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Distributive Justice in the Field: How do Indian Farmers Share Water?*

Benjamin Ouvrard[1,2], Arnaud Reynaud[1], Stéphane Cezera[1], Alban Thomas[1], Dishant Jojit James[3], and Murudaiah Shivamurthy[4]

[1]Toulouse School of Economics, INRAE, University of Toulouse Capitole, Toulouse, France
[2]Université Grenoble Alpes, INRAE, CNRS, Grenoble INP, GAEL, 38000 Grenoble, France
[3]Wyższa Szkoła Bankowa University, Gdańsk, Poland
[4]Department of Agricultural Extension, GKVK, UAS, Bangalore, India

Abstract

We use a framed-field experiment to analyze the preferences of Indian farmers regarding water sharing. Farmers play a dictator game (DG) behind the veil of ignorance in which a limited quantity of water has to be allocated between two farmers. We vary the equity/efficiency trade-off by introducing some heterogeneity between farmers' productivity and by considering an upstream/downstream spatial configuration. We first show that generosity in the DG is high (on average, respectively 44% and 47% of the total quantity of water or the total profit are left by the dictator). Only a small proportion of farmers act in the DG as selfish profit maximizers, a majority of them adopting efficient, egalitarian in payoff or egalitarian in quantity behaviors. We then show that it is possible to induce more efficient water allocation behaviors in the DG by modifying farmer's choice architecture. A loss framing induces farmers to share more efficiently the water resource, but only when the most productive farmer is located downstream. On the contrary, we find mild evidence that farmers choose less often the efficient solution with a gain framing.

Keywords : Dictator Game; Framed-field experiment; Framing; Water sharing.

JEL Codes : C91, D63, Q25.

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How do Indian Farmers Share Water?

Abstract

We use a framed-field experiment to analyze the preferences of Indian farmers regarding water sharing. Farmers play a dictator game (DG) behind the veil of ignorance in which a limited quantity of water has to be allocated between two farmers. We vary the equity/efficiency trade-off by introducing some heterogeneity between farmers' productivity and by considering an upstream/downstream spatial configuration. We first show that generosity in the DG is high (on average, respectively 44% and 47% of the total quantity of water or the total profit are left by the dictator). Only a small proportion of farmers act in the DG as selfish profit maximizers, a majority of them adopting efficient, egalitarian in payoff or egalitarian in quantity behaviors. We then show that it is possible to induce more efficient water allocation behaviors in the DG by modifying farmer's choice architecture. A loss framing induces farmers to share more efficiently the water resource, but only when the most productive farmer is located downstream. On the contrary, we find mild evidence that farmers choose less often the efficient solution with a gain framing.

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1 Introduction

One classic debate in economics is related to the equity/efficiency trade-off that concerns, among several topics, the design (Deaton, 1977) and impacts of taxes (Goulder et al., 2019) or environmental policies (Dietz and Atkinson, 2010, Wu and Yu, 2017), the way medical resources (Ubel and Loewenstein, 1996) or water (Dinar and Tsur, 1999, Ambec and Sprumont, 2002, Hu et al., 2016) can be allocated among competitive users.

The equity/efficiency trade-off is generally attributed to Okun (1975) who shows in the United States that while the civil society is pushing towards equality in rights and justice, the existing institutions tend to favor more an efficient economy. Since then, this trade-off has been analyzed both from theoretical and empirical points of view, in particular regarding economic growth (see Osberg 1995 for a review). The tension between equity and efficiency has received specific attention from an experimental point of view, in particular since it allows to assess distributional preferences. Different experimental approaches have been proposed including dictator games (DG thereafter) (Cappelen et al., 2007, Fisman et al., 2007, Ambec et al., 2019), distribution games (Beckman et al., 2002, Engelmann and Strobel, 2004) or trust games (Charness and Rabin, 2002).

In this paper, we study the equity/efficiency trade-off in the context of water sharing. More precisely, our work aims first at understanding how Indian farmers solve this arbitrage, through the adoption of specific behaviors (among profit maximizer, egalitarian in quantity, egalitarian in payoff, efficient behavior or proportional in quantity), and second at checking if it is possible to induce farmers to share water more efficiently by using specific informational treatments. The case of Indian farmers is particularly relevant since the lack of water pushes them, as well as policymakers, to try to find solutions to better manage the water resource. Indeed, in August 2019 the World Resource Institute has ranked India among the 17 countries in the world being the most affected by water stress.[1] We focus on farmers in the State of Karnataka, where agriculture represents a vital sector, contributing to around one third of the State's GDP (Patil et al., 2019). The lack of water is expected to be more stringent in the next decade in Karnataka, due to climate change and population growth (more than 8 million inhabitants in the city of Bangalore in 2011, the capital of the state, estimated 13 million in 2021). Understanding how farmers wish to share water is therefore of interest to inform policymakers and to design more adapted policies.

We propose a framed-field experiment with a simple DG in which a limited quantity of water

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[1] See `https://www.wri.org`

has to be shared between two farmers. The two farmers differ first according to their location with respect to the water resource, one being located uptsream and the other downstream (see also Janssen et al. 2011, Janssen et al. 2012 and Anderies et al. 2013). This spatial configuration illustrates, for instance, farmers located along a canal, as well as other situations described in the literature (Ostrom and Gardner, 1993). Farmers also differ regarding their water profitability (high or low). Giving more water to the farmer with the highest water profitability allows to achieve efficiency, at the expense of equity, and conversely. Our spatial configuration treatments (most productive farmer located upstream or downstream) allow us to vary the intensity of the tension between equity and efficiency, and to assess how it may shape farmers' behaviors.

In our setting farmers play behind a "veil of ignorance" (Schildberg-Horisch, 2010, Ambec et al., 2019), i.e., they choose an allocation of resources without knowing their own future position in the group (upstream or downstream), nor the one of the other members. Playing behind the veil of ignorance, individuals should be able to deliberate independently from their self-interest and, therefore, reveal their preferences for fair outcomes. In the literature, Schildberg-Horisch (2010) find that subjects more often choose equal distributions behind the veil of ignorance than in front of the veil, while Ambec et al. (2019) show that subjects more often seek to equalize payoffs.

Our first objective is to characterize the behaviors of Indian farmers in a water sharing contextualized DG. Indeed, following the existing literature, it appears that, contrary to the theoretical prediction of rational and selfish agents, few subjects actually keep the entire resource for themselves in DG (Engel, 2011, Korenok et al., 2012). Subjects may not be only motivated by their private interest and their preferences may put some weight on egalitarian criteria (Jakiela, 2013) or on other-regarding preferences (Andreoni and Miller, 2002, Edele et al., 2013).

Our second objective is to assess whether or not it is possible to induce Indian farmers to share in a more efficient way the available quantity of water. Efficiency may be fostered using monetary incentives (Bar-Shira et al. 2006, Pfeiffer and Lin 2014). However, given that water is not priced and in the absence of universal water metering, the scope for pricing mechanisms appear limited in the Karnataka State. An alternative solution to induce more efficiency in water sharing could be to rely on non-monetary incentives such as nudges (Thaler and Sunstein, 2008). In the context of water management, empirical evidence highlights encouraging results of these types of instruments (Ferraro et al., 2011, Bernedo et al., 2014, Brent et al., 2016, Schultz et al., 2016, Bhanot, 2017, Christian et al., 2022). Our approach builds on this literature with a particular focus on using information for shaping individual decisions of farmers. From a behavioral point of view, empirical evidence emphasizes that it is possible to change individuals' decisions, including those involving resource distribution, by framing the outcomes differently (e.g., De Dreu 1996, Fiedler and Hillenbrand 2020). This approach, based on Kahneman and Tversky (1979)' work, relies on the fact that individuals do not behave the same in gain and loss domains, in particular because of loss aversion. From a public policy point of view, framing is notably used by policymakers or NGOs to influence individuals (Fiedler and Hillenbrand, 2020). We therefore introduce, in addition to the spatial configuration treatments, two types of framing: *Gain* and *Loss*. In the *Gain* treatment, we make more salient the additional gains for the group compared to the worse possible allocation. In the *Loss* treatment, we emphasize losses for the group compared with the best possible allocation.

Overall, we propose a 2 × 3 experimental design: more productive farmer located upstream or downstream combined with the different types of framing (baseline, *Gain* or *Loss*). One interest of this experiment is that we consider a sample of farmers, and not students, in the same spirit that Tsusaka et al. (2015), which provides direct information in terms of policy recommendations, through a high external validity (Higgins et al., 2017, Palm-Forster et al., 2019). This is a difference with most studies in which nudges have been tested on consumers, the study of Chabe-Ferret et al. (2019) being an exception with farmers. Moreover, another interest of our framed-field experiment is that farmers share water instead of money, knowing that there is evidence that both are not shared the same way (Kause et al., 2018).

Our experiment contributes to several streams of literature. It first participates to the literature on framed-field experiments on water sharing (e.g., Velez et al. 2009, D'Exelle et al. 2012, Van Campenhout et al. 2015), the studies of D'Exelle et al. (2012) and Van Campenhout et al. (2015) being the closest to ours. They focus on the equity/efficiency trade-off regarding water sharing in Tanzania. Both studies emphasize that most farmers share equally the resource, since egalitarian norms prevail in Tanzania. Contrary to these framed-field experiments, and as previously explained, in our experiment farmers play behind a veil of ignorance as we want them to elaborate independent deliberations from their self-interest, to reveal their preferences for fair outcomes. Our game also allows us to go further in the classification of fair behaviors (profit maximizer, egalitarian in quantity, egalitarian in payoff, proportional in quality and efficient behavior), therefore enhancing the understanding of farmers' preferences for fair distributions.

Second, and related to the previous point, through the investigation of farmers' preferences for water allocation, we contribute to the literature on distributive justice in the field and, in particular, on case studies on water sharing (Syme and Fenton, 1993, Lukasiewicz and Dare, 2016, Hammond Wagner and Niles, 2020). The main difference with these studies is that we do not rely on questionnaire based studies, but on an experiment, which allows us to test treatments aimed at shaping farmers' behaviors.

Third, our study speaks to the literature on gain/loss framing (e.g., De Dreu et al. 1994, De Dreu 1996, Fiedler and Hillenbrand 2020, Balew et al. 2022). Similarly to Balew et al. (2022)' experiment, one advantage of our framework is to directly test on farmers the two framing treatments. However, differently from Balew et al. (2022), we assess in our case the effectiveness of the gain/loss framing in pushing farmers to share water more efficiently. This is performed with three different matching methods, including the propensity score approach, to determine whether the loss framing is more adapted than the loss one to provide incentives for adopting a more efficient behavior. Moreover, our empirical approach also allows us to estimate aggregate preference parameters for Indian farmers, directly from the experimental results. These parameters inform us on the weight given to farmers located upstream vs. downstream, and on the curvature of the decision-maker indifference curve.

Anticipating on our results, we first show that generosity in terms of quantity left to the other farmer is, on average, high (44% of the total stock). Second, we are able to characterize, overall, 65% of farmers' behaviors: in line with the existing literature (Engel, 2011), few of them adopt a profit maximizer behavior and adopt, instead, efficient, egalitarian in payoff or in quantity behaviors. Finally, we show that the *Loss* treatment can foster the adoption of efficient behaviors only in the case where the most productive farmer is located downstream. When the most productive farmer is located upstream, the *Gain* treatment pushes toward the adoption of the egalitarian in quantity behavior. We additionally find mild evidence that farmers less often choose the efficient solution with the *Gain* framing.

The remaining of this article is organized as follows. We present the conceptual framework in Section 2 and, then, detail the field experiment in Section 3. We spell out the results in Section 4, followed by a discussion in Section 5. We conclude in Section 6.

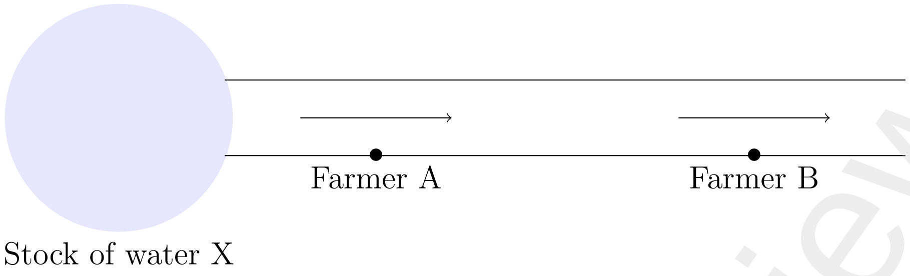
2 Conceptual framework

2.1 Structure of the DG

We consider a contextualized DG where two farmers located along a canal, *Farmer A* and *Farmer B*, use a common stock of water, denoted by X. This simple game is illustrated in

Figure 1.

Figure 1: The DG with farmers A and B location.



Farmer A, located upstream, plays as a dictator by choosing first the quantity of water $x_A \in [0, X]$ he is going to use. Farmer B located downstream gets the quantity of water which is not used by farmer A, if any. We denote $x_B = X - x_A$ the quantity of water left by farmer A to farmer B. By construction, $x_B \in [0, X]$.

Water is used by farmers to produce crops. The agricultural profit of farmer $i \in A, B$ is given by:

$$\pi_i = \alpha_i \sqrt{x_i}. \tag{1}$$

The choice of a concave benefit function reflects a decreasing marginal profitability of water. We allow parameters α_i to be different across farmers to reflect a difference in marginal productivity of water. In reality, the parameter α_i may capture differences in crops grown by farmers: some crops may need more water than others.

When $\alpha_A \neq \alpha_B$, the dictator faces a trade-off between equity and efficiency. For instance, when $\alpha_A > \alpha_B$, giving more to farmer A favors the most efficient farmer of the two, at the expense of equity.

2.2 Dictator decision problem with distributional preferences

CES utility function We consider a Decision Maker (DM) whose preferences are expressed by a utility function depending on farmers' profit levels.

We specify this utility as a constant elasticity of substitution (CES) functional form, since it allows to represent several distributional preferences of the DM.[2]

$$U(\pi_A, \pi_B) = \left[c \cdot \pi_A^{\rho} + (1 - c) \cdot \pi_B^{\rho}\right]^{\frac{1}{\rho}}, \tag{2}$$

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[2] The CES utility function is also used to explain other-regarding preferences in dictator games in Andreoni and Miller (2002), Cox et al. (2007), Fisman et al. (2007), Jakiela (2013) and Grech and Nax (2020).

where $c \in [0,1]$ represents the relative weight put on the profit for farmers A and B, and $\rho \in (-\infty, 1]$ captures the curvature of the indifference curves, with $\sigma = 1/(1-\rho)$ being the elasticity of substitution between the profit of the two farmers. As c and ρ vary, the CES utility function therefore captures a diversity of social preferences, as:

- **Profit maximizer A**. If $c = 1$, the DM only seeks to maximize farmer A's profit.
- **Profit maximizer B**. If $c = 0$, the DM only seeks to maximize farmer B's profit.
- **Efficiency concern**. As $\rho \to 1$ preferences reflect a concern for efficiency where utility is determined by summing (weighted) profits of both farmers. The case $c = 0.5$ represents strict efficiency, with both farmers receiving the same weight.

Note also that, as $\rho \to 0$, the indifference curves approach those of a Cobb-Douglas function, while as $\rho \to -\infty$ we reach maximin preferences, where only increases to the worst-off farmer increase utility. Thus, in Equation (2), c is a measure of the DM's concern between self-interest and altruism, while ρ quantifies his/her efficiency orientation which ranges from equality-concern to pure efficiency-orientation (Grech and Nax, 2020).

In the next subsection, we further discuss other social preferences that rely on specific combinations of α_A and α_B.

Program We assume that each DM, each characterized by given values of c and ρ, maximises the following program:

$$\max_{x_A, x_B} \left[c\pi_A^{\rho} + (1-c)\pi_B^{\rho} \right]^{\frac{1}{\rho}} \tag{3}$$
$$s.t. \quad x_A + x_B \leq X,$$
$$x_A \geq 0, x_B \geq 0.$$

Substituting π_A and π_B for, respectively, x_A and x_B in the first constraint of (3), we obtain the set of constraints

$$\left(\frac{\pi_A}{\alpha_A}\right)^2 + \left(\frac{\pi_B}{\alpha_B}\right)^2 \leq X,$$
$$\pi_A \geq 0, \pi_B \geq 0.$$

The first constraint in (3) is similar to a budget constraint that, in our case, characterizes the set of feasible allocations of profits depending on the available quantity of water X. We can rewrite this constraint as:

$$\pi_A^2 + \left(\frac{\alpha_A}{\alpha_B}\right)^2 \cdot \pi_B^2 \leq {\alpha_A}^2 \cdot X.$$

Finally, operating a change in variables with $\tilde{\pi}_A = \pi_A^2$ and $\tilde{\pi}_B = \pi_B^2$, and considering that all resource is used, the DM's problem becomes

$$\max_{\tilde{\pi}_B} \left[c\Big(X\alpha_A^2 - \tilde{\pi}_B \Big(\frac{\alpha_A}{\alpha_B}\Big)^2 \Big)^{\frac{\rho}{2}} + (1-c)\tilde{\pi}_B^{\frac{\rho}{2}} \right]^{\frac{1}{\rho}}. \tag{4}$$

The first-order condition leads to:

$$\tilde{\pi}_B = \frac{\kappa X \alpha_A^2}{1+\kappa\left(\frac{\alpha_A}{\alpha_B}\right)^2} \ \text{ i.e., } \ \pi_B = \frac{\kappa^{\frac{1}{2}} X^{\frac{1}{2}} \alpha_A}{\left(1+\kappa\left(\frac{\alpha_A}{\alpha_B}\right)^2\right)^{\frac{1}{2}}} \tag{5}$$

and

$$\tilde{\pi}_A = \frac{X \alpha_A^2}{1+\kappa\left(\frac{\alpha_A}{\alpha_B}\right)^2} \ \text{ i.e., } \ \pi_A = \frac{X^{\frac{1}{2}} \alpha_A}{\left(1+\kappa\left(\frac{\alpha_A}{\alpha_B}\right)^2\right)^{\frac{1}{2}}}, \tag{6}$$

with $\kappa = \left[\frac{c}{1-c}\left(\frac{\alpha_A}{\alpha_B}\right)^2\right]^{\frac{1}{\frac{\rho}{2}-1}}$. Note that the relative profit is:

$$\frac{\pi_B}{\pi_A} = \kappa^{\frac{1}{2}} = \left[\frac{c}{1-c}\Big(\frac{\alpha_A}{\alpha_B}\Big)^2\right]^{\frac{1}{\rho-2}}. \tag{7}$$

Straightforward computations lead to:

$$x_A = \frac{X}{1+\kappa\left(\frac{\alpha_A}{\alpha_B}\right)^2} \ \text{ and } \ x_B = \Big(\frac{\alpha_A}{\alpha_B}\Big)^2 \frac{\kappa X}{1+\kappa\left(\frac{\alpha_A}{\alpha_B}\right)^2}, \tag{8}$$

$$\frac{x_B}{x_A} = \kappa\Big(\frac{\alpha_A}{\alpha_B}\Big)^2 = \left[\frac{c}{1-c}\Big(\frac{\alpha_A}{\alpha_B}\Big)^2\right]^{\frac{2}{\rho-2}} \Big(\frac{\alpha_A}{\alpha_B}\Big)^2. \tag{9}$$

A key point that emerges from Eq. (7) and (9) is that both relative profits and relative shares of water are independent from the total stock of resource X. These properties come from the CES specification of the DM's utility function which implies homogeneity of degree one with respect to X both for the demand functions and for the indirect utility function. In the empirical part we will vary the stock of resource in order to check that these properties are indeed satisfied with our data. The relative profits and relative shares of water depend however on the c and ρ parameters, which drive the DM's other-regarding preferences, and on α_A and α_B, which determine farmers A and B marginal productivity of water. We next discuss the different ways to share water, based on the existing literature, according to these different parameters.

Focal solutions in the DG game Based on the discussion in the introduction (Andreoni and Miller, 2002, Charness and Rabin, 2002, Engel, 2011, Jakiela, 2013, Edele et al., 2013), we consider here different types of behavior which may be plausibly adopted by the DM:

- **Efficient** : the DM maximizes the sum of profits;
- **Profit A maximizer**: the DM only considers farmer A's profit;
- **Profit B maximizer**: the DM only considers farmer B's profit;
- **Egalitarian in quantities**: the DM equalizes the quantity of water allocated to both farmers;
- **Egalitarian in profits**: the DM equalizes the profit of both farmers;
- **Proportional in quantities**: the share of total water allocated to a farmer reflects his relative productivity;
- **Proportional in profits**: the share of total profit allocated to a farmer reflects his relative productivity.

We describe these different "focal behaviors" in Table 1, which characterizes in particular the mapping between parameters representing DM's other-regarding preferences (c, ρ), parameters representing the farmer's differences in terms of water profitability (α_A, α_B) and the different focal behaviors (see Appendix A for details). One should stress at this point that our setting does not allow to distinguish the focal solution *Egalitarian in quantities* from the focal solution *Proportional in profits*: given the specification of the profit function, a DM who splits the quantity of water available equally between farmers A and B allocates the profits proportionally to the relative water profitability of farmers.

Table 1: Share of water and profit allocated to downstream farmer according to the focal solutions

Focal solution	Values of c and ρ	Share of water to B x_B/x_A	Share of profit to B π_B/π_A
Efficient (Eff)	c = 0.5 and $\rho = 1$	$\left(\frac{\alpha_B}{\alpha_A}\right)^2$	$\left(\frac{\alpha_B}{\alpha_A}\right)^2$
Profit A maximizer (PA)	c = 1, $\forall \rho \neq 0$	0	0
Profit B maximizer (PB)	c = 0, $\forall \rho \neq 0$	.	.
Egalitarian in quantities (EQ)	c = $\frac{\alpha_B^\rho}{\alpha_A^\rho+\alpha_B^\rho}$, $\forall \rho \neq 0$	1	$\frac{\alpha_B}{\alpha_A}$
Egalitarian in profits (EP)	c = $\frac{\alpha_B^2}{\alpha_A^2+\alpha_B^2}$, $\forall \rho \neq 0$	$\left(\frac{\alpha_A}{\alpha_B}\right)^2$	1
Proportional in quantities (PropQ)	c = $\frac{\alpha_B^{\frac{3}{2}}}{\alpha_A^{\frac{3}{2}}+\alpha_B^{\frac{3}{2}}}$, $\forall \rho \neq 0$	$\frac{\alpha_B}{\alpha_A}$	$\left(\frac{\alpha_B}{\alpha_A}\right)^{\frac{3}{2}}$
Proportional in profits (PropP)	c = $\frac{\alpha_B^2}{\alpha_A^2+\alpha_B^2}$, $\forall \rho \neq 0$	1	$\frac{\alpha_B}{\alpha_A}$

3 The field experiment

3.1 Context

Our experiment took place in the Karnataka State, located in the southwest of India, which is the eighth largest State in terms of population (61 million inhabitants according to the 2011 Indian census, estimated population of 70 million in 2021).

In Karnataka, and in India more generally, there is a high level of water stress. Indeed, and as emphasized in the introduction, India has been ranked in 2019 by the World Resource Institute among the countries with the highest water stress. There is therefore a necessity to better manage water. However, as pointed out by the 2012's National Water Policy, water mismanagement is also a strong concern (Governement of India - Ministry of Water Resources, 2012), although several solutions exist, including water pricing, better demand management through planning and coping strategies, etc. Notwithstanding, water pricing remains difficult to consider as it relies on the use of meters - which are not currently installed in the countryside; and because policymakers consider that, since farmers have not been paying water for now, they would be averse to the introduction of a price for water (Biswas and Venkatachalam, 2015, Mitra et al., 2022).

Both the depletion of water resources and water mismanagement have several economic consequences, in particular for agriculture. Following the Karnataka State Water Policy's report (KJA Task Group, 2019), agriculture water use represents 80-85% of total demand, knowing that around 70% of the total gross cultivated area is rain fed (which is limited to three to four months per year).

Therefore, investigating both the topics of farmers' water management as well as the question of fair water sharing is relevant, and is an objective set up by the Indian National Water Policy (Governement of India - Ministry of Water Resources, 2012).[3] Currently, water in India is managed at the state level through the *Panchayat Raj* system (Ahmed and Araral, 2019), which relies on three administrative levels: the *Zilla Panchayat* and the *Taluk Panchayak*, two water bodies with elected and appointed officials at the, respectively, district and block levels; and the *Gram Panchayat*, a water body regrouping around 10 villages with elected officials. The *Taluk* and *Gram Panchayats* are in charge of the implementation and the monitoring of water programs. This is in the context of such a decentralized organization that we are interested in farmers' preferences for water sharing with the objective to gain understanding about

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[3] The report highlights that "Principle of equity and social justice must inform use and allocation of water".

the potential to achieve a successful co-management of the water resource, in line with Ostrom (1990)'s perspective.

3.2 Decisions in the DG

In the DG we have described above, each subject plays as Farmer A (dictator) behind the veil of ignorance, i.e., without knowing if he will be payed as farmer A or farmer B (see instructions in Appendix B). At the end of the experiment, subjects are randomly matched in pairs (A, B). An additional draw chooses which of the two subjects will be Farmer A and B. Playing behind the veil of ignorance is supposed to reveal in the DG impartial social preferences (Schildberg-Horisch, 2010, Ambec et al., 2019).

The DG is repeated three times, with different stocks of water: 4,000m^3, 8,000m^3 or 12,000m^3. For each stock of water, the DM has to choose the water to be allocated to the upstream farmer (farmer A) and to the downstream farmer (farmer B). The order of stock sizes is randomized between sessions. We vary the stock size of available water to assess whether or not the DM behavior depends on the quantity of resource that has to be shared.

3.3 Treatments

We are interested in evaluating preferences of Indian farmers regarding water sharing. To do so, we first implement treatments in which we vary the location of the most productive farmers, to vary the intensity of the efficiency/equity trade-off (3.3.1). Additionally, to assess whether or not it is possible to induce Indian farmers to share water more efficiently, we implement framing treatments (3.3.2).

3.3.1 Spatial configuration treatment

We first consider two spatial configurations in which we vary the intensity of the equity/efficiency trade-off to assess how they shape farmers' decisions to share the stock of water.

In the first spatial configuration (*UpProd*), where the upstream farmer has a higher water profitability ($\alpha_A > \alpha_B$), we let $\alpha_A = 4$ and $\alpha_B = 2$. In the second spatial configuration (*DownProd*), the upstream farmer has a lower water profitability ($\alpha_B > \alpha_A$), and we specify $\alpha_A = 2$ and $\alpha_B = 4$. We detail in Table 2 the theoretical solutions depending on the focal behaviors and the spatial configuration.

Denoting as Π the group welfare, with these parameters we obtain that:

$$\Pi^{Eff} > \Pi^{PropQ} > \Pi^{EQ} > \Pi^{PA} > \Pi^{EP} > \Pi^{PB} \tag{10}$$

Table 2: Theoretical solutions depending on the focal behaviors and the spatial configuration

	UpProd							*DownProd*						
	$\alpha_A = 4$ and $\alpha_B = 2$							$\alpha_A = 2$ and $\alpha_B = 4$						
	x_A	x_B	$\frac{x_B}{x_A}$	π_A	π_B	$\pi_A+\pi_B$	$\frac{\pi_B}{\pi_A}$	x_A	x_B	$\frac{x_B}{x_A}$	π_A	π_B	$\pi_A+\pi_B$	$\frac{\pi_B}{\pi_A}$
Efficient (Eff)	$0.8X$	$0.2X$	0.25	$3.58\sqrt{X}$	$0.89\sqrt{X}$	$4.47\sqrt{X}$	0.25	$0.2X$	$0.8X$	4	$0.89\sqrt{X}$	$3.58\sqrt{X}$	$4.47\sqrt{X}$	4
Profit A maximizer (PA)	X	0	0	$4\sqrt{X}$	0	$4\sqrt{X}$	0	X	0	0	$2\sqrt{X}$	0	$2\sqrt{X}$	0
Profit B maximizer (PB)	0	X	.	0	$2\sqrt{X}$	$2\sqrt{X}$	.	0	X	.	0	$4\sqrt{X}$	$4\sqrt{X}$	.
Egalitarian in quantities (EQ)	$0.5X$	$0.5X$	1	$2.83\sqrt{X}$	$1.41\sqrt{X}$	$4.24\sqrt{X}$	0.5	$0.5X$	$0.5X$	1	$1.41\sqrt{X}$	$2.83\sqrt{X}$	$4.24\sqrt{X}$	2
Egalitarian in profits (EP)	$0.2X$	$0.8X$	4	$1.79\sqrt{X}$	$1.79\sqrt{X}$	$3.58\sqrt{X}$	1	$0.8X$	$0.2X$	0.25	$1.79\sqrt{X}$	$1.79\sqrt{X}$	$3.58\sqrt{X}$	1
Proportional in quantities (PropQ)	$0.67X$	$0.33X$	0.5	$3.27\sqrt{X}$	$1.15\sqrt{X}$	$4.42\sqrt{X}$	0.35	$0.33X$	$0.67X$	2	$1.15\sqrt{X}$	$3.27\sqrt{X}$	$4.42\sqrt{X}$	2.83
Proportional in profits (PropP)	$0.5X$	$0.5X$	1	$2.83\sqrt{X}$	$1.41\sqrt{X}$	$4.24\sqrt{X}$	0.5	$0.5X$	$0.5X$	1	$1.41\sqrt{X}$	$2.83\sqrt{X}$	$4.24\sqrt{X}$	2

if $\alpha_A = 4$ and $\alpha_B = 2$, and

$$\Pi^{Eff} > \Pi^{PropQ} > \Pi^{EQ} > \Pi^{PB} > \Pi^{EP} > \Pi^{PA} \tag{11}$$

if $\alpha_A = 2$ and $\alpha_B = 4$.

Considered jointly, inequalities (10) and (11) illustrate the equity/efficiency trade-off (Dietz and Atkinson, 2010, Balafoutas et al., 2013, Wu and Yu, 2017). In both spatial configurations, choosing the efficient solution yields the maximum total profit for the group, but at the expense of equity between farmers A and B (and conversely). Our experimental design therefore allows us to push farmers to face this trade-off when choosing the quantity of water they want to keep for themselves, should this trade-off be of interest for them.

3.3.2 Framing

Based on this setting, we also wish to assess whether or not we can modify farmers' efficiency/equity concern using framing.

Going back to the seminal work of Kahneman and Tversky (1979), economic agents are sensitive to framing effects and, more precisely, do not behave the same in the gain and loss domains. In particular, agents value more a loss than a gain having the same (absolute) size, an attitude that has been confirmed from an empirical point of view (De Dreu et al., 1994, De Dreu, 1996). While De Dreu (1996) emphasizes that subjects pay less attention to distributional consequences (both equality and equity) in the loss framing compared with the gain one, Fiedler and Hillenbrand (2020) show that when the payoff of the sender is higher than the one of the receiver, subjects are more likely to choose an altruistic distribution with the gain framing (compared with the loss one).

From a psychological point of view, several reasons may explain these observed differences between the gain and loss framing. For De Dreu et al. (1994), loss aversion induces subjects to become more concerned with maximizing their own wealth. More recently, Baumeister et al. (2001) have explained that the difference between gains and losses in agents' valuation can be explained by a difference of attention, with losses that increase agents' attention regarding the considered task (Yechiam and Hochman, 2013). Finally, Balew et al. (2022) show in their study that the loss framing is the best complement to either private or social rewards to improve knowledge diffusion among farmers.

Knowing that framing matters, we thus implement a *Gain* and *Loss* framing in addition to a baseline (see Appendix C for a presentation of the decision sheets for each treatment). In the baseline, the information provided to the DM is, for the different possible allocations of water between A and B, the profit for farmer A, the profit for farmer B and the total group profit. In the *Gain* treatment, the additional information provided to the DM for each possible allocation of water is the group profit gain with respect to the worst possible allocation. The *Gain* treatment introduces the worst allocation as a reference point, and makes any improvement more salient with respect to this allocation. In the *Loss* treatment, the additional information provided to the DM for each possible allocation of water is the group profit loss with respect to the efficient water allocation. In the *Loss* treatment, the efficient allocation becomes a reference point, and makes more salient any loss with respect to this allocation.

Considering both our spatial configuration and framing treatments, this results in a 2 × 3 design (two spatial configurations and three framing conditions, including a baseline one). Farmers were randomly allocated to one treatment and could not participate in other treatments.

3.4 Hypotheses

Following the presentation of the conceptual framework in Section 2, different testable hypotheses can be derived. Since the resource stock size does not appear into Eq. (7) and (9), our first hypothesis is:

> **H1:** The relative share of profit/water left to the downstream farmer does not depend upon the resource stock size.

It should be noted that the experimental evidence is mixed regarding the role of stock size in DG. Forsythe et al. (1994), Cherry et al. (2002), Carpenter et al. (2005) emphasize that, in DG, the size of the resource to be shared has no influence on the dictator behavior. On the contrary, Engel (2011) concludes in his meta-analysis that subjects are less likely to give when the stock to be shared increases.

Second, our results indicate that the share of profits/water left to farmer B increases with the ratio $\frac{\alpha_A}{\alpha_B}$. In our case, this is of particular importance since we are interested in the equity/efficiency trade-off. Thus, the location of the most productive farmer (*UpProd* or *DownProd*) induces different behaviors, as explained with the following hypothesis:

> **H2:** When the most productive farmer is located upstream ($\alpha_A > \alpha_B$), more water/profits is left to farmer B, compared with the case where the most productive farmer is located downstream ($\alpha_A < \alpha_B$).

Evidence in the literature have emphasized that spatial configuration matters, with upstream subjects extracting more resource than those located downstream (Janssen et al., 2011, 2012, Anderies et al., 2013).

Next, with the two framing treatments (*Gain* and *Loss*) we explicitly make salient the gain (loss) for the group resulting from subjects' decisions. More precisely, we create a reference point (Kahneman and Tversky, 1979) based on the efficient solution. We thus expect these two treatments to focus subjects' attention (Baumeister et al., 2001) on that solution.

> **H3:** Farmers more often adopt an efficient behavior in the framing treatments, compared to those in the baseline.

Finally, based on the above discussion on the gain and loss framing (De Dreu et al., 1994, De Dreu, 1996), we may expect the *Loss* framing to be more effective than the *Gain* one in pushing farmers to adopt the efficient behavior. Indeed, *Loss* framing has been shown to be more effective in triggering subjects' attention compared to the *Gain* framing (Yechiam and Hochman, 2013), or to give incentive to farmers to increase efforts in diffusing information (Balew et al., 2022).

> **H4:** Farmers treated with the *Loss* framing more often adopt the efficient behavior compared to those treated with the *Gain* framing.

3.5 Implementation

The field experiment has been jointly developed by researchers belonging to the Department of Agricultural Extension in Bangalore (India), and by researchers from the French National Research Institute for Agriculture, Food and the Environment (INRAE, France). It has been structured into two parts. The first one refers to the DG experiment. The second part comprises socio-economic information of farmers (education level, gender, cropping patterns, etc.).

Upon arrival, we welcomed farmers and explained them that they would participate to an economic experiment and that their decisions would allow them to earn real money. Then, they were randomly assigned to one office picking a card numbered between 1 and 24. We told them that they should not discuss anymore and that should they have a question, they should raise their hand and an experimenter would answer their questions. Subjects received written instructions (translated into Kannada, the official language of Karnataka) that were explained orally by a native speaker using a video-projector (see Appendix B). They knew that the experiments comprised four parts. Before the start of the game, we asked them cognitive comprehension questions that were then corrected orally.

The DG experiment has been incentivized with real payments. We explained farmers that they would all play as farmer A and that their role was to choose how much water they wanted to keep for themselves, the rest being automatically given to farmer B. However, given that we were interested in altruistic behaviors, we told them that, at the end of the experiment, they would be randomly matched with another farmer of the session and that one of the two would be farmer A, the other one being farmer B. Moreover, we explained to them that only one period would be randomly selected for the payment.[4] Farmer A's decision would directly impact farmer B's payoff. We adopted this strategy to make farmers understand that their decisions could have an impact on another farmer in the room and to elicit, as previously explained, impartial social preferences. Farmers' payment was given by Eq. 1, with the values of α_A and α_B adapted depending on the treatment (see Table 2). To help farmers understand the payment scheme, we provided some examples in the instructions.

To limit experimenter demand effects (Zizzo, 2010), we reminded farmers that they were totally free to choose their quantity of water, and that their anonymity was guaranteed.

3.6 Experimental sessions and data

We conducted a total of 10 sessions in eight villages of Karnataka, each session with 24 farmers.[5] In each session, farmers were randomly allocated to one of the six treatments. Given that farmers did not interact in our game, we therefore have a total of 40 independent observations per treatment. Sessions lasted 2.5 hours on average. The average payment was 263.08 INR (3.32 euros), with a standard deviation of 96.79 INR. In Table 3, we report the main socio-economic characteristics of our sample.

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[4] At the end of the experiment, one farmer was randomly selected and ask to pick a card numbered from 1 to 3 (corresponding to periods 1 to 3).

[5] See Table D.1 in Appendix D for the different locations.

Variable	Value	Responses	Number of respondents
Gender	Male	88.28%	239
	Female	11.72%	
Age		40.04	240
Education	Below primary school	3.54%	226
	Primary school	9.29%	
	High school	36.73%	
	Bachelor's degree	39.38%	
	Master's degree	10.62%	
	None	0.44%	
Number of children		0.96	218
Income in 2018		81,749.01 INR	203
Land area (in acre)		7.23	234
Main Crop	Finger millet	16.95%	236
	Paddy	14.41%	
	Arecanut	13.98%	
	Ragi	8.47%	
	Tomato	8.05%	
	Other	38.14%	

Table 3: Socio-economic characteristics of the sample of farmers.

We compare in Table D.2 (Appendix D) these characteristics between treatments. Overall, our samples are well-balanced in terms of gender, age, education, number of children and income. However, the Kruskal-Wallis test reveals a significant difference between treatments regarding farms' land size, but only at the 10% level.

4 Results

We now detail the analyses conducted to test our different hypotheses. We first analyze how farmers share water and, then, turn to the assessment of the effects of spatial configuration and the framing treatments on subjects' behavior.

4.1 How do farmers share water?

Our first hypothesis is that the relative share of profit/water left to the downstream farmer does not depend upon the resource stock size. To assess its validity, we detail in Table 4 how the stock of water is allocated between the two farmers and how the resulting profits are shared, abstracting for now from the spatial configurations and the framing treatments.

Water and profit sharing are at least partially driven by efficiency concerns. Indeed, the most

Table 4: Allocation of water and profits in the DG – Aggregate analysis

		Stock		
	All	4000	8000	12000
Total profit (A+B)	352.51	256.27	362.30	438.97
	(90.14)	(34.02)	(51.71)	(60.91)
Share of water left to downstream	0.44	0.45	0.43	0.44
	(0.28)	(0.27)	(0.29)	(0.29)
Share of profit left to downstream	0.47	0.47	0.45	0.48
	(0.25)	(0.24)	(0.26)	(0.25)
Share of water left to most productive	0.53	0.53	0.56	0.52
	(0.29)	(0.27)	(0.29)	(0.30)
Share of profit left to most productive	0.66	0.66	0.67	0.66
	(0.20)	(0.18)	(0.21)	(0.20)

Mean value and (standard deviation).

productive farmer gets on average 53% of the quantity of water available which corresponds to two-third of the total profit. Again, we note only a very limited impact of the stock of water available on these figures.

On average, the farmer located downstream (farmer B) receives 44% of the available quantity of water, and 47% of the total profit generated by water use. These percentages remain very similar whatever the stock of water considered and are not significantly different (Paired T-tests, *p-value* = 0.212 for a stock of 4,000 vs 8,000; *p-value* = 0.721 for a stock of 8,000 vs 12,000; and *p-value* = 0.212 for a stock of 8,000 vs 12,000).

Result 1 In line with **H1**, we find evidence that the share of water/profit left to the B farmer does not depend on the available stock of water.

To further investigate the role of stock size, we report in Table 5 the proportions of adopted focal behaviors depending on the stock of water to be shared.

We observe that the higher the quantity of water is, the less we explain behaviors (focusing on the category 'Other'). The efficient behavior is always the most represented focal behavior, although we observe a drop when the stock is high (12,000). The egalitarian in profits and the egalitarian in quantities behaviors are the two other focal behaviors the most observed, with different patterns. Regarding the egalitarian in profits behavior, the rate of adoption is U-shaped, with a minimum when the stock of water is medium (8,000). On the contrary, for the egalitarian in quantities behavior, when the available quantity of water is low (4,000), there are twice more farmers who adopt an egalitarian in quantities behavior compared with medium (8,000) and large (12,000) stock sizes. Overall, these observed differences are significant (chi-squared test, *p-value* < 0.01).

Table 5: Adoption of focal behaviors in the DG – Aggregate analysis

		Stock		
	All	4000	8000	12000
Efficient	21.67% (156)	22.50% (54)	24.17% (58)	18.33% (44)
Profit A maximizer	4.44% (32)	3.33% (8)	7.08% (17)	2.92% (7)
Profit B maximizer	4.03% (29)	2.92% (7)	3.75% (9)	5.42% (13)
Egalitarian in quantities	13.19% (95)	19.17% (46)	10% (24)	10.42% (25)
Egalitarian in profits	16.67% (120)	20% (48)	13.75% (33)	16.25% (39)
Proportional in quantities	4.58% (33)	7.50% (18)	4.17% (10)	2.08% (5)
Other	35.42% (255)	24.58% (59)	37.08% (89)	44.58% (107)
χ^2 test		*p-value* <0.01		

Percentage and (frequency).

Based on the first column ('All') of Table 5, our classification of behaviors allows to explain, on average, 64.58% of observed behaviors during the DG. When the stock of water is low (4,000), we explain 75% of observed behaviors, while we explain only 55% of observed behaviors when the stock is high (12,000). Among the focal behaviors we focus on, the efficient behavior is the most represented one (21.67%), followed by the egalitarian in profits (16.67%) and the egalitarian in quantities (13.19%).

Result 2 We find evidence that farmers rely mostly on focal behaviors when it comes to dividing water, and that their adoption is influenced by the available stock of water.

It therefore appears that the size of the water stock does have an effect on the adoption of focal behaviors (Table 5), but it does not affect the way water is shared (Table 4). We now refine our analysis taking into account spatial configuration and, then, the framing treatments.

4.2 Effect of spatial configuration on the adoption of focal behaviors

Our second hypothesis is that, when the most productive farmer is located upstream, more water/profits is/are left to farmer B, compared with the case where the most productive farmer is located downstream. We investigate the effect of spatial configuration on water sharing in Table 6.

Table 6: Allocation of water and profits in the DG – Spatial configuration analysis

		Stock		
	All	4000	8000	12000
Panel A: Most productive farmer located upstream				
Total profit (A+B)	361.62	262.35	374.55	447.97
	(89.65)	(30.71)	(39.38)	(64.25)
Share of water left to downstream	0.41	0.43	0.37	0.42
	(0.27)	(0.25)	(0.26)	(0.28)
Share of profit left to downstream	0.31	0.31	0.28	0.32
	(0.18)	(0.17)	(0.17)	(0.20)
Panel B: Most productive farmer located downstream				
Total profit (A+B)	343.49	250.18	350.04	429.98
	(89.84)	(36.15)	(59.29)	(56.22)
Share of water left to downstream	0.48	0.48	0.49	0.47
	(0.29)	(0.29)	(0.30)	(0.30)
Share of profit left to downstream	0.63	0.63	0.62	0.63
	(0.21)	(0.20)	(0.23)	(0.19)

Mean value and (standard deviation).

The share of water left to the downstream farmer (farmer B) is influenced by the spatial configuration of the DG. When the downstream farmer is less productive, he obtains 41% of water resources compared with 48% when he is more productive (t-test, $p\text{-}value < 0.01$). We also find that the share of water resource allocated to the most productive farmer differs according to the spatial configuration. When the most productive farmer is located upstream (farmer A), he obtains 59% of the water available (1-0.41). The share of water obtained by the most productive farmer drops to only 48% when he is located downstream. A premium representing 11 percentage points of the water resources is then attached to the upstream location. This premium attached to the upstream location may reflect riparian property rights.

Result 3 Contrary to our prediction with **H2**, we find that, when the most productive farmer is located upstream, less water is left to farmer B, compared with the case where the most productive farmer is located downstream.

We also investigate the role of spatial configuration on the adoption of focal behaviors in

Appendix E (see Table E.1). We show that the type of focal behaviors adopted by farmers does depend on spatial configuration.

4.3 Inducing efficiency with the *Gain* and *Loss* framing

Our third hypothesis is that farmers treated with a framing treatment are more likely to adopt the efficient behavior, compared with the baseline (without any framing). To test this hypothesis, we analyze in Table 7 the effect of the framing treatments on the adoption of focal behaviors. A more detailed analysis is provided in Appendix E.

We compare the distributions of adoption of focal behaviors between treatments, in each panel, with chi-squared contingency tests. In both spatial configurations, the distributions of focal behaviors between treatments differ (at the 5% level for Panel A and at the 1% level for Panel B). As previously outlined, the proportion of farmers adopting one of the two profit-maximizing behaviors in both panels is low compared with the other types of focal behaviors. Moreover, while the efficient behavior is the most often adopted behavior in Panel A, in Panel B it depends on the treatment: the egalitarian in profits behavior is the most often adopted behavior in the baseline and in the *Gain* framing, while it is the efficient behavior in the *Loss* framing.

Surprisingly, in Panel A the *Gain* framing reduces the proportion of farmers adopting the efficient behavior compared to the baseline, while it increases the proportion of those adopting the egalitarian in quantities behavior. The *Loss* framing has almost no effect on the adoption of the efficient behavior compared with the baseline, but does increase the proportion of farmers adopting the egalitarian behavior, but to a lesser extent than the *Gain* framing. On the other hand, in Panel B, we note a clear effect of the *Loss* framing on the adoption of the efficient behavior, compared with the baseline, but also with the *Gain* framing. This latter treatment has no specific effect on the adoption of focal behavior compared with the baseline, but it increases the proportion of "Other" behaviors. Note that, in both panels, the *Loss* framing induces the lowest percentage of "Other" behaviors, i.e., it allows to explain more behaviors than in the baseline and *Gain* framing.

Therefore, only the *Loss* framing seems to be effective in pushing farmers to adopt more efficient behaviors compared with the baseline, but only when the most productive farmer is located downstream. To better analyze the effect of the framing treatments, we report in Table 8 the results of multinomial logit estimations in which we explain the probability to adopt focal behaviors taking into account the two framing treatments. The reference category,

Table 7: Adoption of focal behaviors in the DG - Framing analysis

	Baseline	Gain	Loss
Panel A: Most productive farmer located upstream			
Efficient	29.17% (35)	18.33% (22)	27.50% (33)
Profit A maximizer	1.67% (2)	6.67% (8)	5% (6)
Profit B maximizer	3.33% (4)	1.67% (2)	3.33% (4)
Egalitarian in quantities	8.33% (10)	24.17% (29)	14.17% (17)
Egalitarian in profits	11.67% (14)	5.83% (7)	13.33% (16)
Proportional in quantities	10.83% (13)	8.33% (10)	3.33% (4)
Other	35% (42)	35% (42)	33.33% (40)
χ^2 test *p-value* $= 0.011$			
Panel B: Most productive farmer located downstream			
Efficient	13.33% (16)	11.67% (14)	30% (36)
Profit A maximizer	3.33% (4)	3.33% (4)	6.67% (8)
Profit B maximizer	8.33% (10)	2.50% (3)	5% (6)
Egalitarian in quantities	15.83% (19)	12.50% (15)	4.17% (5)
Egalitarian in profits	25% (30)	20.83% (25)	23.33% (28)
Proportional in quantities	0.83% (1)	3.33% (4)	0.83% (1)
Other	33.33% (40)	45.83% (55)	30% (36)
χ^2 test *p-value* < 0.01			

Percentage and (frequency).

'Other', includes all types of behaviors not explained by one of the focal behaviors, except the Proportional in quantity behavior that we include in that category, since a very small number of farmers adopted this behavior (see Table E.2 in Appendix E). Moreover, based on the previous evidence that spatial configuration matters, we separate our estimations between the two spatial configurations. To explain the adoption of focal behaviors, we include dummy variables for stocks of 8,000 and 12,000 m^3 (4,000 m^3 being the reference) and for the *Gain* and *Loss* framing (the baseline being the reference). We also control for farmers cultivating in a rainfed area with a corresponding dummy variable (the reference is command area).

These estimates confirm our past observations. First, it appears that farmers are less likely to adopt an egalitarian in quantity behavior when the size of the stock is medium or high, compared to the case where it is low, in both spatial configurations. We also note that farmers are less likely to adopt the efficient behavior when the stock of resource is high, compared with a low stock of resource, when the most productive farmer is located downstream.

Second, depending on the spatial configuration, our two framing treatments do not lead to the same effects. When the most productive farmer is located upstream, the *Gain* framing has a positive and significant effect (at the 5% level) on the probability to adopt an egalitarian in quantity behavior (compared to 'Other' behaviors). However, when the most productive farmer is located downstream, the *Loss* framing has a negative and significant effect on the probability to adopt an egalitarian in quantity behavior, while it has a positive and significant effect on the probability to adopt the efficient behavior (both at the 5% level). In that spatial configuration, the *Gain* treatment has no significant effect on the probability to adopt an egalitarian in quantity behavior, but it has a negative and significant effect on the probability to adopt a profit-maximizing behavior (at the 5% level).

Note that these results for the *Loss* framing are robust when controlling successively for farmers' age, gender and whether or not they grow paddy. When controlling for farmers' income, we no longer detect a significant effect of the *Loss* framing on the adoption of the efficient behavior when the most productive farmer is located downstream.[6]

In sum, when the most productive farmer is located upstream, farmers adopt the third best solution (Egalitarian in quantity) more often, under the implementation of the *Gain* framing. On the contrary, when the most productive farmer is located downstream, subjects adopt the first best solution (efficient) more often, but only with the *Loss* framing.

Result 4 In line with **H3**, we find evidence that the *Loss* framing can influence farmers' decisions to adopt the efficient behavior, but only when the most productive farmer is located downstream. However, we do not find support for **H3** regarding the *Gain* framing.

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[6] Results are available upon request.

Table 8: Adoption of focal behaviors - Multinomial logit estimations (category ‘Other’, including Proportional in quantity, is the reference)

	Most productive upstream					Most productive downstream				
	Egalitarian in profits	Egalitarian in quantity	Efficient	Profit A maximizer	Profit B maximizer	Egalitarian in profits	Egalitarian in quantity	Efficient	Profit A maximizer	Profit B maximizer
Stock = 8000	-0.547	-0.922**	0.005	0.930	-0.574	-0.729**	-0.904**	-0.446	0.146	0.209
	(0.447)	(0.403)	(0.336)	(0.707)	(0.938)	(0.358)	(0.443)	(0.382)	(0.617)	(0.670)
Stock = 12000	-0.815*	-0.884**	-0.471	-0.047	0.175	-0.537	-1.174**	-0.791**	-0.929	0.260
	(0.454)	(0.380)	(0.347)	(0.797)	(0.759)	(0.341)	(0.464)	(0.396)	(0.766)	(0.655)
Gain	-0.636	1.123***	-0.441	1.476*	-0.634	-0.562	-0.620	-0.521	-0.362	-1.566**
	(0.504)	(0.420)	(0.343)	(0.821)	(0.889)	(0.343)	(0.407)	(0.427)	(0.739)	(0.689)
Loss	0.364	0.762*	0.162	1.333	0.220	0.045	-1.223**	0.950**	0.795	-0.407
	(0.421)	(0.451)	(0.325)	(0.847)	(0.737)	(0.351)	(0.556)	(0.387)	(0.657)	(0.564)
Rainfed area	-0.282	-0.372	-1.121***	1.186*	0.087	-0.539*	-0.400	-1.164***	0.404	-0.038
	(0.372)	(0.322)	(0.284)	(0.667)	(0.668)	(0.284)	(0.372)	(0.327)	(0.572)	(0.501)
Constant	-0.775*	-0.949**	0.210	-4.566***	-2.599***	0.396	0.108	-0.007	-2.388***	-1.571**
	(0.429)	(0.429)	(0.327)	(1.059)	(0.828)	(0.353)	(0.413)	(0.401)	(0.771)	(0.660)
Observations	360					360				
Log-likelihood	-497.824					-525.424				
Wald χ^2	64.341					66.140				
Prob. > χ^2	0.0000					0.0000				

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.4 Comparison of the *Gain* and *Loss* framing

Following our fourth hypothesis, farmers treated with the *Loss* framing adopt the efficient behavior more often, compared with those treated with the *Gain* framing. Therefore, to compare the effect of the two framing treatments, we now consider propensity score analyses, which allow to assess the causal effect of our treatment on the mean number of individual choices of the efficient behavior. Formally, let Y_{1i} denote the mean number of choices of the efficient behavior of individual i if he receives a treatment (we do not distinguish between the *Gain* and *Loss* framing for now). Let Y_{0i} denote the mean number of choices of the efficient behavior of individual if he does not receive any treatment. Moreover, we denote as T_i the dummy variable equal to 1 if individual i is treated, and 0 otherwise. The average treatment effect on the treated (ATET) therefore reads:

$$E[Y_{1i} - Y_{0i} | T_i = 1]. \tag{12}$$

In addition to the usual propensity score matching[7], we consider two other matching methods to assess the robustness of the treatment effects: the nearest neighbor matching method with the Mahalanobis distance metric[8] and the inverse probability weighting matching method[9]. Finally, to avoid biased estimates, we match farmers using their age, gender, land area and whether or not they grow paddy (see Table 3). Results are reported in table 9.

Overall, we confirm our past observation that the *Loss* framing significantly pushes towards the adoption of the efficient behavior, compared with the baseline, when the most productive farmer is located downstream. This result is quite robust whatever the matching method, although it is only significant at the 10% level with the nearest matching method and the inverse probability weighting. However, we also find weak evidence that the *Gain* framing reduces the adoption of the efficient behavior, compared with the baseline, when the most productive farmer is located upstream (negative and significant coefficient at the 10% level with the nearest matching method and the inverse probability weighting).

Result 5 In line with **H4**, we find mild evidence that the *Loss* framing is more adapted

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[7] A treated farmer is matched with the closest farmer in the baseline based on the euclidean distance for each confunding variable considered.

[8] Instead of considering the Euclidean distance between each characteristic, weights are considered such that the characteristics which are the most correlated receive higher weights.

[9] The sample is weighted such that the populations in the control and the treatment groups are approximately similar. More precisely, for a given individual, the outcome variable is weighted by the inverse of the probability of being assigned to a treatment (*Loss* or *Gain* framing), based on the set of covariates.

Table 9: Propensity score analyses - Average treatment effect on the treated regarding the adoption of the efficient behavior (depending on the spatial configuration)

Matching method	Type of framing	Most productive farmer is Upstream	Most productive farmer is Downstream
Propensity score matching	Gain	-0.145 (0.112)	-0.053 (0.082)
	Loss	0.008 (0.127)	0.214*** (0.072)
Nearest neighbor matching	Gain	-0.205* (0.124)	-0.009 (0.075)
	Loss	0.042 (0.115)	0.145* (0.082)
Inverse probability weighting	Gain	-0.151* (0.086)	-0.100 (0.088)
	Loss	-0.036 (0.088)	0.140* (0.078)

Standard errors in parentheses. Age, gender, land area and the type of crop (paddy) are used as confounders.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

than the *Gain* framing to push farmers to adopt an efficient behavior.

4.5 Aggregate preference parameters

A last interest of our approach relies on the possibility to estimate aggregate preference parameters, namely c (i.e., the relative weight put on the profit for farmers A and B) and ρ (i.e., efficiency orientation). Taking the logarithm of Equation (7), under the condition that $\pi_A \neq 0$, we obtain

$$ln\Big(\frac{\pi_B}{\pi_A}\Big) = \frac{1}{\rho - 2}ln\Big(\frac{c}{1-c}\Big) + \frac{2}{\rho - 2}ln\Big(\frac{\alpha_A}{\alpha_B}\Big)$$

that is to say,

$$ln\Big(\frac{\pi_B}{\pi_A}\Big) = \hat{\lambda} + \hat{\theta} ln\Big(\frac{\alpha_A}{\alpha_B}\Big) + \tilde{\epsilon}, \tag{13}$$

with $\hat{\lambda} = \frac{1}{\rho-2}ln\Big(\frac{c}{1-c}\Big)$ and $\hat{\theta} = \frac{2}{\rho-2}$. Straightforward computations lead to the following estimates of structural parameters ρ and c:

$$\hat{\rho} = \frac{2}{\hat{\theta}} + 2 \text{ and } \hat{c} = \frac{e^{\frac{2\hat{\lambda}}{\hat{\theta}}}}{1 + e^{\frac{2\hat{\lambda}}{\hat{\theta}}}}. \tag{14}$$

We estimate Eq. (13) using OLS and then derive parameters ρ and c from Eq. (14). We report them in Table 10, first considering the whole sample (column 'All'), and then separately for each framing treatment (including the baseline). Because we need different values of α_A and α_B to estimate ρ and c, we pool together treatments *UpProd* and *DownProd*.

Overall, farmers give more weight to farmer A's profits ($c = 0.568$) with some concern towards efficiency ($\rho = 0.269 > 0$). Considering each treatment separately, farmers give less weight to farmer A's profits in the baseline ($c = 0.500$) compared with those in the *Gain* and *Loss* framing ($c = 0.609$ and $c = 0.593$, respectively). Regarding the ρ parameter, the results are inconclusive, except for the *Gain* framing ($\rho = 0.384$).

Table 10: Estimates of the CES utility function

Dependent variable:	$ln\left(\frac{\pi_B}{\pi_A}\right)$			
	All	Baseline	Gain	Loss
$\hat{\rho}$	0.269*	0.277	0.384**	0.128
	(0.162)	(0.298)	(0.186)	(0.368)
$\hat{c}$	0.568***	0.500***	0.609***	0.593***
	(0.032)	(0.060)	(0.043)	(0.064)
Observations	720	240	240	240
R^2	0.182	0.184	0.243	0.138

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

It therefore appears that the *Gain* treatment has an influence on the concern for efficiency parameter (ρ), which suggests that there is a malleability of distributional preferences. We do not find such an effect for the *Loss* treatment. However, one should keep in mind that our estimations do not account for the *UpProd* and *DownProd* treatments, which may have an influence on the estimated parameters.

In the literature, estimates for parameter c range between 0.576 and 0.758 in Andreoni and Miller (2002), from 0.892 to 0.941 in Jakiela (2013), and from 0.421 to 0.930 in Robson (2021). In our case, we are therefore closer to the lower bound of those estimates, i.e., farmers seem to give more weight to the other player's profits compared with the subjects in these experiments. This may be due to the nature of our game (farmers play behind a veil of ignorance), as well as to the nature of the good that is shared (irrigation water instead of money).

Regarding parameter ρ, estimation results in the literature present large variations. While estimates are negative (between -0.684 and -0.8214) in Jakiela (2013), they are either positive (between 0.621 and 0.669) or negative (-0.350) depending on the type of model in Andreoni and Miller (2002), and they are positive (between 0.102 and 1.221) in Robson (2021).

Note that, in our case, one limitation may come from the smaller sample size used to compute these estimates at the treatment level. We have 240 observations for each treatment, which is close to the sample size used in Andreoni and Miller (2002) (between 230 and 380 depending on the type of model), but less than in Jakiela (2013) (912 observations) and Robson (2021) (between 432 and 1809 observations).

5 Discussion

One surprising observation made when analyzing our empirical results is that upstream farmers offer, on average, 44% of the available quantity of water to downstream farmers, which contradicts the self-centered prediction of a zero offer. This share is also higher to what is generally observed in DG. In his meta-analysis, Engel (2011) explains that a large number of individuals do offer non-zero, often sizeable portions of the pie to the recipient. But, on average, subjects donate between 20–30% of the total pie.

Moreover, with our classification of behaviors we are able to explain, on average, 65% of observed decisions (Table 5), and even more than 70% of them when the most productive farmer is located downstream and the stock of resource is low (Table E.1). Overall, very few farmers adopt profit-maximizing behaviors and instead, they tend to rely on efficient or egalitarian (in quantities or in profits) behaviors. This therefore contradicts the hypothesis of self-centered agents.

Several reasons may explain these observations. First, differently from most DGs in the literature, subjects here are allocating water and not money. Finding a high rate of giving for water is in line with Kause et al. (2018) who show that dictators tend to offer higher shares when they face a stock of water compared to a stock of money (on average 56% versus 37%, respectively). A second explanation could be related to the fact that our subjects play the DG game behind a “veil of ignorance”. This choice is known to reduce subjects’ strategic behaviors and, therefore, to reveal true preferences.

Some institutional and cultural characteristics of India may contribute to explain both the high giving rate and the high proportion of farmers adopting focal behaviors. First, the idea of a “just and fair society” ensuring distributive justice is part of India Fundamental Rights (Ramanujam et al., 2019). In particular, Ramanujam et al. (2019) emphasize that the Indian Supreme Court favors such an approach when it turns to environmental issues, in order to achieve fairness. Second, cultural factors may also explain this inclination towards sharing. Indeed, social behaviors in India can be explained by both *daan* and *deservingness* (Krishnan, 2005). *Daan* is prescribed by religion and is related to the act of giving, or even giving up, a resource for instance. From a traditional perspective, *daan* can be explained by the fact that one should not let others asking for help, and give before they do. The other cultural reason, *deservingness*, is related to the fact that one should obtain what ones deserves. This is a notion that is rooted in traditional Indian texts and that shares some links with distributive justice. Following Krishnan (2005), in the traditional Indian perspective, concepts such as equity, equality and proportionality between someone's contribution and the associated reward are of particular importance, and failing to respect these concepts should lead to punishment.

Related to the adoption of focal behaviors, note that if we are are able to explain most farmers' decisions with focal behaviors, we also observe that, in general, the higher the available stock of water, the less we explain behaviors. Two reasons may explain this finding. The first one is that farmers adapt their behavior to the context they face. Second, it may be the case that, when increasing the stock of water, finding these focal behaviors in the list of possible water allocations becomes more difficult.

A direct application of our experiment is related to water sharing involving upstream-downstream agents (e.g., Kilgour and Dinar 2001, Ambec et al. 2013, Ansink and Houba 2016). We show that using the *Loss* framing is an effective way to foster water sharing efficiency, when the most productive farmer is located downstream. Changing the choice architecture in which farmers take their decisions is another tool that may be used by public authorities in charge of water management, in addition to water pricing, sharing agreements or quotas. On the contrary, our results do not indicate that the *Gain* framing can help farmers in choosing the efficient solution more often. We even find mild evidence that it may push them to more often deviate from the efficient solution. This observed difference between the *Gain* and *Loss* framing is not surprising and is in line with the existing literature (De Dreu et al., 1994, Baumeister et al., 2001, Yechiam and Hochman, 2013, Balew et al., 2022). Thus, as highlighted with our results, spatial configuration matters and, in particular, when it turns to the efficiency of our treatments.

These results also highlight that providing incentives to farmers is complex due to farmer heterogeneity regarding their adhesion to fairness principles, and to the spatial configuration (upstream versus downstream) which results in very asymmetric positions between farmers. Other works have also emphasized the need to consider farmer's heterogeneity when implementing non-monetary incentives. Using a social comparison nudge in a randomized experiment setting, Chabe-Ferret et al. (2019) have shown that only large farmers tend to reduce their water consumption. This differs from studies where such incentives have been tested on consumers with encouraging results (Ferraro et al., 2011, Bernedo et al., 2014, Brent et al., 2016, Schultz et al., 2016, Bhanot, 2017). Overall, and related to the issue of water management, our results therefore indicate that local conditions and context characteristics must be accounted for to provide effective incentives to farmers to share water more efficiently. Although some of the results of our framing treatments are mixed, we believe that they are of particular interest for public authorities in charge of water management especially since they are based on a sample of farmers which provide a higher external validity compared to experiments conducted with students (Higgins et al., 2017, Palm-Forster et al., 2019).

6 Conclusion

In this paper we first provide evidence that, contrary to what could be expected from economic theory, few farmers behave as profit maximizers. Most of them adopt what we call in this paper focal behaviors and, in particular, efficient, egalitarian in quantity or egalitarian in payoff behaviors. This result, which is in line with those in the experimental literature (Engel, 2011, Jakiela, 2013, Andreoni and Miller, 2002, Edele et al., 2013, Charness and Rabin, 2002), highlights how important it may be to account for focal behaviors when designing public policies targeted toward farmers.

Second, we show that it is possible to induce farmers to behave in a more efficient way by modifying the choice architecture they are confronted to, and in particular by making more salient a *Loss* framing. However, the effectiveness of these incentives depends on the local context: when implemented on the most productive farmers, a *Loss* framing is more likely to induce farmers to choose a second-best allocation (egalitarian in quantity behavior). A detailed knowledge of the population to be treated is then required before implementing such incentive schemes.

In the absence of water metering, a solution often implemented in developing countries is to allocate water through quotas based on extraction time. From a public policy point of view, one concrete example of implementation of the *Loss* framing could be to inform farmers about the monetary loss that other farmers incur for each minute of water extraction beyond the quota.

The efficiency/equity trade-off is not specific to the field of agricultural economics (Wu and Yu, 2017) and concerns several domains (health, design of taxes, etc.) when users are competitive. In that spirit, our approach has the merits to be helpful for other researchers and/or policymakers interested in assessing the role of this trade-off to explain individual behaviors. We, however, acknowledge that the main limitation of our approach relies on the fact that accessing specific actors, as farmers in our case, may be a difficult and costly task.

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A Derivation of focal solutions in the DG

The focal solutions depend on specific values of c and ρ as presented in Table 1. We now detail the computations for each solution.

Efficient If $c = 0.5$ and $\rho = 1$, then the DM adopts an efficient water allocation between both farmers, which is the solution to the following program:

$$\max_{x_A, x_B} 0.5\alpha_A\sqrt{x_A} + 0.5\alpha_B\sqrt{x_B} \tag{15}$$

$$s.t. \quad x_A \geq 0, x_B \geq 0,$$

$$x_A + x_B \leq X.$$

Denoting by x_A^* and x_B^* the efficient allocation of water for farmer A and B respectively, the first order conditions lead to:

$$x_A^* = \frac{X\alpha_A^2}{\alpha_A^2 + \alpha_B^2} \text{ and } x_B^* = \frac{X\alpha_B^2}{\alpha_A^2 + \alpha_B^2}. \tag{16}$$

The resulting profits for each farmer read:

$$\pi_A^* = \frac{\alpha_A^2\sqrt{X}}{\sqrt{\alpha_A^2 + \alpha_B^2}} \text{ and } \pi_B^* = \frac{\alpha_B^2\sqrt{X}}{\sqrt{\alpha_A^2 + \alpha_B^2}} \tag{17}$$

and total profit is:

$$\pi^* = \sqrt{\alpha_A^2 + \alpha_B^2}\sqrt{X}. \tag{18}$$

Since

$$\frac{x_A^*}{x_B^*} = \frac{\pi_A^*}{\pi_B^*} = \left(\frac{\alpha_A}{\alpha_B}\right)^2, \tag{19}$$

our setting introduces a tension between efficiency and equity motives (defined either in terms of profits or in term of water quantities) as soon as $\alpha_A \neq \alpha_B$. Moreover, the tension between efficiency and equity motives increases in a quadratic way with the ratio of the α's parameters.

Profit A maximizer If $c = 1$, then the DM maximizes farmer A's profit, without any consideration put on the profit of farmer B, which leads to :

$$x_A^{P_A} = X \text{ and } x_B^{P_A} = 0. \tag{20}$$

Profits for farmers A and B read:

$$\pi_A^{P_A} = \alpha_A\sqrt{X} \text{ and } \pi_B^{P_A} = 0, \tag{21}$$

and total profit is:

$$\pi^{P_A} = \alpha_A\sqrt{X}. \tag{22}$$

Profit B maximizer If $c = 0$, then the DM maximizes farmer B's profit, without any consideration put on the profit of farmer A, which leads to :

$$x_A^{P_B} = 0 \text{ and } x_B^{P_B} = X. \tag{23}$$

Profits for farmers A and B read:

$$\pi_A^{P_B} = 0 \text{ and } \pi_B^{P_B} = \alpha_A \sqrt{X}, \tag{24}$$

and total profit is:

$$\pi^{P_B} = \alpha_B \sqrt{X}. \tag{25}$$

Egalitarian in quantities So far we have focused on classic economic behaviors. Still, other motives may drive decisions to share a common water resource. In particular, the decision-maker (DM) may be motivated by egalitarian criteria such that the equality in quantity principle, if c = $\frac{\alpha_B^\rho}{\alpha_A^\rho + \alpha_B^\rho}$. The allocation of water is in that case:

$$x_A^{EQ} = \frac{X}{2} \text{ and } x_B^{EQ} = \frac{X}{2}. \tag{26}$$

Individual profits are:

$$\pi_A^{EQ} = \alpha_A \sqrt{\frac{X}{2}} \text{ and } \pi_B^{EQ} = \alpha_B \sqrt{\frac{X}{2}} \tag{27}$$

and total profit is:

$$\pi^{EQ} = (\alpha_A + \alpha_B)\sqrt{\frac{X}{2}}. \tag{28}$$

Egalitarian in profits According to the equality in profit principle, the DM determines a water allocation such that both farmers obtain the same profit, if c = $\frac{\alpha_B^2}{\alpha_A^2 + \alpha_B^2}$. Straightforward computations give:

$$x_A^{EP} = \frac{X\alpha_B^2}{\alpha_A^2 + \alpha_B^2} \text{ and } x_B^{EP} = \frac{X\alpha_A^2}{\alpha_A^2 + \alpha_B^2}. \tag{29}$$

Individual profits are:

$$\pi_A^{EP} = \frac{\alpha_A \alpha_B \sqrt{X}}{\sqrt{\alpha_A^2 + \alpha_B^2}} \text{ and } \pi_B^{EP} = \frac{\alpha_A \alpha_B \sqrt{X}}{\sqrt{\alpha_A^2 + \alpha_B^2}} \tag{30}$$

and total profit is:

$$\pi^{EP} = \frac{2\alpha_A \alpha_B \sqrt{X}}{\sqrt{\alpha_A^2 + \alpha_B^2}}. \tag{31}$$

Proportional rule in quantity If c $= \frac{\alpha_B^{\frac{3}{2}}}{\alpha_A^{\frac{3}{2}}+\alpha_B^{\frac{3}{2}}}$, then the DM determines a water allocation between both farmers such that the quantity of water received is proportional to farmers' productivity. This allocation of water is such that:

$$\frac{x_A}{x_B} = \frac{\alpha_A}{\alpha_B}. \tag{32}$$

Straightforward computations give:

$$x_A^{PrQ} = \frac{\alpha_A X}{\alpha_A + \alpha_B} \text{ and } x_B^{PrQ} = \frac{\alpha_B X}{\alpha_A + \alpha_B}. \tag{33}$$

Individual profits are:

$$\pi_A^{PrQ} = \alpha_A \sqrt{\frac{\alpha_A X}{\alpha_A + \alpha_B}} \text{ and } \pi_B^{PrQ} = \alpha_B \sqrt{\frac{\alpha_B X}{\alpha_A + \alpha_B}} \tag{34}$$

and total profit is:

$$\pi^{PrQ} = \frac{\alpha_A \sqrt{\alpha_A X} + \alpha_B \sqrt{\alpha_B X}}{\sqrt{\alpha_A + \alpha_B}}. \tag{35}$$

Proportional rule in profits If c $= \frac{\alpha_B^2}{\alpha_A^2+\alpha_B^2}$, then the DM determines a water allocation between both farmers such that farmers' profits are proportional to their productivity. This allocation of water is such that:

$$\frac{\pi_A}{\pi_B} = \frac{\alpha_A}{\alpha_B}. \tag{36}$$

Straightforward computations give:

$$x_A^{PrP} = \frac{X}{2} \text{ and } x_B^{PrP} = \frac{X}{2}, \tag{37}$$

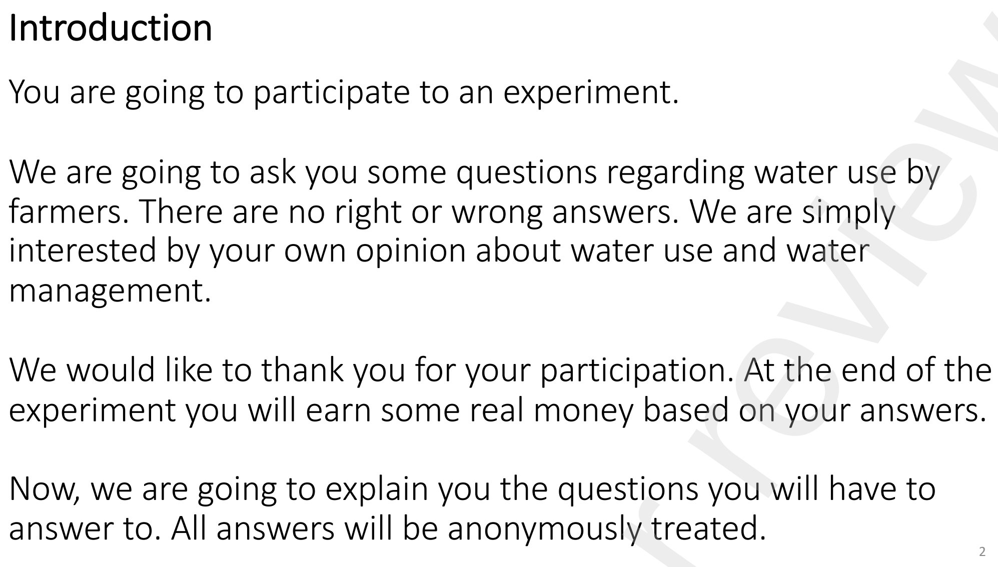
which are the same than those obtained with the egalitarian in quantities focal solution. Individual profits are therefore:

$$\pi_A^{PrP} = \alpha_A \sqrt{\frac{X}{2}} \text{ and } \pi_B^{PrP} = \alpha_B \sqrt{\frac{X}{2}} \tag{38}$$

and total profit is:

$$\pi^{PrP} = (\alpha_A + \alpha_B)\sqrt{\frac{X}{2}}. \tag{39}$$

B Instructions



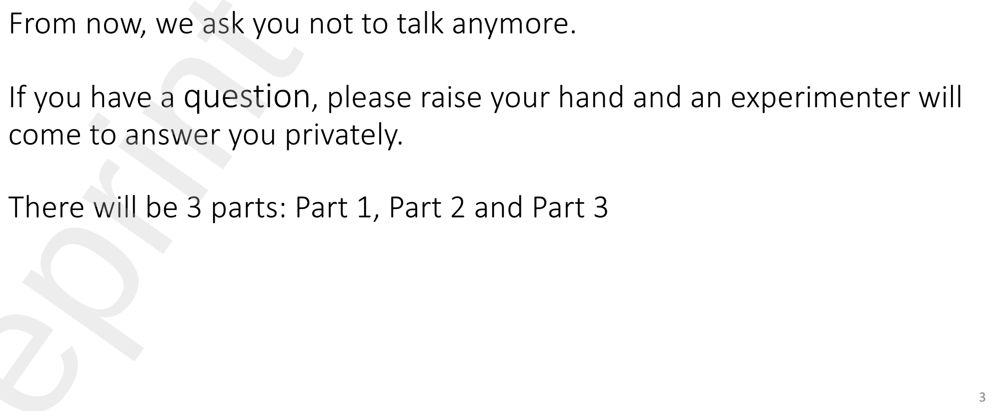
Introduction

You are going to participate to an experiment.

We are going to ask you some questions regarding water use by farmers. There are no right or wrong answers. We are simply interested by your own opinion about water use and water management.

We would like to thank you for your participation. At the end of the experiment you will earn some real money based on your answers.

Now, we are going to explain you the questions you will have to answer to. All answers will be anonymously treated.



From now, we ask you not to talk anymore.

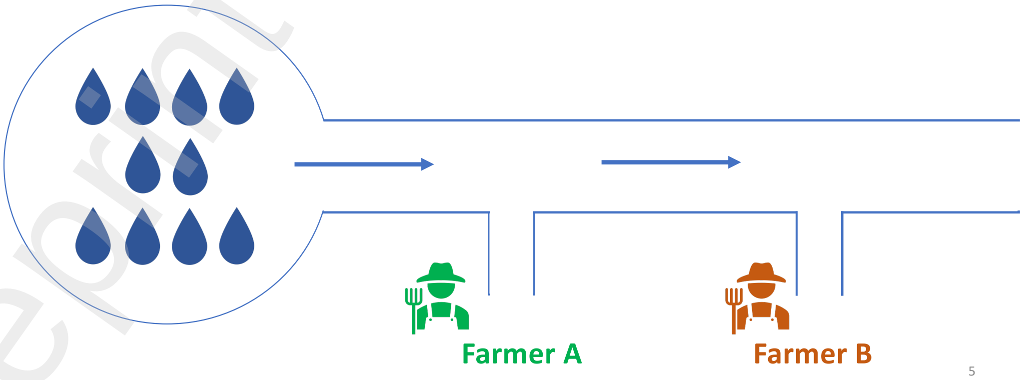
If you have a question, please raise your hand and an experimenter will come to answer you privately.

There will be 3 parts: Part 1, Part 2 and Part 3

Part 1

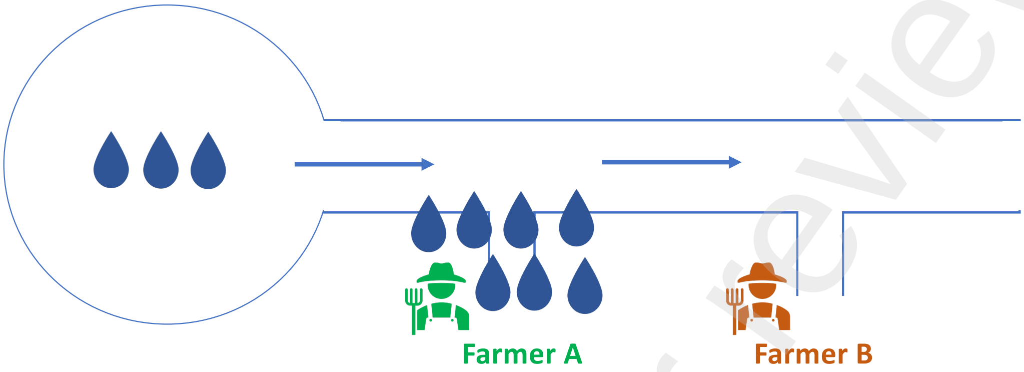
The setting

Imagine a reservoir with a stock of water available for two farmers A, B.
Farmer A and farmer B get water from a canal connected to the reservoir.
Farmer A is located upstream and farmer B downstream



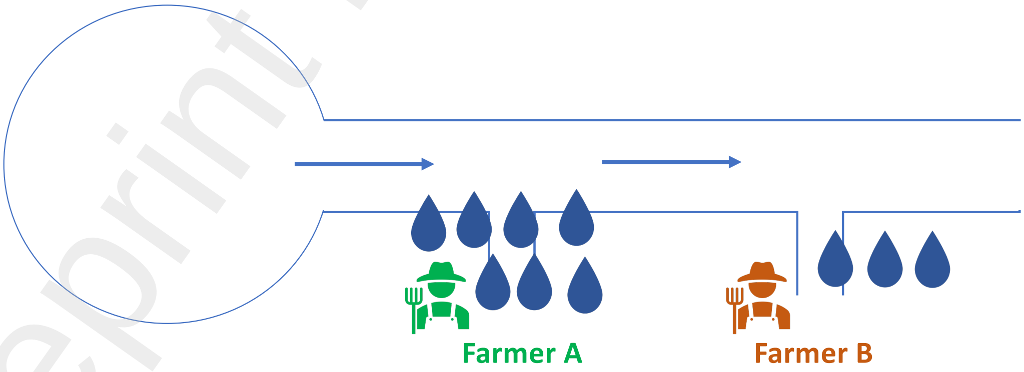
Timing

First, Farmer A chooses the quantity of water he/she wants to use



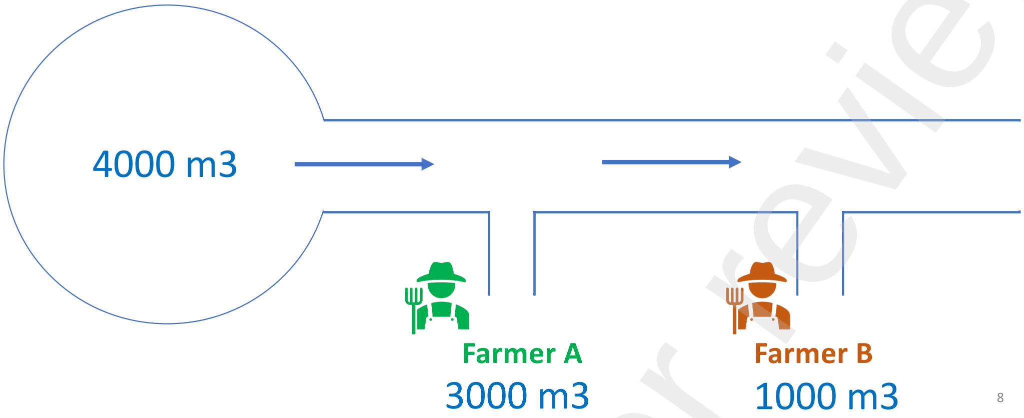
Timing

Then, Farmer B obtains the remaining quantity of water (if some is remaining)



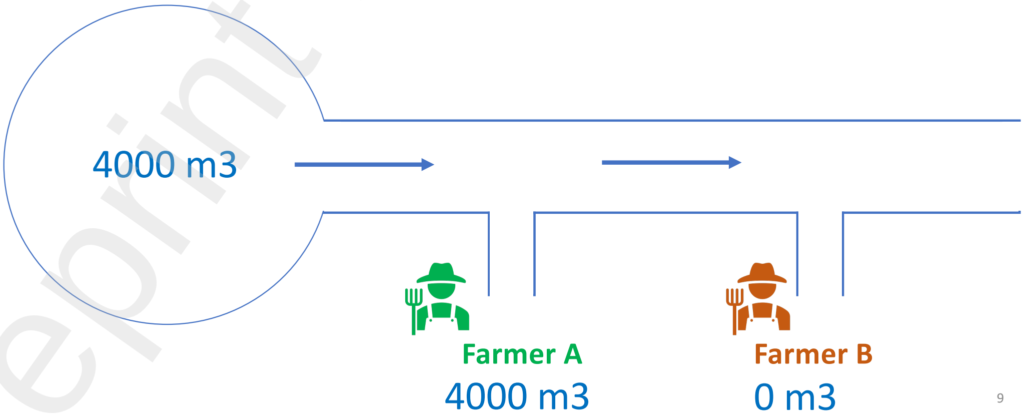
Example 1

4000 m3 of water are available.
If Farmer A takes 3000 m3 of water, Farmer B obtains 1000 m3



Example 2

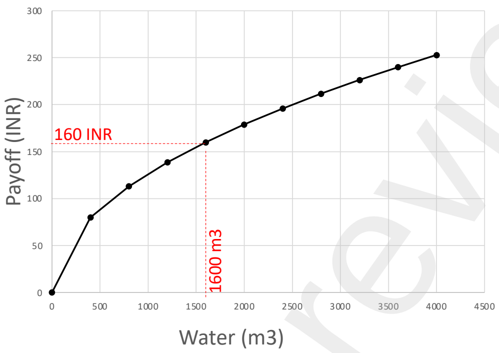
4000 m3 of water are available.
If Farmer A takes 4000 m3 of water, Farmer B obtains 0 m3



Farmer’s payoff from water use

Farmer A and farmer B use water to produce a crop and get a payoff

Water (m3)	Payoff (INR)
0	0
400	80
800	113
1200	139
1600	160
2000	179
2400	196
2800	212
3200	226
3600	240
4000	253

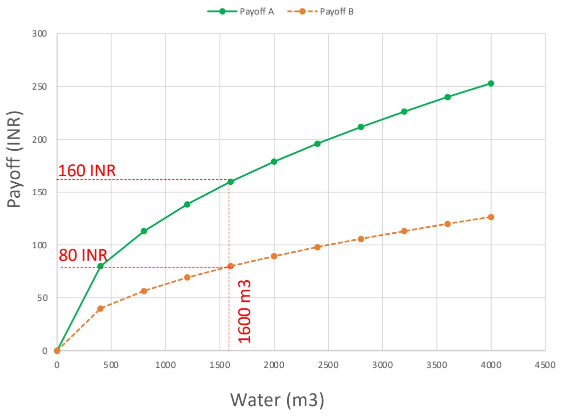


The payoff increases with the quantity of water used

Farmer’s payoff from water use

Farmer A and farmer B may have different payoff functions

Water (m3)	Payoff A (INR)	Payoff B (INR)
0	0	0
400	80	40
800	113	57
1200	139	69
1600	160	80
2000	179	89
2400	196	98
2800	212	106
3200	226	113
3600	240	120
4000	253	126



Here farmer A gets a higher payoff than farmer B for the same water use

The game

- You learn how much water (in m3) is available in the reservoir

- You learn what are the payoff functions of farmer A and farmer B

- You play as farmer A. So you have to decide how much water you keep for you, and how much water you give to farmer B

- Then both farmers get payoffs from the crop.

- This game is repeated 3 times with 3 different quantities of water available in the reservoir

Example of game

- You learn that 4000 m3 of water are available in the reservoir
- You learn the payoff function for farmer A and farmer B

Water for A (m3)	Payoff A (INR)	Water for B (m3)	Payoff B (INR)
0	0	4000	126
400	80	3600	120
800	113	3200	113
1200	139	2800	106
1600	160	2400	98
2000	179	2000	89
2400	196	1600	80
2800	212	1200	69
3200	226	800	57
3600	240	400	40
4000	253	0	0

- If you decide to keep 3600 m3 your payoff will be 240 INR. Then Farmer B will get 4000-3600=400 m3 and his payoff will be 40 INR

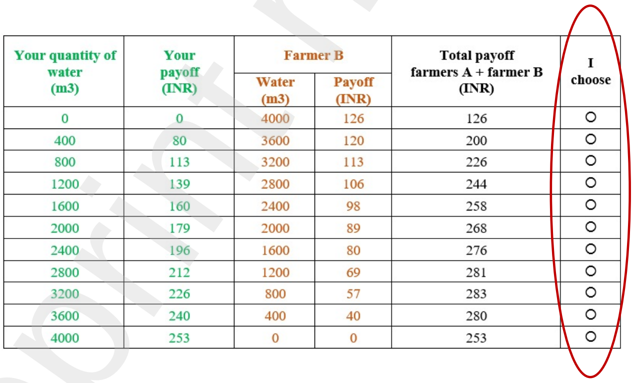
Example of game

- You learn that 4000 m3 of water are available in the reservoir
- You learn the payoff function for farmer A and farmer B

Water for A (m3)	Payoff A (INR)	Water for B (m3)	Payoff B (INR)
0	0	4000	126
400	80	3600	120
800	113	3200	113
1200	139	2800	106
1600	160	2400	98
2000	179	2000	89
2400	196	1600	80
2800	212	1200	69
3200	226	800	57
3600	240	400	40
4000	253	0	0

- If you decide to keep 1200 m3 your payoff will be 139 INR. Then Farmer B will get 4000-1200=2800 m3 and his payoff will be 106 INR

Your choice



Your quantity of water (m3)	Your payoff (INR)	Farmer B		Total payoff farmers A + farmer B (INR)	I choose
		Water (m3)	Payoff (INR)		
0	0	4000	126	126	○
400	80	3600	120	200	○
800	113	3200	113	226	○
1200	139	2800	106	244	○
1600	160	2400	98	258	○
2000	179	2000	89	268	○
2400	196	1600	80	276	○
2800	212	1200	69	281	○
3200	226	800	57	283	○
3600	240	400	40	280	○
4000	253	0	0	253	○

To select your quantity of water as Farmer A, you tick 1 of the lines in the answer sheet

You can only select 1 line per answer sheet

Your choice

- Your choice is anonymous
- There are no right or wrong answers: only your choice matters
- All information provided is to help you in your decision: please keep in mind that you are free to choose your quantity of water

How you will be paid?

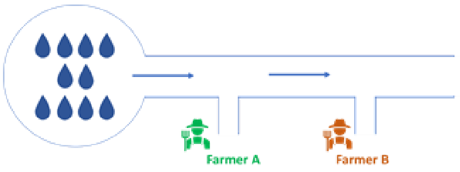
- You will repeat the game 3 times, each time with a different stock of water
- At the end of the experiment:
  - You will be matched with another participant
  - One of the 3 periods will be randomly chosen
  - You will discover if you are Farmer A or Farmer B
- If you are Farmer A: your payoff is determined by the quantity of water you have chosen
- If you are Farmer B: your payoff depends on the quantity of water the other participant (Farmer A) has left for you

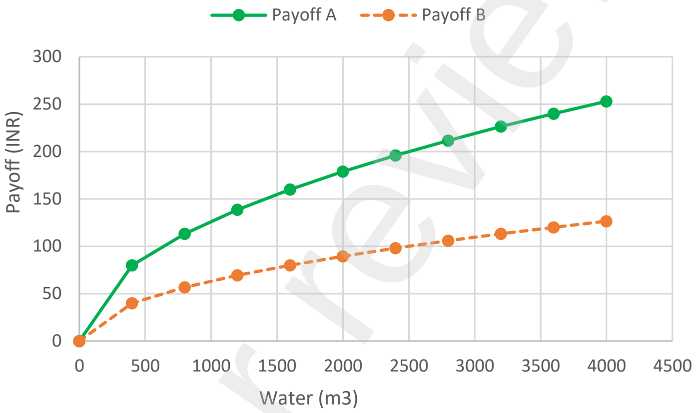
C Treatments

C.1 Decision sheet - Baseline

ID: **Answer Sheet** [4000 – 4|2 - B]

- **Total quantity of water available: X = 4000**
- **Payoff function of farmer A and farmer B from water use**





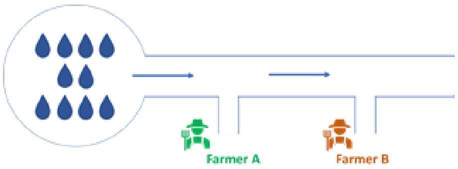
- **Please select in the following table your preferred quantity of water as farmer A**

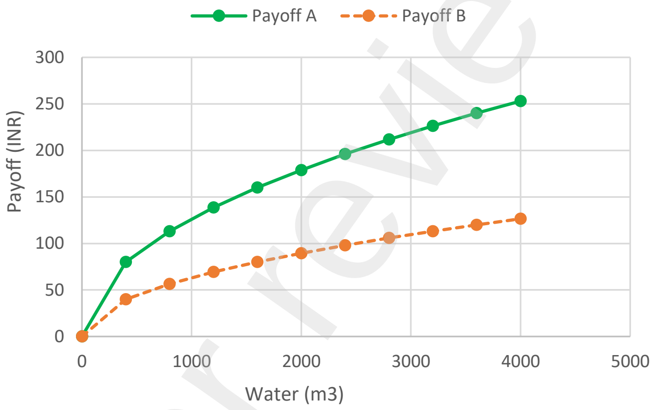
Your quantity of water (m3)	**Your payoff (INR)**	**Farmer B**		**Total payoff farmer A + farmer B (INR)**	**I choose**
		Water (m3)	**Payoff (INR)**		
0	0	4000	126	126	○
400	80	3600	120	200	○
800	113	3200	113	226	○
1200	139	2800	106	244	○
1600	160	2400	98	258	○
2000	179	2000	89	268	○
2400	196	1600	80	276	○
2800	212	1200	69	281	○
3200	226	800	57	283	○
3600	240	400	40	280	○
4000	253	0	0	253	○

C.2 Decision sheet - Gain

ID: **<u>Answer Sheet</u>** [4000 – 4|2 – E]

- **Total quantity of water available: X = 4000**
- **Payoff function of farmer A and farmer B from water use**





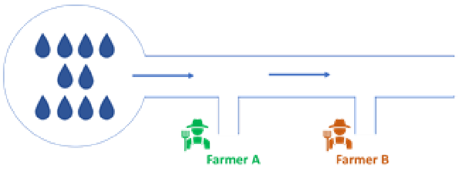
- **Please select in the following table your preferred quantity of water as farmer A**

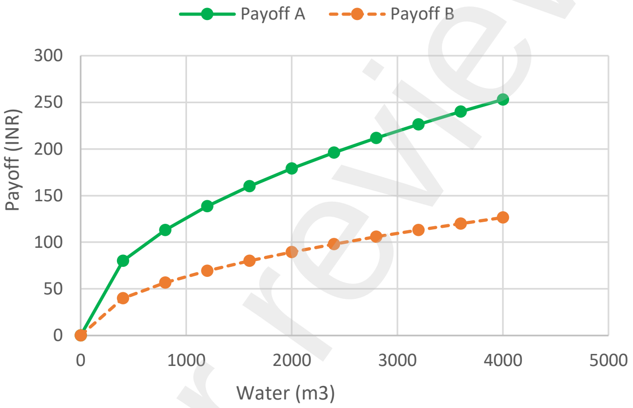
Your quantity of water (m3)	**Your payoff (INR)**	**Farmer B**		**Total payoff farmer A + farmer B (INR)**	**Payoff GAIN for the group thanks to YOUR choice of water use compared to the worst possible allocation (INR)**	**I choose**
		Water (m3)	**Payoff (INR)**			
0	0	4000	126	126	0	○
400	80	3600	120	200	74	○
800	113	3200	113	226	100	○
1200	139	2800	106	244	118	○
1600	160	2400	98	258	131	○
2000	179	2000	89	268	142	○
2400	196	1600	80	276	149	○
2800	212	1200	69	281	154	○
3200	226	800	57	283	156	○
3600	240	400	40	280	154	○
4000	253	0	0	253	126	○

C.3 Decision sheet - Loss

ID: **Answer Sheet** [4000 – 4|2 – S]

- **Total quantity of water available: X = 4000**
- **Payoff function of farmer A and farmer B from water use**





- **Please select in the following table your preferred quantity of water as farmer A**

Your quantity of water (m3)	**Your payoff (INR)**	**Farmer B**		**Total payoff farmer A + farmer B (INR)**	**Payoff LOSS for the group due to YOUR choice of water use compared to the best possible allocation (INR)**	**I choose**
		Water (m3)	**Payoff (INR)**			
0	0	4000	126	126	-156	○
400	80	3600	120	200	-83	○
800	113	3200	113	226	-57	○
1200	139	2800	106	244	-38	○
1600	160	2400	98	258	-25	○
2000	179	2000	89	268	-15	○
2400	196	1600	80	276	-7	○
2800	212	1200	69	281	-2	○
3200	226	800	57	283	0	○
3600	240	400	40	280	-3	○
4000	253	0	0	253	-30	○

D Farmers' locations and characteristics

Table D.1: Place of farmer's surveys

Session	District	Place	Water
1	Tumkur	Patrehalli village	Rainfed area
2	Mandya	Kattedoddi village	Command area
3	Bengaluru rural	Hadonahalli village	Rainfed area
4	Bengaluru urban district	Farmer Training Institute	Rainfed area
5	Chikmagalur	Bhavikere village	Command area
6	Shimoga	Navile village	Command area
7	Shimoga	Navile village	Command area
8	Chikmaglur	Bhavikere village	Command area
9	Kolar	Chintamani village	Rainfed area
10	Kolar	Kolar	Rainfed area

Table D.2: Comparison of the farmers' socio-economic characteristics between treatments

	Most productive upstream			Most productive downstream			Kruskal-Wallis test
	Baseline	Gain	Loss	Baseline	Gain	Loss	*p-values*
Gender (males = 1)	0.897	0.900	0.850	0.875	0.875	0.900	0.979
	(0.307)	(0.304)	(0.362)	(0.335)	(0.335)	(0.304)	
Age	41.05	41.02	40.25	39.40	39.65	38.88	0.872
	(13.20)	(11.41)	(12.39)	(12.90)	(14.11)	(13.88)	
Bachelor degree or higher	0.500	0.525	0.500	0.500	0.400	0.400	0.779
	(0.506)	(0.506)	(0.506)	(0.506)	(0.496)	(0.496)	
Number of children	0.974	0.919	1.027	0.914	0.865	1.091	0.951
	(0.986)	(0.924)	(0.897)	(0.981)	(0.918)	(1.071)	
Income in 2018	68437.5	63128.6	54621.2	51455.9	182458.8	69712.9	0.632
	(92773.0)	(76449.5)	(58499.9)	(78759.0)	(696374.0)	(118680.1)	
Land area (in acre)	6.427	12.45	6.139	4.619	7.724	6.135	0.081
	(6.353)	(19.90)	(9.711)	(4.371)	(8.419)	(10.27)	

Mean and (standard deviation).

E Additional analyses

E.1 Effect of spatial configuration on the adoption of focal behaviors

The spatial configuration does have an effect on the distribution of focal behaviors. When farmer A is the most productive farmer (Panel A), the efficient behavior is the most adopted behavior (25%), followed by egalitarian in quantities (15.56%) and egalitarian in profits (10.28%). On the contrary, when farmer A is the least productive farmer (Panel B), subjects adopt more often an egalitarian in profits behavior (23.06%), followed by the efficient behavior (18.33%) and the egalitarian in quantities (10.83%). With some exceptions, these observations are robust to changes in stock size. The observed difference between these two distributions for Panels A and B (for the category 'All') is significant (chi-squared test, $p\text{-}value < 0.01$).

Table E.1: Adoption of focal behaviors in the DG – Spatial configuration analysis

		Stock		
	All	4000	8000	12000
Panel A: Most productive farmer located upstream				
Efficient	25%	24.17%	29.17%	21.67%
	(90)	(29)	(35)	(26)
Profit A maximizer	4.44%	2.50%	7.50%	3.33%
	(16)	(3)	(9)	(4)
Profit B maximizer	2.78%	2.50%	1.67%	4.17%
	(10)	(3)	(2)	(5)
Egalitarian in quantities	15.56%	22.50%	10.83%	13.33%
	(56)	(27)	(13)	(16)
Egalitarian in profits	10.28%	13.33%	9.17%	8.33%
	(37)	(16)	(11)	(10)
Proportional in quantities	7.50%	10.83%	8.33%	3.33%
	(27)	(13)	(10)	(4)
Other	34.44%	24.17%	33.33%	45.83%
	(124)	(29)	(40)	(55)
Panel B: Most productive farmer located downstream				
Efficient	18.33%	20.83%	19.17%	15%
	(66)	(25)	(23)	(18)
Profit A maximizer	4.44%	4.17%	6.67%	2.50%
	(16)	(5)	(8)	(3)
Profit B maximizer	5.28%	3.33%	5.83%	6.67%
	(19)	(4)	(7)	(8)
Egalitarian in quantities	10.83%	15.83%	9.17%	7.50%
	(39)	(19)	(11)	(9)
Egalitarian in profits	23.06%	26.67%	18.33%	24.17%
	(83)	(32)	(22)	(29)
Proportional in quantities	1.67%	4.17%	0%	0.83%
	(6)	(5)	(0)	(1)
Other	36.39%	25%	40.83%	43.33%
	(131)	(30)	(49)	(52)
Panel A versus Panel B (χ^2 test)	*p-value* <0.01			

Percentage and (frequency).

E.2 Effect of the framing treatments on the adoption of focal behaviors

Table E.2: Adoption of focal behaviors in the DG taking into account the framing treatments, spatial configuration and stock size – Detailed analysis

	Stock =4000			Stock =8000			Stock =12000		
	Baseline	Gain	Loss	Baseline	Gain	Loss	Baseline	Gain	Loss
Panel A: Most productive farmer located upstream									
Efficient	25%	25%	22.50%	32.50%	20%	35%	30%	10%	25%
	(10)	(10)	(9)	(13)	(8)	(14)	(12)	(4)	(10)
Profit A maximizer	2.50%	2.50%	2.50%	2.50%	12.50%	7.50%	0%	5%	5%
	(1)	(1)	(1)	(1)	(5)	(3)	(0)	(2)	(2)
Profit B maximizer	5%	0%	2.50%	2.50%	0%	2.50%	2.50%	5%	5%
	(2)	(0)	(1)	(1)	(0)	(1)	(1)	(2)	(2)
Egalitarian in quantities	15%	30%	22.50%	5%	17.50%	10%	5%	25%	10%
	(6)	(12)	(9)	(2)	(7)	(4)	(2)	(10)	(4)
Egalitarian in profits	15%	10%	15%	12.50%	2.50%	12.50%	7.50%	5%	12.50%
	(6)	(4)	(6)	(5)	(1)	(5)	(3)	(2)	(5)
Proportional in quantities	15%	12.50%	5%	10%	10%	5%	7.50%	2.50%	0%
	(6)	(5)	(2)	(4)	(4)	(2)	(3)	(1)	(0)
Other	22.50%	20%	30%	35%	37.50%	27.50%	47.50%	47.50%	42.50%
	(9)	(8)	(12)	(14)	(15)	(11)	(19)	(19)	(17)
Panel B: Most productive farmer located downstream									
Efficient	12.50%	15%	35%	15%	10%	32.50%	12.50%	10%	22.50%
	(5)	(6)	(14)	(6)	(4)	(13)	(5)	(4)	(9)
Profit A maximizer	0%	5%	7.50%	7.50%	5%	7.50%	2.50%	0%	5%
	(0)	(2)	(3)	(3)	(2)	(3)	(1)	(0)	(2)
Profit B maximizer	7.50%	0%	2.50%	12.50%	2.50%	2.50%	5%	5%	10%
	(3)	(0)	(1)	(5)	(1)	(1)	(2)	(2)	(4)
Egalitarian in quantities	22.50%	15%	10%	10%	15%	2.50%	15%	7.50%	0%
	(9)	(6)	(4)	(4)	(6)	(1)	(6)	(3)	(0)
Egalitarian in profits	27.50%	30%	22.50%	20%	10%	25%	27.50%	22.50%	22.5°%
	(11)	(12)	(9)	(8)	(4)	(10)	(11)	(9)	(9)
Proportional in quantities	0%	10%	2.50%	0%	0%	0%	2.50%	0%	0%
	(0)	(4)	(1)	(0)	(0)	(0)	(1)	(0)	(0)
Other	30%	25%	20%	35%	57.50%	30%	35%	55%	40%
	(12)	(10)	(8)	(14)	(23)	(12)	(14)	(22)	(16)

Percentage and (frequency).