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THE MATERIAL BASIS OF COOPERATION: HOW SCARCITY REDUCES TRUSTING BEHAVIOUR

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Trusting behaviour is a cornerstone of cooperation and, hence, economic performance, not least in poorer communities where economic transactions often rely on informal agreements. But trusting behaviour is potentially costly since the counterpart may decide to defect. In this study, we investigate whether food scarcity influences the level of trusting behaviour in rural Tanzania by leveraging quasi-experimental variation in food supply induced by the harvest. Through a lab-in-the-field experiment, we document that farmers display lower levels of trusting behaviour during the lean season compared to the abundant season and show that the difference is explained by variation in food scarcity.

Trusting behaviour underpins cooperation and is therefore essential for the functioning of economies; countries, communities, organisations, and families with higher levels of trusting behaviour have recurrently been found to attain better economic outcomes (Banfield, 1967; Putnam, 1993; Knack and Keefer, 1997; La Porta et al., 1997; Algan and Cahuc, 2010; Barr et al., 2019). At the individual level, however, trusting entails an element of risk (Ashraf et al., 2006; Butler et al., 2016; Bigoni et al., 2019), as non-reciprocal individuals might take advantage of their trusting peers. This risk may be exacerbated by scarcity—especially food shortages—since losses are relatively more costly near the subsistence level. Consequently, scarcity may simultaneously increase the need for cooperation (as a coping mechanism) and reduce the level of trusting behaviour, the very act that underpins cooperative arrangements.

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In this paper, we ask whether an increase in scarcity, more specifically a higher incidence of food scarcity, reduces trusting behaviour.1 In order to evaluate this hypothesis, we measure trusting behaviour among farmers in rural Tanzania through a pre-registered lab-in-the-field experiment, which we conduct before and after the yearly harvest. The experiment is a framed trust game, where one player chooses how much to invest in a joint venture and a second player decides how to split the resulting profits. Investing by the first player, henceforth referred to as trusting behaviour, is socially efficient and potentially privately profitable. However, the outcome is uncertain, as it rests on reciprocation from the second player.2

In line with our hypothesis, we find that the level of trusting behaviour is significantly lower before compared to after the harvest. This change in trusting behaviour is evident, both in between-subject and within-subject analyses.3 We further show that food scarcity, which is significantly more prevalent before, compared to after the harvest, mediates the impact of the harvest on trusting behaviour. When food scarcity is accounted for, the negative effect of participating in the lean season (compared to the abundant season) turns insignificant.

We corroborate the conclusion that food scarcity reduces trusting behaviour using a range of identification strategies. First, we rule out that the harvest changed trusting behaviour for reasons unrelated to food scarcity. The estimated effect of the harvest on trusting behaviour remains stable when accounting for a number of demographic controls as well as potentially confounding time-varying factors, such as seasonal festivities. Second, we document strong negative effects of food scarcity on trusting behaviour through instrumental variable regressions that rely on the quasi-experimental variation in food scarcity induced by the harvest. Third, using randomised manipulations of the experimental instructions, we investigate two complementary questions: whether the mental salience of scarcity and inter-group interaction aggravate the effect of food scarcity on trusting behaviour. The results are indicative of food scarcity reducing cooperation more when food scarcity is (experimentally) made salient and when the interaction partner is from outside the local community, but the difference-in-difference regressions are not estimated with sufficient precision in most specifications. Finally, we leverage satellite imagery on crop farming, and show that the impact of the harvest on trusting behaviour is particularly pronounced in areas that rely more heavily on crop farming for subsistence. In conclusion, the evidence is consistent with the hypothesis that lower levels of trusting behaviour in the lean period is a result of higher levels of food scarcity.

The present study extends a growing literature on the relationship between poverty and economic behaviour (Bertrand et al., 2004), which encompasses studies on, e.g., self-control (Banerjee and Mullainathan, 2010), risk aversion (Blalock et al., 2007; Yesuf and Bluffstone, 2009) and financial decision-making (Agarwal et al., 2009; Shah et al., 2012; Fehr et al., 2022). In particular, we contribute to the emerging literature concerned with the causal impact of scarcity on economic preferences and behaviour (Shah et al., 2012; Haushofer et al., 2013; Prediger et al., 2014; Fisman et al., 2015; Carvalho et al., 2016; Ananyev and Guriev, 2019; Boonmanunt and Meier, 2020; Boonmanunt et al., 2020; Bartós, 2021; Fehr et al., 2022). While we build on a

1 While the link between scarcity and cooperation at the international level has received much academic attention (see, e.g., Dinar, 2009), the causal pathway from scarcity to cooperative behaviour at the interpersonal level remains comparatively understudied.

2 The trust game provides an incentivised, experimental, measure of trusting behaviour ideal for the present purposes to establish a causal link between food scarcity and trusting behaviour.

3 A sub-sample of participants were part of both the pre- and post-harvest experiments. This design feature allows us to study how trusting behaviour relates to scarcity while holding time-invariant personal characteristics constant.
rich research agenda on the behavioural economics of poverty, our work stands out in important respects.

First, by conducting the study in largely subsistence-based communities, we focus on how food scarcity—rather than the more commonly studied scarcity of financial resources (e.g., Carvalho et al., 2016; Ananyev and Guriev, 2019)—impacts economic behaviour. Food scarcity is common throughout the world, especially in developing rural contexts. Food scarcity is seasonal, and most acute cases take place during the ‘lean season’, the period during which the stocks from last year’s harvest are depleted and the next harvest is yet to be realised (Vaitla et al., 2009). Hunger, even if temporary, is a severe type of deprivation (Miguel, 2005); undernourishment has been demonstrated to have significant effects on economic performance, both in the short and long terms (e.g., Arcand, 2001; Miguel and Kremer, 2004; Schofield, 2014). Historical accounts from areas experiencing acute food shortages describe how, in addition to the obvious physical and mental effects hunger has on those who suffer it, scarcity damages social order and relationship ties. During periods of severe food scarcity, crime rates go up, inter-group tensions worsen and institutions break down (Gráda, 2009; Västerbro, 2018). According to Gráda (2009, p. 47), ‘Primeval impulses, such as […], the need to socialize and cooperate, the desire to help others, […], give way to drastic efforts to preserve one’s own being’. Yet, how food scarcity influences cooperative behaviour has not been investigated through rigorous empirical designs. To the best of our knowledge, this study is the first to demonstrate a causal relationship between food scarcity and trusting behaviour.

Second, our empirical approach, which combines variation induced by the harvest with spatial and experimental variation, enables both a strong causal claim and a nuanced depiction of the link between scarcity and trusting behaviour. By showing that communities with heavier reliance on the harvest for subsistence display larger variation in trusting behaviour, we highlight a key structural factor that influences where behavioural implications are more pronounced. At the same time, this heterogeneity analysis supports the causal interpretation of the relationship between food scarcity and trusting behaviour. The combination of temporal and spatial variation in resource scarcity distinguishes us from Prediger et al. (2014), who proxied for scarcity using spatial variation in biomass production, and Aksoy and Palma (2019), who captured scarcity through a dummy indicator for pre-/post-harvest participation. Similarly, in order to support and refine the main conclusion, the experimental treatments (scarcity prime and ingroup/outgroup manipulation) allow us to investigate potential moderators of the harvest’s impact on trusting behaviour (note that one sentence in the pre-registration induced ambiguity regarding the intention behind the experimental design). The findings suggestively align with the pre-registered hypotheses that real scarcity should reduce trusting behaviour more (a) when mentally salient and (b) toward outgroup members, but statistical significance falls below conventional levels.

4 According to FAO et al. (2019), 796.5 million people worldwide were undernourished in 2016. A majority of the world’s undernourished are landless rural labourers or live in small farm households (Vaitla et al., 2009).

5 In one sentence we wrote: ‘While the main focus is on how each treatment independently impacts behaviour in the investment game […]’. In contrast, the general message in the pre-registration emphasised the intention to study how the treatments moderated the effect of real scarcity on trusting behaviour. In other words, any impacts of the experimental primes on trusting behaviour were expected to be conditional on participants experiencing real scarcity. In the abstract, we wrote: ‘We test whether farmers are less likely to choose the socially efficient, but personally risky option, in the investment game [trust game] when they live in relative scarcity. By means of a randomised prime, we further investigate whether this effect is more pronounced when the current economic conditions are made salient. Lastly, we study the effect of scarcity on cooperative behaviour with ingroup vs outgroup members.’
in the majority of the difference-in-difference specifications. In sum, our approach of combining variation from several sources to support the conclusion that scarcity reduces trusting behaviour extends the set of strategies used by researchers interested in the causal impacts of scarcity.

The paper is structured as follows. In Section 1, we discuss relevant features of the Singida region in Tanzania, the empirical setting of the present study. Section 2 outlines our experimental design. We present the findings leveraging quasi-experimental variation in scarcity in Section 3 and the results based on experimental variation in Section 4. In Section 5, we turn to heterogeneous effects due to variation in crop farming reliance. Section 6 discusses potential mechanisms, and Section 7 concludes.

1. Empirical Setting: The Region of Singida

The study was conducted in the Ikungi and Manyoni districts of Singida, a semi-arid region in central Tanzania with an economy heavily centred around agricultural production. In our sample, 88.1% report that (at least) some of their income comes from farming. The farmers mainly cultivate food crops: 9 out of 10 participants in our sample grow corn and about 4 out of 10 grow either sorghum or millet, or both. Sunflower seeds and sweet potatoes, which are respectively cultivated for food consumption and sometimes as cash crops, are cultivated by 40% and 15% of the farmers. While the timing of the harvest differs slightly for different crops, the harvest of the majority of crops, including the main food crops, is realised between May and July, during the yearly harvest (known as the Msimu harvest).6

Because of widespread poverty7 and a general lack of consumption smoothing mechanisms, such as storage and saving facilities,8 the one-shot nature of the harvest induces seasonal variation in food supply and, hence, food consumption. Among the participants in our study, 94% reported that March to April was the worst time in terms of food. Naturally, food scarcity is particularly prevalent during the lean season following a poor harvest, as was the case during our field work (77% of our participants reported that the previous harvest had been ‘worse’ or ‘much worse’ than normal).

As described in ‘An Ethnography of Hunger’ by Phillips (2018), the residents of Singida are no strangers to scarcity. For instance, in 2005–06, Singida, like much of East Africa, was hit by severe droughts and ensuing hunger. During ethnographic field work in the region, Phillips (2009) observed how communal work ceased during the lean season, and that guards were posted to protect public property. One villager explained that ‘You cannot trust anyone with food when it is the time of hunger’ (Phillips, 2009, p. 28). In what follows, we detail our identification strategy to evaluate empirically whether food scarcity indeed reduces trusting behaviour.

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6 According to reports from our field sites, the harvest in 2020 started in late May/early June. While other parts of Tanzania are bi-modal in their harvest cycles (i.e., have two harvests per year), the central dry parts of Tanzania, where Singida is located, are uni-modal, i.e., they rely solely on the Msimu harvest.

7 According to International Food Policy Research Institute (IFPRI), 6 out of 10 residents in Central Tanzania lived below the poverty line ($1.9/day in purchasing power parity) in 2012. This is well above the averages both in Sub-Saharan Africa (45.49%) and in the world (13.88%) (Development Research Group of the World Bank, 2021).

8 Less than 7% of the participants reported having access to a bank account and less than 5% to a savings group. Instead, the most prevalent wealth storage facility is livestock. In our sample, 43.1% of the households have at least one goat, 46.5% at least one cow and 72.2% at least one chicken.

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Fig. 1. Decision Tree.

Notes: The figure displays the decision tree and, thereby, the information set of player A when making the initial decision. The amount in curly brackets refers to the initial endowment of player A. The amounts in parentheses indicate the potential payoffs of player A for the different scenarios. We denote by $X_1$ and $X_2$ the sums that player B decides to keep for herself in the scenarios when 2,000 and 4,000 TSh were invested by player A. Here $X_1$ is bounded between 0 and 6,000, whereas $X_2$ is bounded between 0 and 12,000.

2. Experimental Design

We measure trusting behaviour through a modified trust game à la Berg et al. (1995) that we conduct before and after the yearly harvest, with participants from two sets of randomly selected villages in Singida. In this section, we outline the trust game, introduce the two embedded experimental conditions, discuss our sampling strategy and, finally, detail the econometric specifications.

2.1. The Trust Game

We used a modified trust game framed as a situation familiar to farmers: crop seed investments. As in the standard trust game, our set-up included two interacting players, player A and player B, who were anonymous to each other. Player A was initially endowed with 4,000 Tanzanian shillings (TSh), roughly corresponding to 1.75 USD and the equivalent of a day’s worth of the minimum wage in the agricultural sector in Tanzania (De Blasis, 2020). S/he had to decide how much of these 4,000 TSh to invest in seeds that would yield a harvest worth three times the investment, knowing that the other player, player B, would decide how the yield from the harvest would be split between the two players. Our analysis is centred around the behaviour of the first player (player A). This variable constitutes an experimental measure of trusting behaviour since player A should only invest if s/he expects a non-negative return on the investment (i.e., trusts player B to reciprocate). In Figure 1 we depict the sequencing of actions and the corresponding payoff functions.

The framing and the simplified rules of the trust game (player A could invest all, half or none of the initial endowments) were chosen to ensure comprehension (see Khadjavi et al., 2021 for a similar rationale behind the experimental design). We also facilitated understanding through visual aids and tested comprehension in a number of practice questions.9 After the instructions and practice questions were completed, player A was asked to indicate how much

9 Unless participants answered the practice questions correctly, they could not begin the game. In robustness checks, we control for cognitive ability and show that it does not affect the results, indicating that the game was understandable to participants.
Table 1. Distribution of Player A Participants across Conditions.

<table>
<thead>
<tr>
<th></th>
<th>Pre-harvest</th>
<th>Post-harvest</th>
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<tbody>
<tr>
<td></td>
<td>Ingroup</td>
<td>Outgroup</td>
</tr>
<tr>
<td>Scarcity prime</td>
<td>45</td>
<td>38</td>
</tr>
<tr>
<td>No prime</td>
<td>39</td>
<td>45</td>
</tr>
</tbody>
</table>

s/he wanted to invest. Player B, on the other hand, was asked to indicate how much s/he would give back to player A for each level of investment that player A could have made (the so-called strategy method). In order to minimise experimenter demand effects that might be caused by the presence of interviewers, participants were asked to make their choice in a private space by indicating their decision on an answer sheet that they then had to fold and hand back to the enumerator (who would not look at their answer until after the interview). The payoffs were delivered in cash at the end of working days when all participants had completed the game and an accompanying survey. In Online Appendix B, we outline the experimental procedure in detail.\(^\text{10}\)

Our conceptualisation of trusting behaviour implies that the act of trusting is socially optimal and (potentially) privately profitable. As such, the measure differs from behaviour observed in, e.g., one-shot prisoner’s dilemmas (Boonmanunt and Meier, 2020), where defecting invariably is the most profitable option, and cooperative behaviour can thus be seen as an act of altruism. Moreover, trusting behaviour is different from generalised trust.\(^\text{11}\) While generalised trust is the expectation of others’ trustworthiness (Gambetta, 2000), trusting behaviour is an action that depends on social preferences and norms (Fehr and Fischbacher, 2002; Fehr and Schurtenberger, 2018) as well as on instrumental cost-benefit analyses (Neugebauer et al., 2009).

2.2. Treatment Conditions

We rely on seasonal variation in food scarcity induced by the harvest to identify the causal effect of food scarcity on trusting behaviour. In addition, we embed two individually randomised primes in the trust game to experimentally vary two potential moderating factors: (a) the mental salience of scarcity and (b) group identity of the interaction partner. The pre- and post-harvest sampling in conjunction with the two experimental conditions gives rise to a \(2 \times 2 \times 2\) design that we summarise in Table 1.\(^\text{12}\)

Our first experimental condition builds on emergent literature that suggests that poverty may impact decision-making through psychological mechanisms (Shah et al., 2015). It is argued that, at least to some extent, it is through increased awareness of trade-offs (e.g., between risk and reward)—what Mullainathan and Shafir (2013) label a scarcity mindset—that scarcity influences behaviour. In line with this literature, we hypothesise that experiencing food shortages should be especially detrimental for trusting behaviour when the state of scarcity is made more salient, i.e., when the scarcity mindset is activated. To investigate this proposition, we asked participants a series of questions about their current financial and food situation (we detail the questions

\(^\text{10}\) We also discuss precautions that were undertaken to ensure a safe execution of the data collection in the early days of the COVID-19 pandemic.

\(^\text{11}\) Generalised trust is typically captured by the standard survey question ‘Generally speaking, would you say that most people can be trusted or that you cannot be too careful in dealing with people?’.

\(^\text{12}\) Player B’s were randomly distributed across the same treatments as player A’s. Experimentally conditioning player B was a convenience choice, and, as per the pre-registration, these treatments are not analysed in this paper.
in Online Appendix Figure B4). Half of our participants (primed) are asked these questions before they play the trust game, and the other half (control) answer the questions after they finish the game. The rationale is that responding to questions about scarcity should activate a scarcity mindset, but only for participants who are currently experiencing scarcity (see Cohn and Maréchal, 2016 for a discussion on the use of priming in economics). If experimental variation in scarcity salience moderates the behavioural impact of food shortages, this would corroborate the conclusion that scarcity exerts a causal influence on the level of trusting behaviour and suggest a psychological channel that reinforces this relationship.

Our second experimental manipulation is employed to test whether scarcity is more damaging for cooperation with socially distant people. This prediction resonates with the thesis of Banfield (1967), which held that poverty should reduce the willingness to cooperate with everyone except the nuclear family. To test the hypothesis, one half of the participants are told that player B is another (anonymous) person from their own village, while the rest are told that player B is from another part of Tanzania.13 The ingroup/outgroup manipulation is embedded in the game instructions outlined in Online Appendix B.

2.3. Sampling

The timing of the data collection was chosen with respect to the Msimu harvest, from which farmers in Singida derive most of their food and income. To measure trusting behaviour among farmers, we restrict our sample to participants who obtained at least some income from the harvest. We conducted the first round of surveying prior to the harvest, May 1st to May 6th, while the second round was conducted at a time when the gains from the harvest had been realised, July 9th to July 16th.

Our key identifying assumption is that farmers in the pre- and post-harvest samples are identical on average in all relevant respects, but for scarcity. In order to obtain samples that are identical in expectation, we followed a multi-stage cluster sampling procedure. First, we purposefully selected the districts of Manyoni and Ikungi in the Singida region as field sites.14 Next, we randomly sampled six ‘wards’ (administrative units consisting of several villages) from each district for the first wave of surveying.15 From each ward, we then randomly selected one village, such that the sample of the first wave consisted of 12 villages in total. In the second wave, we randomly sampled eight of the wards from the first round and drew one new (randomly selected) village for each of the wards. By sampling villages from the same wards in the two survey rounds, we ensure that villages in the pre- and post-harvest waves are as similar as possible. In addition, we re-visited the remaining four villages from the first wave and interviewed the same participants a second time. This feature allows us to leverage within-subject variation to complement our main specification, which relies on between-subject variation. Finally, to increase statistical power, in the second wave we included two additional villages from randomly selected wards that were

13 Having used the expression ‘another part of Tanzania’ allowed us, without deception, to match participants who were in fact from different parts of the same village. This procedure allowed us to conduct the experiment in one village at a time. Coordinating the game between different villages would have been logistically impossible given the lack of internet connection in the more remote localities.

14 These districts were suitable for the present study since they have an annual (rather than biannual) harvest, are predominantly rural and have relatively high levels of poverty. This means that a large proportion of the population receives a substantial positive shock to food and income in conjunction with the harvest.

15 We excluded a number of wards from the randomisation due to infrastructural constraints (some wards were temporarily inaccessible by car during the first survey round). Importantly, these wards were excluded from both the pre- and post-harvest rounds.

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not part of the first round. In total, we visited 22 unique villages, four of which were sampled twice. The sampled wards and villages are detailed in Online Appendix Table A1. In Figure 2, we map the sampled districts and wards.

In each village, we randomly selected households by means of a random walk sampling methodology, and invited one (randomly chosen) adult per household to conduct a (randomly selected version of the) survey. The number of participants from each village ranges between 28 and 32 (approximately half of whom conducted the game as player A’s) and the final sample consists of 363 subjects in the role of player A (whose decision is our primary focus). Among them, 46 were interviewed both in the pre- and post-harvest waves. The enumerators stayed for just one day in each village in order to minimise the risk that participants would learn from one another (which could contaminate the data). This conveyed the additional advantage that the pre- and post-harvest rounds were completed in just six and eight days, respectively, ensuring consistency in terms of food situation within the respective survey waves. In Online Appendix Table A2, we document that the random selection of villages and households was successful in attaining balance between the pre/post-harvest samples, the scarcity prime/no scarcity prime samples and the outgroup/ingroup samples. Online Appendix Table A2 also presents useful descriptive statistics showing, inter alia, that the vast majority of farmers rely on rainfed agriculture, and that only a small proportion use fertiliser. In Online Appendix Table B3, all survey question wordings are listed.

2.4. Econometric Specifications

Our primary hypothesis is that the harvest increases trusting behaviour by changing the food situation of farmers. The following equation thus describes the baseline model:

\[ TG_i = \alpha + \beta_1 PreHarvest_i + X_i \gamma + \xi_i. \] (1)

16 The decision to sample additional villages was taken prior to the data collection phase.
Here $T G_i$ is the amount of money sent by participant $i$ in the trust game; $PreHarvest_i$ is a dummy capturing whether the experiment took place before the harvest; $X_i$ is a vector of individual characteristics and $\xi_i$ denotes idiosyncratic error. The model is estimated for four different samples: (1) a full sample, which includes all farmers in our sample; (2) a restricted sample, from which we exclude the post-harvest data from participants that participated in both waves; (3) a within sample, where we focus on individuals who participated twice and include individual-level fixed effects and (4) a village sample, which is obtained by computing averages for each village.

In order to corroborate and nuance the baseline findings, in Section 4 we investigate the impact of the two experimental conditions (scarcity salience and ingroup versus outgroup) by extending the baseline model as

$$ T G_i = \alpha + \beta_1 PreHarvest_i + \beta_2 Prime_i + \beta_3 PreHarvest_i \times Prime_i + X_i \gamma + \xi_i, $$

$$ T G_i = \alpha + \beta_1 PreHarvest_i + \beta_2 Outgroup_i + \beta_3 PreHarvest_i \times Outgroup_i + X_i \gamma + \xi_i, $$

where $Prime_i$ is a dummy indicating participants who are primed on their state of scarcity and $Outgroup_i$ is an indicator variable for playing the game with an outgroup member (as opposed to an ingroup member).

Finally, in Section 5, we explore how geographical variation in crop farming moderates the impact of the harvest on trusting behaviour. To this end, we compute a measure of land dedicated to crop farming within a 10 km radius of each village centre using satellite imagery data from Ramankutty et al. (2008). The underlying idea is that areas where crop farming is relatively more important should display larger behavioural reactions to the harvest, a proposition which we estimate through the model

$$ T G_i = \alpha + \beta_1 PreHarvest_i + \beta_2 Crop_{k(i)} + \beta_3 PreHarvest_i \times Crop_{k(i)} + X_i \gamma + \xi_i, $$

where $Crop_{k(i)}$ indicates the share of land used for crop farming in village $k$.

### 3. The Harvest, Food Scarcity and Trusting Behaviour

In this section, we present the baseline results of our analysis. First, we show that food scarcity varies greatly between the pre- and post-harvest periods. Second, we present evidence of a significant change in trusting behaviour between the two periods. Third, we show that food scarcity accounts for lower levels of trusting behaviour in the pre-harvest round.

#### 3.1. The Harvest Changes Scarcity Levels

The first step in our analysis is to investigate whether reliance on a yearly harvest leads to fluctuations in food scarcity among the farmers in our sample. In line with expectations, we find substantial variation in self-reported food scarcity between the two survey rounds, with the share of people declaring food shortages falling significantly after the harvest (Figure 3). Only 3 out of 10 households reported a food shortage after the harvest, compared to 7 out of 10 before the harvest.

The results are robust to using an alternative measure of food scarcity, namely the number of days (in the past month) with fewer meals than usual (see Online Appendix Figure C6). In

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17 The rationale for this specification is to ensure that learning effects—which may affect the behaviour of participants that participated twice—do not substantively influence the findings.

18 The data is mapped in Online Appendix Figure C9.

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3.2. Less Trusting Behaviour in the Lean Season

Having established a statistical impact of the harvest on food scarcity, we next turn to the influence of the harvest on trusting behaviour. We estimate (1) to determine the impact of the harvest on trusting behaviour for the four different samples described in Section 2, the full, restricted, within and village samples. The results are reported in Table 2.

Online Appendix Table C4, we present results from OLS regressions confirming that the shift in food shortage is large and strongly statistically significant. Depending on the proxy employed, food scarcity drops to either 37% or 25% of pre-harvest levels, and the reduction in severe cases of food scarcity is even larger.19

19 Of the participants 26% in the pre-harvest sample reported going without enough food to eat ‘many times’ or ‘always’, compared to only 4% of participants in the post-harvest sample.

20 Throughout the empirical sections, village averages are computed from the full sample of player A participants.
Regardless of the specification, the results show that the amount sent in the trust game—our measure of trusting behaviour—is lower in the lean period that precedes the harvest. For the Full sample presented in column (1), we document almost 10% lower levels of trusting behaviour during the lean season. The effect is less precisely estimated when we confine the analysis to the restricted sample that excludes the second entry of subjects who were interviewed in both rounds, but the magnitude of the coefficient is not substantively different. In column (3), we focus on the farmers who participated twice and estimate a model with individual fixed effects. Once again, the impact of the lean season on trusting behaviour is significant and comparatively large in magnitude (note that the within sample also experienced greater variation in food scarcity between the lean and the abundant seasons (panel B of Online Appendix Table C8)). Lastly, in column (4), we report the impact of the harvest on average trusting behaviour at the village level. By studying the effect at this level of aggregation, we ensure that the results are not sensitive to intra-village correlations in trusting behaviour (Angrist and Pischke, 2008). The negative impact of lean season participation is also statistically significant in this specification.

To corroborate the validity of these results, we conduct a number of robustness tests. First, in Online Appendix Table C5, we add a battery of control variables and document a stable effect of the harvest on trusting behaviour (columns 1–3). In this table, we also document a negative association between food scarcity and trusting behaviour that is stronger when controls are added (columns 4–6). Second, we include fixed effects for enumerators’ and participants’ ethnic group identities and find that the results remain unchanged (N = 363, pre-harvest coefficient = −250, p-value = 0.043, linear regression with cluster-robust standard errors). Third, we study the impact of the harvest on trusting behaviour by means of randomisation inference (using the full sample with 363 participants), a test that relaxes the distributional assumptions invoked in OLS regressions. In Online Appendix Figure C7, we show that the estimated coefficient

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**Notes:** This table displays OLS regression estimates of the effect of the harvest on the amount sent in the trust game. Individual FEs stands for individual fixed effects. Standard errors are given in parentheses, with columns (1) and (2) reporting robust standard errors clustered at the village-round level and columns (3) and (4) reporting robust standard errors. * p < 0.10, ** p < 0.05, *** p < 0.010. Source: Agneman et al. (2022).

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21 This relationship is endogenous and likely subject to omitted variable bias. Hence, it is reassuring that the coefficient of food scarcity is larger and estimated with better precision in the specification with the full set of controls (compared to the bivariate specification).

22 This control serves to reduce concerns that differences in ethnic group composition between the lean and the abundant seasons played a role.

23 The method comprises: (1) allocating a placebo treatment to a subset of respondents at random and evaluating treatment outcomes for that (placebo) allocation; (2) repeating this procedure 10,000 times and (3) comparing the actual treatment effect with 10,000 placebo effects. This test is possible since assignment into the pre- and post-harvest samples was random by nature.
Fig. 4. Village-Level Food Scarcity and Trusting Behaviour.

Notes: This figure shows the correlation between village-level food scarcity and trusting behaviour. Moreover, the figure displays how both the level of scarcity and trusting behaviour changed between the pre- (light markers) and post-harvest (dark markers) survey rounds. Food scarcity ranges from 0 (no food scarcity in the past month) to 4 (constant food scarcity in the past month).

Source: Agneman et al. (2022).

is also statistically significant in randomisation inference tests. Finally, we account for the potential influence of a number of seasonally varying factors, namely, (1) participants’ financial situation,24 (2) work load, (3) cognitive ability, (4) festivities and (5) adverse events.25 On page 19 in the Online Appendix, we discuss the logic of controlling for these factors, and in Online Appendix Table C6 we rule out that any of them influenced the baseline findings. In fact, when all potential confounders are accounted for (Online Appendix Table C6, column 9), the link between pre-harvest participation and trusting behaviour is stronger.

3.3. Food Scarcity Accounts for Changes in Trusting Behaviour

The results so far document (a) an impact of the harvest on food scarcity and (b) an impact of the harvest on trusting behaviour. In this sub-section, we test whether the effect of the harvest on trusting behaviour can be attributed to its impact on food scarcity. Figure 4 plots village averages of the amount sent in the trust game against the level of food scarcity in the pre- (light) and post-harvest (dark) samples.

As is evident in Figure 4, the negative correlation between average food scarcity and trusting behaviour is strong and statistically significant \((N = 26, \text{coefficient } = -3.29, p\text{-value } < 0.01, \text{linear regression with robust standard errors})\). The figure also reaffirms that food scarcity is significantly more prevalent prior to the harvest \((N = 26, \text{coefficient } = 0.92, p\text{-value } < 0.001, \text{linear regression with robust standard errors})\), and that participants display less trusting behaviour during the lean

24 While financial resources are coupled to some extent with the food situation, we find that the impact of the harvest runs through food scarcity, but not financial scarcity. This is hardly surprising given the survey locations’ heavy reliance on subsistence farming. Moreover, due to the acute situation that food scarcity implies, it is also likely to have stronger behavioural implications than financial scarcity.

25 Some of these factors varied significantly between the pre- and post-harvest periods (see Online Appendix Figure C8).
season ($N = 26$, coefficient $= -259$, $p$-value $< 0.05$; column (4) of Table 2). When we control for food scarcity, however, the link between the pre-harvest dummy and trusting behaviour turns statistically insignificant ($N = 26$, coefficient $= 117.6$, $p$-value $= 0.448$, linear regression with robust standard errors), suggesting that the effect of the harvest on trusting behaviour is mediated by food supply. These village-level results are replicated in individual-level regressions (Online Appendix Table C7). The estimated effect of the harvest on trusting behaviour is shown to be much smaller in magnitude and statistically insignificant when we control for food scarcity. Coupled with the fact that none of the control variables we introduced in the robustness exercises (Online Appendix Table C6) changed the estimated effect of the harvest, this strongly suggests that farmers displayed less trusting behaviour in the lean period as a result of food scarcity.26

Finally, we go a step further and investigate the direct link between food scarcity and trusting behaviour by means of an instrumental variable (IV) strategy that leverages the harvest as an instrument for food scarcity. Using this approach, we estimate a negative and statistically significant effect of food scarcity on trusting behaviour (Online Appendix Table C8). The coefficient is approximately twice as large as the OLS regressions coefficients presented in Online Appendix Table C5, indicating a downward bias in specifications relying on observational data. However, the IV results should be interpreted with care. While the first stage is strong, with Cragg–Donald Wald $F$-statistics at 30 or higher, we cannot ensure that the exclusion restriction holds (i.e., that the effect of the harvest on trusting behaviour runs exclusively through food scarcity).

4. Experimental Conditions

In this section, we leverage our pre-registered experimental conditions to test the roles of two factors that may condition the effect of food scarcity on trusting behaviour: the mental salience of scarcity and the group identity of the interaction partner.

4.1. Mental Salience of Scarcity

We first study whether food scarcity reduces cooperation more when a state of scarcity is made salient in participants’ minds. According to work by Shah et al. (2012; 2015), Cook and Sadeghein (2018) and Huijsmans et al. (2019), the behavioural effects of scarcity are not due solely to the state of scarcity as such. Rather, a ‘scarcity mindset’ can be activated or deactivated, depending on contextual circumstances such as the salience of scarcity. A scarcity mindset implies, inter alia, a strong trade-off awareness, which, in our context, could lead distressed farmers to re-evaluate their strategies in favour of safe, but low-yielding options. Accordingly, we expect that shifting attention toward present scarcity further aggravates the negative effect of scarcity on trusting behaviour. To test this proposition, we experimentally exposed a subset of the participants to a scarcity prime, which is intended to make the state of scarcity more salient. The prime consisted of a number of questions inquiring about participants’ consumption, relative wealth and potential food shortages (Online Appendix Figure B4). Half of the participants played the trust game before answering these questions, whereas the other half played after being exposed to the same questions.

26 Still, it should be noted that the coefficient on the pre-harvest dummy is not a precisely estimated zero when we account for food scarcity. This may be due to an insufficiently precise measurement of food scarcity, but it may also be due to other seasonal factors exerting moderate influences on trusting behaviour.
In Table 3, we show how exposure to the scarcity prime altered the relationship between the harvest and trusting behaviour. In column (1), we document a negative, but statistically insignificant, impact of the harvest on trusting behaviour among participants who were not exposed to the scarcity prime. In comparison, the pre-harvest coefficient is substantially larger (and statistically significant) for participants who were primed on their current consumption levels (column (2)). In column (3) we repeat the analysis on the full sample using an interaction term between the pre-harvest dummy and the scarcity prime. The coefficient of the interaction is negative, but statistically insignificant. In Online Appendix Table C9, we repeat the analysis using as the main variable of interest the interaction between food scarcity and the salience prime. The interaction term falls below conventional significance levels when using a continuous operationalisation of food scarcity, but emerges as statistically significant when capturing food scarcity through a dummy for severe food scarcity. In conclusion, our findings indicate that food scarcity matters especially when mentally salient, but the moderating effect of the experimental manipulation is not estimated with sufficient precision in most difference-in-difference specifications.

4.2. Group Identity

Next, we investigate whether the effect of scarcity on trusting behaviour is contingent upon the identity of the interaction partner (player B). Previous research suggests that inter-group discrimination is particularly pertinent to situations that entail interdependence (such as a trust game; Balliet et al., 2014), and that resource scarcity can enhance group differentiation (Krosch and Amodio, 2014). Taken together, these results imply that food scarcity should reduce trusting behaviour more toward outgroup members than toward ingroup members. To investigate this...
proposition, we experimentally varied the identity of the second player as someone from the local village or someone from another part of Tanzania.\textsuperscript{27}

In Table 3, we find suggestive evidence of food scarcity being more damaging to cooperation with outgroup members. The results display a relatively weaker link between the pre-harvest dummy and trusting behaviour when the interaction partner is from the ingroup (column (4)) compared to when the interaction partner is from the outgroup (column (5)). These results contrast with Aksoy and Palma (2019) and Boonmanunt and Meier (2020), who found ingroup bias to be smaller during the lean season (in studies on cheating and altruism). The bulk of evidence on scarcity and discrimination, on the other hand, shows that scarcity, in line with our findings, tends to enhance group differentiation (see, e.g., Krosch and Amodio, 2014). When we repeat the analysis using the full sample and an interaction between the outgroup prime and the pre-harvest dummy, we find that the interaction term is negative, but imprecisely estimated (column (6)). Online Appendix Table C9 presents the same analysis with self-reported food scarcity replacing the pre-harvest dummy. In line with the results presented below, food scarcity is shown to be more strongly associated with trusting behaviour toward the outgroup (compared to trusting behaviour toward the ingroup), but the interaction between food scarcity and the outgroup prime is statistically insignificant. To conclude this section, Online Appendix Table C10 displays the estimates when the pre-harvest indicator and the experimental conditions are included in the same regression. The experimental manipulations are shown to have no (statistically significant) independent impact on trusting behaviour, suggesting that their effects are contingent upon participants experiencing real scarcity.

5. Spatial Heterogeneity Results

5.1. Crop Farming and Fluctuations in Food Scarcity

While participants in our study primarily rely on agriculture, the extent to which crop farming, husbandry and other activities provide for subsistence, varies across the sample along with variation in geoclimatic conditions (National Bureau of Statistics, Tanzania, 2017). For example, more than three quarters of the participants in Chungu (Ikungi) reported owning a cow, whereas that was the case for less than one in eight in Kintinku (Eastern Manyoni). As a result, not all villages were equally affected by the harvest; some villages did not experience substantial scarcity before the harvest, and a couple of villages featured relatively high levels of food scarcity even after the harvest (Figure 4).

We conjecture that areas more reliant on crop farming should experience relatively larger fluctuations in food supply between the lean and abundant seasons, and farmers from those areas should thus exhibit stronger behavioural effects of the harvest. To test for such heterogeneity, we leverage spatial variation in the importance of crop farming, using satellite imagery obtained from Ramankutty et al. (2008) to identify the amount of land used for crop farming around each village. We compute a measure of cropland as the average pixel value—where higher values mean that more land is used for crop farming—within spatial buffers drawn around the centroids of villages (Online Appendix Figure C9).\textsuperscript{28} As a validation exercise, we show

\textsuperscript{27} Since networks of support in rural Tanzania are often formed at the village level, this design captures a salient ingroup/outgroup distinction.

\textsuperscript{28} In general, the village populations are relatively dispersed, and hamlets can be located several kilometers away from the village centre. The buffers have a radius of 10 km (0.1 degrees) in the baseline specification, an assumption that we later relax in robustness checks.
Table 4. **Cropland Amplifies the Effect of the Harvest on Trusting Behaviour.**

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Full (1)</th>
<th>Restricted (2)</th>
<th>Within (3)</th>
<th>Village (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-harvest</td>
<td>-62.13</td>
<td>-41.85</td>
<td>-314.6</td>
<td>-64.20</td>
</tr>
<tr>
<td></td>
<td>(160.3)</td>
<td>(163.4)</td>
<td>(354.5)</td>
<td>(170.8)</td>
</tr>
<tr>
<td>Cropland</td>
<td>126.9***</td>
<td>116.9</td>
<td>-2717.6***</td>
<td>127.9***</td>
</tr>
<tr>
<td></td>
<td>(36.64)</td>
<td>(75.14)</td>
<td>(433.8)</td>
<td>(38.68)</td>
</tr>
<tr>
<td>Pre-harvest × cropland</td>
<td>-213.2***</td>
<td>-203.2**</td>
<td>-199.6</td>
<td>-209.3**</td>
</tr>
<tr>
<td></td>
<td>(68.96)</td>
<td>(95.23)</td>
<td>(172.8)</td>
<td>(75.81)</td>
</tr>
<tr>
<td>Constant</td>
<td>2937.4***</td>
<td>2917.1***</td>
<td>4523.1***</td>
<td>2932.3***</td>
</tr>
<tr>
<td></td>
<td>(74.04)</td>
<td>(80.17)</td>
<td>(275.4)</td>
<td>(79.78)</td>
</tr>
<tr>
<td>Observations</td>
<td>363</td>
<td>317</td>
<td>92</td>
<td>26</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.0190</td>
<td>0.0111</td>
<td>0.504</td>
<td>0.276</td>
</tr>
<tr>
<td>Dep. var. mean</td>
<td>2,942.1</td>
<td>2,902.2</td>
<td>2,913.0</td>
<td>2,939.1</td>
</tr>
</tbody>
</table>

*Notes:* This table reports OLS regressions with the amount sent in the trust game as the dependent variable, and the interaction between pre-harvest and cropland as the explanatory variable of main interest. Cropland is standardised such that a unit corresponds to an SD with the minimum value equal to 0. Standard errors are given in parentheses, with columns (1) and (2) reporting cluster-robust standard errors at the village-round level and columns (3) and (4) reporting robust standard errors. ** $p < 0.05$, *** $p < 0.01$. Source: Agneman et al. (2022).

in Online Appendix Table C11 that participants from areas with more land dedicated to crop farming are less likely to own animals that provide alternative sources of subsistence, such as cows, chickens, goats and sheep, but no less likely to own donkeys, which are mainly used as pack animals. Finally, we investigate whether areas with more cropland experienced larger effects of the harvest on food scarcity. In Online Appendix Table C12, we show that this indeed is the case.

### 5.2. **Crop Farming and the Harvest’s Behavioural Impact**

If the harvest impacts behaviour through changes in the food situation, we should expect a larger effect of the harvest on trusting behaviour in areas with a stronger reliance on crop cultivation. In Table 4, we show regression estimates of (2) for the full-, restricted-, within- and village-level samples that support this hypothesis. The coefficient of interest is on the interaction between the pre-harvest dummy and cropland. The regressions show stronger behavioural effects of the harvest in areas more reliant on crop farming; increasing the value of cropland by one SD increases the impact of the harvest on trusting behaviour by approximately 17% of an SD. The effect is statistically significant in all but the within-subject sample. We note, however, that the coefficient of interest in the within sample is of similar magnitude as in the other samples, and the insignificant effect can thus likely be attributed to the smaller sample size.

Lastly, we test the sensitivity of the spatial heterogeneity results to different buffer sizes. In Online Appendix Table C13, we show that the results are robust to using 5 km rather than the baseline 10 km buffers. The results are qualitatively similar when using 15 km buffers, albeit with smaller effect sizes and borderline significant estimates. This is to be expected since accuracy diminishes when the cropland measure encompasses lands further away from the village centre.
6. Why Does Scarcity Reduce Trusting Behaviour?

Although our experiment was not designed to pin down mechanisms, this section offers some reflections on factors that may explain why scarcity affects the level of trusting behaviour. According to standard theory, trusting behaviour should be affected both by beliefs (expectations) and preferences. In what follows, we consider the influence of each one in turn.

6.1. Expectations

The extent of trusting behaviour displayed by player A should depend on her expectations of prospective returns (i.e., the money that player B sends back; Ashraf et al., 2006). Therefore, a change in expectations between the lean and abundant seasons could drive the change in trusting behaviour. To proxy for expectations, we measured participants’ expected returns in the trust game as well as their group-specific trust.

6.1.1. Expected returns in the trust game

First, we attempt to gauge the role of expectations using a direct measure of player A’s expected returns in the trust game. After the trust game was completed, we asked player A how much s/he expected to receive in return for each level of investment s/he could have made (see Online Appendix Table B3).29 We find, intuitively, that players who expect positive returns invest more on average. Specifically, we estimate a positive and significant relationship between the amount sent and expectations of non-negative returns when sending 4,000 TSh ($N = 363$, coefficient $= 748$, $p$-value $< 0.001$, linear regression with village cluster-robust standard errors).30 It should be noted, however, that the relationship between expected returns and money sent in the game could be endogenous, potentially influenced, e.g., by participant characteristics (Costa-Gomes et al., 2014).31

Despite the intuitive correlation we detect between player A’s expected returns and their trusting behaviour, expected returns cannot account for the impact of the harvest on trusting behaviour since they do not change between the two periods.32 This is consistent with the fact that the amount player B returns remains constant as well. Indeed, as shown in Online Appendix Figure C11, player B’s decision appears to be characterised by a strong and stable fairness norm: in the two seasons, no less than 73% of player B’s send back more than player A’s initial investment.33

6.1.2. Group-specific trust

Next, we study expectations as captured by a survey question that asks respondents whether they think that people from their village/another part of Tanzania can be trusted, a modified

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29 The questions eliciting expected returns were asked after the trust game was completed in order not to prime participants on strategic motivations.
30 The relationship is non-monotonic, with money sent increasing sharply up to non-negative returns and remaining flat in the positive domain (Online Appendix Figure C10).
31 Costa-Gomes et al. (2014) found, however, no significant differences in the estimated relationship between beliefs and behaviour in the trust game when using ‘naïve OLS regressions’ as compared to when using IV regressions, indicating that endogeneity does not give rise to a major bias.
32 The effect of pre-harvest on the amount player A expects to receive if sending 4000: $N = 363$, coefficient $= -258$, $p$-value $= 0.250$, linear regression with village cluster-robust standard errors.
33 This means that trusting behaviour on the part of player A paid off in expectation, albeit with a degree of risk (around 11% of player A’s would have been better off if they had sent less money than they did).
version of the standard question on generalised trust (Online Appendix Table B3). Following the conceptualisation proposed by Gambetta (2000), the question arguably captures the expectation of the trustworthiness of others. Generalised trust is therefore different from the act of trusting (as measured in our trust game), since the latter is a behaviour potentially influenced by a range of factors, whereas the former is a belief. We leverage a matching between group-specific trust and the amount sent in the ingroup versus outgroup conditions. This approach allows us to perform a placebo test in addition to testing the hypothesised relationships.

In Online Appendix Table C14, we show that self-reported ingroup trust increases trusting behaviour in the ingroup treatment condition, and that self-reported outgroup trust increases trusting behaviour in the outgroup treatment condition. Conversely, we find no link between self-reported ingroup trust and money sent in the outgroup condition, nor any evidence of self-reported outgroup trust increasing trusting behaviour in the ingroup condition. The fact that only trust in the group that matches the identity of the interaction partner predicts behaviour in the game mitigates concerns about omitted factors causing the link between group-specific trust and trusting behaviour. However, as for expected returns, we find no evidence that group-specific trust can explain the change in trusting behaviour between periods, since self-reported trust in others (ingroup and outgroup) does not change significantly from before to after the harvest.

6.2. Preferences

Another potential explanation for the change in trusting behaviour between the lean and abundant periods is changes in preferences. Trusting behaviour should depend positively on both altruism and risk tolerance, which we measured through self-reported survey questions: How do you assess your willingness to share with others without expecting anything in return? How willing are you to take risks, in general? In Online Appendix Table C15, we show that trusting behaviour increases both with self-reported trust and with risk tolerance. The positive associations hold when controlling for a range of potential confounding variables, such as age, gender and education. However, we do not find evidence of preferences changing between the lean and abundant seasons. Hence, preferences, as captured by our self-reported survey questions, cannot explain our main result.

In conclusion, we find that trusting behaviour depends on beliefs and preferences in accordance with standard theory. Yet, we do not find that a specific mechanism can account for our reduced-form result on scarcity and trusting behaviour. This is not surprising, however, since trusting behaviour is multifactorial, and changes in trusting behaviour may thus be due to multiple (potentially unmeasured) channels. This venue constitutes a promising alley for future work.

34 Gambetta (2000) argued that trust in someone, as measured by the standard survey question, is ‘the probability that he will perform an action that is beneficial or at least not detrimental to us is high enough for us to consider engaging in some form of cooperation with him’.

35 The two concepts should be correlated, although previous studies have found contradictory evidence as to whether this is the case or not (see, e.g., Glaeser et al., 2000; Fehr et al., 2003).

36 In Online Appendix Figure C12, we show that trusting behaviour increases monotonically with self-reported ingroup/outgroup trust.

37 In turn, risk tolerance has recurrently been found to be positively associated with income and wealth (e.g., Vieider et al., 2018 found risk tolerance to increase with wealth in a sample of Ethiopian subsistence farmers).
7. Discussion and Conclusion

The nexus between scarcity and economic behaviour is multifaceted, and the research on the interlinkages is only in its infancy. In this paper, we demonstrate that food scarcity reduces trusting behaviour, a tendency that prevents cooperation from functioning as a coping mechanism during difficult times.

On the face of it, our results may seem at odds with a recent paper by Buggle and Durante (2021), where the authors show that regions with more adverse weather shocks in the past feature higher interpersonal trust today. The results are, however, entirely compatible. Indeed, if scarcity reduces cooperation, communities that are better able to maintain cooperation in the face of scarcity have a comparative advantage over other communities. Hence, although scarcity reduces trusting behaviour in the short run (as we show), it may sharpen group selection and favour the propagation of cooperative norms in the long run (as Buggle and Durante, 2021 demonstrate).

Furthermore, there are interesting parallels between our work and a study by Cassar et al. (2017), who documented a positive effect of a natural disaster on cooperative norms. A potential explanation for the divergent results is the nature and scale of the adverse shocks. Whereas natural disasters tend to hit whole communities and thus present residents with collective challenges, food scarcity (in our context) is a family-centred or individualised experience that hits households heterogeneously. Moreover, natural disasters do not necessarily imply resource (or food) scarcity. In Cassar et al. (2017), the relationship between natural disaster exposure and cooperative norms disappears when conditioned on an indicator for whether subjects had received aid. Overall, the findings thus seem to indicate that adverse events do not influence cooperative behaviour in a deterministic manner, but rather that the behavioural consequences depend on the type of shock and how society responds.

In conclusion, the present study adds important evidence to the emergent strand of research concerned with the behavioural consequences of adverse shocks. If a shortage of food reduces trusting behaviour and breaks down networks of cooperation, this means that scarcity, even if temporary, can induce more scarcity in the future. Subsequent studies should consider interventions that can reduce seasonal scarcity and, thereby, the associated behavioural implications. A more ambitious research agenda on how adverse events affect economic performance is of great importance, as it may inform policy levers that can reduce human suffering both today and in the future.

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Additional Supporting Information may be found in the online version of this article:

Online Appendix
Replication Package

References

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