expected to vary seasonally, within or outside the hunger season: time, risk,

social and environmental preferences. The full list of attributes and the type of preference they represent is shown in Table 1 and a sample of choice card is available in Appendix I.

The first PES contract attribute is the variation in when the annual PES payment would be made to farmers who agree to enrol in the PES scheme, reflecting farmers' time preference. The timing of payments varied from immediately, 3 months-time after signing the contract, 6 months-time after and 12 months-time after signing the contract. The timing selected when signing the contract would remain the same after each yearly contracts' renewal. If a farmer selects the option '3 months-time from signing the contract' at the time of the first CE (March), this means that each year, payments will be made to farmers in June.

Risk preferences are expected to be reflected in preferences for the second contract attribute: the fraction of the PES payment which participating farmers received which would be dependent on an uncertain environmental outcome (improvement of Lake Alaotra's water level). This outcome depends not just on an individual's decision to commit to the programme, but also on the unknown behaviour of other farmers. If most farmers stop cultivating on the lake's shore, the water level should rise. However, the water level also depends on weather conditions, which also results in a high degree of uncertainty. Selecting the 1/3 result-based option would mean that 2/3 of the payment would be made conditioned on compliance with the required reedbed conservation actions, while the other third, result based, would rely on the completion of the objective, that is the increase in water level. Higher fractions of contract payment tied to the environmental outcome (lake water level increases) are thus riskier choices for the farmer.

Social preferences are expected to be reflected in preferences for an attribute showing how much of the total payment offered would be made to farmers as a collective rather than to individual participants. The option "2/3 for collective payment" means that one third of the payment is made to the individual while the remaining two third is made to the farmer's VOI.

Finally, environmental preferences are reflected through preferences for an attribute representing an improved final environmental condition around the lake in terms of area of reedbeds replanted by an NGO, ranging from zero to 30%. The option 20% implies that 20% of lake shores will be restored by replanting reeds. We assume that farmers with stronger environmental preferences will prefer a higher area of reedbed conserved than a lower area.

A focus group with 5 farmers from Alaotra Mangoro enabled us to confirm the attribute selection and the eligibility of the behavioural preference module. The survey was tested beforehand in a pilot (N=20) and prior values of preferences were used to generate a d-efficient Bayesian design in NGene for the final survey's choice experiment. The final design contained 4 blocks of 6 choice cards each.

Table 1: Attributes and their levels, used to describe the alternative PES programmes in the choice experiment

Attributes	Definition	Levels	Preference domain
First payment	Date of first payment	Now, in 3 months-time, in 6 months-time, in 12 months-time (continuous)	Time preferences
Result-based share (%)	Share of the payment that is conditioned on achieving environmental results, which depends on other farmer's adherence to the programme and weather conditions	0, 33, 66 and 100 % (continuous)	Risk preferences
Collective payment (%)	Share of the total payment that is paid to the farmers group, the rest being paid to the individual farmer	0, 33, 66 and 100% (continuous)	Social preferences
Additional environmental improvement	Share of reeds that will be restored on the lake by the local NGO if the PES programme is implemented	0, 10%, 20%, 30% (continuous)	Environmental preferences
Payment	Total payment associated with participation in the programme, in MGA[1]	100,000; 120,000; 140,000; 160,000; 180,000; 200,000. (continuous)	

The choice data was analysed using a standard mixed logit modelling approach (Train, 2009), using 1,000 Sobol draws (Czajkowski and Budinski 2019). The database preparation was undertaken using Stata 15, while all choice modelling was done using the Apollo package in R (Hess and Palma, 2019, 2022).

3.2.   The behavioural preferences module

The behavioural preferences module (see Appendix II) was added as a cross-check on the CE results for risk, time, social and environmental preferences. To this end, we draw on the Global Preference Survey (Falk et al., 2022), which was developed to offer a reliable, simple, time efficient and cost-effective tool to measure individual time, risk and social preferences. The questions

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[1] Daily wage in rural area is around 10,000MGA.

selected are those which offered the best predictors of preferences observed in incentivised choice experiments. Time preferences were measured through a sequence of five interdependent hypothetical binary choices between immediate and delayed financial rewards (the staircase method), and qualitative measures of patience given by respondents' self-assessment on their willingness to wait on an 11-point Likert scale. While the former measures patience in a purely financial sense, the latter is more encompassing and refers to patience in a more general way.

Risk preferences were elicited using similar procedure, based on a series of five binary choices between a fixed lottery in which one could win an amount 'x' or zero, versus a sure payment 'y'. A qualitative item additionally asks for the respondent 's self-assessment of their willingness to take risks on an 11-point Likert scale. Similarly to the time preference measurement, the first measure relates to economic risk while the second asks about more general attitudes towards risky behaviour.

Altruism was measured through a qualitative question asking participant's willingness to give to good cause without expecting anything in return on an 11-point scale. They were also asked a quantitative question in which participants unexpectedly receive 100,000 Ariary and are asked to state how much of this amount they would donate. Additionally, we implemented the Prosocial Behavioral Intentions Scale (Baumsteiger & Siegel, 2019), a 4-item self-report survey which lists prosocial behaviours and asked respondents how likely they are to undertake such behaviours (e.g., helping to care for a sick relative).

Finally, for environmental preferences, we used the revised New Ecological Paradigm (NEP) scale (Dunlap, 2020), a survey-based instrument designed to measure individual pro environmental concerns and views via 15 statements against which respondents are asked to indicate the strength of their agreement or disagreement with each.

3.3.   Data

We collected 400 individual observations in total among 9 villages surrounding Lake Alaotra (Table 2). 200 observations were collected before harvest (in March) and the other 200 after harvest (in August) in the year 2022. In this year, the harvest started slightly later than usual (about 2 months after) in April-May due to climatic pattern, with a peak in July. About 80 percent of participants in our

sample had no stock left in February. We drop 9 participants as they do not grow rice, leaving 391 observations balanced as in Table 2 in between the 2 periods and 9 villages. We also check sample characteristics across the two periods (Table 3). Balancing checks report no major differences in between the two samples except for gender, with women being less represented in the pre-harvest sample. We looked for gender effects in the behavioural preferences module (see Appendix V) and find no significant differences with the exception for one item in social preferences, which we discuss in the respective part. To ensure that the gender imbalance does not affect our results, we conduct a robustness check in section 4.3.

Table 2 - Sample distribution amongst villages before and after harvest

	Before	After	Total
AMBATOMAINTY	16	19	35
AMBATOSORATRA	23	24	47
AMBOHIDAVA	20	20	40
AMPARIHIMPONY	22	23	45
ANDRANOMENA	22	21	43
ANDREBA GARE	30	33	63
ANGOJA	15	15	30
LOHAFASIKA	22	22	44
VOHIDRAZANA	22	22	44
	192	199	391

Table 3 - Sample balancing checks Before and After harvest with statistical difference (Student t-test)

	Pre-harvest			Post-harvest			Difference
	n	Mean	St. Dev.	n	Mean	St. Dev	p-value
Gender (0 if female, 1 if male)	191	0.623	0.035	199	0.508	0.036	0.022
Household size	192	4.776	1.905	199	4.809	1.818	0.861
Share of small producers (harvest < 1000 kg)	192	0.495	0.501	199	0.417	0.494	0.124

To estimate farmers' preferences for the alternative PES scheme designs, reflecting their behavioural preferences, we estimated 3 mixed models (MXL 1, 2 and 3, Table 4). Note that 3 individuals failed to fill in the choice experiment part of the post-harvest survey, so MXL1 and MXL2 results rely on the 388 remaining observations. MXL1 includes an Alternative Specific Constant

(ASC), accounting for farmers' preferences for moving out of the status quo, irrespective of the PES scheme characteristics described by the attributes, and includes all available choices in the dataset. However, the option not to participate was only chosen 88 times out of the 2328 choices made by the 388 farmers, 4 times before harvest and 84 times after harvest, leading to difficulties in reliably estimating this constant (ASC). Therefore, to check the robustness of our results despite this low rate of opt out, we test two alternatives specification: one without Alternative Specific Constant (ASC) in the model with all respondents still included (MXL 2), and one without the ASC and excluding the 88 opt out choices from the analysis, allowing to check how these influence the results we obtained (MXL 3). 2 respondents consistently chose to opt out in all their choices so MXL3 relies on 386 observations.

4. Results

We start by analysing farmers' overall preferences for PES scheme designs and how these relate to their risk, time, environmental and social preferences (see section 4.1 below). We then turn to analyse the seasonality of such preferences, in subsection 4.2. In all models, the attributes were interacted with a variable that identifies the Post-Harvest choice experiment (`post'). This allows us to disentangle whether preferences differ before and after harvest. Finally, we test the robustness of our results, in light of the gender imbalance in the pre and post-harvest samples (section 4.3).

4.1.   Farmers' preferences and conservation behaviour

We first see that farmers have a strong preference for participation in the PES scheme rather than continuing in their current situation. This is reflected in the positive and significant coefficient associated with the Alternative Specific Constant (ASC) in MXL1 (Table 4).

We find no effect of the timing of the first payment when a constant is included in the models (MXL1), but a positive effect otherwise (MXL2 and MXL3), suggesting that farmers prefer to receive payments later rather than sooner. Farmers prefer schemes with a lower share of the payment conditioned on achievement of environmental results (`output'), displaying risk aversion. Farmers seem to prefer schemes that provide payments to individuals rather than the group of farmers.

Farmers display positive and significant preferences for schemes associated with more wetland restoration holding everything else constant, therefore displaying positive environmental preferences. Finally, the payment attribute has a positive and significant effect on farmers' choices (the higher the payment offered, the more farmers will participate).

	MXL 1		MXL 2		MXL 3	
	Estimate	Rob.std. err.	Estimate	Rob.std. err.	Estimate	Rob.std. err.
Mean						
asc	6.385 ***	1.008				
asc_post	-0.880	1.157				
First	0.006	0.014	0.074 ***	0.015	0.078 ***	0.016
First_post	0.012	0.021	0.008	0.024	0.020	0.026
Output	-0.006 ***	0.001	-0.008 ***	0.002	-0.008 ***	0.002
Output_post	0.006 ***	0.002	0.007 ***	0.002	0.008 ***	0.003
Collective	-0.008 ***	0.002	-0.007 ***	0.002	-0.007 ***	0.002
Collective_post	0.001	0.002	-0.002	0.003	0.002	0.003
Enviro	0.065 ***	0.010	0.100 ***	0.014	0.105 ***	0.014
Enviro_post	0.023	0.016	0.029	0.025	0.041	0.028
Payment	0.004 **	0.001	0.017 ***	0.001	0.018 ***	0.001
Payment_post	-0.004	0.002	-0.006 ***	0.002	-0.002	0.002
St. Dev.						
asc	-1.953 ***	0.387				
asc_post	3.849 ***	0.563				
First	0.055 *	0.024	-0.081 ***	0.029	0.097 ***	0.026
First_post	-0.019	0.036	-0.100 **	0.045	-0.113 ***	0.040
Output	-0.009 ***	0.002	0.012 ***	0.002	0.012 ***	0.003
Output_post	0.002	0.002	-0.008	0.005	-0.005	0.013
Collective	0.011 ***	0.002	-0.013 ***	0.003	0.014 ***	0.002
Collective_post	0.008 **	0.003	-0.019 ***	0.004	-0.004	0.005
Enviro	0.081 ***	0.010	0.098 ***	0.016	-0.101 ***	0.016
Enviro_post	0.098 ***	0.017	-0.159 ***	0.032	0.136 ***	0.045
N (individuals)	388		388		386	
Nb of choices	2328		2328		2240	
LL :	-1543.04		-1653.34		-1477.17	
AIC:	3130.08		3342.67		2990.34	
BIC:	3256.64		3446.22		3093.2	

*Note: *** for p-value < 0.01, ** for p-value < 0.05, * for p-value < 0.10*

Table 4 - results from the mixed logit models estimations[2]

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[2] All models were estimated using the Apollo software in R, created by Hess and Palma (2019).

To the question 'how difficult was it to make a decision', farmers have found it similarly difficult before (3.1, SE=0.12) and after (2.795, SE=0.12) harvest (z=1.479, p=0.13). We also asked them in the post CE survey if they ignored any attributes. The timing of the payment and the amount of the payment were the two least-ignored items before harvest. Farmers were more likely to ignore the timing of payment after harvest than before (26.5% vs 5%; z=-5.895, p=0.000) and the same goes with the value of payment (19% vs 8.5%; z=-3.045, p<1%). Also, they were more likely to ignore the individual vs collective aspect of the payment before than after harvest (29.5% vs 11%; z=4.598, p=0.000) as well as for the action vs result based attribute (28.5% vs 18%; z=2.483, p<0.01%). In sum, decisions seem more likely to focus on primary aspects of the programme such as amount and timing of payment before harvest, while the focus shifts to what we could call secondary aspects of the programme such as the collective dimension or the result-based calculation after harvest.

4.2.   Seasonal variation of farmers' preferences

The choice experiment's results show that the only PES design preference that varies between the pre-harvest (hunger) and the post-harvest season, i.e. with relative scarcity, is their preference for the share of payment conditioned on uncertain outcomes (Table 4). We find no difference before or after harvest for preferences regarding the timing of the first payment, the share of payment being made to the collective, or the environmental restoration included in the scheme (Table 4). Interestingly, results from the behavioural module display a similar pattern: while the change in risk preferences is clear, results from the other part of the behavioural module are less conclusive (and are discussed in appendix IV).

Indeed, in the choice data, farmers' preference for schemes with a lower share of the payment conditioned on achievement of environmental results (`output') changes after harvest as farmers tend to have more positive preferences for result-based payments after harvest (`ouput_post') (Table 4). This would indicate that, while being globally risk averse, farmers are more willing to accept risk after harvest. This result is supported by farmers' risk preferences elicited in the behavioural module. We find strong evidence for a change in risk preference before and after harvest (Table 5). Farmers are taking significantly more risk after harvest compared to the pre harvest

context. The 32-points staircase measure indicates a +4 points rise (p=0.000) in between the two periods. Similarly, the 10 points self-assessment measure shows a +0.9 points increase (p=0.000). This aligns to predictions according to which conditions of relative plenty would make people more confident to take risks, whilst temporary resource scarcity leads people to adopt more cautious behaviour. We find a very strong correlation (0.870, Spearman correlation test, p=0.000) between the two measures of risks, strengthening the robustness of our findings as well as the reliability of the two survey tools to assess risk preferences. When comparing to the GPS and other regional averages, surprisingly, farmers from Madagascar seem to be more risk averse than their counterparts from Sub-Saharan Africa, scoring 0.34 on the Risk-taking index, and seem closer to European (ranging from -0.11 to 0.15) or South and East Asian respondents (-0.10).

Table 5 - Average Risk Preferences before and after harvest (behavioural preferences module)

	Pre-Harvest		Post-Harvest		Mann-Whitney test	
	Mean	S.E.	Mean	S.E.	z	Prob>z
Risk (staircase measure, 1-32[3]), n=383[4]	11.08	0.86	14.97	0.86	-4.373	0.0000
Self-assessment (Likert scale, 1-10), n=391	4.06	0.25	4.97	0.24	-3.201	0.0014
Risk index (GPS), n=383	-0.1566	0.067	0.1466	0.067	-4.252	0.0000

4.3.   Robustness checks: correcting for gender imbalance

To account for the imbalance in gender representation in the before and after-harvest groups, we run the whole analysis by gender. The results of the models are presented in the two tables of Appendix VI. We see that our results on farmers' preferences for scheme designs before and after harvest hold, both for men and women. However, the increase in risk taking attitudes, and related increase acceptance of a larger share of the payment being conditioned on environmental results being achieved, is less strong (and become unsignificant in MXL1_female and MXL2_female) for female farmers than for male farmers. Since female farmers are under-represented pre-harvest

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[3] 1=extremely risk averse ; 32=extremely risk seeker
[4] 8 respondents failed to complete the risk preference staircase module

compared to post-harvest, we are likely underestimating the effect of relative poverty on risk-related characteristics of PES characteristics, compared to a gender-balanced sample.

In addition, we check that our results hold when the ratio of males and females in the pre-harvest and the post-harvest samples is kept constant. For this, we use a bootstrapping approach. We first bootstrap MXL3 with 100 iterations, randomly selecting, with replacement, 76 of the 118 male respondents of the pre-harvest survey in each iteration, thereby constraining the proportion of males in the pre-harvest sample (51.35%) to be as close as possible to that of the post-harvest sample (51.28%). The results are presented under "Bootstrap 1" in Table 7. We then run a second bootstrap, running 100 iterations of MXL3, randomly selecting, with replacement, 61 of the 95 female respondents of the post-harvest survey in each iteration, thereby constraining the proportion of males in the pre-harvest sample (61.10%) to be as close as possible to that of the post-harvest sample (62.11%). The results are shown as "Bootstrap 2" in Table 7.

Table 7: Results from bootstrap, mean and Standard Deviation of parameters across runs (100 iterations)

	Bootstrap 1 (i=100)		Bootstrap 2 (i=100)	
	Mean across runs	St. Deviation (across bootstrap runs)	Mean across runs	St. Deviation (across bootstrap runs)
Mean				
First	0.074	0.008	0.078	0.001
First_post	0.023	0.009	0.015	0.009
Output	- 0.008	0.001	- 0.008	0.000
Output_post	0.008	0.001	0.009	0.001
Collective	- 0.008	0.001	- 0.008	0.000
Collective_post	0.003	0.001	0.002	0.001
Enviro	0.103	0.007	0.105	0.002
Enviro_post	0.040	0.007	0.043	0.009
Payment	0.018	0.001	0.018	0.000
Payment_post	- 0.002	0.001	- 0.002	0.001
St. Dev.				
First	- 0.040	0.077	- 0.035	0.090
First_post	0.047	0.112	0.010	0.126
Output	0.002	0.011	- 0.005	0.012
Output_post	0.001	0.005	- 0.001	0.005
Collective	- 0.001	0.013	- 0.001	0.011
Collective_post	- 0.001	0.007	- 0.002	0.008
Enviro	0.077	0.065	0.071	0.073
Enviro_post	0.099	0.094	0.017	0.139
Mean LL	*-1309.02*		*-1350.62*	

Table shows that, when restoring the balance in the number of male and female respondents in the sample, the same results as described in sections 4.1 and 4.2 hold, as the mean of the parameters estimated through the two bootstraps do not differ from Mean parameters estimated in MXL3 in Table *4.*

5. Conclusion

This paper has examined how seasonal scarcity affects decision-making in the context of a realistic but hypothetical PES scheme used to encourage behaviour change amongst farmers in a rural in a developing country setting. Drawing on a choice experiment and a behavioural preferences module carried out before and after harvest in a sample of around 400 rural farmers in Madagascar, we have

examined farmer's preferences to engage in a PES scheme and how it depends on risk and time preferences as well as on social and environmental preferences. We then studied how seasonal scarcity affects preferences and the willingness to engage in the PES scheme. We thereby contribute to the literature on poverty and decision-making (e.g., Spears 2011; Mullainathan & Shafir 2013; Haushofer & Fehr 2014). In contrast to channels suggesting resource scarcity may impede cognitive function, our focus is on changes in the economic situation, examining how preferences change when shifting from relatively poorer to relatively richer. We find that farmers in rural Madagascar are very willing to enrol in the PES scheme and that they risk preferences are significantly affected by shifts in relative scarcity. Crucially, we find no effects of seasonal scarcity on the other three preference measures. Overall, our findings thus suggest that the generally high PES support is not inhibited by seasonal scarcity fluctuations. However, the design of PES schemes throughout the harvest cycle should be designed such as to accommodate variable risk preferences. This is particularly relevant when considering whether to set up PES schemes as performance or action-based schemes (e.g. Derissen and Quaas 2013) and suggests that schemes might feature mixed incentive structures that are relatively more focussed on inputs during times of seasonal scarcity.

References

Agneman, G., Falco, P., Joel, E., Selejio, O. (2023). The Material basis of Cooperation: how Scarcity Reduces Trusting Behaviour. *The Economic Journal*, 133 (652): 1265–1285, https://doi.org/10.1093/ej/ueac087

Ashraf, N., Karlan, D., Yin, W., (2006). Tying Odysseus to the mast: Evidence from a commitment savings product in the Philippines. *The Quaterly Journal of Economics*, 121(2): 635-672.

Bartoš, V. (2021)/ Seasonal scarcity and sharing norms. Journal of Economic Behavior & Organization, 185: 303-316, https://doi.org/10.1016/j.jebo.2021.02.019.

Baltussen, G., Post, G.T., Van den Assem, M.J. (2012). Random incentive systems in a dynamic choice experiment. Experimental Economics. 15: 418–443. https://doi.org/10.1007/s10683-011-9306-4

Baumsteiger, R., Siegel, J.T., (2019). Measuring Prosociality: The Development of a Prosocial Behavioral Intentions Scale, Journal of Personality Assessment, 101:3, 305-314, DOI:10.1080/00223891.2017.1411918.

Belachew T, Hadley C, Lindstrom D, Gebremariam A, Lachat C, Kolsteren P. (2011). Food insecurity, school absenteeism and educational attainment of adolescents in Jimma Zone Southwest Ethiopia: a longitudinal study. Nutrition Journal. (10);10:29. doi: 10.1186/1475-2891-10-29. PMID: 21477343; PMCID: PMC3090325.

Bertrand, M., Mullainathan, S., Shafir, E.,(2004). A Behavioral-Economics View of Poverty. American Economic Review, 94(2):419-423.

Binswanger, H. P. (1980). Attitudes toward Risk: Experimental Measurement In Rural India. *American Journal of Agricultural Economics*, 62(3), 395–407.

Boucher, S.R., Carter, M.R., Guirkinger, C. (2008). Risk rationing and wealth effects in credit markets: theory and implications for agricultural development. *American Journal of Agricultural Economics*. 90 (2): 409–423.

Carvalho, L. S., Meier, S., Wang, S.W. (2016). Poverty and Economic Decision-Making: Evidence from Changes in Financial Resources at Payday. *American Economic Review*, 106(2): 260-84.DOI: 10.1257/aer.20140481

Chen, X., Lupi, F., He, G., Liu, J. (2009). Linking social norms to efficient conservation investment in payments for ecosystem services. *Proceedings of the National Academy of Sciences of the United States of America* 106(28): 11812-11817.

Czajkowski, M. and W. Budzinski (2019). Simulation error in maximum likelihood estimation of discrete choice models. *Journal of choice modelling* 31, 73–85

Clot, S., Andriamahefazafy, F., Grolleau, G., Ibanez, L., Méral, P. (2015). Compensation and Rewards for Environmental Services (CRES) and efficient design of contracts in developing countries. Behavioral insights from a natural field experiment. *Ecological Economics*, 113: 85-96.

Clot, S., Stanton, C. Y. (2014). Present bias predicts participation in payments for environmental services: evidence from a behavioural experiment in Uganda. *Ecological Economics,* 108: 162-170, DOI: 10.1016/j.ecolecon.2014.07.026

Derissen, S., & Quaas, M. F. (2013). Combining performance-based and action-based payments to provide environmental goods under uncertainty. *Ecological Economics*, *85*, 77-84.

Dercon, S., Christiaensen, L. (2011). Consumption risk, technology adoption and poverty traps: evidence from Ethiopia. *Journal of Development Economics*. 96 (2): 159–173.

Dobbie, W., Paige M. S. (2013). Information Asymmetries in Consumer Credit Markets: Evidence from Payday Lending. *American Economic Journal: Applied Economics.* 5 (4): 256–82.

Dolan, P., Peasgood, T., White, M. (2008). Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. *Journal of Economic Psychology*, 29(1), 94–122.

Duflo, E., M. Kremer, J. Robinson. (2011). Nudging Farmers to Use Fertilizer: Theory and Experimental Evidence from Kenya. *American Economic Review*, 101(6): 2350-90.

Dunlap, R. E. (2008). The new environmental paradigm scale: From marginality to worldwide use. *Journal of Environmental Education*, 40(1), 3–18.

Di Falco, S., Veronesi, M., Yesuf, M. (2011). Does Adaptation to Climate Change Provide Food Security? A Micro-Perspective from Ethiopia. American Journal of Agricultural Economics, 93(3): 825-842.

Eckel, C.C., Grossman, P.J. (2008). Forecasting risk attitudes: An experimental study using actual and forecast gamble choices. *Journal of Economic Behavior and Organization,* 68(1): 1-17.

Falk, A., Becker, A., Dohmen, T. J., Huffman, D., & Sunde, U. (2022). The preference survey module: A validated instrument for measuring risk, time, and social preferences. Management Science, 69(4).

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., Sunde, U. (2018). Global evidence on economic preferences. Quarterly Journal of Economics, 133 (4), 1645–1692.

Fiebig, D.G., Keane, M.P., Louviere, J. and Wasi, N. (2010). The Generalized Multinomial Logit Model: Accounting for Scale and Coefficient Heterogeneity. Marketing Science, 29: 393–421.

Fraslin, J. H. (2003). CECAM: A Cooperative Agricultural Financial Institution Providing Credit Adapted to Farmers' Demand in Madagascar. Case Study, International Association for Agricultural and Rural Credit–ICAR, US Agency for International Development, Washington, DC, and World Council of Credit Unions, Inc., Madison, WI.

Frederick, S., Loewenstein, G., O'donoghue, T. (2002). Time discounting and time preference: a critical review. *Journal of Economic Literature*, 40: 351–401.

Galarza, F.B. (2009), Choices under risk in rural Peru , *Staff Paper Series 542, Agricultural and Applied Economics*, University of Wisconsin.

Gu, Y., Hole, A.R., Knox, S. (2013) Fitting the generalized multinomial logit model in Stata. *The Stata Journal* 13(2): 382-397.

Haisley, E., Mostafa, R., & Loewenstein, G. (2008). Myopic risk-seeking: The impact of narrow decision bracketing on lottery play. *Journal of Risk and Uncertainty*, 37(1), 57–75. https://doi.org/10.1007/ s11166-008-9041-1.

Hanley, N., Banerjee, S., Lennox, G. D., & Armsworth, P. R. (2012). How should we incentivize private landowners to "produce" more biodiversity? *Oxford Review of Economic Policy*, *28*(1), 93–113. https://doi.org/10.1093/oxrep/grs002

Hanley N., Czajkowski M. (2019). The role of stated preference valuation methods in understanding choices and informing policy. *Review of Environmental Economics and Policy*, 13 (2), 248-266, 10.1093/reep/rez005.

Haushofer, J., Fehr, E. (2014). On the psychology of poverty. *Science*, 344, DOI: 10.1126/science.1232491

Haushofer, J., Schunk, D., Fehr, E. (2013). Negative income shocks increase discount rates. *University of Zurich Working Paper, h*ttp://web.mit.edu/joha/www/publications/ Haushofer_Schunk_ Fehr_2013.pdf

Jacobson, S., Petrie, R. (2009). Learning from Mistakes: What Do Inconsistent Choices Over Risk Tell Us?, *Journal of Risk and Uncertainty*, 38(2): 143-158.

Hess, S. & Palma, D. (2019), Apollo: a flexible, powerful and customisable freeware package for choice model estimation and application, Journal of Choice Modelling, Volume 32, September 2019, 100170

Hess, S. and D. Palma (2022). Apollo: a flexible, powerful and customisable freeware package for choice model estimation and application. User manual.

Kaczan, D., Swallow, B.M., Adamowicz, W.L., (2013). Designing a payment for ecosystem services (PES) program to reduce deforestation in Tanzania: An assessment of payment approaches. *Ecological Economics*, 95: 20–30.

Kinzig, A.P., Perrings, C., Chapin, F.S., Polasky, S., Smith, V.K., Tilman, D., Turner, B.L. (2011). Paying for Ecosystem Services - Promise and Peril. *Science*, 334(6056), 603-604.
Kinzig, A.P., Perrings, C., Chapin, F.S., Polasky, S., Smith, V.K., Tilman, D., Turner, B.L. (2012). Ecosystem services: Free lunch no more. *Science*, 335(6069), 656-657.

Kuhfuss, L., Préget, R., Thoyer, S., Hanley, N. (2016). Nudging farmers to enrol land into agri-environmental schemes: the role of a collective bonus. *European Review of Agricultural Economics*, Online Advance Access published October 31, 2015.

Kuhfuss, L., Préget, R., Thoyer, S., De Vries, F.P., Hanley, N. (2022). Enhancing spatial coordination in payment for ecosystem services schemes with non-pecuniary preferences. *Ecological Economics*, 192 (107271), https://doi.org/10.1016/j.ecolecon.2021.107271.

Le Cotty, T., Maître d'Hôtel, E., Soubeyran, R. and Subervie, J. (2019), Inventory Credit as a Commitment Device to Save Grain Until the Hunger Season. *American Journal of Agricultural Economics*, 101: 1115-1139. https://doi.org/10.1093/ajae/aaz009

Liu, J., Li, S., Ouyang, Z., Tam, C., Chen, X. (2008). Ecological and socioeconomic effects of China's policies for ecosystem services. *Proceedings of the National Acadamy of Sciences of the United States of America*, 105(28), 9477-9482.

Mani, A., Mullainathan, S., Shafir, E., Zhao, J. (2013). Poverty Impedes Cognitive Function. *Science*, 341: 976-980, DOI: 10.1126/science.1238041

Mullainathan, S., Shafir, E. (2013). Scarcity: Why having too little means so much. New York: Henry Holt and Company.

Muradian, R., Arsel, M., Pellegrini, L., Adaman, F., Aguilar, B. Agarwal, B., Corbera, E., Ezzine de Blas, D., Farley, J., Froger, G., Garcia-Frapolli, E. Gómez-Baggethun, E., Gowdy, J., Kosoy, N., Le Coq, J.F., Leroy, P., May, P., Méral, P., Mibielli, P., Norgaard, R., Ozkaynak, B., Pascual, U., Pengue, W., Perez, M., Pesche, D., Pirard, R., Ramos-Martin, J., Rival, L., Saenz, F., Van Hecken, G., Vatn, A., Vira, B., Urama, K. (2013). Payments for ecosystem services and the fatal attraction of win-win solutions. *Conservation Letters*, 0, 1-6.

Mutschler, T., Randrianarisoa, J., Feistner, A. (2001). Population status of the Alaotran gentle lemur Hapalemur griseus alaotrensis. *Oryx*, 35: 152 - 157. 10.1046/j.1365-3008.2001.00167.x.

Porras, I., M. Grieg-Gran, G. Meijerink. (2007). Farmers' Adoption of Soil and Water Conservation: Potential Role of Payments for Watershad Services. *Green Water Credits Report. ISRIC - World Soil Information, Wageningen.*

Prediger, S., Vollan, B, Herrmann, B. (2014). Resource scarcity and antisocial behavior. *Journal of Public Economics*, 119:1-9.

Riley, M., Sangster, H., Smith, H., Chiverrell, R., Boyle, J. (2018). Will farmers work together for conservation? The potential limits of farmers' cooperation in agri-environment measures, *Land Use Policy*, 70: 635-646.

Shujing, L., Dajun Y., Yuejun, L. (2021). The Effect of Perceived Scarcity: Experiencing Scarcity Increases Risk Taking, *The Journal of Psychology*, 155(1): 59-89, DOI: 10.1080/00223980.2020.1822770

Snilsveit, B, Stevenson, J, Langer, L, Tannous, N., Ravat, Z., Nduku, P., Polanin, J., Shemilt, I., Eyers, J., Ferraro, P.J. (2019). Incentives for climate mitigation in the land use sector—the effects of payment for environmental services on environmental and socioeconomic outcomes in low- and middle-income countries: A mixed-methods systematic review, *Campbell Systematic Reviews*, 15(1045). https://doi.org/10.1002/cl2.1045

Sommerville, M., Jones, J.P.G., Rahajaharison, M., Milner-Gulland, E.C. (2010). The role of fairness and benefit distribution in community-based Payment for Environmental Services interventions: A

case study from Menabe, Madagascar, Ecological Economics, 69(6): 1262-1271,https://doi.org/10.1016/j.ecolecon.2009.11.005.

Stoudmann N, Reibelt LM, Kull CA, Garcia CA, Randriamalala M, Waeber PO. (2019). Biting the Bullet: Dealing with the Annual Hunger Gap in the Alaotra, Madagascar. *Sustainability*, 11(7):2147. https://doi.org/10.3390/su11072147

Tanaka, T., Camerer, C. F., Nguyen, Q. (2010). Risk and Time Preferences: Linking Experimental and Household Survey Data from Vietnam. *American Economic Review*, 100(1): 557-71, DOI: 10.1257/aer.100.1.557

Thaler, R.H., Sunstein, C.R. (2008). Nudge: Improving Decisions About Health, Wealth, and Happiness. *Environmental and Resource Economics*, 47(1), 149-150.

Train, K. (2009). Discrete Choice Methods with Simulation, Chapter 6: Mixed Logit. Second Edition: Cambridge University Press

Wilmé, L. (1994). Status, Distribution and Conservation of two Madagascar Bird Species Endemic to Lake Alaotra: Delacour's Grebe Tachybaptus rufolavatus and Madagascar Pochard Aythya innotata. *Biological Conservation*, 69: 15–21. 10.1016/0006-3207(94)90324-7.

Yesuf, M., Bluffstone, R. (2008). Wealth and Time Preference in Rural Ethiopia. *Environment for Development Discussion Paper*, EfD DP 08-16, http://www.rff.org/RFF/ Documents/EfD-DP-08-16.pdf

Appendix I – Survey module

Study on your preferences regarding the exploitation of Lake Alaotra

- First of all, it should be clarified that this survey refers to entirely hypothetical scenarios. We are conducting a study on the preferences of people living around Lake Alaotra . The purpose is not to set up an aid program. We just want to know your preferences among a set of possible situations.

- We are studying change support tools. For example, we know that in your region the destruction of the reeds of the lake is prohibited, but that the difficulties of feeding at certain times push you to defy this prohibition to cultivate rice " vary aloha". So, we would like to study, hypothetically, what would be the assistance scenarios that could help you to not need to rip the reeds anymore.

- We are going to present a set of scenarios with the objective of offering you compensation if you agree to no longer cut reeds to cultivate " vary aloha" rice . This compensation is intended to compensate you for the loss caused if you can no longer cultivate this rice.

- This constitutes a real commitment, which would be subject to regular checks. If during a check it turns out that these practices (uprooting reeds and cultivating rice vary aloha) still takes place, this would lead to the immediate termination of your compensation contract. Of course, you also have the option of opting out of this program.

- In this questionnaire, only your opinion counts, and you can freely choose not to participate if you find that the options offered do not suit you.

These aid scenarios involve financial support, or compensation, in exchange for stopping reed cutting to grow vary aloha rice, with different characteristics:

1. **Who receives the compensation** : the aid can be paid at an individual level or at a collective level (your community). So in the case where you receive the compensation at the individual level, you are the direct beneficiary of the compensation, while in the case where it is the community, it is the community who will be the beneficiary of the compensation and you will benefit indirectly. , through the actions carried out by the community.

2. **How compensation is determined** : the amount of compensation may depend either on your commitment to no longer cut reeds, or on the result of stopping this practice.

   - Commitment is your decision to stop cutting the reeds by signing the contract. In the case of commitment compensation, the compensation depends solely on you signing the contract. If the compensation amounts is 150,000 MGA, and you agree not to cut any more reeds (and the checks confirm that you have not removed any reeds), then you will receive 150,000 MGA.

   - The result is measured by the rise in the water level of the lake. The water level of the lake depends on the level of precipitation, but also on the action of all the farmers. Indeed, it has been proven that the uprooting of reeds contributes to the drying up of the lake. So if a large number of you stop cutting the reeds, the water will be better retained and the water level of the lake will rise. The result will therefore depend on your action, but also on that of others, as well as on nature itself. In this case, if you sign the contract for compensation of 150,000MGA to compensate for stopping reed cutting, but the water level of the lake does not increase, either because other farmers have continued to uproot reeds, or because the rains are too low, you will not receive the compensation of 150,000 MGA. This type of compensation is more uncertain but can also turn out to be higher.

   - There may also be intermediate situations with part of the compensation paid for your commitment and another linked to the result. In the case for example where 1/3 of the compensation is linked to the result, for a compensation of 150,000 MGA, you will

therefore receive 150,000 MGA if the water level has increased, or 100,000 MGA, if the water level has not increased.

3. **When you will receive this compensation** : this can be at the time of signing, or 3 months after signing, 6 months after signing, or one year after signing. For example, if you sign today for compensation of 150,000 MGA, you can choose to receive this amount now in March , in 3 months, in June, or in 6 months, either in September or next year in March.

4. A benefit for the environment: at the same time, the organization would contribute to improving the environment by replanting reeds on the banks of the lake. There are different levels of replanting, based on the area currently covered: either it increases by 10%, 20% or 30%, or it does not increase at all.

5. Finally, one of the characteristics is the amount you would be willing to receive to see the scenario in question come true. This is your compensation.

During this survey, we ask you to choose your preferred scenario, and even if it is not your ideal scenario, among a set of possible scenarios concerning future developments on the edges of Lake Alaotra, and which are defined by a certain number of parameters (which we have just described).

Example 1:

		1	
Commitment-based and/or result-based compensation		1/3 on commitment 2/3 to the result	Year 1: 90,000 MGA Year 2 and all subsequent years: 30,000MGA if the lake water level has not risen or 90,000MGA if the lake level has risen (annual contract, renewed each year)
Share of individual or collective compensation		2/3 individual 1/3 collective	60,000 MGA individual and 30,000 MGA collective, or 20,000 MGA individual and 10,000 MGA collective, when the level of the lake has not increased
Payment month (same each year)		MATRS ATVRII MATI JUIN JUILLET AOUT SEPTEMBRE OCTOBRE NOVEMBRE DEVSEMBRE JATNOTVIER FEVRIER	Payments will take place in August of each year
Associated environmental benefit: Replanting of reeds: 0, +10%, 20%, 30% of the initial surface of the banks		Reed restoration: +10%	The program includes a 10% increase in reed surface
Annual compensation value		90,000 MGA in total	Annual compensation if compliance with the contract after control
CHOICE		☐	

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Example 2:

|		**1**	
Commitment-based and/or result-based compensation		 2/3 on commitment 1/3 to result	Year 1: 180,000 MGA Year 2 and all subsequent years: 120,000MGA if the lake water level has not risen or 180,000MGA if the lake level has risen (annual contract, renewed each year)
Share of individual or collective compensation		 2/3 individual 1/3 collective	120,000 MGA individual and 60,000 MGA collective, or 80,000 MGA individual and 40,000 MGA collective, when the level of the lake has not increased
Payment month (same each year)			Payments will take place in August of each year
Associated environmental benefit: Replanting of reeds: 0, +10%, 20%, 30% of the initial surface of the banks		 Reed restoration: +10%	The program includes a 10% increase in reed surface
Annual compensation value		180,000 MGA in total	Annual compensation if compliance with the contract after control
CHOICE		☐	

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Appendix II: Sample of a Choice Card

		1	2	
Compensation based on commitment or on the result		1/3 on commitment 2/3 to the result	2/3 on commitment 1/3 to result	
Share of individual or collective compensation		1/3 individual 2/3 collective	2/3 individual 1/3 collective	Neither, I wouldn't participate
Payment month (same each year)		MARS AVRIL MAI JUIN JUILLET AOUT SEPTEMBRE OCTOBRE NOVEMBRE dECEMBRE JANVIER **FEVRIER** — 1st installment in 12 months	MARS AVRIL MAI JUIN JUILLET **AOUT** SEPTEMBRE OCTOBRE NOVEMBRE dECEMBRE JANVIER FEVRIER — 1st installment in 6 months	
Associated environmental benefit: Replanting of reeds: 0, +10%, 20%, 30% of the initial surface of the banks		Reed restoration: +20%	Reed restoration: +10%	
Annual compensation value		120,000 MGA in total	180,000 MGA in total	
CHOICE		☐〰	☐〰	☐〰

1. Social preferences

Imagine that you face the following opportunities to help others. Please rate how willing you would be to engage in each behaviour from 1 (definitely would not) to 7 (definitely would). If you are more likely to perform one type of behaviour (eg, helping a stranger find a key) than another (eg, helping a stranger find a missing pet), please respond to the task you would be most likely to perform.

1. Comfort someone I know after they have been through a hardship

0	1	2	3	4	5	6	7

2. Help a stranger find a lost item, like their their ID document

0	1	2	3	4	5	6	7

3. Help care for a sick friend or relative

0	1	2	3	4	5	6	7

4. Helping a stranger with a small task (e.g. helping him carry his groceries, watching his things while he goes to the bathroom)

0	1	2	3	4	5	6	7

2.Environmental preferences

The statements below relate to the relationship between people and the environment. For each statement, please indicate whether you "TOTALLY DISAGREE", "DISAGREE ", " NEITHER DISAGREE NOR AGREE", "AGREE" or "TOTALLY AGREE ", circling the answer of your choice:

1. We are approaching the maximum number of inhabitants the earth can support.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

2. People have the right to modify the natural environment to suit their needs.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

3. When humans interfere with nature, it often leads to disastrous consequences.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

4. Human ingenuity will NOT make the earth unlivable.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

5. Humans seriously abuse the environment.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

6. The earth would have enough natural resources if we simply learned to value them.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

7. Plants and animals have as much right to exist as men.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

8. The balance of nature is stable enough to withstand the impact of modern industrial nations.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

9. Despite our special abilities, humans are still subject to the laws of nature.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

10. The so-called "ecological crisis" facing humanity has been greatly exaggerated.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

11. The earth is like a local bus, with very limited habitat and resources.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

12. Humans were meant to rule all of nature.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

13. The balance of nature is very fragile and easily upset.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

14. Men will eventually know nature well enough to be able to control it.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

15. If current trends continue, we will soon experience a major ecological disaster.

NOT AGREE AT ALL	DISAGREE	NEITHER DISAGREE NOR AGREE	ALL RIGHT	TOTALLY AGREE

Intertemporal preferences

In this part, we are interested in your relationship to time.

A/ Suppose you have the following options: receive a payment today or a payment in 12 months. We will now present five situations to you. Today's payment is the same in each of these situations. The payment in 12 months is different in each situation. For each of these situations, we would like to know which one you would choose.

1. Would you prefer to receive 10,000 Ariary today or 15,380 Ariary in 12 months?

(a) today → go to question 17

(b) in 12 months → go to question 2

2. Would you prefer to receive 10,000 Ariary today or 12,540 Ariary in 12 months?

(a) today → go to question 10

(b) in 12 months → go to question 3

3. Would you prefer to receive 10,000 Ariary today or 11,240 Ariary in 12 months?

(a) today → go to question 7

b) in 12 months → go to question 4

4. Would you prefer to receive 10,000 Ariary today or 10,610 Ariary in 12 months?

(a) today → go to question 6

b) in 12 months → go to question 5

5. Would you prefer to receive 10,000 Ariary today or 10,300 Ariary in 12 months?

until today

b) in 12 months

6. Would you prefer to receive 10,000 Ariary today or 10,920 Ariary in 12 months?

until today

b) in 12 months

7. Would you prefer to receive 10,000 Ariary today or 11,880 Ariary in 12 months?

(a) today → go to question 8

(b) in 12 months → go to question 9

8. Would you prefer to receive 10,000 Ariary today or 12,210 Ariary in 12 months?

(a) today

(b) in 12 months

9. Would you prefer to receive 10,000 Ariary today or 11,560 Ariary in 12 months?

(a) today

(b) in 12 months

10. Would you prefer to receive 10,000 Ariary today or 13,920 Ariary in 12 months?

(a) today → go to question 14

(b) in 12 months → go to question 11

11. Would you prefer to receive 10,000 Ariary today or 13,230 Ariary in 12 months?

(a) today → go to question 13

(b) in 12 months → go to question 12

12. Would you prefer to receive 10,000 Ariary today or 12,880 euros in 12 months?

(a) today

(b) in 12 months

13. Would you prefer to receive 10,000 Ariary today or 13,570 Ariary in 12 months?

(a) today

(b) in 12 months

14. Would you prefer to receive 10,000 Ariary today or 14,640 euros in 12 months?

(a) today → go to question 16

(b) in 12 months → go to question 15

15. Would you prefer to receive 10,000 Ariary today or 14,280 euros in 12 months?

(a) today

(b) in 12 months

16. Would you prefer to receive 10,000 Ariary today or 15,010 Ariary in 12 months?

(a) today

(b) in 12 months

17. Would you prefer to receive 10,000 Ariary today or 18,500 Ariary in 12 months?

(a) today → go to question 18

(b) in 12 months → go to question 25

18. Would you prefer to receive 10,000 Ariary today or 20,160 Ariary in 12 months?

(a) today → skip to question 22

(b) in 12 months → go to question 19

19. Would you rather receive 10,000 Ariary today or 19,320 Ariary in 12 months?

(a) today → go to question 20

(b) in 12 months → go to question 21

20. Would you rather receive 10,000 Ariary today or 19,740 Ariary in 12 months?

(a) today

(b) in 12 months

21. Would you prefer to receive 10,000 Ariary today or 18,910 Ariary in 12 months?

(a) today

(b) in 12 months

22. Would you prefer to receive 10,000 Ariary today or 21,030 Ariary in 12 months?

(a) today → go to question 23

(b) in 12 months → go to question 24

23. Would you rather receive 10,000 Ariary today or 21,460 Ariary in 12 months?

(a) today

(b) in 12 months

24. Would you prefer to receive 10,000 Ariary today or 20,590 Ariary in 12 months?

(a) today

(b) in 12 months

25. Would you prefer to receive 10,000 Ariary today or 16,900 Ariary in 12 months?

(a) today → skip to question 29

(b) in 12 months → go to question 26

26. Would you rather receive 10,000 Ariary today or 16,130 Ariary in 12 months?

(a) today → skip to question 28

(b) in 12 months → go to question 27

27. Would you prefer to receive 10,000 Ariary today or 15,750 Ariary in 12 months?

(a) today

(b) in 12 months

28. Would you prefer to receive 10,000 Ariary today or 16,510 Ariary in 12 months?

(a) today

(b) in 12 months

29. Would you rather receive 10,000 Ariary today or 17,690 Ariary in 12 months?

(a) today → go to question 31

(b) in 12 months → go to question 30

30. Would you rather receive 10,000 Ariary today or 17,290 Ariary in 12 months?

(a) today

(b) in 12 months

31. Would you prefer to receive 10,000 Ariary today or 18,090 Ariary in 12 months?

(a) until today

b) in 12 months

B/ Compared to others, are you a person who is generally willing to give up something today to benefit from it in the future or are you not willing to do so? Please use a scale of 0 to 10, where a 0 means you are "not at all willing to give up something today" and a 10 means you are "very willing to give up something today ". You can also use intermediate values to indicate your position on the scale.

0	1	2	3	4	5	6	7	8	9	10

4.Risk preferences

In this part, we are interested in your relationship to risk.

A/ Please imagine the following situation: You can choose between safe payment and a lottery. The lottery gives you a 1 in 2 chance of receiving 30,000 Ariary . With an equally high probability, you receive nothing. Now imagine that you had to choose between the lottery and a safe payment. We are going to show you five different situations. The lottery is the same in all situations. Safe payment is different in every situation.

1. What would you prefer: participate in a lottery where you have a 50% chance of winning 30,000 Ariary while at the same time, there is a 50% chance of winning nothing, or would you prefer to receive an amount of 16,000 Ariary as safe payment?

(a) lottery → go to question 17
(b) safe payment → go to question 2

2. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer the amount of 8,000 Ariary as a safe payment?

(a) lottery → go to question 10

(b) safe payment → go to question 3

3. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 4,000 Ariary as a safe payment?

(a) lottery → go to question 4
(b) safe payment → go to question 7

4. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer the amount of 6,000 Ariary as a safe payment?

(a) lottery → go to question 5
(b) safe payment → go to question 6

5. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 7,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

6. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer to have the amount of 5,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

7. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 2,000 Ariary as a safe payment?

(a) lottery → go to question 8
(b) safe payment → go to question 9

8. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer the amount of 3,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

9. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 1,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

10. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer the amount of 12,000 Ariary as a safe payment?

(a) lottery → go to question 14
(b) safe payment → go to question 11

11. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 10,000 Ariary as a safe payment?

(a) lottery → go to question 13
(b) safe payment → go to question 12

12. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer the amount of 9,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

13. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 11,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

14. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer the amount of 14,000 Ariary as a safe payment?

(a) lottery → go to question 15
(b) safe payment → go to question 16

15. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer the amount of 15,000 Ariary as a safe payment?

(a) Lottery
(b) secure payment

16. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer to have the amount of 13,000 Ariary as a safe payment?

(a) Lottery
(b) secure payment

17. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 24,000 Ariary as a safe payment?

(a) lottery → go to question 25
(b) safe payment → go to question 18

18. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer the amount of 20,000 Ariary as a safe payment?

(a) lottery → skip to question 22
(b) safe payment → go to question 19

19. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 18,000 Ariary as a safe payment?

(a) lottery → skip to question 20
(b) safe payment → go to question 21

20. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer the amount of 19,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

21. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer to have the amount of 17,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

22. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer to have the amount of 22,000 Ariary as a safe payment?

(a) lottery → go to question 23
(b) safe payment → go to question 24

23. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 23,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

24. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 21,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

25. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer to have the amount of 28,000 Ariary as a safe payment?

(a) lottery → go to question 29
(b) safe payment → go to question 26

26. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer to have the amount of 26,000 Ariary as a safe payment?

(a) lottery → go to question 27
(b) safe payment → go to question 28

27. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer the amount of 27,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

28. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 25,000 Ariary as a safe payment?

(a) Lottery
(b) secure payment

29. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer to have the amount of 30,000 Ariary as a safe payment?

(a) lottery → go to question 31
(b) safe payment → go to question 30

30. What do you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or do you prefer to have the amount of 29,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

31. What would you prefer: 50% chance of winning 30,000 Ariary while at the same time there is a 50% chance of winning nothing, or would you prefer the amount of 31,000 Ariary as a safe payment?

(a) Lottery
(b) safe payment

B/ How do you see yourself: are you a person who is generally ready to take risks, or do you try to avoid taking risks? Please use a scale of 0 to 10, where a 0 means you are "completely risk averse" and a 10 means you are "very risk averse". You can also use intermediate values to indicate your position on the scale.

0	1	2	3	4	5	6	7	8	9	10

5. Social preferences - bis

(a) Imagine the following situation: you have won 1,000,000 Ariary in the lottery. How much would you give to charity ?

_____ MGA

(b) How would you rate your willingness to share with others without expecting anything in return when it comes to charity? Please use a scale of 0 to 10, where 0 means you are "not at all willing to share" and 10 means you are "very willing to share". You can also use intermediate values to indicate your position on the scale.

0	1	2	3	4	5	6	7	8	9	10

Does this sentence correctly describe you "When someone does me a favor, I want to reciprocate" On a scale of 0 to 10, where do you rank? " *0 = This does not describe me at all"* to " *10 = This describes me perfectly"* .

0	1	2	3	4	5	6	7	8	9	10

Does this sentence describe you correctly "If someone is unfair to me, I will take revenge at the first opportunity, even if it costs me. » On a scale of 0 to 10, where do you rank? " *0 = This does not describe me at all"* to " *10 = This describes me perfectly"* .

0	1	2	3	4	5	6	7	8	9	10

Do you agree with the following sentence: "I assume that the others are all well intentioned" On a scale of 0 to 10, where do you rank? " *0 = This does not describe me at all"* to " *10 = This describes me perfectly"* .

0	1	2	3	4	5	6	7	8	9	10

6. Activities

1. What is your main activity ?_ _____
2. Approximately how much rice do you harvest each year?_ _____ kilo
3. how much rice do you sell each year?_ _____ kilo
4. In general , how much rice do you eat each month (as a household)? _____kilo
5. When does your stock run out? _____(month)
6. Do you own land (in addition to the one you live on)? ☐No ☐Yes => What is the area of this land?_ _____ acre

7. Do you have additional activities ?

☐No additional activities
☐Arts and crafts
☐Employee (specify _____)
☐Alternative crops (☐beans/ ☐ginger/ ☐onions)
☐Sale of wood/charcoal

7. Additional questions

8. Over the last 7 days, have you eaten your fill:

☐ Every day
☐ Almost every day
☐ Rarely
☐Never

9. According to you, the lean period is:
-Harder and harder
- Less and less difficult
-Still so difficult

10. How would you rate your fitness on a scale of 1 to 7?

1=very fit	2	3	4	5	6	7= very tired

11. How would you rate your morale on a scale of 1 to 7?

1= very good morale	2	3	4	5	6	7= very low morale

Have you ever burned reeds?

☐Yes
☐No

Gender :
☐Male
☐Women

Origin :
☐born here
☐ happened _____ years ago (from: _____)

Date of birth:_ _____

Number of people in the household:_ _____

GPS coordinates:_ _____
Name of place: _____
Identity (surname and first name):_ _____

Appendix IV: Results from the analysis of variation in preferences, pre and post-harvest, based on responses to behavioural module.

Results time preferences measures in the behavioural module similarly show unconclusive results, as the data indicates mixed results (**Error! Reference source not found.**). The staircase measure s uggests that farmers are slightly more patient in economic terms after harvest, but this difference is not significant at the 95% level. This aligns with the hypothesis of a positive relationship between relative poverty and discount rates. The self-assessment measure of patience in generic term indicates the opposite, reporting a 0.8 decrease in the patience level after harvest compared to before harvest ($p<0.05$), which could be explained by the fact that during the hunger season, farmers are constrained by a waiting environment, having to put a range of expenses (e.g. furniture for the house, school materials, clothes) and needs (e.g. health, groceries) on hold, and as such consider themselves as more patient during this period. The GPS computed time preference measure indicates that farmers are impatient both before and after harvest with a negative index (-0.019 and -0.0051 respectively) which is coherent with the measures found in the GPS with Sub-Saharan Africa scoring -0.16 on average compared to 0.49 for Western Europe (Falk et al., 2018). Interestingly, Kenya and Malawi, two very close country in terms of geographic and cultural context, scored in a similar range (-0.076 and -0.045 respectively).

Table 6 - Time Preferences (behavioural preferences module)

	Pre - Harvest	S.D.	Post- Harvest	S.D.	Mann- Whitney test	Prob>z
Patience (staircase measure, 1-32[5]), n=384[6]	**6.78**	9.63	**7.43**	11.35	0.467	0.6402
Self-assessment (Likert scale, 1-10), n=391	**3.78**	3.34	**2.94**	3.22	2.265	0.0235
Patience index (GPS), n=384	**-0.019**	0.064	**-0.0051**	0.066	1.520	0.1286

On the social preference aspect, we observe two main differences in between the 2 periods. First, the Altruism index from the GPS survey indicates farmers are less willing to share with others after than before harvest ($p<0.01$). At the same time, from the Prosocial Behavioural Intention scale (see **Error! Reference source not found.**), respondents declare themselves more likely to take care of a

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[5] 1=extremely impatient ; 32=extremely patient

[6] 7 respondents failed to complete the time preference staircase module

sick relative (from 5.87 to 6.17 on the 10 points likert scale, p<0.01) after than before harvest. The caring aspect is likely to be associated with financial responsibility for healthcare, which often falls onto duties of relatives as soon as they have the financial capacity, which is more likely to happen after harvest. On the other side, the social aspect of sharing with 'others' in general would be more pronounced during the hunger season (i.e. before harvest) when many people are running out of stock. In sum, it would mean that resource scarcity is associated to stronger social ties among villagers to fight the hunger season. Other questions from the Prosocial Behavioral Intention Scale relating to strangers lead to unsignificant results, which could also be due to the fact that 'strangers' has poor meaning in this rural context. Comparing the GPS Altruism index, the post-harvest index (-0.12) is closely related to the one found for Sub-Saharan Africa (-0.15) while the pre harvest index is closer to North Africa and Middle Est or South and East Asia (0.13).

The pre vs post-harvest context does not seem to affect significantly other social preferences as we find no major changes in positive reciprocity, negative reciprocity nor trust between the two periods (see Appendix IV for respective figures).

Table 7 - Altruism, before and after harvest (N=391)

	Pre - Harvest	S.D.	Post-Harvest	S.D.	Mann-Whitney test	Prob>z
Imagine the following situation: you've won 1,000,000 Ariary in a lottery. How much would you donate to charity?	21.97%	18.7	21.30%	17.75	0.176	0.8601
How would you rate your willingness to share with others without expecting anything in return when it comes to charity?	7.06	2.42	6.13	2.79	3.478	0.0005
Altruism index (GPS)	0.12	0.05	-0.12	0.06	2.533	0.0113

Table 8 - The Prosocial Behavioural Intentions Scale (n=391)

	Pre - Harvest	S.D.	Post-Harvest	S.D.	Mann-Whitney test	Prob>z
Comforting someone I know after they've been through an ordeal	5.71	1.29	5.85	1.29	-1.325.	0.1853

	Pre -Harvest		Post- Harvest		Mann Whitney test		
Help a stranger find a lost object, such as a key or a pet[7]	**5.51**	1.58	**5.34**	1.5	1.517	0.1294	
Helping care for a sick friend or relative	**5.87**	1.31	**6.17**	1.14	-2.500	0.0124	
Helping a stranger with a small task	**5.57**	1.45	**5.59**	1.46	-0.243	0.8083	

The Nep scale offers interesting insights on environmental preferences which contrasts between the two periods. First, respondents perceive nature as less fragile after harvest. Before harvest, people are more likely to agree that humans should not be interfering with nature (NEP3, p<0.01), they are also more likely to agree that nature balance is very fragile and easily threatened (NEP13, p<0.05). Second, farmers also seem to adopt a more pro-environmental view after harvest, adopting a more tolerant position relatively to nature. For instance, they give more rights to plants and animals to exist after harvest (+0.4, p<0.01). Finally, farmers are more conscious about the reality of limits to growth after harvest: the pattern holds for the 3 items and is highly significant (p<0.01)

Table 9 - Nep scale: average score and statistical difference before and after harvest, (N=391)

Nep Item		Pre -Harvest		Post- Harvest		Mann Whitney test		
		Mean	s.e.	Mean	s.e.	z value	Prob>z	
	Reality of limits to growth	**3.14**	0.04	**3.27**	0.04	-2.935	0.0033	***
1	We are approaching the limit of the number of people the earth can support - *Nous approchons le nombre maximum d'habitants que votre région peut accueillir.* (5=Absolutely agree)	**3.64**	0.07	**3.97**	0.08	-4.62	0.0000	***
6	The earth has plenty of natural resources if we just learn how to develop them - *La région aurait assez de ressources (eau et nourriture) pour tout le monde si on apprenait à mieux s'en occuper.* (5=Absolutely Disagree)	**2.04**	0.05	**1.86**	0.06	2.958	0.0031	***
11	The earth has only limited room and resources - *La région a des ressources (eau et nourriture) très limitées.* (5=Absolutely agree)	**3.74**	0.07	**3.97**	0.07	-2.419	0.0156	**
	Anti- anthropocentrism	**3.09**	0.05	**3.3**	0.05	-2.779	0.0055	***
2	Humans have a right to modify the natural environment to suit their needs - *Les hommes ont le droit de changer la nature pour l'adapter à leurs besoins.* (5=Absolutely Disagree)	**2.73**	0.07	**2.56**	0.08	1.628	0.10	*
7	Plants and animals have equal rights as humans to exist - *Les plantes et les animaux ont autant le droit que les hommes d'être là.* (5=Absolutely agree)	**3.84**	0.08	**4.26**	0.06	-4.032	0.0001	***
12	Humans were meant to rule over the rest of the nature - *Les hommes doivent dominer la nature.* (5=Absolutely Disagree)	**2.70**	0.08	**3.09**	0.08	-3.455	0.0005	***
	Fragility of nature's balance	**3.69**	0.04	**3.74**	0.04	-0.552	0.5809	n.s.

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[7] We find women to be more willing to help a stranger than men after harvest (5.551 vs 5.128, p=0.048). With more women in the post harvest sample the difference in between the 2 periods would be thus even less pronounced than it is with the current sample.

3	When humans interfere with nature, it often produces disastrous consequences - *Lorsque les hommes veulent aller contre la nature, cela conduit souvent à des conséquences désastreuses.* (5=Absolutely agree)	**4.45**	0.05	**4.27**	0.04	3.542	0.0004	***
8	The balance of nature is strong enough to cope with the impacts of modern industrial development -*La nature est assez forte pour faire face au changement du climat.* (5=Absolutely Disagree)	**2.46**	0.07	**2.9**	0.08	-3.766	0.0002	***
13	The balance of nature is very delicate and easily upset - *La nature est très fragile et facilement abîmée.* (5=Absolutely agree)	**4.19**	0.06	**4.06**	0.05	2.117	0.0342	**
	Rejection of exceptionalism	**2.58**	0.04	**2.59**	0.03	-0.102	0.9185	n.s.
4	Human intelligence will ensure that we don't make the earth unlivable - *Le savoir (les connaissances) de l'homme sur la nature va permettre de rendre la région plus facile à vivre.* (5=Absolutely Disagree)	**1.97**	0.05	**1.89**	0.04	0.234	0.8153	n.s.
9	Despite our special abilities, humans are still subject to the laws of nature - *Les hommes sont toujours moins forts que la nature.* (5=Absolutely agree)	**3.59**	0.07	**3.30**	0.07	2.932	0.0034	***
14	Humans will eventually learn enough about how nature works to be able to control it - *Un jour, les hommes vont comprendre la nature et ils seront plus forts qu'elle.* (5=Absolutely Disagree)	**2.18**	0.05	**2.56**	0.07	-4.494	0.0000	***
	Possibility of an eco-crisis	**3.76**	0.04	**3.68**	0.04	1.477	0.1397	*
5	Humans are severely abusing the environment -*Les hommes abusent gravement de la nature.* (5=Absolutely agree)	**4.16**	0.06	**4.07**	0.06	0.961	0.3366	n.s.
10	Human destruction of the environment has been greatly exaggerated - *Les discours sur le changement climatique sont exagérés (=trop alarmiste).* (5=Absolutely Disagree)	**2.69**	0.09	**2.54**	0.09	1.171	0.2415	n.s.
15	If things continue going as they presently are, we will soon experience a major ecological disaster - *Si cela continue, nous allons bientôt avoir une catastrophe naturelle très grave.* (5=Absolutely agree)	**4.44**	0.04	**4.42**	0.04	0.734	0.4269	n.s.

Appendix IV - Social preferences - GPS

Positive reciprocity						
Cette phrase vous décrit-elle correctement "Quand quelqu'un me fait une faveur, je veux rendre la pareille » Sur une échelle de 0 à 10, où vous situez vous ?	**8.005**	1.97	**7.94**	2.72	ns	ns
PR (GPS)	**0.013**	0.06	**-0.013**	0.08		
Negative reciprocity						
Cette phrase vous décrit-elle correctement "Si on est injuste avec moi, je me venge à la première occasion, même si cela me coûte. » Sur une échelle de 0 à 10, où vous situez-vous ?	**2.05**	2.60	**2.18**	3.2	ns	ns
NR(GPS)	**-0.02**	0.06	**0.02**	0.08		
Trust						
Êtes-vous d'accord avec la phrase suivante: "J'assume que les autres sont tous bien intentionnés" Sur une échelle de 0 à 10, où vous situez vous ?	**5.095**	2.28	**5.26**	2.99	ns	Ns
Trust (GPS)	**-0.030**	0.06	**0.030**	0.08		

Appendix V – Behavioural preferences measures Pre and Post Harvest by gender with standard deviation in parenthesis and statistical test of significance (Student t-test)

	Pre -Harvest			Post- Harvest		
	Women	Men	Prob>t	Women	Men	Prob>t
Patience (staircase measure, 1-32), n=384	6.070 (8.571)	7.008 (10.014)	0.5133	6.183 (10.172)	8.667 (12.341)	0.1252
Patience Self-assessment (Likert scale, 1-10), n=391	3.819 (3.177)	3.714 (3.415)	0.836	2.775 (3.272)	3.118 (3.185)	0.4542
Risk (staircase measure, 1-32), n=383	11.342 (11.883)	11.008 (11.798)	0.8527	14.453 (11.667)	15.475 (12.536)	
Risk Self-assessment (Likert scale, 1-10), n=391	4.083 (3.571)	4.025 (3.479)	0.9119	5.163 (3.415)	4.792 (3.362)	0.4407
Imagine the following situation: you've won 1,000,000 Ariary in a lottery. How much would you donate to charity? n=391	194027.8 (175051.9)	237028 (193437.9)	0.1247	221938.8 (169283.9)	204475.2 (185717)	0.4893
How would you rate your willingness to share with others without expecting anything in return when it comes to charity? n=391	6.763 (2.376)	7.260 (2.440)	0.1704	5.908 (3.025)	6.346 (2.543)	0.2694
Comforting someone I know after they've been through an ordeal, n=391	5.701 (1.288)	5.663 (1.303)	0.5104	5.989 (1.214)	5.712 (1.358)	0.135
Help a stranger find a lost object, such as a key or a pet, n=391	5.458 (1.669)	5.537 (1.550)	0.7391	5.551 (1.324)	5.128 (1.647)	0.048
Helping care for a sick friend or relative, n=391	5.708 (1.378)	5.991 (1.378)	0.1477	6.132 (1.206)	6.207 (1.079)	0.6432
Helping a stranger with a small task, n=391	5.541 (1.509)	5.588 (1.410)	0.8298	5.734 (1.328)	5.445 (1.584)	0.1651

Appendix VI: choice models by gender

Male	MXL 1_male			MXL 2_male			MXL 3_male		
	Estimate		Rob.std.err.	Estimate		Rob.std.err.	Estimate		Rob.std.err.
Mean									
asc	6.204	***	1.295						
asc_post	-1.882		1.209						
First	0.015		0.020	0.080	***	0.022	0.088	***	0.023
First_post	0.001		0.032	-0.009		0.037	-0.014		0.039
Output	-0.005	***	0.002	-0.007	***	0.002	-0.007	***	0.002
Output_post	0.008	***	0.003	0.008	**	0.004	0.010	***	0.004
Collective	-0.005	***	0.002	-0.004	*	0.002	-0.004	*	0.002
Collective_post	-0.002		0.003	-0.006		0.005	-0.003		0.004
Enviro	0.072	***	0.012	0.110	***	0.017	0.112	***	0.017
Enviro_post	0.029		0.022	0.027		0.030	0.043		0.030
Payment	0.005	**	0.002	0.018	***	0.002	0.018	***	0.002
Payment_post	-0.007	*	0.004	-0.008	***	0.002	-0.003		0.003
St. Dev.									
asc	1.776	***	0.456						
asc_post	2.532	***	0.404						
First	-0.099	***	0.026	-0.142	***	0.028	0.142	***	0.030
First_post	-0.033		0.022	-0.027		0.104	0.134	**	0.060
Output	-0.010	***	0.002	-0.013	***	0.003	0.014	***	0.003
Output_post	0.007	*	0.004	-0.011	*	0.007	0.004		0.010
Collective	-0.012	***	0.003	-0.016	***	0.004	-0.015	***	0.003
Collective_post	-0.016	***	0.005	-0.023	***	0.008	0.013	*	0.008
Enviro	-0.083	***	0.012	0.107	***	0.019	-0.106	***	0.016
Enviro_post	-0.113	***	0.024	-0.160	***	0.037	-0.136	***	0.033
N (individuals)	219			219			218		
Nb of choices	1314			1314			1261		
LL:	-875.74			-924.38			-825.96		
AIC:	1795.49			1884.76			1687.93		
BIC:	1909.46			1978.02			1780.44		

Female	MXL 1_female			MXL 2_female			MXL 3_female		
	Estimate		Rob.std.err.	Estimate		Rob.std.err.	Estimate		Rob.std.err.
Mean									
asc	5.005	***	0.973						
asc_post	1.226		2.343						
First	-0.009		0.020	0.062	***	0.020	0.063	***	0.020
First_post	0.035		0.029	0.035		0.031	0.056		0.036
Output	-0.005	***	0.002	-0.008	***	0.003	-0.008	***	0.003

	Model 1			Model 2			Model 3		
Output_post	0.004		0.003	0.006		0.003	0.007	*	0.004
Collective	-0.011	***	0.002	-0.013	***	0.003	-0.012	***	0.003
Collective_post	0.005	*	0.003	0.005		0.005	0.008	*	0.004
Enviro	0.058	***	0.017	0.099	***	0.030	0.100	***	0.027
Enviro_post	0.022		0.025	0.021		0.052	0.041		0.043
Payment	0.002		0.002	0.017	***	0.002	0.018	***	0.003
Payment_post	0.000		0.003	-0.004		0.003	0.000		0.004
St. Dev.									
asc	-0.135		1.080						
asc_post	-4.473	***	1.103						
First	-0.001		0.010	-0.001		0.054	-0.007		0.034
First_post	0.000		0.024	0.094	**	0.047	0.116	**	0.046
Output	0.008	***	0.003	-0.011	***	0.003	-0.010	***	0.003
Output_post	0.000		0.001	0.004		0.009	-0.006		0.008
Collective	0.004		0.006	-0.008	*	0.004	0.009	*	0.005
Collective_post	0.008		0.006	0.016	***	0.004	-0.006		0.014
Enviro	-0.086	***	0.017	0.101	**	0.040	0.102	***	0.033
Enviro_post	0.088	***	0.026	-0.154	**	0.065	0.144	**	0.064
N (individuals)	168			168			167		
Nb of choices	1008			1008			973		
LL:	-653.68			-711.49			-634.51		
AIC:	1351.36			1458.99			1305.01		
BIC:	1459.51			1547.47			1392.86		