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Resource Scarcity, Spite and Cooperation

May 2013

Sebastian Prediger, Björn Vollan and Benedikt Herrmann[1,2]

Abstract: Using an experimental approach, this paper examines how scarcity of natural resources affects people's readiness to cooperate and to engage in antisocial behaviour. The experiments were carried out with pastoralists from southern Namibia whose livelihoods are highly dependent on grazing availability on their collectively used rangelands. We split the study region into two areas according to exogenous differences in biomass production, a high-yield and a low-yield area, and conduct a one-shot public goods experiment and the joy-of-destruction experiment with pastoralists from both areas. Results from the joy-of-destruction experiment reveal that a substantial fraction of people is willing to reduce another subject's income, although this comes at an own cost. We show that this kind of spiteful behaviour occurs twice as often in the area where resources are scarcer and hence competitive pressure is higher. By contrast, levels of cooperation are very similar across areas. This indicates that scarcity does not hamper cooperation, at least as long as a sub-survival level has not been reached. Our data further reveal a coexistence of prosocial and antisocial behaviour within individuals, suggesting that people's motivations depend on the experimental environment they are acting in. One possible explanation is that subjects are ready to cooperate when substantial net gains can be realized, but turn to spiteful money burners when there is no scope for efficiency improvements and the risk of "falling behind" is particularly salient.

Keywords: competition, natural resource scarcity, antisocial behaviour, cooperation, Namibia, lab-in-the-field experiments

JEL: C71, C72, C91, D03, H41, Q24

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1. Introduction

The depletion of natural resources is a key challenge of the twenty-first century. An inescapable consequence of increasing resource scarcity is the intensification of competition among affected resource users. Using the exogenous variation in real life resource scarcity as a proxy for differences in the intensity of competition, this paper investigates experimentally whether and how increased exposure to competition for scarce resources affects common-pool resource users' behaviour towards fellow resource users. In particular, our study aims at answering the following questions: Does resource scarcity undermine subject's willingness to engage in mutually beneficial cooperation? Does resource scarcity bring forward antisocial behaviour? To address these questions, we take two one-shot experiments to pastoralists from southern Namibia whose livelihoods strongly depend on grazing resources that are managed under common-property regimes that exclude outsiders from using the resource. Grazing resources are particularly interesting as they produce a limited flow of resources with rivalry in consumption and hence stress the trade-off between selfish profit maximization and mutual cooperation to sustain their resource stock. Our study contributes to two related strands of literature that so far have either solely focused on the relationship between resource scarcity and cooperativeness, or on that between increased competition for scarce resources and antisocial or unethical behaviour.[3] The set-up of our study is similar to that of Leibbrandt et al. (2011), who take a series of experiments to real-life fishermen to investigate the effects of ecological peculiarities on behaviour.

Resource scarcity implies competition. Economic theory typically considers competition as desirable. Competition facilitates the functioning of markets, improves efficiency and welfare and may spur people to try harder. However, relatively little is known about the behavioral effects of competition. Recent studies demonstrate that competition may also motivate people to engage in inefficient, antisocial or unethical practices. Charness et al. (2011) and Balafoutas et al. (2012), for example compare low competition with high competition and show that a more competitive environment can encourage people to sabotage the performance of others. Using the examples of, inter alia, excessive executive pay, employment of children and corruption, Shleifer (2004) illustrates that competition may undermine ethical behavior. Interestingly, in all examples he considers, censured behavior either reduces costs or raises

[3] While the link between resource scarcity and behaviour at the micro-level has so far received relatively little attention, there is a comprehensive literature on the relation between resource scarcity and violent conflict at macro-level. Although plagued with problems of endogeneity, several studies find a positive relationship between scarcity and the onset of conflict (e.g. Brander and Taylor, 1998; Homer-Dixon, 1999; 1991; Stalley, 2003; Zhang et al.,2007; 2006).

revenues, and thus enhances economic efficiency. In his excellent study on witch killing in rural Tanzania, Miguel (2005) provides an extreme example of unethical (but again economically efficient) behavior in the face of increased resource scarcity and intra-household competition. He finds that natural disasters like floods or drought, resulting in crop failures and large income drops, lead to a significant increase in the murder of elderly (and less productive) women from poor households. Victims are accused of being witches and typically killed by relatives. Miguel (2005) points out that murderer in the Tanzanian study region do not have to fear social exclusion or stigmatization. Witch killing rather seems to be viewed as a legitimate means to promote community welfare in times of extreme economic hardship.[4] Similar to Miguel (2005), we also study the impact of increased competition for scarce resources on peoples' readiness to engage in (a comparably innocuous kind of) antisocial behavior. In contrast to his study, however, we propose a decontextualized experimental setup, in which antisocial behavior cannot be driven by economic motives such as personal material gains or efficiency concerns, and where it is probably in conflict with social norms.

The second focus of our study lies on the relationship between resource scarcity and cooperative behaviour. There is no consensus among scholars on the impact of scarcity on cooperation. Some posit that collective action is more likely to emerge after resource users have experienced substantial scarcity (Arnold, 1998; Ostrom et al., 1999), while others argue that scarcity may drive appropriative competition among users, leading to an even faster rate of exhaustion (Grossmann and Mendoza, 2003; Varghese et al., 2013). Experimental studies that examine the effect of induced scarcity on appropriation behavior obtain mixed results. Osés-Eraso and Viladrich-Grau (2007) study university students' extraction decisions in a common-pool resource experiment under different resource allocations using a between-subject design. They report lower extraction levels (and hence higher levels of cooperation) in the event of scarcity. Rutte et al. (1987) obtain similar results. By contrast, Blanco et al. (2012) obtain reversed results in a framed common-pool resource experiments. They confront Colombian watershed users with different levels of resource availability and find a higher occurrence of uncooperative behavior in the face of strong scarcity shocks. Our work distinguishes from these studies as we examine whether differences in the exposure to *real-life* resource scarcity affects behavior of common-pool resource users.

[4] In the anthropological literature Turnbull (1972) describes extreme individualistic practices among the Ik people in Uganda during a severe famine when scarcity of resources had reached a sub-survival limit resulting in a break-up of mutual help and humanity.

We use two one-shot experiments to measure subjects' behaviour. The first experiment is the joy-of-destruction game (Abbink and Herrmann, 2011), also known as the maximizing-difference game (e.g. Halevy et al., 2012). The experiment is similar to the money burning experiments employed by Zizzo and Oswald (2001) and Kebede and Zizzo (2011), but removes inequity aversion or envy as potential motives for money burning. In this two-player game, a subject can decide to sacrifice income in order to lower another persons' payoff below one's own. The design is tailor-made to identify the existence of antisocial preferences, which we understand in reference to Abbink et al. (2010) as a willingness to lower another person's payoff below one's own, even if this comes at an own cost, and absent motives of negative (sequential) reciprocity. We also refer to this kind of attitude as spite. The second experiment is a standard linear public goods game (e.g. Fehr and Gächter, 2000) that resembles a typical social dilemma situation. The public goods game is the major workhorse in experimental economics to study cooperation. To preview our results, we find a high incidence of antisocial behaviour: One-third of all subjects are willing to reduce a fellow resource users' income at an own cost. Interestingly, antisocial behavior is twice as high in areas where grazing resources are scarcer and hence competition probably more intense. Yet, peoples' willingness to cooperate does not seem to suffer from the exposure to scarcity. Levels of cooperation are found to be similar across both areas, being slightly (but insignificantly) higher in the area where resources are scarcer. A within-subject comparison further shows that people who behave spitefully in the joy-of-destruction set-up tend to be more cooperatively in the public goods experiment.

2. Description of the study site

Our study was carried out in the communal lands of the Berseba constituency in the Karas region, southern Namibia. This area is situated within a semi-arid biome, and is almost exclusively populated by the Nama people, an indigenous ethnic group sharing a long tradition of pastoralism on commonly managed rangelands. Rainfall varies spatially and temporally in the study area, ranging from 50 to 290 mm per annum (Kuiper and Meadows, 2002). The semi-arid conditions are not suitable for agriculture and the majority of residents live on extensive livestock production based on subsistence.

< Figure 1 about here>

2.1 Measure for resource scarcity

Figure 1 shows the estimated average seasonal biomass production from 1985-2007 for the Karas region, measured in kilogram per hectare.[5] The higher the biomass production, the more abundant are grazing resources. As depicted in Figure 1, biomass production varies spatially, ranging from less than 100 kg/ha up to 1200 kg/ha. We split the study region into two areas according to their biomass production: in one area biomass production ranges from 400 kg/ha up to 800 kg/ha (high-yield area) and in the other area biomass production is below 100 kg/ha (low-yield area). Locations situated in between (the light-brown area in Figure 1) were not considered in order to have a clear and considerable difference regarding resource availability between the selected areas. Note that the biomass production figures reported in Figure 1 are averaged over the last 23 years. In case of extreme climatic events, like prolonged droughts, biomass production can deviate from that reported in the Figure. Yet, over the last 23 years, it was always substantially higher in the high-yield area than in the low-yield area. Moreover, in all but two seasons of serious drought (98/99 and 02/03) biomass production was well above 400 kg/ha in the high-yield area and below 100 kg/ha in the low-yield area. Devereux and Næraa (1996) calculated that during a severe drought in Namibia 40% of small stock and 22% of cattle died. This resulted in a reduction of the median flock size of goats from 30 to 17, and of sheep from 26 to 18, and hence left most flocks well below the considered minimum viability level of 30-35 head. Given less resource availability and smaller herd sizes in the low-yield area, farmers there are particularly vulnerable to droughts which constitute a serious temporary threat to local livelihoods.

Of course, lower biomass production alone does not imply less resource availability per se: Resource availability crucially depends on the number of users, too. According to own calculations based on official census data conducted by the Namibian Planning Commission in 2001 (CBS, 2004), the population densities are 0.204 and 0.213 persons per km² in the high-yield area and the low-yield area, respectively.[6] These figures show that per-capita resource availability is indeed higher in the high-yield area. This claim is substantiated by

[5] The map was produced by Celeste Espach, Ministry of Agriculture, Water and Forestry in Windhoek. The seasonal biomass production was calculated from NOAA/AVHRR and SPOT/Vegetation satellite images, with the Satellite Monitoring of Arid Rangeland (SMAR) software based on the Monteith model.

[6] For the calculations we used the enumeration areas in which the locations we considered in our study where situated, and divided the enumeration areas' population by area size. Visited locations in the high-yield area (low-yield area) are scattered across an area of 4235 (3800) km² supporting a population of 868 (811) people. We thank Thimo Hangula from the National Planning Commission for providing us with the data. For consistency checks, we consulted the local extension officers Anton Losper (Ministry of Agriculture, Water and Forestry), Karl Eiseb and Sixtus Isaacks (both Rural Water Supply Keetmanshoop) who operate in the study region. All of them guessed the population density to be lower in the high-yield area.

participants' subjective perceptions about resource availability in their areas. As illustrated in Figure 2, 63 per cent of the participants from the high-yield area rate pasture quality and availability as either "good" or "very good". This stands in stark contrast to the perceptions held by farmers from the low-yield area, where only about 17% held pasture quality for good or very good while more than half the sample was the opinion that their pastures are of "poor" or "very poor" quality (Mann-Whitney U test: $Z = 5.59$, $p<.001$, $n=119$). Moreover, in the high-yield area 46% believe that the quality of their pastures is better than in most other places in the communal lands of Berseba, while only 21% of low-yield area residents were of this opinion and 52% said that the pasture quality is worse than in most other places ($Z = 2.657$, $p < .01$, $n=100$). To sum up, both objective measures based on satellite images as well as resource users' perceptions provide strong evidence that resources are much scarcer in the area we labelled as "low-yield area".

< Figure 2 about here >

2.2 Exogeneity of resource scarcity in our study area

When studying the relationship between resource scarcity and behaviour it is crucial to establish an unambiguous direction of causality. One could reason that the differences in the availability of resources across areas are endogenous, i.e. the result of differences in the distribution of "behavioural types". In particular, one could assume that an adverse selection due to initial resource conditions or migration of behavioural types had taken place in the study area, such that subjects with a higher inclination towards antisocial or selfish behaviour settled in the low-yield area while more cooperative individuals settled in the high-yield area. However, at least three aspects speak against this conjecture. First, the variation in biomass production between the areas can be attributed to different soil types in the region, and hence to geological peculiarities. The western part of the communal lands, where biomass production is higher, is referred to as the Swartrand terrain, which is characterised by rocky grounds that ease water infiltration and plant growth. East of Berseba, i.e. in the low-yield area, the Witrand terrain begins, a different soil type seen as less favourable for plant growth than the Swartrand.[7] Therefore, resource differences are not human made. Second, an adverse selection of preference types would have required substantial migratory movements between

[7] Pers. com. with Anton Losper, extension officer from the Ministry of Agriculture, Water and Forestry (5th October 2009). This is also in line with the perception of our participants: Sixty-nine per cent of them were of the opinion that quality is better in the Swartrand terrain than in the Witrand area, and only 9% were of the opposite opinion. The remainder thought there was no difference between the areas.

and within the areas in the past and present. But there is no evidence for that. The communal rangelands have never been open-access resources, and although migration within the communal lands is generally possible, it strongly depends on the affirmation of traditional authorities and nowadays also of local Water Point Associations (WPAs). The traditional authority has the customary right to allocate grazing lands to individuals (Republic of Namibia, 2000), while WPAs, which consist of local resource users, have the formal right to grant or deny access to their water resources (Republic of Namibia, 2004). In accordance with that, discussions held with participants in our study confirm that migrants (mostly relatives of residents) have to ask permission before they can settle in a certain area. None of the places considered in this study experienced migratory movements over the last ten years. Even in case of drought farmers will continue to use their assigned grazing land and eventually sell some of their animals.[8] Third, people in the high-yield area possess more livestock. Thus, if the resource stock were to react purely on grazing pressure the high-yield area would be quickly transformed to a low-yield area. The higher average biomass production over the last 23 years clearly speaks against this conjecture. Hence, differences in resource availability must be assumed exogenous.

2.3 Socio-economic background

In social psychology and sociology it is long established that personal identities emerge in society and are reflective of the society (Stryker, 1980). Scholars in economics (e.g. Potetee et al., 2010; Vollan and Ostrom, 2010) have only recently begun to emphasize the relevance of micro and broader contextual factors for understanding differences in behaviour across groups or individuals, too. In particular, it has been shown that culture-specific norms resulting from different economic, political and social backgrounds can affect behaviour in a systematic way (e.g. Henrich et al., 2001; Herrmann et al., 2008; Ockenfels and Weimann, 1999). Hence, in order to attribute potential differences in behaviour between low-yield and high-yield area residents to the variation in resource availability and competitive pressure, we had to ensure that other important contextual factors, like the cultural, institutional, political or religious background, are very similar across both areas. The study region fulfils this precondition: All 120 participants belong to the Nama ethnicity. They speak the same language (Nama), reside

[8] A questionnaire issued in the low-yield area in 2006 exemplifies this. The question "Remember the last time when most of the fodder in your normal grazing area was already consumed. What did you do?" (multiple answers possible). The first choice for 11 out of 13 farmers is to continue their assigned grazing area. 2 farmers said that they would ask someone. Their second choice was to buy fodder (n=4) or sell animals (n=4) or call a meeting (n=1). Nobody stated to move the animals elsewhere.

in the same constituency, and all follow Christianity. Inter- and intragroup conflicts have not taken place in the study region since the Nama uprising against German colonizers in 1904.

People in both areas are similarly dependent on the availability of natural resources. Wage employment is rare in the whole Berseba constituency, and the large majority of inhabitants makes a living from extensive livestock production on commonly managed pastures (CBS, 2004). Accordingly, in our sample about 81% state livestock production as their most important source of income, and 95% possess livestock (the sample characteristics are presented in Table A.1 in the appendix). Only 14% receive income from wage labour, among which about one-fourth are employed as herders. Livestock is not only an important source of income and food, but fulfils an insurance function and represents social status in the Nama culture as well (Klocke-Daffa, 2001). The average herd size of our sample, measured in terms of small stock units (SSU), is 119 SSU.[9] As a consequence of better resource availability, people in the high-yield area possess larger herds (mean=135 SSU, median=85 SSU) than those in the low-yield area (mean=103 SSU, median=60 SSU). Though the difference in herd sizes between the areas is not statistically significant ($Z=0.48$, $p=0.63$, $n=120$), it is economically very sizeable. Differences in grazing availability seem to affect herd composition, too, as 67% of livestock owners in the high-yield area keep cattle as compared to about 12% in the low-yield area. High-yield area farmers also own significantly more sheep than low-yield area farmers. Cattle and sheep are more demanding with respect to fodder requirements than goats and donkeys, both in terms of quantity and quality.[10] Livestock is kept around water points, and people typically rotate their livestock in a radius of about six kilometres around their houses.

3. Experimental design and procedures

We carried out 20 experimental sessions in 15 locations. Ten sessions were held in each area (high- and low-yield). Six persons participated per session, resulting in a total sample size of 120. Participants were on average 42 years old, and have attended school for about 7.4 years. Two-thirds are male. A session consists of four tasks: (1) a joy-of-destruction experiment, (2) a public goods experiment, (3) an individual follow-up questionnaire and (4) a short group

[9] Examples for small stock include goats and sheep. Large stock, like cattle, donkey and horse, are converted into SSU at the common conversion rate of 1:6 (i.e. 1 cattle is equal to 6 SSU). Though donkeys and horses are mainly kept for transport, their meat is nevertheless a component of many people's diet.

[10] Personal communication with Leon Lubbe (Chief Agricultural Researcher at the Ministry of Agriculture, Water and Forestry, November 26th 2009) and Anton Losper (extension officer in the Karas region, Ministry of Agriculture, Water and Forestry, October 5th 2009).

discussion on migration, internal conflicts and environmental problems at the very end of the session. A session lasted 90 minutes on average, including the questionnaires and discussion. All sessions were conducted between November and December 2009. This period constitutes the end of the dry season in the study area, when pasture scarcity is most pronounced.

3.1 The joy-of-destruction experiment

To investigate differences regarding antisocial behaviour across subjects and between areas, we use a one-shot version of the joy-of-destruction (JoD) experiment (Abbink and Sadrieh, 2009; Abbink and Herrmann, 2011). The design of the JoD experiment offers a simple way to analyse spiteful attitudes. In the experiment, two subjects are randomly matched. Both receive an initial endowment of N$10 (equivalent to PPP US$1.6) and have to decide whether or not to reduce ("burn") the other player's income by N$5 at an own cost of N$1.[11] Thus, destruction entails no material benefits for the destroying subject but a personal sacrifice. Because it is played one-shot and decisions are made anonymously, strategic aspects should not matter and *not burn* is the strictly dominant strategy of a rational self-concerned player. The experiment has three possible outcomes that are summarized in Table 1: First, both subjects decide not to reduce the other's income. In that case each subject remains with N$10. Second, each subject decides to destroy the other's income, leaving both with N$4. Third, one subject reduces the other's return while the other does not, resulting in an unequal payoff distribution of N$9 for the destroying party and N$5 for the victim of destruction. After a subject had made her decision, she was asked to state her expectation about the interaction partner's choice. The elicitation of beliefs was not incentivized, i.e. subjects were not reward for having the right belief.

< Table 1 about here >

3.2 Design of the public goods experiment

In a public goods experiment cooperation is required to achieve socially optimal outcomes while incentives for free-riding are present. In the applied version, the participants are randomly and anonymously divided into two groups of three members. Each member is endowed with N$10 and has to decide how much she wants to contribute to a public account

[11] Subjects were asked "Do you want to pay one dollar to reduce your partner's income by 5 dollars?" In the following, however, we use the terms "burn", "destroy" or "reduce" interchangeably.

(referred to as *project* in our study) and how much to keep for herself. People can contribute any integer value between N$0 and N$10. The dollars kept constitute the private earnings, while those contributed determine earnings from the public good. For each N$1 contributed, each participant receives N$0.5 from the public good, irrespective of whether she contributed any. Because the marginal per-capita return from the public good is lower than that from the private account, keeping all the money is the dominant strategy of a rational actor motivated by self-interest. However, if nobody contributes, individual earnings are lower than in the socially optimal situation, where all contribute their entire endowment (N$10 compared to N$15). The gap between self and social interest captures the dilemma inherent to public goods. The PG experiment is played one-shot and decisions are made anonymously. After a player had made her contribution decision, she was asked whether or not she believes that the other two group members have made a positive contribution.

3.3 Experimental Procedures

The standard procedures of economic experiments were applied: Communication among participants was strictly prohibited. All decisions were made anonymously and in private and neither the group composition in the PG experiment nor the identity of the interaction partner in the JoD experiment were disclosed to the participants. We used uniform instructions that were translated from English into Afrikaans and presented orally by a local field assistant. We employed the same field assistant for all twenty sessions. One co-author was always at present. The experiments were conducted by pen and paper.

The experiments were carried out consecutively, without a break in between. To control for order effects, we alternated the sequence in which the experiments were held (i.e. half of all sessions started with the JoD (PG) experiment). Both games were played for one single round. That way we could eliminate strategic aspects like reputation building or the fear of retaliation that arise from repetition of the game (Cubitt et al., 2011). A potential drawback of one-shot designs is that subjects cannot learn from experience. To overcome this, we put special emphasis on detailed explanations and gave numerous examples to ensure that all participants understood the mechanisms of the games (the instructions included examples and are provided in the appendix). In addition, subjects were encouraged to pose questions that were asked and answered in private.

Subjects were paid individually and privately at the end of the entire session. They earned on average N$30.5 (PPP US$5), including a show-up fee of N$10. In comparison, the daily salary of a wage-worker in the study region amounts about N$40.

3.4 Recruitment

Due to the very low population density in the study region, and the fact that settlements and livestock posts are far scattered within the large territory, recruitment was a challenging task. Most locations are livestock posts that comprise four to eight houses. Logistically, it would have been extremely time-consuming –and sometimes impossible- to bring together people from different locations. Because of this and the fact that we tried to avoid having more than one participant from the same household, we considered livestock posts with six or more houses only. Thirteen locations fulfilled this requirement and are considered in this study. The remaining seven sessions were held in two settlements: four sessions in Kutenhoas (high-yield area, comprised of 32 households) and three in Snyfontain (low-yield area, comprised of 27 households).[12] To minimise cross-talk confounds in these two villages, participants were recruited right before the session started. Results from Kruskal Wallis tests provide no evidence for cross-talk or contagion effects.[13] We invited one person per household to participate. In case of more than 6 households per location, we randomly determined the households that could send a member for participation. In the two bigger settlements the experiments were conducted in the kindergarten and school; on livestock posts where these facilities were not available, sessions took place open-air.

4. Conjectures

The central question addressed in this paper is whether certain economic behaviours emerge under different degrees of resource scarcity. A natural starting point for the formulation of conjectures is to draw on theoretical models. Yet, neither the homo oeconomicus approach nor models on other-regarding preferences help in deriving predictions regarding cross-area differences. Based on the assumption that people are rational and solely interested in

[12] A Mann-Whitney U test assessing whether the mean contributions in the PG experiment differ between settlements and livestock posts cannot reject the null hypothesis of equal means, neither for the low-yield area (p=0.17) nor for the high-yield area (p=0.29). The same applies for burning decisions in the JoD experiment according to a Fisher's exact tests (p=0.37 in the high-yield area p=0.39 in the low-yield area).

[13] Kruskal Wallis tests performed to test for differences among the sessions held in Snyfontain (Kutenhoas) yield a p-value of p=0.53 (p=0.74) for the PG experiment and p=0.20 (p=0.51) for the JoD experiment.

maximizing their own payoffs, the homo oeconomicus model for example would predict that nobody will burn money in the joy-of-destruction game and everybody will contribute zero in the public goods game. This prediction holds irrespective of whether the subject resides in an area with plenty of resources or scarce resources. Although models on other-regarding preferences typically allow for heterogeneous preferences, the neglect of potential interactions between behaviour and contextual factors, such as the exposure to resource scarcity, is also a common feature of them (e.g. Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999). However, models in evolutionary biology postulate a positive relationship between resource scarcity and spite or competitiveness (e.g. Lehmann et al., 2009). Based on that and recent evidence from empirical studies in economics (e.g. Miguel, 2005) and psychology (e.g. Shah et al., 2012) we assume that resource scarcity does affect behaviour. In particular, we expect a higher incidence of antisocial behaviour in the low-yield area where resources are scarcer.

Predictions regarding the relationship between scarcity and cooperation are less clear. Both, theoretical and empirical evidence is mixed in this regard. Several scholars emphasize the important cooperation-enhancing effect resource scarcity may have (e.g. Arnold, 1998; Platteau, 2000; Ostrom et al., 1999; Ostrom, 1992). Ostrom (1992), for example, postulates that resource users need to be exposed to scarcity before cooperation strategies evolve. Otherwise, if a resource is very abundant, she argues, users face little incentives to engage in cooperation. Yet, other authors argue that scarcity will spur appropriate competition and hence impede cooperation (Grossman and Mendoza, 2005). On the empirical side, there are some studies finding a positive correlation between experimentally induced scarcity and cooperation (e.g, Rutte et al., 1987; Osés-Eraso et al., (2008)), while others come to the opposite result (e.g. Blanco et al., 2012; Varghese et al., 2013). We hence do not have a clear hypothesis regarding cooperation behaviour and exposure to real-life resource scarcity.

5. Results

Our empirical analysis is separated into three parts. Section 5.1 and 5.2 examine individual behaviour in the joy-of-destruction game and in the public goods game, respectively. In section 5.3, we exploit the within-subject design to analyse subjects' behaviour across both games. Our main interest lays in behavioural differences between the low-yield and the high-yield area.

5.1 Joy-of-destruction experiment and resource scarcity

Thirty-two per cent (38 out of 120) of all subjects decided to reduce their partner's income in the JoD experiment, though this came at an own cost.[14] This clearly contradicts the predictions of the homo oeconomicus model, but is in line with results from related studies (e.g. Abbink and Sadrieh, 2009; Abbink and Herrmann, 2011; Zhang and Ortmann, 2012). As illustrated in Figure 3, money burning happened more frequently in the low-yield area. There, 40% of all subjects destroyed their partner's income, compared to 23.3% in the high-yield area. A Fisher's exact test rejects the null hypothesis that subjects from both areas are equally likely to destroy money against the one-sided alternative (p=0.04).

< FIGURE 3 about here >

Table 2 displays the results of linear probability regressions where we regress subject's burning decision (y=1 if subject burns money) on area of residence, beliefs and further covariates.[15] In line with our conjecture and descriptive results, we find a statistically significant and economically sizeable difference between areas in the incidence of antisocial behaviour. In the first model of Table 2, the probability for destroying money increases by about 17 percentage points if the subject was from the low-yield area. The area effect remains significant across all specifications. Hence, we come to the following result for the joy-of-destruction game:

> ***Result 1:*** *Antisocial behaviour occurs significantly more frequently in resource scarce areas.*

Unsurprisingly, we further find individuals' beliefs about the other player's behaviour to have very strong predictive power for burning decisions: The probability of choosing to destroy another person's income increases by about 66 percentage points if the subject expected that she herself will suffer a destruction of income.[16] Twenty-five per cent of the sample had negative beliefs, and among them 81% reduced the other's income. This closely resembles the results of Abbink and Herrmann (2011), who report that 86% of the money burners had

[14] Demand effects might affect the absolute frequency of antisocial behaviour revealed in the JoD experiment. Yet, the presence of demand effects should not drive differences in behaviour between the high-yield and low-yield area, on which this paper focusses.

[15] We obtain qualitatively the same results if we use probit models (see Table A.2 in the appendix).

[16] Because our estimates become more precise if we include beliefs, we keep it in all other models reported in Table 2. The difference between areas, however, remains significant if we exclude beliefs from the regressions (see Table A.3 in the appendix).

negative beliefs.[17] In our sample, this kind of "conditional" or "pre-emptive" spite occurs more frequently in the low-yield area, where 93% destroyed money when they expected to become victims of destruction, compared to 69% in the high-yield area. It is also worth analysing behaviour of subjects who did *not* expect their counterparts destroying their money. In the low-yield area, 22% of them nevertheless burned money, compared to 7% in the high-yield area. From estimation 3 in Table 2, it becomes visible that this difference is significant between areas (t=1.93, p=0.06).[18]

< TABLE 2 about here >

By controlling for the number of friends and members of the extended family within the same group as well as for smouldering conflicts with other group members, we also account for the possibility that social relationships to other group members may affect decision making in the JoD game. The negative signs of *Number of friends* and *Number of family member* suggest that respectively the more friends and family members in the same group are the lower is the probability for destroying another group member's money, but the effects are not significant at conventional levels. The same applies for conflicts with other group members. Table 2 further reveals that neither the chronological sequence in which the two experiments were performed nor the amount contributed in the PG experiment have explanatory power for burning decisions. Socio-demographic characteristics do not seem to affect behaviour in the JoD game either.

From regressions 4-7 in Table 2 it further becomes apparent that subjects whose main source of income is farming do not behave differently than wage workers and pensioners, who constitute the reference category of *farmer*. We also explore whether differences in absolute and relative income affect burning decisions. As a proxy for income, we use subjects' herd size, which is measured in terms of small stock units. Regression 4 shows that people with larger herds tend to be less likely to destroy money, but the economic effect is small. Interestingly, there is no evidence for interaction effects between *herd size* and *low area* (estimation 5), suggesting that absolute herd size has similar effects in both areas. To examine

[17] Since the elicitation of subjects' beliefs was not incentivized in our setup, we cannot rule out that at least some money burners pretended having a negative expectation even though they had not in order to justify nasty acts. However, if we regress player i's destruction decision on her belief and the frequency of destruction decisions of the other session members j=1…5, it turns out that the group variable is insignificant while individual expectation remains significant. This suggests that individual beliefs were accurately describing other people's behaviour.

[18] Due to the inclusion of the interaction term between belief and area in model 3, there *low-yield area* informs about differences between areas for subjects who did not have negative beliefs.

the impact of a subject's relative income position within her group, we divided groups according to herd size into tertiles. From model 6 in Table 2 we can see that subjects in the upper tertile are significantly less likely to burn money than those in the lower tertile, suggesting that positional concerns mattered indeed.

Apparently, herd size is a fairly good proxy for farmers' income, but not for that of wage workers and pensioners. For the latter two groups, livestock production typically constitutes a secondary source of income. As a robustness test, we hence run the same regressions as in Table 2 for a sample restricted to farmers (n=97). When doing so, it turns out that the effects of relative and absolute income (and of all other covariates) are the same as those obtained for the entire sample, with the exception that significance for the upper tertile of herd size vanishes (see Table A.4 in the appendix). Since the area difference remains highly significant if we control for subjects' absolute and relative income, we infer that income poverty alone does not explain the higher incidence of antisocial behaviour among low-area residents.

Finally, in model 7 of Table 2, we replace *low area* by a variable that captures individuals' perception about the quality of their pasture. This variable is highly correlated with the area dummy (ρ=.44, $p<.001$). It takes the value of 1 if the subject was the opinion that the pasture is of poor or very poor quality and 0 otherwise. We observe a significant higher incidence of antisocial behaviour (i.e. burning decisions) among those who had negative perceptions about the state of their resource base. Separate regressions for each area reveal that this is the case for both areas (see Table A.5 in the appendix). In the high-yield area, only 6 out of 59 subjects were the opinion that their pastures are of poor or very poor quality. Among those 6 subjects, 3 decided to reduce their partner's income. In the low-yield area the majority (51.7%) assessed the quality as poor or very poor and 45 per cent of them were willing to destroy money. We interpret these finding as further evidence for our claim that the exposure to resource scarcity increases subject's readiness to engage in spiteful acts.

5.2 Public goods experiment and resource scarcity

In this section we investigate whether and how differences in resource availability affect resource users' willingness to cooperate. As a proxy for cooperativeness, we use the fraction of endowment a subject contributed towards the group account in the one-shot public goods experiment. Taking the entire sample, only 7.5% made zero contributions. This fraction of strict free-riders is substantially lower than in related studies held with western students (e.g. Fischbacher and Gächter, 2010; see Biel and Thogersen (2007) for a review of one-shot PG

experiments). At the other extreme, we found about 12% of participants in the high-yield area and 15% in the low-yield area contributing their entire endowment. On average, subjects gave 46% of their initial endowment.

Turning to a comparison between areas, we find cooperation levels to be slightly higher in the low-yield area (N$ 4.73, i.e. 47%) as compared to the high-yield area (N$ 4.45), but the difference is statistically not significant (Z=0.539, p=0.589). OLS regressions of individual contribution decisions on the same covariates as considered above confirm our descriptive results (see Table 3). The positive coefficient of the treatment variable (*Low-yield area*) found across all specifications in Table 3 indicates that low-yield area subjects tend to contribute slightly more than their counterparts from the high-yield area, but the difference is not statistically insignificant.[19] Perceptions about the quality of the pasture and beliefs about the contribution decisions of the other two group members do not seem to affect cooperation behaviour either.

> ***Result 2:*** *A higher degree of resource scarcity does not hamper subject's willingness to cooperate.*

Apparently, the only independent variables considered in Table 3 that had an impact on individual' cooperativeness are *JoD first* and *Upper tertile herd size*. The positive sign of *upper tertile* indicates that people with larger herd sizes (our proxy for income) make higher contributions than those in the lowest tertile. The variable *JoD first* controls for task order effects and takes 1 if the session started with the JoD game and 0 otherwise. Its negative sign suggests that ceteris paribus subjects contributed smaller amounts if the JoD game was conducted at first. Then, average contributions amounted to N$3.86, compared to N$5.3 if the session started with the PG experiment. According to Mann-Whitney U tests, the difference is highly significant for the entire sample (Z=3.003, p<0.01) as well as for the subsamples from the low-yield area (Z=2.212, p=0.03) and the high-yield area (Z=2.065, p=0.04).[20] Hence, the mere exposure to a "conflictive" experimental environment appears to crowd-out cooperativeness among participants in a subsequent experimental situation.[21] A similar

[19] We obtain qualitatively very similar results when performing double-censored Tobit regressions instead of OLS (Table A. 6 in the appendix). The only difference is that in the Tobit regressions player's expectations are significant at the 10 per cent level in regression 2.

[20] The incidence of money burning behaviour does not systematically vary with the chronological order in which the experimental tasks were carried out (Fisher's exact test: p=.556; see also Table 2).

[21] Consistent with that, Capra (2004) and Kirchsteiger et al. (2006) report lower levels of prosocial behaviour if subjects were induced with a negative mood as compared to a situation in which they were induced with a positive mood. Psychologists refer to a related phenomenon as the "licensing effect", where people show an

observation has been made by Herrmann and Orzen (2008), who report a substantial reduction in cooperation levels in a prisoners' dilemma game after subjects had participated in the competitive environment of a rent-seeking contest.

<TABLE 3 about here>

5.3 Individual behaviour across experiments

So far we have examined whether certain economic behaviours emerge under different degrees of resource scarcity. At group level, we found a higher incidence of antisocial behaviour under scarcer conditions but no differences regarding cooperative behaviour. A related question is whether an individual's inclination towards other players is principally the same across the two different experimental contexts. Most previous studies have either focused exclusively on prosocial behaviours, or exclusively on antisocial behaviours, but have rarely investigated whether both coexist within one and the same individual. Exceptions are the studies by Herrmann and Orzen (2008) and Sadrieh and Schröder (2012), as well as recent work on parochial altruism (e.g. Abbink et al., 2012; De Dreu et al., 2010).

<TABLE 4 about here>

Each of our experiments leaves the decision-maker with two strategies: *burn* or *not burn* in the JoD experiment and *cooperate* or *free-ride* (i.e. contribute zero) in the PG experiment. For the sequence of both games we hence obtain four possible cross-game strategy combinations which are summarized in Table 4.[22] The first one is *not burn* and *free-ride*, which is the dominant strategy combination of a purely self-regarded individual only interested in maximizing the own material payoff. In our sample, only 8 individuals (6.7%) reveal such a behavioural pattern. A large majority of 62% do not burn money either, but contribute positive amounts (i.e. cooperate) in the PG experiment, and hence display prosocial inclinations. This pattern of *not burn* and *cooperate* can be explained by a range of models on other-regarding preferences, and may be motivated by altruism, inequity aversion or concerns for social efficiency. However, our study was not designed to distinguish between underlying

increased tendency to act 'immorally' if they have already displayed 'moral' behavior (see e.g. Monin and Miller, 2001).

[22] Given the simultaneous one-shot design of the experiments we exclude strategy combinations based on (sequential) reciprocal behaviour. In models on reciprocity, decisions may depend on beliefs about the interaction partners' player type (e.g. Levine, 1998) or intension (e.g. Falk and Fischbacher, 2006), and multiple equilibria are possible.

motives of prosocial behaviour. The third possible cross-game strategy combination is *burn* and *free-ride*, which may be the preferred option for individuals solely guided by a desire to maximize one's relative payoff. Subjects yielding a utility gain from reducing another's income for the mere purpose of increasing one's relative payoff are typically referred to as spiteful (e.g. Falk et al., 2005; Fehr et al., 2008) or competitive (e.g. Charness and Rabin, 2002) player types. Among those 38 subjects who burned money in the JoD experiment, only one person free-rode in the PG experiment by making zero contribution. All others made positive contributions. That is, only one subject exhibited a behavioural pattern that is consistent with a purely spiteful "trait". By contrast, 14% of money burners gave their entire endowment toward the public good. A simple comparison of the average contribution levels in the PG experiment further reveals that money-burners tend to be *more* cooperatively than non-burners: The first contribute on average 51.3% of their endowments as compared to 43.4% given by non-burners (this also holds for different orders of the experimental games). The difference is only marginally significant in a Mann-Whitney U test (Z=1.68, p=0.09) and turns insignificant in the multivariate analyses (see Table 2 and 3). Yet, the result clearly demonstrates that people who exhibit a disposition toward spiteful behaviour in a conflictive experimental environment are not necessarily less cooperative in a social dilemma situation. Table 4 demonstrates that the mixed cross-game strategy combination *burn* and *cooperate* occurs significantly more frequently (Fisher's exact: p=0.06) in the low-yield area as compared to the high-yield area.[23]

Result 3: *Spiteful and cooperation behaviour coexists within individuals*

6. Discussion

The analyses in section 5.1 reveal a striking and highly significant difference in the incidence of spiteful money burning behaviour across areas dependent on availability of natural resources. In the area where resource scarcity is more prevalent, 40% of all subjects displayed a readiness to destroy their fellow resource users' income at an own cost, compared to 23% in the high-yield area. This difference between areas is unlikely to be attributed to distinct cultural, institutional or political backgrounds. All our subjects live in the same political constituency and share the same ethnicity (Nama). The higher incidence of spite in the

[23] When we impose a stricter definition of *cooperate*, by considering only those subjects as cooperative who contributed 5 or more tokens in the PG (mean = 4.6 tokens), we still find a significantly (p=.03) higher incidence of mixed behaviour in the low-yield area (25%) than in the high-yield area (10%). According to this definition of cooperation, we would classify 39% of the total sample as *selfish* (i.e. do not burn in the JoD game and contribute less than 5 in the PG game), 29% as *prosocial*, 14% as *antisocial*, and 18% as having *mixed* motives.

resource scarce area does not seem to be rooted in income poverty either. We include subjects' herd size as a measure for income in our regression analyses and still obtain a significant difference between areas. Differences in observable socio-economic characteristics neither can explain why antisocial behaviour is more prevalent among low-yield area residents. The same applies for smouldering conflicts: At individual level, we directly accounted for the possibility that conflicts with other group members could have triggered spiteful attacks, but it turned out to be insignificant in multivariate regressions.[24] Moreover, anthropological research (Klocke-Daffa, 2001) conducted in the study region does not report any inter- or intragroup conflicts for the last hundred years.

We argue that the main difference between the two areas is the exogenous variation in resource availability which stems from geological peculiarities and which allows us to estimate the effect of relative scarcity on behaviour.[25] We provide direct evidence for this claim as we find a strong correlation between subjects' perceptions about pasture quality and money burning decisions: Those who perceived their pasture's quality as poor or very poor were significantly more likely to burn money than those who held the quality for good. This observation has been made for both areas.

A positive correlation between spiteful behaviour and resource scarcity is in line with theoretical models (e.g. Lehmann et al., 2009) arguing that spite can be evolutionary favorable, particularly in periods of scarcity and high competition, as it increases the agent's fitness relative to the harmed competitor. Our result is also consistent with previous empirical evidence demonstrating that people are more likely to engage in antisocial acts if exposed to a higher degree of competition (e.g. Charness et al., 2011; Balafoutas et al., 2012) and/or resource scarcity (Miguel, 2005). Unlike Miguel's study, however, we can preclude economic efficiency concerns as an explanation for antisocial behaviour. In our setup, people who engage in money burning behaviour do so at an own cost and overall welfare is reduced.

There are several possible explanations on the motivations behind one's readiness to engage in antisocial behaviour, including a desire for payoff dominance, (e.g. Falk et al., 2005; Fehr et al., 2008), concerns for social status (e.g. Charness et al., 2011; Balafoutas et al., 2012), or a pure pleasure of being nasty (Abbink and Sadrieh, 2009). Although our research design does not allow us to provide insights on motivations, we can infer that concerns about relative payoffs seem to loom larger in resource scarce areas. Psychological research shows that

[24] We also gathered information about disputes at village level by asking participants during the post-game group discussion whether there have been any unsolved conflicts among residents. This was abnegated in all sessions.
[25] At the same time, population densities are similar in both regions and migration is strongly limited.

persons "*selectively perceive those social objectives that are most relevant to currently salient roles*" (McCall and Simons, 1978);[26] and that scarcity alters the way in which people allocate their attention (Shah et al., 2012). Related to our research, it might be that people who live in a more competitive environment and who hence need to try harder in sustaining their livelihood are more inclined to perceive their interaction partner in the JoD experiment as a competitor against whom one has to prevail. This perception might result in stronger concerns for relative payoffs (see e.g. Eaton and Eswaran, 2003) and a reduced willingness to take the risk of "falling behind" (by not burning). Further, there is evidence that the exposure to competition negatively affects emotions and people's disposition towards others (Brandts et al., 2009), which might also lower the inhibition threshold to engage in antisocial behaviour. In line with that, we find the incidence of money burning despite *positive* beliefs about the interaction partner's behaviour to be significantly higher among residents in the resource scarce area. There, 22% of all subjects who did not expect to become victims of unkind treatment nevertheless decided to reduce the other's income, compared to 7% in the high-yield area. We interpret such behaviour as a clear indication for negative dispositions towards others.

Our analyses further suggest that resource scarcity does not impede subjects' willingness to cooperate; at least as long as a sub-survival level of scarcity has not been exceeded. This result is in line with the proposition that scarcity may be conducive to collective action (see e.g. Ostrom et al., 1999). People in our study region share a long tradition of joint common-pool resource management. In both areas they strongly depend on mutual cooperation to sustain the resource base they live on, which may also explain why cooperation is similar across areas. Other experiments conducted in the study region report high levels of cooperation as well (Prediger et al., 2011; Vollan, 2008; 2012). Examples of every-day cooperation among farmers range from joint efforts to maintain their water infrastructure, to watching others' livestock or helping out in times of financial need (Klocke-Daffa, 2001). The result can also be explained from an evolutionary perspective. Assuming that periodic changes in the availability of resources shaped the evolution of human behaviour (see e.g. Choi and Bowles, 2007), one would expect the evolution of brains that quickly recognize and exploit the chance for socially efficient interactions in which net gains from cooperation can be realised. From that perspective, it would be detrimental to the survival chances of the human species if the predisposition to spot and use such non-zero sum interactions were

[26] For example, McCall and Simons (1978) write "[…] *as he drives down the street, a hungry man is most likely to perceive an EAT or CAFÉ sign, and a man with a headache is most likely to perceive a DRUGS sign.*"

reduced during a period of scarce resources. Consistent with that, Rand et al. (2012) show that cooperative behaviour follows an intuitive impulse, rather than reflective reasoning. From our results it appears that scarcity (if not directly life-threatening) does not reduce this human impulse for cooperation.

Turning to a more puzzling result, we found that subjects displaying a spiteful inclination in the JoD experiment tend to behave more cooperatively in the PG experiment than non-burners. Though more prevalent in the low-yield area, this observation holds for both areas. and is consistent with the idea that individual's motivation can strongly depend on the economic environments in which they are acting (see e.g. Brandts et al., 2009; Bowles, 2008; Dreber et al., 2013; Vollan and Ostrom, 2010). There are some other studies observing a coexistence of antisocial and prosocial behaviour within individuals (e.g. Abbink et al., 2012; Herrmann et al. 2008; Herrmann and Orzen, 2008; Sadrieh and Schröder, 2012).[27] The work closest to ours in that respect are the papers by Herrmann and Orzen (2008) and Sadrieh and Schröder (2012). Herrmann and Orzen (2008) find a large fraction of subjects trying to maximize payoff differentials in the context of a Tullock rent-seeking game, thereby willing to spend parts of their endowments to reduce the income of other players. They show that both selfish subjects and prosocial subjects (as measured in a prisoners' dilemma game) turn into (advantageous) inequity-affine players when entering the rent-seeking contest. Sadrieh and Schröder (2012) study the give-and-destroy experiment that combines positive and negative decision-making domains in a within-subject design. They find a surprising high share of student subjects willing to pay for both increasing as well as destroying others' income. The authors attribute this kind of behaviour to people's desire to influence others. We cannot exclude this being the case for our subjects. However, at least with regard to spiteful actions our results suggest that the desire to influence others would be context dependent: The higher real-life resource scarcity, the more "influencers" turn spiteful.

Probably a more appealing explanation for our results would be that both absolute and relative payoff considerations matter for choices, and that people distinguish between situations that leave scope for efficiency improvements and those that do not. The PG game provides a setup where substantial net gains from mutual cooperation can be realized. In such an environment

[27] Herrmann et al. (2008), and Gächter and Herrmann (2009), for example, observed in many places subjects which would first contribute to a public good but to punish afterwards group members which contributed more than they themselves. However, this behavioural pattern, dubbed "antisocial" or "perverse" punishment, occurs as a not particular congruent set of social preferences, but can be explained in the logic of the dynamic of a repeated public goods game where a low contributing group member might punish high contributors in retaliation of anticipated punishment from the high contributors.

people may put more weight on efficiency concerns and absolute outcomes than in the JoD experiment, where mutual cooperation does not create net gains. In addition, it seems that many subjects' perceived the JoD experiment as a more conflictive environment than the PG experiment, which might undermine prosocial inclinations and trigger concerns for relative outcomes. Two observations provide evidence for that claim: First, negative expectations or beliefs about the interaction partner's choice are twice as frequent in the JoD game as in the PG game. Second, contributions levels in the PG experiment are significantly lower when conducted after the JoD game as compared to when held at first.

7. Conclusion

We examined how differences in the exposure to real-life competition for scarce natural resources affect cooperative and spiteful behaviour among Namibian pastoralists in two experimental environments. As a measure for the degree of resource scarcity, we used exogenous variations in the average biomass production in the research region. To our best knowledge this is the first study investigating the relationship between real-life resource scarcity and experimentally measured behaviour.

Our study obtains three main results. First, we observe a strongly positive correlation between resource scarcity and spite: Subjects' readiness to engage in antisocial behaviour is much more prevalent in the area where natural resources are scarcer and hence where competitive pressure among resource users must be assumed stronger. In the resource-scarce area, almost twice as many subjects decided to destroy their fellow resource user's income at an own cost. Second, we find levels of cooperation to be similar across areas. This suggests that a stronger exposure to resource scarcity does not hamper cooperativeness; at least as long as a sub-survival level of scarcity has not been exceeded. Third, we provide evidence for the coexistence of antisocial and prosocial behaviour within individuals (absent motives of parochial altruism). Almost all individuals displaying antisocial attitudes in the joy-of-destruction game exhibit cooperative behaviour in the public goods experiment. Unfortunately, with the data at hand it is not possible to give an ultimate answer to the question of why both behaviours coexist within individuals. It appears that a substantial fraction of subjects are willing to behave prosocially if mutual cooperation can generate net gains, but turn to inequity-affine money burners in an experimental environment where efficiency cannot be enhanced and the risk of falling behind is more salient. In any case, this

observation suggests that individuals' motivations can strongly depend on the economic environment they are facing.

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TABLES

TABLE 1: Payoff table for the joy-of-destruction experiment

Player B / Player A	Burn	not burn
burn	**4 / 4**	**9 / 5**
not burn	**5 / 9**	**10 / 10**

TABLE 2: Determinants of individual burning decisions in the Joy-of-destruction game

Y= Money burning	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Low-yield area	0.167**	0.178***	0.154*	0.159**	0.198**	0.165**	
	(0.074)	(0.057)	(0.078)	(0.062)	(0.087)	(0.068)	
Perception of poor pasture quality							0.214**
							(0.079)
Negative belief		0.664***	0.619***	0.678***	0.668***	0.683***	0.656***
		(0.085)	(0.112)	(0.085)	(0.091)	(0.074)	(0.081)
Negative belief x Low area			0.092				
			(0.169)				
Socio-demographics							
Male				0.012	0.020	0.017	0.009
				(0.079)	(0.080)	(0.080)	(0.078)
Age				-0.000	-0.000	-0.000	-0.000
				(0.003)	(0.003)	(0.003)	(0.004)
Education (highest grade)				0.006	0.006	0.007	0.003
				(0.018)	(0.018)	(0.019)	(0.018)
Economic situation							
Farmer				-0.063	-0.059	-0.094	-0.033
				(0.073)	(0.075)	(0.059)	(0.066)
Herd size				-0.000**	-0.000		-0.000**
				(0.000)	(0.000)		(0.000)
Herd size x Low-yield area					-0.000		
					(0.000)		
Middle tertile herd size						0.052	
						(0.077)	
Upper tertile herd size						-0.156**	
						(0.072)	
Social relations to other group members							
Number friends				-0.024	-0.026	-0.030	-0.018
				(0.018)	(0.018)	(0.019)	(0.018)
Number family members				-0.018	-0.019	-0.022	-0.015
				(0.021)	(0.021)	(0.022)	(0.021)
Conflict with others				0.062	0.050	0.067	0.043
				(0.092)	(0.085)	(0.104)	(0.102)
Other controls							

JoD first				-0.045	-0.048	-0.044	-0.067
				(0.056)	(0.054)	(0.061)	(0.071)
Contribution in PG				-0.009	-0.009	-0.009	-0.008
				(0.010)	(0.011)	(0.011)	(0.010)
Constant	0.233***	0.056	0.068*	0.280	0.274	0.291	0.285
	(0.043)	(0.037)	(0.034)	(0.265)	(0.269)	(0.284)	(0.284)
Observations	120	120	120	120	120	120	119
R-squared	0.032	0.423	0.424	0.474	0.477	0.489	0.487
F	5.011	93.97	66.97	119.7	147.8	169.1	38.08
P	0.037	0	0	0	0	0	0
Adjusted R-squared	0.024	0.413	0.410	0.415	0.413	0.427	0.429

Notes: Linear probability models. Dependent variable: Burning decision in the JoD experiment (burn = 1, not burn = 0). The number of observations included in regression 7 deviates from the actual sample size due to 1 missing values in *Perception of poor pasture quality***.** Regression estimations are reported with heteroskedasticity-robust standard errors clustered at session level (in parentheses). ***, **, and * indicates statistical significance at the 1%, 5% and 10% level, respectively.

TABLE 3: OLS regressions for individual contribution decisions in the public goods experiment

Y=Amount contributed	(1)	(2)	(3)	(4)	(5)	(6)
Low-yield area	0.283	0.180	0.181	0.318	0.207	
	(0.565)	(0.568)	(0.561)	(0.838)	(0.584)	
Perception of poor pasture quality						-0.009
						(0.502)
Negative belief		-1.288	-0.855	-0.837	-0.897	-0.906
		(0.808)	(1.002)	(1.032)	(0.981)	(0.989)
Socio-demographics						
Male			0.084	0.114	0.085	0.021
			(0.486)	(0.544)	(0.427)	(0.516)
Age			-0.020	-0.020	-0.018	-0.016
			(0.029)	(0.030)	(0.028)	(0.030)
Education (highest grade)			-0.147	-0.144	-0.149	-0.134
			(0.096)	(0.097)	(0.093)	(0.089)
Economic situation						
Farmer			-0.305	-0.296	-0.458	-0.265
			(0.674)	(0.677)	(0.797)	(0.663)
Herd size			0.001	0.001		0.001
			(0.002)	(0.002)		(0.002)
Herd size x Low-yield area				-0.001		
				(0.004)		
Middle tertile herd size					0.819	
					(0.613)	
Upper tertile herd size					0.977*	
					(0.556)	
Social relations to other group members						
Number friends			-0.110	-0.115	-0.105	-0.113
			(0.146)	(0.149)	(0.126)	(0.145)

Number family members			0.079	0.072	0.104	0.084
			(0.243)	(0.234)	(0.245)	(0.237)
Conflict with others			-0.745	-0.787	-0.877	-0.734
			(1.313)	(1.347)	(1.440)	(1.259)
Other controls						
JoD first			-1.389**	-1.399**	-1.406**	-1.438**
			(0.563)	(0.577)	(0.563)	(0.535)
Destroyed money in JoD			0.506	0.475	0.526	0.509
			(0.707)	(0.729)	(0.731)	(0.734)
Constant	4.450***	4.683***	7.362***	7.344***	6.857***	7.261***
	(0.421)	(0.446)	(1.607)	(1.626)	(1.568)	(1.521)
Observations	120	118	118	118	118	117
R-squared	0.002	0.024	0.118	0.119	0.137	0.119
F	0.251	1.518	3.421	3.282	8.244	3.579
P	0.622	0.244	0.008	0.009	0	0.006

Notes: OLS regressions. Dependent variable is the total amount contributed towards the public good, ranging from 0 to 10. The number of observations included in the regression deviates from the actual sample size due to 2 missing values in *Negative belief* and one missing in *Perception of poor pasture quality* (only applicable for regression 7). Heteroscedasticity-robust standard errors clustered on session level are reported in parentheses. ***, **, and * refers to significance at the 1%, 5% respectively 10% level.

TABLE 4: Summary of different cross-game strategy combinations and relative frequency

Motives	**Strategy in JoD / PG**	**Pooled**	**Low-yield area**	**High-yield area**	**Fisher's exact**
Selfish	*not burn / free-ride*	6.7%	5%	8.3%	p=0.36
Prosocial	*not burn / cooperate*	61.7%	55%	68.3%	p=0.09
Antisocial	*burn / free-ride*	0.8%	1.7%	0	p=0.50
Mixed	*burn / cooperate*	30.8%	38.3%	23.3%	p=0.06

FIGURES

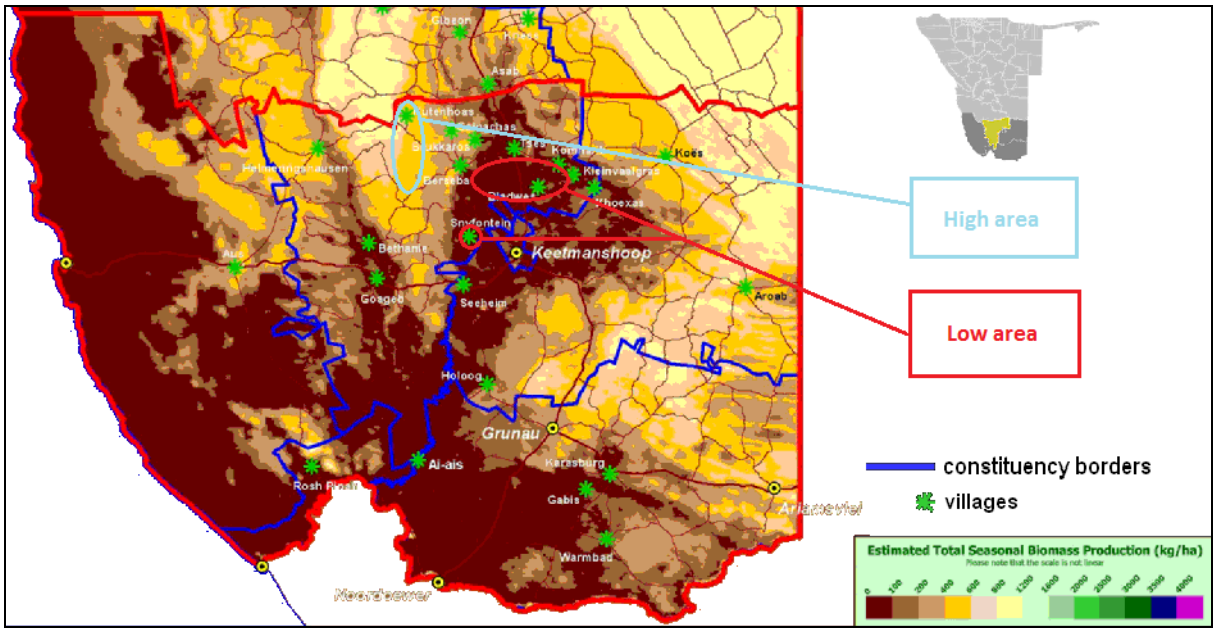

FIGURE 1: Map of estimated mean biomass production from 1985-2007 in southern Namibia.
The red line indicates the border of the Karas region. The blue lines mark constituency boundaries. The green stars are bigger settlements (e.g., Snyfontain); towns (e.g., Keetmanshoop) are marked by yellow circles. **Source**: Based on Espach et al., Agro-Ecological Zoning Programme, Ministry of Agriculture, Water and Forestry (MAWF), Windhoek (Namibia).

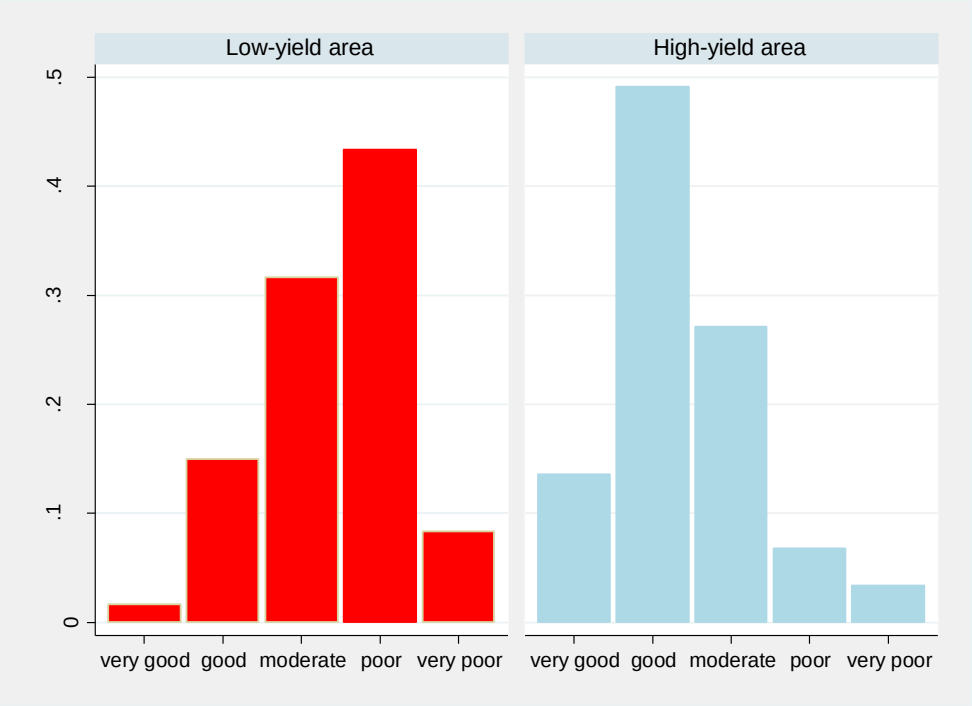

FIGURE 2: Individual perceptions of pasture quality
The left-hand and right-hand side of Figure 2 illustrates the distribution of individual perceptions about pasture quality for low-yield area and high-yield area residents, respectively. N=119

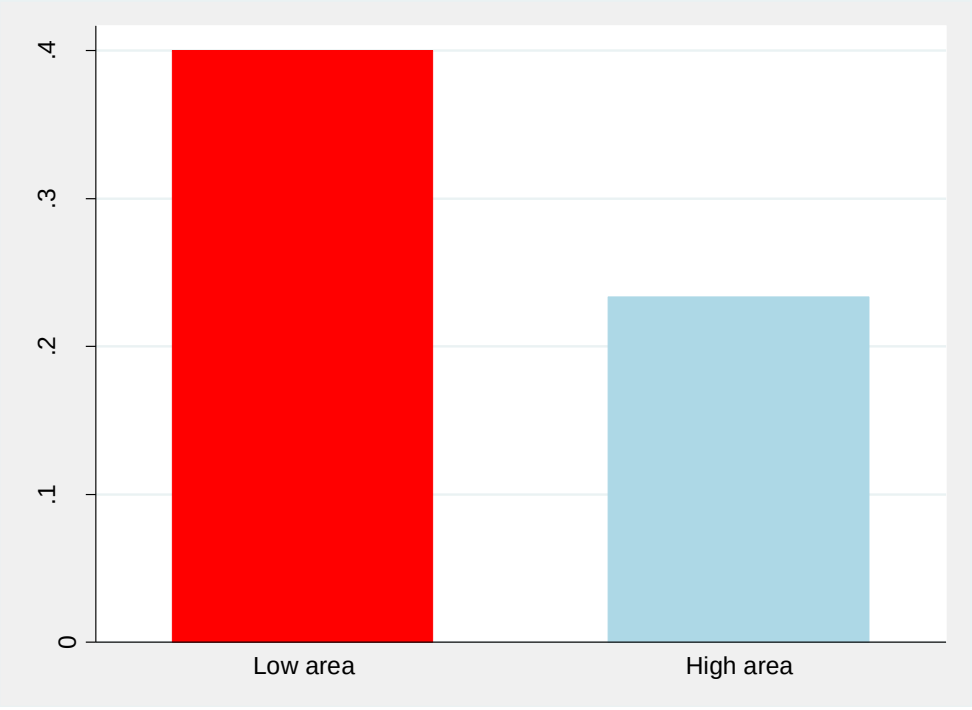

FIGURE 3: Burning rates in the joy-of-destruction game, separated by area.
The Figure shows the fraction of low-yield area (left bar) and high-yield area (right bar) residents that decided to reduce their partner's income in the joy-of-destruction minigame.

Appendix

This appendix is not intended to be published. It is a supplementary appendix and is meant to be made available to interested readers. It contains descriptive statistics, additional tables with robustness checks and sensitivity analyses and the experimental protocol.

Appendix A: Sample characteristics

TABLE A.1: Socio-demographic characteristics of the participants, separated by area

	Low-yield Area			**High-yield Area**			**Comparison**
Socio-demographics	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	p-value
Age	60	42.12	13.86	60	41.57	12.02	(M) 0.74
Male	60	0.67		60	0.63		(F) 0.85
Education	60	7.1	2.536	60	7.7	2.708	(M) 0.19
Nama ethnicity	60	1	.	60	1	.	(F) 1
Main source of income							
Farmer (livestock production)	60	0.80		60	0.82		(F) 1
Wage labour	60	0.13		60	0.15		(F) 1
Other income source	60	0.07		60	0.03		(F) 0.34
Livestock							
Livestock possession	60	0.98		60	0.92		(F) 0.21
Herd size (SSU)	60	102.97	118.38	60	135.37	211.17	(M) 0.63
Cattle	60	0.78	2.87	60	5.03	10.60	(M) 0.00
Sheep	60	7.33	32.10	60	22.43	79.50	(M) 0.01
Goats	60	47.73	73.74	60	35.63	46.50	(M) 0.38
Donkey and horses	60	7.20	5,97	60	7.85	10,38	(M) 0.29
Herd size (excluding donkeys and horses)	60	59.76	93.09	60	88.26	170.19	(M) 0.09
Other							
Number of friends	60	2.82	2,159	60	2.7	2.003	(M) 0.72
Number of family members	60	1.6	1,44	60	2.13	1.501	(M) 0.04
Conflicts	60	0.08		60	0.02		(F) 0.10

Notes: The table summarises socio-demographic characteristics of the sample, separated for each area. The far right column reports the p-values obtained from tests assessing whether the mean values of the variables are equal for the high-yield and the low-yield area. Mann-Whitney U (M) tests were applied for continuous or interval variables and Fisher's exact (F) tests for categorical variables. *Male*, *Nama ethnicity*, *Farmer*, *Wage labour*, *Other income source*, *Livestock possession* and *No friends or family* are categorical variables taking the value of 1 if the subject was male etc. The variable *Other income source* includes pensioners (4.17%) and cash transfer recipients (0.8%). *Education* ranges from 0 to 12 and measures the highest qualification completed at

school. *Herd size* is measured in terms of small stock units (SSU) and is a proxy for income generating possibilities of farmers. The variables *Number of friends* and *Number of family members* count the number of other participants within the same group/session the respondent considers as friends or members of the extended family, respectively. They range from 0 (no friends/family members in the group) to 5 (all other participants are friends/family members). The variable *No friends or family* takes the value of 1 if the respondent considered none of the other group members as a friend or family members. Finally, *Conflicts* is a categorical variable taking the value of 1 if the participant stated having a conflict with one of the other five group members.

Appendix B: Further analyses

Figure A.1 shows the distribution of the incidence of burning decisions at group level, separated by area. The number of burning decisions could have ranged between 0 (nobody in the session burned money) and 6 (all group members burned their partner's money); but the maximum is 4 and occurs in two sessions, both carried out in the low-yield area. A situation where none of the subjects burned money is observed in only one session in each area. The modes of burning rates are 2 per session in the low-yield area and 1 in the high-yield area. The corresponding mean numbers of money burners per session are 2.4 and 1.4 in the low-yield and high-yield area, respectively.

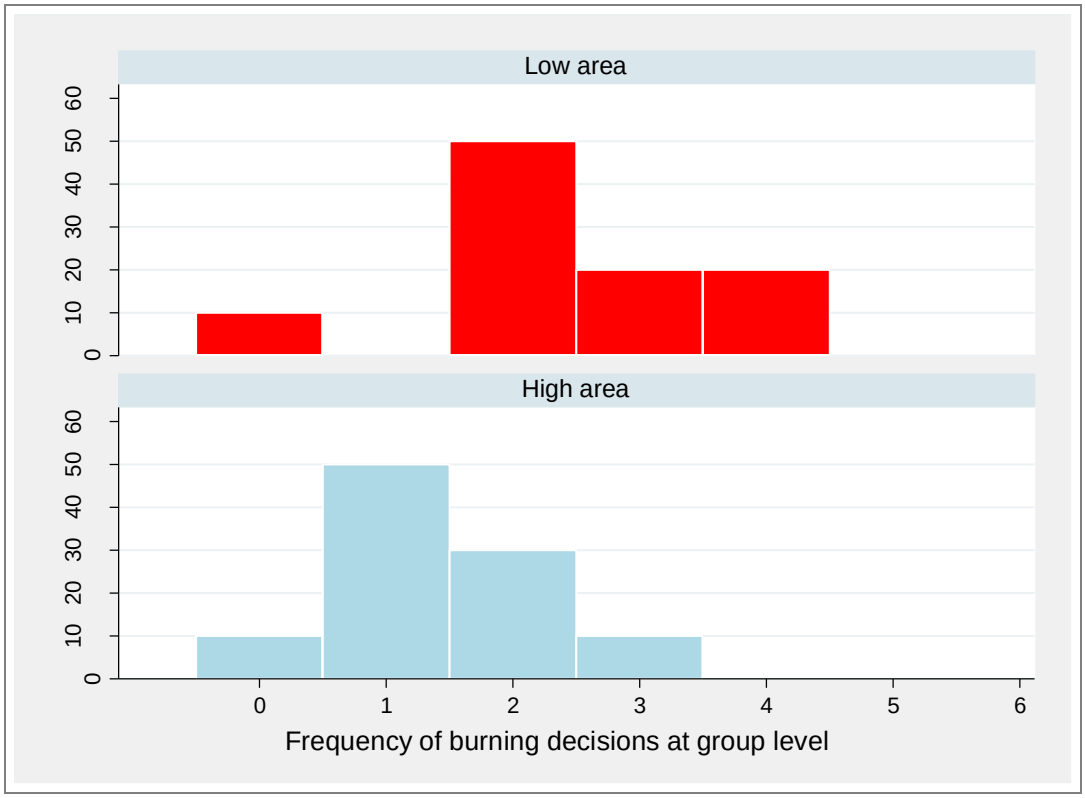

FIGURE A.1: Distribution of burning decisions in the joy-of-destruction game at group level, separated by area.
The upper (lower) part of the figure illustrates the number of money burners in the sessions carried out in the low-yield (high-yield) area.

Table A.2 reports the marginal effects for the probability of destroying money in the joy-of-destruction game after probit estimations. The table is analogous to Table 2 in the manuscript. The effects are qualitatively the same as those for the linear probability models. However, the statistical significance of the area effect is higher when we use probit estimations.

TABLE A.2: Marginal effects after Probit regressions for burning decisions in the JoD experiment

Y = burning decision	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Low-yield area	0.167**	0.263***	0.241**	0.271***	0.291**	0.291***	
	(0.074)	(0.071)	(0.111)	(0.090)	(0.137)	(0.083)	
Perception of poor pasture quality							0.336***
							(0.093)
Negative belief		0.704***	0.675***	0.802***	0.799***	0.835***	0.773***
		(0.082)	(0.110)	(0.087)	(0.096)	(0.072)	(0.080)
Negative belief x Low area			0.102				
			(0.260)				
Socio-demographics							
Male				0.042	0.043	0.031	0.012
				(0.108)	(0.109)	(0.112)	(0.124)
Age				-0.001	-0.001	-0.000	0.000
				(0.004)	(0.004)	(0.004)	(0.004)
Education (highest grade)				0.013	0.013	0.017	0.010
				(0.022)	(0.022)	(0.023)	(0.022)
Economic situation							
Farmer				-0.112	-0.116	-0.162*	-0.044
				(0.118)	(0.114)	(0.089)	(0.099)
Herd size				-0.001**	-0.001	-0.001	-0.001*
				(0.001)	(0.001)	(0.001)	(0.001)
Herd size x Low-yield area					-0.000		
					(0.002)		
Middle tertile herd size						0.098	
						(0.116)	
Upper tertile herd size						-0.172*	
						(0.104)	
Social relations to other group members							
Number friends				-0.039	-0.040	-0.048*	-0.029
				(0.025)	(0.025)	(0.028)	(0.026)
Number family members				-0.032	-0.033	-0.037	-0.028
				(0.029)	(0.029)	(0.032)	(0.028)
Conflict with others				0.115	0.108	0.078	0.133
				(0.148)	(0.143)	(0.173)	(0.167)
Other controls							
JoD first				-0.047	-0.047	-0.017	-0.099
				(0.084)	(0.083)	(0.081)	(0.103)
Contribution in PG				-0.013	-0.012	-0.008	-0.009
				(0.016)	(0.016)	(0.015)	(0.016)
Observations	120	120	120	120	120	120	119
chi2	5.088	44.42	53.04	139.3	203.1	127.6	62.79
p	0.0241	2.26e-10	0	0	0	0	6.96e-09
r2_p	0.0259	0.353	0.354	0.446	0.446	0.476	0.453
ll	-72.98	-48.49	-48.40	-41.50	-41.48	-39.28	-40.80

Notes: Probit regressions. Dependent variable: Burning decision in the JOD experiment (burn = 1, not burn = 0). The table reports the marginal effects for the probability of burning the partner's income. Regression estimations

are reported with heteroskedasticity-robust standard errors clustered at session level (in parentheses). ***, **, and * indicates statistical significance at the 1%, 5% and 10% level, respectively

In Table 2 in the manuscript we include individual's beliefs as an explanatory variable as it has high explanatory power and increases the precisions of the estimations. Table A.3 reports the results of linear probability regressions if beliefs are excluded. It becomes visible that the area effect remains statistically significant across all specifications but in model 4. There. the t-value is 1.66 and the corresponding p-value is 0.11.

TABLE A.3: Determinants of individual burning decisions in the Joy-of-destruction game, excluding beliefs as explanatory variable

Y= burning decision	(1)	(2)	(3)	(4)	(5)
Low-yield area	0.167**	0.131*	0.243***	0.137	
	(0.074)	(0.076)	(0.083)	(0.082)	
Perception of poor pasture quality					0.248**
					(0.087)
Socio-demographics					
Male		0.029	0.052	0.034	0.022
		(0.094)	(0.098)	(0.095)	(0.093)
Age		-0.003	-0.004	-0.003	-0.003
		(0.004)	(0.004)	(0.004)	(0.004)
Education (highest grade)		-0.016	-0.013	-0.015	-0.018
		(0.020)	(0.021)	(0.021)	(0.021)
Economic situation					
Farmer		0.023	0.032	-0.005	0.057
		(0.093)	(0.093)	(0.097)	(0.092)
Herd size		-0.000*	-0.000		-0.000*
		(0.000)	(0.000)		(0.000)
Herd size x Low-yield area			-0.001***		
			(0.000)		
Middle tertile herd size				0.052	
				(0.114)	
Upper tertile herd size				-0.127	
				(0.097)	
Social relations to other group members					
Number friends		-0.030	-0.034	-0.035	-0.024
		(0.023)	(0.024)	(0.024)	(0.025)
Number family members		0.001	-0.003	-0.002	0.007
		(0.033)	(0.033)	(0.035)	(0.032)
Conflict with others		0.253	0.208	0.258	0.202
		(0.206)	(0.206)	(0.221)	(0.177)
Other controls					
JoD first		-0.012	-0.022	-0.011	-0.043
		(0.075)	(0.067)	(0.082)	(0.085)
Contribution in PG		0.013	0.012	0.013	0.013
		(0.018)	(0.018)	(0.018)	(0.018)

Constant	0.233***	0.531	0.505	0.539	0.491
	(0.043)	(0.334)	(0.332)	(0.341)	(0.360)
Observations	120	120	120	120	119
R-squared	0.032	0.121	0.143	0.131	0.156
F	5.011	5.360	21.65	2.821	8.996
p	0.0374	0.000722	1.48e-08	0.0212	2.12e-05
r2_a	0.0239	0.0319	0.0471	0.0340	0.0690

Notes: Linear probability models. Dependent variable: Burning decision in the JoD experiment (burn = 1, not burn = 0). The number of observations included in regression 5 deviates from the actual sample size due to 1 missing values in *Perception of poor pasture quality***.** Regression estimations are reported with heteroskedasticity-robust standard errors clustered at session level (in parentheses). ***, **, and * indicates statistical significance at the 1%, 5% and 10% level, respectively.

Table A.4 is analogous to Table 2 in the manuscript but considers the decisions of farmers only. Farmers are subjects who receive their income mainly or exclusively from farming. For them, herd size is a fairly good proxy for income. Results are very similar to those obtained for the full sample. We observe that low-yield area farmers are more likely to burn money in the JoD experiment than high-yield area farmers. The same applies for subjects who perceived their pasture quality as poor or very poor. It further turns out that farmers with larger herds tend to be less likely to engage in spiteful behaviour. The same has been observed for the entire sample.

TABLE A.4: Determinants of farmers' burning decisions in the Joy-of-destruction game

Y = burning decision	(1)	(2)	(4)	(5)	(6)	(7)
Low-yield area	0.192*	0.244***	0.222***	0.282***	0.221***	
	(0.093)	(0.056)	(0.059)	(0.086)	(0.068)	
Perception of poor pasture quality						0.249**
						(0.093)
Negative belief		0.678***	0.673***	0.661***	0.673***	0.638***
		(0.093)	(0.094)	(0.098)	(0.088)	(0.097)
Socio-demographics						
Male			-0.008	0.004	0.002	0.004
			(0.073)	(0.073)	(0.076)	(0.072)
Age			0.000	-0.000	0.000	0.001
			(0.003)	(0.004)	(0.003)	(0.004)
Education (highest grade)			-0.002	-0.001	-0.004	-0.002
			(0.015)	(0.016)	(0.016)	(0.015)
Economic situation						
Farmer			-0.000**	-0.000		-0.000**
			(0.000)	(0.000)		(0.000)
Herd size				-0.001		
				(0.000)		
Herd size x Low-yield area					0.094	
					(0.088)	
Middle tertile herd size					-0.083	

					(0.078)	
Upper tertile herd size						
			-0.016	-0.018	-0.021	-0.007
Social relations to other group members			(0.020)	(0.021)	(0.020)	(0.021)
Number friends			0.002	0.001	-0.002	0.002
			(0.023)	(0.023)	(0.024)	(0.023)
Number family members			0.081	0.060	0.088	0.083
			(0.087)	(0.080)	(0.101)	(0.094)
Conflict with others						
			-0.053	-0.058	-0.046	-0.056
Other controls			(0.061)	(0.057)	(0.068)	(0.078)
JoD first			-0.008	-0.008	-0.009	-0.006
			(0.010)	(0.010)	(0.011)	(0.009)
Contribution in PG						
Constant	0.224***	0.003	0.173	0.164	0.154	0.169
	(0.049)	(0.028)	(0.293)	(0.296)	(0.305)	(0.291)
Observations	97	97	97	97	97	96
R-squared	0.042	0.473	0.511	0.517	0.517	0.512
F	4.246	165.0	92.15	144.6	76.48	27.68
p	0.0533	0	0	0	0	0
r2_a	0.0324	0.462	0.448	0.448	0.448	0.448

Notes: Linear probability model. Dependent variable: Burning decision of farmers in the JOD experiment (burn = 1, not burn = 0). Regression estimations are reported with heteroskedasticity-robust standard errors clustered at session level (in parentheses). ***, **, and * indicates statistical significance at the 1%, 5% and 10% level, respectively.

Table A.5 presents the results of linear probability models performed separately for each area to check for heterogeneous area effects (regressions 1-4 for the low-yield area and regressions 5-8 for the high-yield area). Instead of an area dummy, we include a variable that captures individual's perception about the grazing quality of her pastures. It takes the value of 1 if the subject was the opinion that the pasture is of poor or very poor quality and 0 otherwise. We observe a higher incidence of antisocial behaviour (i.e. burning decisions) among those who had a negative perception about the state of their resource base. As visible in Table A.5, this effect looms larger in the high-yield area. There, only six out of 60 respondents perceived pasture quality as poor or very poor, and three of them decided to reduce their counterpart's income. In the low-yield area, 52% were the opinion that pasture quality is poor, and 48% of them burned money. In regression 4 we observe that the perception variable loses statistical power if we restrict our analysis to farmers, but the p-value (=0.14) is still very close to the 10% level.

TABLE A.5: Determinants of individual burning decisions, separated by area

Y= burning decision	Low-yield area				High-yield area			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Perception of poor pasture quality	0.240**	0.188*	0.183*	0.186	0.292	0.226*	0.261*	0.350**
	(0.084)	(0.096)	(0.094)	(0.116)	(0.194)	(0.117)	(0.131)	(0.145)
Negative belief		0.657***	0.746***	0.668***		0.701***	0.701***	0.689***
		(0.148)	(0.119)	(0.148)		(0.122)	(0.117)	(0.114)
Age		-0.005	-0.003	-0.004		0.007	0.008*	0.010**
		(0.004)	(0.004)	(0.004)		(0.005)	(0.004)	(0.004)
Male		-0.085	-0.134	-0.148		0.080*	0.056	0.059

		(0.132)	(0.144)	(0.161)		(0.041)	(0.057)	(0.059)
Education		-0.004	0.000	-0.005		0.011	0.009	0.016
		(0.022)	(0.021)	(0.020)		(0.017)	(0.017)	(0.015)
Farmer		0.113	0.051			-0.126	-0.065	
		(0.073)	(0.064)			(0.111)	(0.124)	
Herd size		-0.001				-0.000*		
		(0.000)				(0.000)		
Middle tertile herd size			0.212*	0.164			-0.149*	-0.091
			(0.112)	(0.143)			(0.074)	(0.109)
Upper tertile herd size			-0.051	-0.067			-0.227*	-0.150
			(0.107)	(0.154)			(0.107)	(0.088)
Constant	0.276***	0.417	0.249	0.427	0.208***	-0.258	-0.250	-0.496**
	(0.058)	(0.257)	(0.285)	(0.279)	(0.052)	(0.331)	(0.326)	(0.176)
Observations	60	60	60	48	59	59	59	48
R-squared	0.060	0.481	0.516	0.458	0.043	0.550	0.558	0.689
F	8.247	73.71	575.4	27.27	2.269	22.88	264.9	211.0
P	0.0184	3.16e-07	0	2.30e-05	0.166	4.79e-05	9.20e-10	3.00e-09
r2_a	0.0439	0.411	0.440	0.363	0.0264	0.488	0.487	0.635

Notes: Linear probability models. Dependent variable: Burning decision in the JOD experiment (burn = 1, not burn = 0). Regressions 1-4 only consider low-yield area residents. Regressions 5-8 are restricted to subjects from the high-yield area. Due to one missing value for *perception of poor pasture quality*, the number of observations reduces to 59 for the high-yield area. Regressions 4 and 8 consider farmers only. Robust standard errors clustered at session level (in parentheses). ***, **, and * indicates statistical significance at the 1%, 5% and 10% level, respectively.

Table A.6 reports Tobit regressions for individual contribution decisions in the PG experiment. It is analogous to Table 3 in the manuscript and produces qualitatively very similar results.

TABLE A.6: Tobit regressions for individual contribution decisions in the public goods experiment

Y= amount contributed	(1)	(2)	(3)	(4)	(5)	(6)
Low-yield area	0.374	0.230	0.211	0.210	0.242	
	(0.677)	(0.684)	(0.662)	(1.050)	(0.695)	
Perception of poor pasture quality						-0.075
						(0.566)
Negative belief (PG)		-1.864*	-1.413	-1.413	-1.426	-1.483
		(1.096)	(1.260)	(1.302)	(1.217)	(1.244)
Socio-demographics						
Male			0.032	0.032	0.057	-0.035
			(0.555)	(0.631)	(0.497)	(0.590)
Age			-0.023	-0.023	-0.020	-0.018
			(0.034)	(0.035)	(0.032)	(0.034)
Education (highest grade)			-0.184	-0.184	-0.186*	-0.172
			(0.112)	(0.113)	(0.109)	(0.104)
Economic situation						

Farmer			-0.292	-0.292	-0.490	-0.256
			(0.784)	(0.780)	(0.903)	(0.772)
Herd size			0.001	0.001		0.001
			(0.003)	(0.004)		(0.003)
Herd size x Low-yield area				0.000		
				(0.005)		
Middle tertile herd size					1.166	
					(0.750)	
Upper tertile herd size					1.183*	
					(0.701)	
Social relations to other group members						
Number friends			-0.120	-0.120	-0.116	-0.123
			(0.165)	(0.165)	(0.144)	(0.163)
Number family members			0.118	0.118	0.153	0.120
			(0.307)	(0.297)	(0.308)	(0.301)
Conflict with others			-0.718	-0.717	-0.883	-0.683
			(1.597)	(1.646)	(1.725)	(1.523)
Other controls						
JoD first			-1.607**	-1.607**	-1.632**	-1.650***
			(0.648)	(0.662)	(0.652)	(0.619)
Reduced income in JoD			0.670	0.671	0.662	0.691
			(0.826)	(0.848)	(0.852)	(0.852)
Constant	4.487***	4.809***	7.872***	7.872***	7.219***	7.801***
	(0.491)	(0.522)	(1.825)	(1.831)	(1.809)	(1.700)
sigma						
Constant	3.530***	3.526***	3.348***	3.348***	3.310***	3.355***
	(0.388)	(0.405)	(0.420)	(0.421)	(0.396)	(0.424)
Observations	120	118	118	118	118	117
F	0.305	1.774	3.248	3.395	5.873	3.316
p	0.582	0.174	0.001	0.000	0.000	0.000

Notes: Double-censored Tobit regressions. Dependent variable is the total amount contributed towards the public good, ranging from 0 to 10. The table is analogous to Table 3 in the manuscript. The number of observations included in the regression deviates from the actual sample size due to 2 missing values in *Negative expectation* and 1 missing value in *Perception of poor pasture quality* (only applicable for model 6). Heteroscedasticity-robust standard errors clustered on session level are reported in parentheses. ***, **, and * refers to significance at the 1%, 5% respectively 10% level.

Appendix C: Experimental protocols

Note, the instructions were translated into Afrikaans and presented orally by a native speaker. The order of the experiments was reversed every second session.

Welcoming the participants

Thank you all for coming today. Today, we want to carry out two experiments where you can earn money that you are permitted to keep and take home. In these experiments you will have to make decisions that will influence your personal outcome. If you listen to the instructions

carefully you can earn a considerable amount of money. The whole procedure will last for about one and a half hours.

Before we start to explain the experiments, we want to announce some general rules that you should know:

1. If at any time you find that this is something that you do not wish to participate in for any reason, you are free to leave whether we have started the experiment or not. But if you feel already uncomfortable, or if you already know that you will not be able to stay for one to one and a half hours, then you should not try to participate, because otherwise we cannot use the results.

2. During the experiment conversation is strictly prohibited. **You cannot ask questions or talk about the experiment while we are in the process of playing.** If you have questions, please raise your hand and wait until we come to answer your question **in private**. A violation of this rule will lead to the exclusion from the experiment **and the payments**.

3. During both experiments you will have the chance to earn cash which will be paid out at the end of both exercises. While you are answering a short questionnaire, we will hand out the earnings to you. You will be paid N$ 10 for showing up plus any additional earnings you have earned during the two experiments.

After knowing these rules, is there anybody who does not want to participate anymore?

Let us start.

After we have read aloud the instructions for the first experiment, all of you will receive a PLAYER NUMBER. You must write down your player number **on each sheet** you get handed during both experiments we are going to play today. This means, **you keep the same player number for both experiments**. It is very important that you don't show your player number to anybody else.

[THE ORDER OF THE EXPERIMENTS CHANGES EVERY SECOND SESSION]

First experimental task: JOD experiment

We start now with the first experiment. During this experiment you will have the chance to earn cash.

In this experiment you are randomly matched with another participant in this room – this person will be your partner in this experiment. You will not learn the identity of the participant you are matched with, and vice versa your partner will never learn about your identity.

You and your partner both receive N$ 10 in the beginning. You then have to decide whether to **reduce** your partner's income or to **leave it** as it is. Reducing your partner's income **will cost you N$ 1**. By paying 1 dollar, you **can reduce the other partner's income by 5 dollars**. Your partner takes the same decision. He/she can also choose between leaving your income unaltered or reducing it by 5 dollars. Your partner will incur the same cost – N$ 1 – if he or she chooses to reduce your income

[PLEASE READ THE FOLLOWING EXAMPLES LOUDLY, SLOWLY AND CLEARLY. DEMONSTRATE THE PAYOFF CONSEQUENCES USING DOLLAR COINS FOR EACH SCENARIO]

If both of you choose to leave the other person's income unaltered, both of you will earn the N$ 10 that you got at the beginning.

If both of you choose to reduce the other person's income, both of you will earn N$ 4 (10-5-1).

If you choose to reduce your partner's income, but he/she decides to leave your income unaltered, you will earn N$ 9 and your partner will earn N$ 5.

If you choose not to reduce your partner's income, but he/she decides to reduce yours, you will earn N$ 5 and your partner will earn N$ 9.

Do you have any questions?

Before we start, please don't forget that you are not allowed to communicate!
Please remember that you will receive your earnings from this part of the experiment only after both parts of the experiments are finished.
It is very important that you keep in mind that the decisions are absolutely private and that your decision will never disclosed to anybody else.

[THE INSTRUCTOR REMAINS IN THE ROOM TO MONITOR AND MAKE SURE THAT ALL ADHERE TO THE NON-COMMUNICATION RULE]

Second experimental task: PG experiment

We explain now the second experiment. In this experiment, all participants (all people here in this room) will be divided into groups of 3 members. Nobody knows who is in which group. Neither before, nor after the experiment, will you learn the identity of your group members.

In this experiment everybody will receive N$10 at the beginning.

The experiment is similar to a situation where people have to make decisions on how much to contribute to a project. You will be a member of a group consisting of 3 persons. Each member of the group gets N$10 and has to decide **how many of these dollars you want to contribute to the project, and how much you want keep for yourself.** The money you keep yourself will be put into your private account.

How are your earnings from your decision calculated?

The earnings of each group member will be calculated in the same way. The earnings consist of two parts:
(1) Money from your private account
(2) Money contributed to the project

Each dollar you don't invest into the project will be yours automatically and will be kept on your private account.

The following will happen with dollars you contributed to the project: We will add 50 cents to each dollar you and the other two group members contributed to the project. This sum will be divided equally among you and the other two group members.

For example, if you contribute N$1 to the project, we will add 50 cents. So the sum, 1+0.5 = 1.5 N$ will be distributed among all 3 group members in equal parts. This means, for every dollar you put into the project you and each other group member will earn 50 cents, since everybody receives the same income from the project. In turn, the contribution of N$1 to the project by another group member will raise your earnings by 50 cents. After all group members have decided on their contributions to the project, the earnings of every participant are determined as follows:

Your total earnings = earnings from the private account + earnings from the project

Let us make a few examples: Remember you have to decide how many dollars you want to contribute to the project and how many dollars you want to keep for yourself:

[DEMONSTRATE ALL EXAMPLES ON THE POSTER]

1. Say you contribute N$10 to the project, the second member N$6 and the third member N$0 then the total group contribution is N$16. For each dollar contributed we add 50 cents. Thus, the sum is 16+8= 24 N$. Because each one of you receives the same income from the project, irrespective of your contribution, we divide the N$24 by 3, which is N$8. Thus, each one of you will earn N$8 **from the project**. But remember, this is only the first part of your earning. To get your total earning, you have to add the dollars you kept for yourself. Let's take a look at yours and the other group members' earnings:
   You: You contributed all N$10. Thus your earning from the private account is 0. You get N$8 from the project. In total you receive 0 + 8 = N$8.
   Second player: The second player contributed N$6. His/her earning from the private account is therefore (10-6) = N$4. N$4 plus the N$8 from the project means a total earning of N$12.
   Third player: The third member of the group contributed nothing to the project but nevertheless gets N$8 from the project. Additionally he/she gets the N$10 he/she kept in his/her private account. His/her total income is therefore 18 dollars.

2. The other two players decide to contribute N$10 to the project, you decide to contribute nothing. In this case the group contribution is (10+10+0=) 20 dollars. For each dollar contributed we add 50 cents. The sum is 20+10= 30 dollars. Because each one of you receives the same income from the project, irrespective of your contribution, we divide the N$30 by 3, which is 10 dollars. Thus, each one of you will earn 10 dollars **from the project**.
   You: You will receive 10 dollars from the project plus the N$10 you kept yourself = 20 dollars.
   Second and third player: The second and third member both contributed N$10, thus they did not keep any dollars in their private accounts. In total they earn N$10

3. Each player contributes all N$10 to the community project. Thus, the total contribution is 3 times 10 = N$30. For each dollar contributed, we add 50 cents. The total amount in the project account is then 45 dollars. N$45 divided by 3 is 15 dollars.

Thus, everybody's earning from the project is 15 dollars. Since nobody kept any dollars for himself, this is also the total earning for everybody.

4. Each player decides to keep his dollars for himself. Thus nobody contributes to the project. In that case everybody will earn 10 dollars from the private account and nothing from the project, because none of you contributed to the project. Thus, the total income of each member is 10 dollars.

How do you make your decisions?

Each of you has to come one by one to us. There you have to decide how much of your N$10 you want to contribute to the project. You can contribute any amount from 0 to 10. We will put your contribution into the project account [blue envelope] and the remaining amount will be stored in your private account [yellow envelope]. When all participants have made their decisions, we will calculate your total earnings from this experiment.

Are there any questions? [SOLVE LAST QUESTIONS IN PRIVATE]

It is very important that you keep in mind that the decisions **are absolutely confidential**, that is, nobody else will learn your decision.

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Sebastian Prediger, Björn Vollan, Benedikt Herrmann

Resource scarcity, spite and cooperation

Abstract
Using an experimental approach, this paper examines how scarcity of natural resources affects people's readiness to cooperate and to engage in antisocial behaviour. The experiments were carried out with pastoralists from southern Namibia whose livelihoods are highly dependent on grazing availability on their collectively used rangelands. We split the study region into two areas according to exogenous differences in biomass production, a high-yield and a low-yield area, and conduct a one-shot public goods experiment and the joy-of-destruction experiment with pastoralists from both areas. Results from the joy-of-destruction experiment reveal that a substantial fraction of people is willing to reduce another subject's income, although this comes at an own cost. We show that this kind of spiteful behaviour occurs twice as often in the area where resources are scarcer and hence competitive pressure is higher. By contrast, levels of cooperation are very similar across areas. This indicates that scarcity does not hamper cooperation, at least as long as a sub-survival level has not been reached. Our data further reveal a coexistence of prosocial and antisocial behaviour within individuals, suggesting that people's motivations depend on the experimental environment they are acting in. One possible explanation is that subjects are ready to cooperate when substantial net gains can be realized, but turn to spiteful money burners when there is no scope for efficiency improvements and the risk of "falling behind" is particularly salient.

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