Realized and elicited cooperation under water scarcity: evidence from a field experiment in Tanzania

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INTRODUCTION

- Unlike rainfed farming, developing and maintaining irrigation systems is not only a technical challenge but also a social one because they require organization.
- As more frequent droughts are expected to affect farmers in countries like Tanzania due to climate change, farmers need to cooperate to ensure the functioning of their irrigation scheme.
- Yet, it is unclear whether the risk of drought will induce a shift towards more cooperation (Nie et al., 2020) or, instead, more defection (Araral, 2009).
- We play a Public Goods Game (PGG) with 470 members of an irrigation scheme who cultivate rice in Morogoro, Tanzania, to measure cooperation.
- We also elicit risk and social preferences which have been shown to vary significantly by region and influence farmers' decisions (Katic & Ellis, 2018).

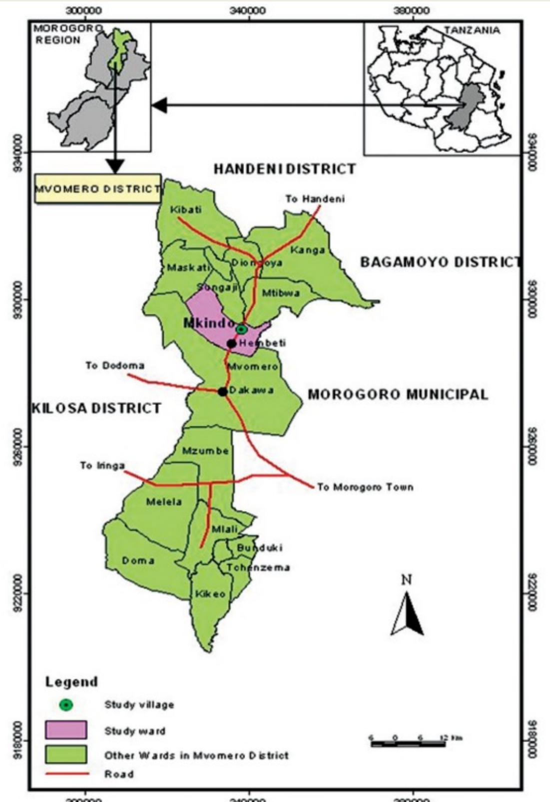

Figure 1: Location map of Mkindo ward in Mvomero District, Morogoro region.

(Kahimba, Kombe & Mahoo, 2013)

OBJECTIVES

1. How does cooperation change when there is a risk to a common resource (i.e., water) versus a risk to a private resource? How does it differ by risk and social preferences?
2. Is the Public Goods Game valid to measure cooperation inside of an irrigation scheme?

GAME

- We play a PGG with four different rounds in random order. In each round, participants get 500 TZS (=0.21 USD) and split it between their private and public accounts. Payouts and second players are hypothetical.
- Amount in public account was multiplied by 1.5 and split between the two players. Amount in private account was kept for the player.
- Round A: standard PGG.
- Round B: Public Account was at 50/50 risk of becoming zero.
- Round C: Private Account was at 50/50 risk of becoming zero.
- Round D: Both accounts were at (uncertain) risk of becoming zero.
- We played a lottery game and modified dictator game to elicit risk and social preferences.

ESTIMATIONS

1. For the first question, we run the following OLS model:

$$Contribution_i = \beta_0 + \beta_1 RoundB_i + \beta_2 RoundC_i + \beta_3\ RoundD_i + \varepsilon \quad (1)$$

- $Contribution_i$ is the contribution of farmer *i to* his/her public account.
- β_1, β_2, and β_3 are indicator variables for Rounds B, C, and D, respectively.
- ε is the idiosyncratic error term.

2. For the second question, we run:

$$Y_i = \beta_0 + \beta_1 \text{Average}Contribution_i + \Gamma' X + \upsilon + \varepsilon \quad (2)$$

- Y_i is one of nine cooperation variables (see columns of Table 1).
- PGG_i is average contribution of farmer *i* to his/her public account.
- X is a vector of individual controls (social and risk preferences, age, wealth, etc.).
- υ are block fixed effects, and ε is the error term.

RESULTS

Cash-Based Cooperation ✗ — columns (1)–(5); Social Cooperation ✓ — columns (6)–(9)

Table 1. Comparing in-game cooperative behaviour with real-life cooperative behaviour.

VARIABLES	(1) Paid bills (Long Rain Season)	(2) Paid bills (Short Rain Season)	(3) Contributed any cash or labour	(4) Days of labour contributed	(5) Total cash given	(6) Voted in past election	(7) Interactions with Water User Association	(8) Interactions with Water User Group	(9) Number of disputes
Average Contribution	-0.001	-3.40e-05	0.001	-0.003***	-48.41	-0.001	0.011***	0.012***	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(38.26)	(0.001)	(0.002)	(0.002)	(0.001)
P-value	0.564	0.964	0.699	0.00	0.207	0.505	0.00	0.00	0.029
Sharpened q-value	0.594	0.75	0.594	0.001	0.262	0.594	0.001	0.001	0.046
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Blocks FE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	447	453	291	402	355	433	446	446	407
adj. R^2/ Pseudo R^2	0.049	0.029	0.121	0.161	0.131	0.114	/	/	0.034

Robust standard errors in parentheses. Models (1), (2), (3) and (6) are probit models. Models (4) and (9) Poisson models. Models (7) and (8) are interval regression models. Model (5) is an OLS model. Controls include risk and social preferences, age, income, education and gender. Anderson's sharpened q-values are computed to control for False Discovery Rate when testing multiple hypotheses (Anderson, 2008).

*** p<0.01, ** p<0.05, * p<0.1

Table 2. Contribution across rounds of the PGG.

VARIABLES	Contribution to public account
Round B: risk to public account	-34.76***
	(8.142)
Round C: risk to private account	8.690
	(8.201)
Round D: risk to both accounts	-8.730
	(7.762)
Constant	239.8***
	(5.664)
A≠B (p-value)	0.00
A≠C (p-value)	0.24
A≠D (p-value)	0.17
B≠C (p-value)	0.00
C≠D (p-value)	0.00
Observations	1,857
Number of players	465
R-squared	0.017

Robust standard errors in parentheses. The risk-less and standard Round A is the base indicator variable in this model. We do a paired t-test of equality of means of rounds and report the two-tailed p-values.

*** p<0.01, ** p<0.05, * p<0.1

RESULTS & CONCLUSION

- When there's a risk to common resources, players decrease their contribution significantly.
- Extremely risk-averse and farmers with socially inefficient preferences decrease their contributions the most in the round where public resources were at risk.
- The Public Goods Game is good at measuring social or non-cash-based cooperation, but not cash-based cooperation.
- *Risk in common resources → less social cooperation.*
- If we extrapolate this behavior to real-life, it means that common shocks, such as droughts or floods, leads to less social cooperation between farmers to maintain the scheme.
- Need for interventions to create incentives and institutions to maintain social cooperation.

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