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# That's My Turf: An Experimental Analysis of Territorial Use Rights for Fisheries in Indonesia

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Carlo Gallier, Jörg Langbein, and Colin Vance[1]

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## Abstract

*We conduct a framed field experiment in Indonesian fishing communities, with an eye towards evaluating the potential of Territorial Use Rights for Fisheries (TURFs) to preserve coral reef fisheries. Conducted in three culturally distinctive sites, the study assembles groups of five fishers who participate in a common-pool resource game. We implement the game with randomly assigned treatments in all sites to explore whether the extraction decision varies according to three recommended non-binding extraction levels originating from (1) a democratic process, (2) a group leader or (3) an external source that recommends a socially optimal extraction level. In one of the sites – that having the highest levels of ethnic and religious diversity – we find that democratic decision-making as well as information originating from outside the community promotes the cooperative behavior that underpins TURFs, a result that is robust to regressions controlling for individual and community attributes.*

*JEL Classification: C93, H43, L31, Q32*

*Keywords: Framed field experiment; commons dilemmas; coral reefs; self-governance*

*October 2016*

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*1 Carlo Gallier, Centre for European Economic Research (ZEW); Jörg Langbein, RWI; Colin Vance, RWI, Jacobs University Bremen -* *We thank Maximilian Huppertz and Sophie Wannemacher for excellent research assistance and are grateful for valuable comments by Christoph M. Schmidt. Expert input from our colleagues Helen Fox, Hari Kushardanto, Erita Narhetali and Sari Wirawan is also greatly appreciated. Financial support by the Leibniz Association (funding code SAW-2014-ZMT-1 317) is gratefully acknowledged. Langbein gratefully acknowledges the support of a special grant (Sondertatbestand) from the German Federal Ministry for Economic Affairs and Energy and the Ministry of Innovation, Science, and Research of the State of North Rhine-Westphalia. –* *All correspondence to: Jörg Langbein, RWI, Hohenzollernstr. 1/3, 45128 Essen, Germany, e-mail: langbein@rwi-essen.de*

# 1. Introduction

The ongoing destruction of coral reef ecosystems ranks among the major drivers of global environmental change, with already more than a quarter of the world's reefs irrevocably damaged from the combined effects of climate change and local stressors (Burke et al. 2011). Beyond serving as repositories of biodiversity and marine nutrients, coral reefs provide a multitude of benefits to local communities, including storm surge protection and livelihood from fishing and tourism. In many regions, coral reefs are located within open-access fisheries, making them vulnerable to overfishing and destructive fishing practices. The establishment of exclusive access privileges in the form of Territorial Use Rights for Fisheries (TURF) reserves is increasingly seen as an effective response to countering this overexploitation (Afflerbach et al. 2014). TURFs have gained traction in recent years largely due to their promotion by non-governmental organizations (NGOs). Nevertheless, the core justification underpinning the implementation of TURFs – that they align the self-interest of individual fishers with the collective stewardship of the fishery – has largely escaped empirical scrutiny.

The present study addresses this issue by undertaking a framed field experiment of extractive behavior in several fishing communities located in Sulawesi, Indonesia. Complementing work by Velez et al. (2010) and Santis and Chávez (2015), who examine enforcement mechanisms using framed field experiments with artisanal fishers in Colombia and Chile, we investigate whether and under what circumstances Indonesian fishers impose stringent use rights to decrease the exploitation of a shared resource. Our experimental design employs a common-pool resource (CPR) game that introduces three treatments corresponding to alternative strategies for encouraging cooperative behavior. Drawing on Cardenas (2004), we specifically investigate whether non-binding recommendations originating either from a democratic decision process, a group leader decision or an external agent affect participants' extraction behavior. By implementing our experiment before the rollout of an actual TURF program by an environmental NGO, we are able to provide evidence that can facilitate a more efficient implementation of the program.

Previous research suggests that participation in decision making affects behavior and increases individuals' willingness to cooperate in social dilemma situations (Bardhan 2000; Ostrom and Nagendra 2006). Several studies from experimental economics demonstrate that the effect of a policy on the level of cooperation is greater when it is chosen democratically (Tyran and Feld 2006; Ertan et al. 2009; Olken 2010; Sutter et al. 2010; Dal Bó et al. 2010; Kube (2015). However, it has also been shown that the means by which community involvement is implemented can have a fundamental bearing on outcomes (e.g. Agrawal and Chhatre 2006; Cinner and Aswani 2007; Persha et al. 2011, Cox et al. 2014). Moreover, there is evidence that the effects of measures that attempt to foster cooperation in social dilemma situations perform differently depending on the underlying set of personal attributes and informal norms prevailing in the community (e.g. Ostrom 1990; Carpenter et al. 2004; Herrmann et al. 2008; Gächter et al. 2010; Vollan et al. 2013).

The present study expands on these themes with an experimental design that links different decision-making processes to different extractive outcomes, revealing how these outcomes are mediated by the socio-cultural setting in which the participants in the experiment reside. Among our main results, we find that both the *external* and *democracy* treatments have a statistically significant effect in drawing participants toward the social optimum in one of the three sites, that having the highest levels of ethnic and religious diversity. This result is robust to regressions controlling for individual and community level factors, which additionally shows that the participant's locus of control (i.e. perceived self-empowerment) as well as living in a non-remote village enhance cooperation. Although we find evidence that democratic decision-making and information originating from outside the community can promote the cooperative behavior that underpins TURFs, the absence of effects in two of the three sites underlines the importance of evaluating effects on a case-by-case basis.

## 2. Background, Community Descriptions, and Sampling

*The Indonesian Context* - Harboring the largest expanse of reefs worldwide, Indonesia is heavily dependent on marine resources, with 54% of the country's animal protein coming from fish and seafood (Burke et al. 2011). A variety of stressors, including agricultural runoff and fishing activities, have put this resource base under severe duress. The World Bank (2014) reports that almost 65% of Indonesia's reefs are threatened by overfishing, and roughly half are threatened by destructive fishing practices.

The Indonesian government recognized the urgency of protecting the reefs decades ago. National and regional laws against destructive fishing practices and overfishing have been introduced over the years, but a lack of monitoring capacities has undermined law enforcement. Conservation NGOs have partially filled this void. A unifying principle of many early interventions was the establishment of Marine Protected Areas (MPAs). The record of MPAs, however, has fallen short of expectations, which has been attributed at least in part to their prioritization of conservation over economic development, and to the non-involvement of local communities in the implementation process (Ferse et al. 2010). TURFs represent an integrated approach to management that couples conservation with development goals by bestowing local fishers with exclusive access to their fishing grounds in the form of territorial use rights.

As documented in a meta-study undertaken by Afflerbach and colleagues (2014), a common trend characterizing the creation of TURFs is a diversity of stakeholders. While TURFs have existed in various forms for centuries, Afflerbach and colleagues (2014) find that in most contemporary cases TURFs have emerged from the collaboration of an NGO, a governmental unit, and/or a community organization. Such is the situation on the island of Sulawesi, where the creation of the TURFs is supported by international NGOs working in tandem with the Indonesian Ministry of Marine Affairs and Fisheries and respective regional governments, which hold the authority to transfer geographically assigned property rights to the communities. The communities, in turn, set operational rules, define monitoring and enforcement procedures, and regulate harvest (Wilen et al. 2012). Monitoring itself is then carried out by local fisherman, who alert the Indonesian coastal police when illegal extraction is detected, a co-management approach that Santis and Chávez (2015) show to be highly effective in maintaining compliance.

Depending on local socio-economic, political and environmental features, NGOs have availed a mix of strategies to rally community support for the establishment of TURFs. Perhaps the most important question in gauging the scope for garnering support relates to the process by which a given community reaches decisions on exploitation and resource extraction. While a variety of decision-making procedures are possible, our experimental approach broadly distinguishes between decisions reached by way of a democratic process, a group leader, or through an outside entity. This division largely captures the alternative channels through which NGOs may attempt to coordinate behavior in the Indonesian context, where rule setting is left to the villages managing the TURF without a clear agreement about the procedure.

*Community Descriptions* - An immediate challenge in undertaking survey work in Indonesia is the country's rich tapestry of cultural and ethnic heterogeneity. Indonesia is home to more than 300 ethnic groups, and around 700 different languages are spoken across its 14,000 islands. Sulawesi, the fourth biggest Indonesian island in territory and the third biggest in population, embodies this heterogeneity, with at least 117 local ethnicities residing on the island (Ananta et al. 2015). While the main religion on the island is Islam, Christians are also prevalent and comprise about 20% of the population. Recognizing that this diversity conspires against drawing samples that allow the extrapolation of findings (e.g. Henrich et al. 2001; Herrmann et al. 2008), we selected culturally distinct communities to test the extent to which generalizations can be drawn. Specifically, we selected three sites from a set of 12 sites in which one of the international NGOs working in the region is in the planning phase of a program to establish TURFs.

Two of the sites are on Wakatobi, a small string of islands in South-East Sulawesi that are primarily populated by two different ethnicities: the Badjo and the Liya. Badjo communities are primarily organized around fishing and have governance structures that are largely democratic, with village leaders determined by elections. Liya communities occupy the same string of islands and are primarily populated by seaweed farmers, who augment their livelihood by part-time fishing. Liya governance is hierarchically organized and the village leader is usually selected from one of several influential families.

While both the Badjo and Liya are relatively cut-off from the remainder of the island, with the main transportation links being ferries and planes, the third site, Bunaken, is situated on the main part of the island in the North-East of Sulawesi. Its centralized location along with its mix of ethnicities and religions makes Bunaken more prototypical of Sulawesi at large. Contrasting with the ethnically homogeneous and nearly exclusively Muslim communities of the Badjo and Liya, Bunaken is represented in our sample by 23 different ethnicities and a religious composition that is 64% Muslim. Governance structures in Bunaken also vary, but are typically comprised of a village council and village leader who is democratically elected.

*Sampling and Descriptive Statistics* - The sample comprises a total of 695 households distributed approximately evenly across the three communities. Bunaken has 10 villages while Liya and Badjo have 4 and 3 villages, respectively. Sampling proceeded according to a design which ensured that the number of households surveyed from every village was proportional to the village's population within the community. The households were selected by approaching every $n^{th}$ household from an arbitrary starting point, with $n$ determined according to the number of households in the village. If a household declined to participate, which occurred only in three cases, the next $n^{th}$ household was approached.

In addition to one member of each household – usually the head – participating in the CPR game, we administered a questionnaire upon initially approaching the household. The questionnaire elicited information on a range of socioeconomic variables that serve as a baseline measure of conditions prior to the introduction of the TURF. Table 1 presents descriptive statistics for a subset of these variables, which are subsequently used in a regression analysis that explores whether the estimated treatment effects vary when controlling for personal, household and village characteristics. The majority of variables come directly from questions pertaining to education, religion, age and other attributes, but two are derived from a battery of questions directed at the respondent's level of trust and perceived self-empowerment, referred to as the locus of control. These questions are derived from the research on the locus of control[1] and trust[2] and then transformed into one indicator ranging from 0 to 1 using principal component analysis.

[1] The locus of control concept measures the person's belief in being able to control events that affect their lives. We apply the method developed by Levenson (1974) to elicit the multidimensionality of the locus of control since several studies have acknowledged the importance of the locus of control for pro-social environmental behavior (for example, Kalamas et al (2014) and Engqvist and Nilsson (2014)). The questions were readjusted to our context.

[2] The importance of trust has long been recognized in a collective action problem (Ostrom 2000). We use seven questions similar to those of the World Value Survey to disentangle the trust nexus from all perspectives.

**Table 1: Household Demographics, Social Capital Indices and Village Characteristics**

| | All Sites | Badjo | Liya | Bunaken |
|---|---|---|---|---|
| **Social Capital** | | | | |
| *Participant trust level* (Linearized index from 0 to 1) | 0.61 | 0.55 (0.01) | 0.62 (0.01) | 0.66 (0.01) |
| *Participant locus of control level* (Linearized index from 0 to 1) | 0.36 | 0.35 (0.01) | 0.36 (0.01) | 0.35 (0.01) |
| *Association membership* (Head of household is member in party or association) | 0.33 | 0.32 (0.03) | 0.27 (0.03) | 0.40 (0.03) |
| **Household Demographics** | | | | |
| *Religion of head of household* (Islamic believer) | 0.87 | 1.0 (0) | 0.99 (0.0) | 0.64 (0.03) |
| *Household fishing intensity* (0 "Never" to 5 "More than 1-2 times per week") | 3.16 | 3.25 (0.15) | 3.58 (0.14) | 2.70 (0.14) |
| *Household expenditures* (in IDR) | 301,481 | 423,149 (60.52) | 198,297 (21.24) | 286,302 (15.18) |
| *Head of household gender* (Male dummy) | 0.81 | 0.76 (0.03) | 0.87 (0.02) | 0.80 (0.03) |
| *Head of household age* (Age of head of household) | 44.72 | 38.60 (0.95) | 47.43 (0.88) | 47.39 (0.77) |
| *Education of head of household* (At least primary education) | 0.41 | 0.30 (0.03) | 0.46 (0.03) | 0.45 (0.03) |
| **Village Characteristics** | | | | |
| *Internet* (Good internet connection) | 0.19 | 0.33 (0.01) | 0 | 0.25 (0.009) |
| *Transit services* (Transit services available) | 0.66 | 0.66 (0.01) | 1 (0) | 0.66 (0.01) |
| Observations | 695 | 225 | 230 | 240 |

Note: The column all sites denotes the average value of the other three sites. Standard errors are in parentheses. Village characteristics are available for 17 communities.

# 3. CPR Model, Experimental Design and Predictions

*CPR model* – In standard CPR games, individuals exert effort to extract a shared resource. Extraction is individually beneficial, but implies negative externalities (e.g. Ostrom et al. 1994). Externalities arise whenever the extraction effort by one individual affects the benefits of others. In order to analyze whether collective decision making is an appropriate approach to increase cooperation within Indonesian fishing communities, we use a CPR game based on Cardenas (2004). Rather than using a standard subject pool and neutral framing, we explicitly framed the experiment as extraction from a common pool fishery for Indonesian fishers. Following the typology of Harrison and List (2004), this classifies as a framed field experiment. The advantage of framing is that the decision is familiar to participants, who in turn bring the experience and context from their daily lives in reaching their decisions.

The design is based on a model of a group of five ($n = 5$) homogenous agents indexed by $i$ who have access to a common-pool resource, e.g. a fish stock. All agents have a maximum labor endowment of 8 units of effort to spend and decide how much effort to spend on extracting, $x_i \in [1,8]$. The instantaneous benefits of extraction accruing to agent $i$, $E_i$, are given by:

$$E_i = ax_i - \frac{1}{2}bx_i^2,$$

where a and b are positive constants. This implies diminishing returns from extraction and that instantaneous benefits received by an appropriator to be independent of the extraction of other appropriators. Additionally, agents receive benefits from conserving the shared resource, $C_i$. Benefits from conserving the resource, in contrast to extracting, depend on the total level of extraction and are given by:

$$C_i = \alpha \sum_{j=1}^{5} (c - x_j),$$

where α and c are positive constants. Note that this introduces a negative externality into the model because an agent's benefit from conservation decreases with total appropriation. Benefits from extraction, $E_i$, and conservation, $C_i$, define agent $i$'s individual payoff:

$$\pi_i = E_i + C_i = ax_i - \frac{1}{2}bx_i^2 + \alpha \sum_{j=1}^{n} (c - x_j).$$

To assure comparability to the previous literature and keep the experiment as simple as possible, we use the same parametrization as Cardenas (2004), i.e. $e = 8$, $a = 60$, $b = 5$, $\alpha = 20$ and $c = 800$. This transfers the experiment basically into a public bad experiment (Andreoni 1995) with corner solutions at $x_i = 1$ and $x_i = 8$. Given that $x_i \in [1,8]$, differentiation with respect to $x_i$ yields that the optimal extraction for agent $i$, $x_i^*$, is given by: $x_i^* = \frac{a-\alpha}{b} = 8$. The social optimum, in contrast, is attained if agents extract in a way that maximizes the joint payoff and is given by individual extraction levels of $x_i^\circ = \frac{a-\alpha n}{b} = 1$.

*Experimental design and predictions* – Our experimental design covers four treatments reflecting regulatory approaches which apply to fishermen operating under TURFs and allows us to study the effect of alternative strategies to implement community participation in defining and following extraction plans. The design is briefly summarized in Table 2. At the beginning of each session, participants were randomly assigned to groups of five. There is no change in the group throughout the whole experiment. In each session one of the four treatments was played. Each session consists of 10 static decision rounds. The experiment was consciously framed in such a way that participants were fully aware of participating in an experiment about fishing in coral reefs.[3]

**Table 2: Experimental design**

| **Treatment** | **Contribution mechanism** | **No. of Subjects (No. of Groups)** |
|---|---|---|
| autonomy | voluntary contribution mechanism | 180 (36) |
| democracy | median of all proposed contribution levels | 175 (35) |
| leader | delegate sets contribution level | 165 (33) |
| external | external recommendation | 175 (35) |
| | | Total: 695 (139) |

The *autonomy* treatment, which we later refer to as the baseline, broadly corresponds to a public bad experiment (e.g. Andreoni 1995) in which each agent autonomously decides how much effort to spend on extracting the common resource, i.e. chooses $x_i \in [1,8]$, in each decision round. After each decision, agents are informed about the individual efforts and the corresponding payoffs. Since each agent decides

[3] The experimental introductions in English can be found in appendix B.

individually, the predicted Nash equilibrium is that all agents spend their individually maximal level of effort, i.e. $x_i^* = 8$, on extracting.

In the *democracy* treatment we introduce community participation by letting groups set their own recommendation on how much effort members should spend on extracting. In each decision round agents vote on the recommended effort level which is, even if selected, non-binding for all group members. Experimental results suggest that voting on binding contributions schemes can substantially increase efficiencies in the private provision of public goods (e.g. Kesternich et al. 2014; Gallier et al. forthcoming) and the use of common pool resources (e.g. Walker et al. 2000). In our experiment, each group member proposes a per-capita effort level, knowing that the median of all proposals will be selected to be the recommended, but non-binding, effort level. Deviating from the previous literature, the recommendation is not enforced and agents can extract more or less than recommended.

In the *leader* treatment one *group leader* is randomly chosen among the members at the beginning of each of the 10 rounds. This *leader*, who remains anonymous, decides upon the non-binding recommended per-capita effort level in each decision round on behalf of the group. This feature distinguishes our experiment from the vast literature on "leading by example" in social dilemma situations (see Güth et al. 2007 for an overview). Moxnes and van der Heijden (2003), for instance, have leadership implemented in a sequential public bad experiment by letting a randomly chosen leader decide and announce his decision first. The leader's decision is communicated to the others, who make their decisions simultaneously. They find that followers respond substantially to the examples set by the leader and that cooperation levels are higher in the presence of a leader. Our leader, in contrast, recommends a non-binding per capita extraction effort for all group members, including him, and it remains unclear whether the recommendation affects others' decisions.

In the *external* treatment an external agenda-setter gives a recommendation on a per-capita effort level in each decision round, i.e. how much effort group members should spend on extracting. Following previous experiments on external regulation in a social dilemma context (e.g. Cardenas et al. 2004; Velez et al. 2010; Lopez et al. 2012), agents received in each decision round the recommendation to spend the socially optimal effort, i.e. $x_i^{\circ} = 1$. The limit of externally imposed and enforced regulations is widely recognized.

Since recommendations are always non-binding, our different mechanisms do not affect the Nash equilibrium and according to standard theory agents should spend their maximum amount of effort on extracting the resource, i.e. $x_i^{*} = 8$.

## 4. Experimental Procedure

The experiments were conducted in 17 different villages within three sites in Sulawesi. Before its implementation, permission was obtained from the head of village to conduct the experiment. Note that the experimental procedure was the same in all cases irrespective of the treatments. After having answered the household questionnaire, participants received an invitation to the local community center where the game was conducted for the following day. They were randomly allocated to different groups once they had registered and entered the community center. One session comprised ideally 4 groups of 5 players and lasted 10 rounds. In total, 36 sessions were played. All groups were placed in the same room and the seating of the participants was arranged in a way that they could not see their fellow group members. Thus, the game was played anonymously, but the participants were obviously aware of who entered the room with them. In all the settings, participants knew each other since they had been living in the same village for most of their life.

Once all participants had taken their seats, an instructor started to explain the experiment verbally owing to the low literacy level of the participants.[4] The instructions stipulated the setting of the simulation as being in fishery management, how own extraction rates are related to those of other group members, and the

[4] In order to ensure that the instructions, which were in Bahasa Indonesia, did not suffer from any translation bias, we had them retranslated by an independent Bahasa Indonesia native speaker. We did not find any inconsistencies. Instructions as well as the payoff table can be found in appendix B and C.

payment. At the end of the instructions, three examples were presented to improve the understanding of the participants about the procedure. Then, a pilot round was played to help participants familiarize themselves with the task. Questions could be asked after the explanation of the instructions as well as after the pilot round. The questions were answered within the larger audience to ensure that at any time everyone had the same information. A large poster with the payoff table was placed in a way that every participant could see it during the presentation of the instructions. Laminated payoff tables were handed out to the participants before the pilot round started. The experiment only started once everyone indicated that they had understood the rules and there were no further questions to discuss. This thorough procedure ensured that every participant fully understood the experiment.

One assistant was assigned to each of the four groups guaranteeing a smooth implementation of the experiment. In every round the participants had to select their extraction rate and then hand it to the group's assistant. The assistant transmitted the sheets to the researchers, who entered the rates in a computer, calculated the respective payoff, filled the payoff in the sheets and handed it back to the assistant who transmitted this information to the participants. Information about the individual extraction rate and payoff of all the group members were indicated on the sheet as well as the average payoff of the group. Thus, the participants always knew their own payoff and the payoff of all other group members.

The procedure of the game was slightly different depending on the treatment and administered on group level. While the baseline treatment was played as a simple CPR game, in the *external* treatment the participants were shown the social optimum individually on a sheet of paper in every round by the respective assistant assigned to their group. For the *leadership* treatment, one group leader per group was drawn randomly in each round and his suggestion was then shown to every participant individually on a sheet of paper by the respective assistant. In the *democracy* treatment, every participant gave a recommendation and the median of these recommendations was shown in every group to each participant individually on a sheet of paper by the respective assistant. Care was taken to ensure that everyone understood the concept of the median before the game commenced.

Our experiment generated data on 695 individuals over 10 rounds. At the end of the game, we randomly drew one round to be paid out. On average, the payoff was 28,505 Indonesian Rupiah (IDR) per person. We also added a lump sum of 10,000 IDR per person for showing up, yielding an individual average earning of 38,505 IDR or 2.89 US-Dollar. This is around 86 percent of the daily working wage in Sulawesi, which is about 45,000 IDR.

## 5. Results

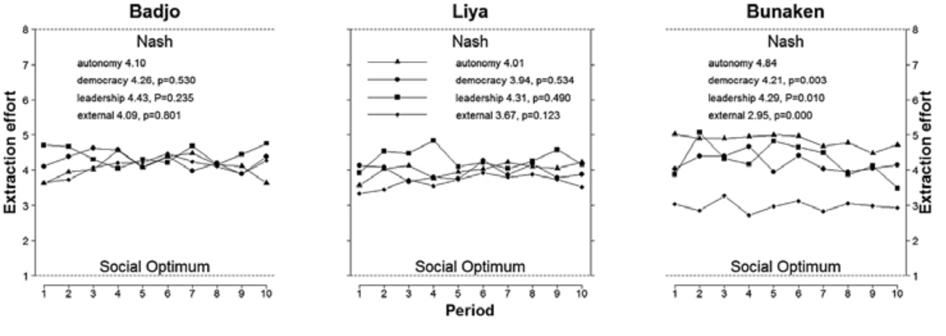
We first analyze participants' extraction rates across treatments aggregated in all sites. Turning to our *autonomy* treatment, we find that participants extract on average 4.3 hours. In the case of the *democracy* and *leadership* treatments, we find that the mean extraction efforts of 4.1 hours (*p*-value 0.128) and 4.3 hours (*p*-value 0.961) are statistically indistinguishable from the level in *autonomy*.[5] The recommendations from an *external* source, by contrast, lead to an average extraction effort of 3.6 hours, which is significantly below the extraction effort in *autonomy* (*p*-value 0.000).

Next we separate our analysis according to the three sites to gauge whether extraction efforts obtained in one site were replicated in others or whether there are significant regional differences in extraction behavior and, especially, treatment effects. The main results of this analysis are contained in Figure 1. We start by comparing extraction efforts in *autonomy* across sites. Based on a Kruskal-Wallis test, we find that average extractions in our *autonomy* treatment differ significantly across sites (*p*-value 0.002). More precisely, extraction efforts in *autonomy* are higher in Bunaken than in Liya (*p*-value 0.001) and in Badjo (*p*-value 0.003). Furthermore, we find that extractions remain relatively stable throughout the experiment in all sites.

[5] The *p*-values in this section correspond to Wilcoxon-Mann-Whitney tests, except where otherwise specified.

Although contrary to the usual non-decrease in cooperation levels over time (e.g. Ledyard 1995), this result is similar to the results obtained in Cardenas (2004), who argues that it could be explained by the non-linearity in the payoff structure. Average extractions in *democracy* and *leadership* are remarkably similar across regions. According to Kruskal-Wallis tests we do not find statistically significant differences in individual extraction decisions across the three regions (*p*-value 0.248 and *p*-value 0.794). In *external*, however, extraction efforts differ significantly across regions (Kruskal-Wallis test, *p*-value 0.003). More precisely, individual extractions in Bunaken are significantly lower than in Badjo (*p*-value 0.001) and Liya (*p*-value 0.035).

**Figure 1: Mean extraction effort across sites**




Note: Average extraction effort in Badjo (left), Liya (middle) and Bunaken (right) during the 10 periods of the *autonomy*, *democracy*, *leadership* and *external* treatment; *p*-values of Wilcoxon-Mann-Whitney tests for change of extraction effort between *democracy*, *leadership*, *external* and *autonomy* by sites.

Figure 1 also suggests that there are substantial differences with regard to the treatment effects across the three different sites. In particular, the statistically significant effect of the *external* treatment in the pooled analysis is seen to be driven by one site, Bunaken, whose extraction rate of 3 hours is roughly 1.8 hours below the site's relatively high level of 4.8 hours in *autonomy* (*p*-value 0.000). The *democracy* (*p*-value 0.003) and *leadership* (*p*-value 0.010) treatments are likewise statistically significant in Bunaken compared to the *autonomy* treatment, albeit with reductions in the extraction level that are substantially lower in magnitude than under the *external* treatment. In Liya and Badjo, by contrast, none of the treatments significantly bear on the extraction rate relative to each site's baseline extraction levels of 4 and 4.1 hours. Given that we test multiple treatments across multiple sites, we corrected our results for multiple hypothesis testing by the corrections suggested in List et al. (2016). In no case are the statistically significant results negated by those corrections.

**Table 2: Random effects estimation for extraction effort**

| Dependent variable | Extraction effort | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| *Democracy* | -0.182 | -0.338** | -0.635*** | -1.241*** |
| | (0.142) | (0.171) | (0.209) | (0.303) |
| *Leadership* | 0.030 | -0.0451 | -0.55*** | -0.430 |
| | (0.147) | (0.195) | (0.210) | (0.364) |
| *External* | -0.754*** | -0.673*** | -1.865*** | -1.661*** |
| | (0.169) | (0.220) | (0.270) | (0.346) |
| *Liya* | | | -0.833*** | -0.743** |
| | | | (0.238) | (0.376) |
| *Badjo* | | | -0.742*** | -1.596*** |
| | | | (0.235) | (0.383) |
| *Democracy x Liya* | | | 0.568* | 0.807** |
| | | | (0.311) | (0.381) |
| *Democracy x Badjo* | | | 0.800** | 1.946*** |
| | | | (0.351) | (0.482) |
| *Leadership x Liya* | | | 0.857** | 0.222 |
| | | | (0.371) | (0.517) |
| *Leadership x Badjo* | | | 0.886*** | 0.777 |
| | | | (0.319) | (0.474) |
| *External x Liya* | | | 1.52*** | 1.260** |
| | | | (0.392) | (0.510) |
| *External x Badjo* | | | 1.85*** | 1.925*** |
| | | | (0.395) | (0.508) |
| *Trust Index* | | 0.459 | | -0.0193 |
| | | (0.438) | | (0.459) |
| *Locus of Control* | | -1.185*** | | -1.226*** |
| | | (0.418) | | (0.415) |
| *Association Membership* | | -0.109 | | -0.0573 |
| | | (0.148) | | (0.140) |
| *Primary Education* | | -0.138 | | -0.230* |
| | | (0.136) | | (0.139) |
| *Muslim* | | 0.228 | | 0.530* |
| | | (0.223) | | (0.319) |
| *Fishing Intensity* | | -0.0859 | | -0.0591 |
| | | (0.0553) | | (0.0558) |
| *Household Expenditures (in IDR)* | | -2.02e-08** | | -1.47e-08 |
| | | (7.95e-09) | | (9.03e-09) |
| *Gender* | | 0.111 | | 0.0821 |
| | | (0.249) | | (0.228) |
| *Age* | | 0.000706 | | -9.29e-05 |
| | | (0.00609) | | (0.00627) |
| *Internet* | | -0.133 | | -0.413** |
| | | (0.169) | | (0.191) |
| *Transit Services* | | -0.671*** | | -0.779*** |
| | | (0.143) | | (0.208) |
| *Round* | -0.005 | -0.0110 | -0.004 | -0.0110 |
| | (0.008) | (0.0103) | (0.008) | (0.0103) |
| *Constant* | 4.34 *** | 5.190*** | 4.866*** | 6.090*** |
| | (0.112) | (0.532) | (0.167) | (0.561) |
| Observations | 6,950 | 4,380 | 6,950 | 4,380 |

Note: Robust standard errors in parentheses; *p < 0.1, **p < 0.05 and ***p < 0.01.

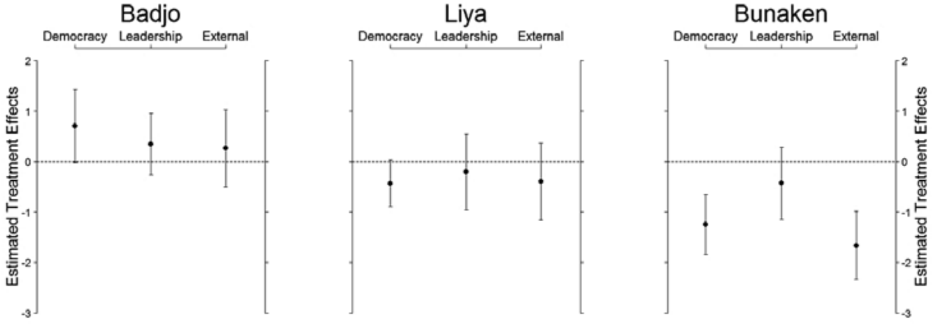
To explore the robustness of these non-parametric comparisons, we estimate a series of random effects models that include the variables presented in Table 2 as controls for individual heterogeneity.[6] The first model in Table 2 includes dummies for the three treatment effects, but, as in the initial unconditional analysis, does not allow for differential effects by site or individual controls and confirms our non-parametric estimates. The second model introduces controls for individual heterogeneity. The coefficient on the *external* dummy is statistically significant at the one percent level and indicates a reduction in the extraction of about 0.67 hours, which is just slightly lower than the magnitude of the unconditional comparison. A statistically significant effect is likewise seen for the *democracy* treatment, which is associated with a reduction in the extraction rate of 0.34 hours. The model additionally reveals that behavior varies with socioeconomic factors. Three of the control variables – the locus of control, household expenditure, and transit services – are statistically significant at the 5% level or below, all of which have negative associations with extraction. The third model in the table expands on the first two regressions by including site dummies and the fourth model additionally includes their interactions with the treatments to allow the magnitude of the treatment effect to vary by site.

Several of these effects are seen to be statistically significant, but the resulting proliferation of coefficients makes it difficult to gauge their magnitude. To ease interpretation, Figure 2 presents estimates of the deviation from the baseline by treatment and for each site, along with the corresponding 95% confidence interval. As in the non-parametric analysis, this comparison shows statistically significant treatment effects in Bunaken. According to the point estimates, both the *democracy* and *external* treatments lower the extraction rate by about 1.3 and 1.7 hours, respectively. The more flexible specification of model 4 also alters the interpretation of some of the control variables. Unlike in model 2, household expenditures are no longer statistically

[6] This results in a loss of about 180 observations owing to instances when a shortened version of the questionnaire was administered because the participant in the CPR game was not present at the household at the time of the interview. When this was the case, we did not record information on the locus of control. As shown in appendix A, the exclusion of this variable from the specification does not affect the remaining coefficient estimates markedly.

significant, while the dummy indicating a good internet connection is highly significant and suggests a decrease in the extraction rate of about 0.41 hours, a three-fold increase in magnitude relative to model 1. The locus of control index remains significant at a 1 percent level and increases in magnitude, with a one standard deviation increase in the index associated with a 0.44 decrease in the hours of extraction. Similar increases in magnitude are seen for the dummies indicating public transit, religion, and primary school education.

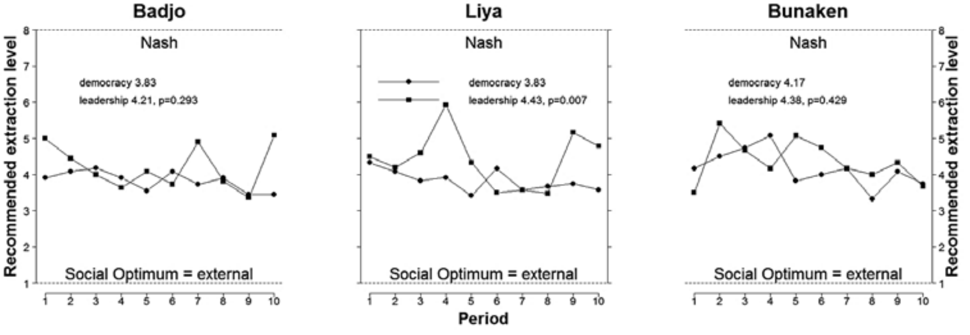
**Figure 2: Estimated treatment effects by sites**




Note: Estimated treatment effects based on regression model in column (4) of Table 2. Confidence intervals at the 95%-level.

In order to analyze what drives the regional heterogeneity we now analyze participants recommendations and if those recommendations are followed across sites. In two treatments, *democracy* and *leadership*, recommended extraction efforts are set by the participants themselves. Across all sites and periods, participants recommend extracting on average significantly less in *democracy* than in *leadership* (*p*-3.95 vs. 4.34, *p*-value 0.008). Controlling for the different sites where the experiment has been conducted reveals that this effect is driven by participants in Liya (see Figure 3). In Liya, the mean recommended extraction effort of 3.8 hours in *democracy* is roughly 0.6 hours below the recommendations in *leadership* (*p*-value 0.007). In Badjo and Bunaken we do not find a statistically significant difference between the recommendations in *democracy* and *leadership.* However, compared across sites, we find only moderate differences with respect to the recommended extraction efforts and, most importantly, recommendations in Bunaken are not systematically lower than those in Badjo or Liya, which could help explain the heterogeneous treatment effects in extraction efforts.

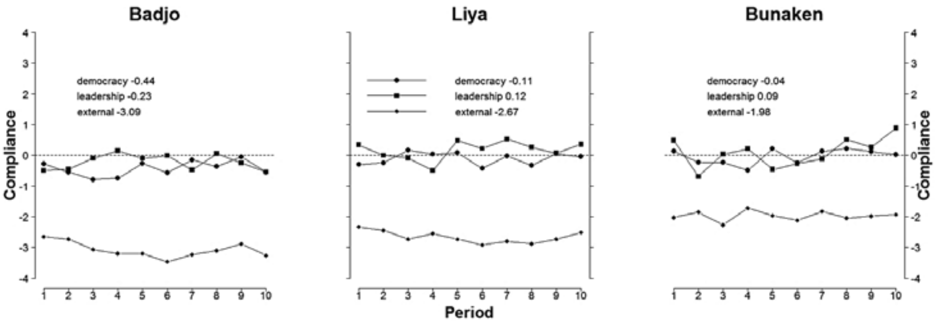
**Figure 3: Mean recommended extraction effort over time by sites**




Note: Average recommended effort in Badjo (left), Liya (middle) and Bunaken (right) during the 10 periods of the *democracy*, and *leadership* treatment; *p*-values of Wilcoxon-Mann-Whitney tests for change of extraction effort between *democracy* and *leadership* by sites.

A final question concerns the issue of compliance, i.e. whether the recommended extraction levels emerging from the treatments differ from those actually selected by the participants. Figure 4 presents these differences by treatment and site, with negative differences indicating the extent to which the recommended extraction level falls below the chosen one, that is, the extent of non-compliance. For the case of *democracy* and *leadership* the difference in compliance across sites is negligible in magnitude and statistically insignificant (Kruskal-Wallis test, *p*-value 0.263 and *p*-value 0.182). Focusing on compliance with externally recommended non-binding extraction efforts we find substantial differences across regions (Kruskal-Wallis test, *p*-value 0.003). More precisely, participants in Bunaken, in particular, follow non-binding recommendations by an external authority. They show a significantly higher compliance than participants from Badjo (-1.98 vs. -3.09, *p*-value 0.001) and Liya (-1.98 vs. -2.67, *p*-value 0.035).

**Figure 4: Mean differences between recommendations and extraction efforts over time by sites**




Note: Average difference between recommendations and actual extraction efforts over periods across all participants from Badjo (left), Liya (middle) and Bunaken (right).

Consequently, the differences in treatment effects across regions are driven primarily by a relatively high extraction in our baseline treatment in Bunaken and consequently a comparatively high compliance in Bunaken in the external treatment.

# 6. Summary and Concluding Remarks

This study examined collective resource management among fishing communities on the Indonesian island of Sulawesi. The island, one of the most biologically diverse expanses of coral reef fisheries globally, has been subject to extensive degradation from overfishing (Burke et al. 2011). In response, international NGOs and regional governments have teamed to coordinate the establishment of TURFs, community-based management regimes that harness locally available monitoring and enforcement capacities for regulating access to the fishery. The experiment is an ex ante analysis of the establishment of a TURF reserve that is being overseen by a large environmental NGO.

Using a common pool resource game conducted in three sites on the island, we explored alternative strategies for garnering the requisite coordination to maintain a TURF. The game involves individual fishers selecting a desired level of harvesting activity varying between one and eight hours per day, with payoffs calibrated such that each player's dominant strategy is to select the maximum harvesting level. Experimental treatments were introduced that consisted of three different non-binding resource extraction recommendations originating from a democratic process, a group leader decision or an external source that recommends a socially optimal level.

Three main findings emerge. First, the most effective treatment in drawing players toward the social optimum is the external recommendation, suggesting that outside expert advice and information campaigns from respected sources may be useful in promoting coordination. Second, while this finding was obtained for the sample as a whole, a disaggregate analysis revealed it to hold only in one of the three sites, Bunaken, illustrating that the mechanisms for fostering cooperation can lead to different outcomes among groups living in similar biophysical environments (e.g. Herrmann et al. 2008). Third, the degree of individual non-compliance with the recommendation was highest for the *external* treatment; it was of a negligible magnitude for the *leadership* and *democracy* treatments, the latter of which also had a statistically significant effect in reducing extraction in Bunaken.

From a policy perspective, the low compliance but high extraction reduction of the external treatment together with the high compliance but somewhat lower extraction reduction of the democracy treatment suggests some promise for coupling external advocacy of the social optimum with a community-based democratic decision process. However, the absence of this effect in two of the sites shows that caution is warranted in generalizing this conclusion to other sites in which TURFs are being considered. Further research should thus be directed at disentangling the root of this difference in ethnically homogeneous villages such as those analyzed in this study.

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# Appendix

## A. Random effects model for extraction effort without locus of control

| **Dependent Variable** | **Extraction effort**<br>(1) | **Extraction effort**<br>(2) |
|---|---|---|
| *Democracy* | -0.185 | -0.935*** |
| | (0.156) | (0.280) |
| *Leadership* | 0.0297 | -0.334 |
| | (0.168) | (0.338) |
| *External* | -0.556*** | -1.538*** |
| | (0.196) | (0.333) |
| *Liya* | | -0.625* |
| | | (0.360) |
| *Badjo* | | -1.205*** |
| | | (0.356) |
| *Democracy x Liya* | | 0.748** |
| | | (0.355) |
| *Democracy x Badjo* | | 1.708*** |
| | | (0.450) |
| *Leadership x Liya* | | 0.443 |
| | | (0.465) |
| *Leadership x Badjo* | | 0.663 |
| | | (0.441) |
| *External x Liya* | | 1.364*** |
| | | (0.461) |
| *External x Badjo* | | 1.848*** |
| | | (0.473) |
| *Trust Index* | 0.541 | 0.297 |
| | (0.407) | (0.431) |
| *Association Membership* | -0.0396 | -0.00283 |
| | (0.133) | (0.129) |
| *Primary Education* | -0.171 | -0.187 |
| | (0.125) | (0.127) |
| *Muslim* | 0.223 | 0.341 |
| | (0.208) | (0.305) |
| *Fishing Intensity* | -0.0271 | -0.00721 |
| | (0.0313) | (0.0306) |
| *Household Expenditure (in IDR)* | -1.26e-08 | -1.01e-08 |
| | (9.54e-09) | (1.02e-08) |
| *Gender* | 0.193 | 0.163 |
| | (0.191) | (0.180) |
| *Age* | 0.00276 | 0.00317 |
| | (0.00515) | (0.00521) |
| *Internet* | -0.216 | -0.462*** |
| | (0.148) | (0.174) |
| *Transit Services* | -0.614*** | -0.689*** |
| | (0.129) | (0.196) |
| *Round* | -0.0111 | -0.0111 |
| | (0.00900) | (0.00901) |
| Constant | 4.161*** | 4.809*** |
| | (0.431) | (0.461) |
| Observations | 5,780 | 5,780 |

## B. Experimental Introduction and Procedure

### B.1. Verbal Introduction (translated into English)

Hello, Good Afternoon/evening...

My Name is...from UI and RWI. As already mentioned in the survey we are here for a research project about fishing behavior. As a complimentary part of our research, we are going to have a simulation. To guarantee a smooth process, we need to establish some rules first:

Please do not talk to each other and do not use any electronic devices such as mobile phones, smart phones, or the like throughout the whole game. If you want to go to restroom, please do it now because we will have the simulation for about 2 hours. If any of you want to go to restroom, you may go now. We won't give permission to go to the restroom when the simulation has begun. During the game, you make your decisions anonymously. Only the researchers will know your identity and your data will be treated confidentially.

In order to make these projects as useful as possible to the local population we heavily depend on exact, truthful, and comprehensive information

Are you ready?

### B.2. Verbal Instructions (translated into English)

**General Information** *(Note: this information was given to all participants)*

In this simulation, you will be sharing a small fish site with four other people. You profit in two different ways from the fish site. By fishing you will earn money, but at the same time you receive benefits from conserving the fish stock. This means, if you refrain from fishing you will help the fish population to grow more sustainable and secure the future of the fish population. At the same time, a more amenable habitat will attract tourists from outside, who pay for the conserved environment. A healthy fish stock will then pay out for you in the future.

You will be asked to decide on the amount of time you spend for fishing. Please note that the more time you use for fishing, the more fish you will get. HOWEVER, at the time you will also reduce the stock of fish, which also means decreasing the profit gained from fish conservation as well as future gains from the fish population.

[Only for externality: Before you make a decision, you will get an official recommendation about how much time you should spend for fishing. Please notice that EVEN THOUGH this is an official recommendation, it is not binding. This means that you and the other four people who share this fish site can spend more or less time fishing than officially recommended].

[Only for democracy: In this simulation, you will be deciding together in your group about the number of hours each participant should spend fishing. Each of the group members will propose how many hours each participant should spend fishing. Following this, the median of all the proposals, which is the third highest value proposed by your group, will be treated as the recommended time duration to fish for every member of the team. Please notice that EVEN THOUGH this is a recommendation, it is not binding. This means that you and the other four people who share this fish site can spend more or less time fishing than recommended]

[Only for the group leader: Before you make a decision, you will get a recommendation about the length of time to fish. This recommendation will be made by the head of this group. This leader will be randomly chosen at the time when the simulation starts. Please notice that EVEN THOUGH this is a recommendation, it is not binding. This means that you and the other four people who share this fish site can spend more or less time fishing than recommended]

In this simulation, you can earn money, to an amount depending on your decisions and your group members' decisions. The decisions you take will determine how much you can earn during the course of the simulation, so please take your time and make your decisions after thinking carefully. This simulation will go on for ten separate rounds, during which you will play the same exercise and interact with the same four people. In each round you can earn money, and at the end of the simulation we will randomly draw one round and this round will then be paid out. Thus, each of your decisions may be the one that will be paid out in the end, so always think carefully about your decisions.

**Autonomy treatment**

*(Note: This information was given only to the participants in the autonomy treatment)*

Remember that in this simulation you will be sharing a small fish site with four other people. You will get benefits from the fish stock in two ways; earning money from fishing or from preserving the fish stock for the future. Your task now is to decide how many hours you want to spend fishing each day. You can spend between one and eight hours fishing per day. Remember, the more hours you spend fishing, the more fish you will catch, but the lower the fish stock. Please remember, the simulation consists of ten separate rounds, in which you always play the same simulation and interact with the same four people. After each round, you will be informed about the amount of fish caught and the payoffs of all the players in your group. Please be aware that all the group members face the same decision like you. Your total earnings in each round depend on:

- The number of hours you spend fishing
- The number of hours the other 4 group members spend fishing

The payoff table shows that the amount of your earning depending on the time that you and the other group members spend fishing per day. Remember your payoff depends on how many hours you and your group members spend fishing per day. Please note, your payoff increases with the hours you spend fishing, but the more hours you and your group spend on fishing, the lower is your benefit from conserving the fish stock.

1 Example: Imagine that you and the other group members spent one hour per day for activities related to fisheries. This means that you and your group members would get 37880 Rupiah at the end of the round.

2nd Example: Imagine that you and all the other group members spent eight hours per day for activities related to fisheries. This means that you and the other group members would get 16000 Rupiah at the end of the round.

3rd Example: Imagine that the other group members spent together ten hours per day for activities related to fisheries and you spend one hour per day for activities related to fisheries. This means that you would get 31880 Rupiah at the end of the round.

4th Example: Imagine that the other group members spent together ten hours per day with activities related to fisheries and you spend eight hours per day for activities related to fisheries. This means that you would get 38000 Rupiah at the end of the round.

We will now play one round to help you to familiarize yourself with the simulation. This round will not count for the payoff.

[Pilot]

Are there any more questions? If not, I will began the game. And please, be reminded that no smartphones are allowed in this room, you should not talk to each other, and there is no permission to go to the restroom after the simulation has begun without losing all your payoffs.

**External Treatment**

*(Note: this information was given only to participants in the external treatment)*

Remember that in this simulation you will be sharing a small fish site together with four other people. You can earn money either by fishing, or by conserving the fish stock. Your task now is to decide how many hours you want to spend fishing.

Please notice that before you make your decision, you will receive an official recommendation on how much hours to spend fishing. This recommendation is official, but not binding. This means that you and the other group member can spend more or less hours fishing than officially recommended.

Remember that the more hours you spend fishing, the larger the amount of fish you are catching, however, the smaller the stock of the fish. The same conditions apply to the other four people in your group. Remember the simulation consists of ten separate rounds, in which you always play the same exercise and interact with the same four people in your group.

After each round, you will be informed about the amount of fish caught and the payoffs of all the other players in your group. Please be aware that all of the group members face the same decision like you. Your total earnings in each round depend on:

- The number of hours you spend fishing
- The number of hours the other 4 group members spend fishing

The payoff table shows the amount of your earning depending on the time that you and the other group members spend fishing per day. Remember your payoff depends on how many hours you and your group members spend fishing per day. Please note, your payoff increase with the hours you spend fishing, but the more hours you and your group spend on fishing, the lower is your benefit from conserving fish stock.

1st Example: Imagine that you get a recommendation to spend one hour per day to fish. You and all other group members follow this recommendation and spend one hour per day fishing. Then you and the other group members earn 37880 Rupiah at the end of the round.

2nd Example: Imagine that you get a recommendation to spend one hour per day to fish, but you and all the group members spend eight hours per day fishing. Then you and the other group members earn 16000 Rupiah at the end of the round.

3rd Example: Imagine that you get a recommendation to spend one hour per day to fish. Then you spent exactly one hour per day to fish, but the other group members spent together ten hours per day to fish. Then you earn 31880 Rupiah at the end of the round.

4th Example: Imagine that you get a recommendation to spend one hour per day to fish. However, it turns out that the other group members spent together ten hours per day fishing, and you spent eight hours per day fishing. Then you earn 38000 Rupiah at the end of the round.

We will now play one round to help you to familiarize yourself with the simulation. This round will not count for the payoff.

[Pilot]

Are there any more questions? If not, I will began the game. And please, be reminded that no smartphones are allowed in this room, you should not talk to each other, and there is no permission to go to the restroom after the simulation has begun without losing all your payoffs.

**Democratcy Treatment**

*(Note: This information was given only to participants in the democracy Treatment)*

Remember that in this simulation you will be sharing a small fish site together with four other people. You can earn money either by fishing, or by conserving the fish stock. Your task now is to decide how many hours you want to spend fishing.

Please note that in this simulation you decide together with the other four group members how many hours each group member should spend fishing. Each of the group members can spend between one and eight hours fishing each day. To decide collectively, each of the group members has to propose how many hours each group member should spend fishing. Afterwards, the median of all proposals will be imposed as non-binding recommendation. In other words, you and the other four group members should spend the median of all proposed hours fishing. Please notice that this recommendation is not binding, meaning that you and the other group members can spend more or less hours to fishing than recommended.

Remember that the more hours you spend fishing, the larger the amount of fish you are catching, however, the smaller the stock of the fish. The same conditions apply to the other four people in your group. Remember the simulation consists of ten separate rounds, in which you always play the same exercise and interact with the same four people in your group.

After each round, you will be informed about the amount of fish caught and the payoffs of all the other players in your group. Please be aware that all of the group members face the same decision like you. Your total earnings in each round depend on:

- The number of hours you spend fishing
- The number of hours the other 4 group members spend fishing

The payoff table shows that the amount of your earning depending on the time that you and the other group members spend for fishing per day. Remember your payoff depends on how many hours you and your group members spend fishing per day. Please note, your payoff increases with the hours you spend fishing, but the more hours you spend on fishing, the lower your benefit from conserving the fish stock.

1st Example: Imagine that you proposed to spend 1 hour per day to fish, and the four other group members proposed to spend 2, 4, 6, and 8 hours per day fishing. This means that you and all the group members should spend 4 hours per day on fishing.

2nd Example: Imagine that you proposed to spend 8 hour per day to fish, and the other four group members proposed to spend 1, 2, 4, and 6 hours per day fishing. This means that you and all the group members should spend 4 hours per day on fishing

[Make clear that the previous examples were about the choosing mechanisms of the median. Now examples of the second step in the simulation.]

3rd Example: Imagine that you and all the group members proposed to spend one hour per day on fishing. This means that you and all the group members should spend 1 hour per day on fishing. By assuming that you and all the other group members follow this proposal you and all of the group members will earn 37880 Rupiah at the end of the round.

4th Example: Imagine that you and all the group members proposed to spend eight hours per day on fishing. This means that you and all the group members should spend 8 hour per day on fishing. By assuming that you and all the other group members follow this proposal you and all the group members will earn 16000 Rupiah at the end of the round.

5th Example: Imagine that you and all the group members proposed to spend 3 hours per day on fishing. However, all of the other group members together spend 10 hours per day on fishing and you spend one hour per day on fishing. Then you earn 31880 Rupiah at the end of the round.

6th Example: Imagine that you and all the group members proposed to spend 3 hours per day on fishing. However, that all of the other group members together spend 10 hours per day on fishing and you spend 8 hours per day on fishing. Then you earn 38000 Rupiah at the end of the round.

We will now play one round to help you to familiarize yourself with the simulation. This round will not count for the payoff.

[Pilot]

Are there any more questions? If not, I will began the game. And please, be reminded that no smartphones are allowed in this room, you should not talk to each other, and there is no permission to go to the restroom after the simulation has begun without losing all your payoffs.

**Leader Treatment**

*(Note: this information was given only to participants in the Leader Treatment)*

Remember that in this simulation you will be sharing a small fish site with four other people. You can earn money by fishing, or by conserving the fish stock. Your task now is to decide how many hours you want to spend fishing.

Please note, that at the beginning of each round one of the group members is selected randomly to become the group leader. The person chosen will be informed about the outcome whereas those not chosen will be informed about this outcome as well. The responsibility of the leader is to provide a recommendation on how many hours to be spent by each group member on fishing. This recommendation is not binding, meaning that you and the group members can spend more or less hours fishing than recommended.

Remember that the more hours you spend fishing, the large the amount of fish you are catching, however, the smaller the stock of the fish. The same conditions apply to the other four people in your group. Remember the simulation consists of ten separate rounds, in which you always play the same exercise and interact with the same four people in your group.

After each round, you will be informed about the amount of fish caught and the payoffs of all the other players in your group. Please be aware that all of the group members face the same decision like you. Your total earnings in each in each round depend on:

- The number of hours you spend fishing
- The number of hours the other 4 group members spend fishing

The payoff table shows the amount of your earning depending on the time that you and the other group members spend fishing per day. Remember your payoff depends on how many hours you and your group members spend fishing per day. Please note, your payoff increase with the hours you spend fishing, but the more hours you spend on fishing, the lower your benefit from conserving the fish stock.

1st Example: Imagine that you were recommended to spend one hour per day to fish. You and all the other group members follow this recommendation. Then you and your group members earn 37880 Rupiah at the end of the round.

2nd Example: Imagine that you were recommended to spend one hour per day to fish, but you and all the other group members spend eight hours per day on fishing. Then you and your group members earn 16000 coins at the end of the round.

3rd Example: Imagine that you were recommended to spend one hour per day to fish. You spend only one hour on fishing per day but the other group members spend ten hours per day fishing. Then you earn 31880 Rupiah at the end of the round.

4th Example: Imagine that you were recommended to spend to spend one hour per day to fish. However, the other group members spend 10 hours per day fishing, and you spend 8 hours per day fishing. Then you earn 38000 Rupiah at the end of the round.

We will now play one round to help you to familiarize yourself with the simulation. This round will not count for the payoff.

[Play the pilot]

Are there any more questions? If not, I will began the game. And please, be reminded that no smartphones are allowed in this room, you should not talk to each other, and there is no permission to go to the restroom after the simulation has begun without losing all your payoffs.

## C. Payoff Table in Indonesian Rupiah (IDR)

| Their effort extracting (in total hours) | My effort extracting ( in hours) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 4 | 37880 | 39500 | 40880 | 42000 | 42880 | 43500 | 43880 | 44000 |
| 5 | 36880 | 38500 | 39880 | 41000 | 41880 | 42500 | 42880 | 43000 |
| 6 | 35880 | 37500 | 38880 | 40000 | 40880 | 41500 | 41880 | 42000 |
| 7 | 34880 | 36500 | 37880 | 39000 | 39880 | 40500 | 40880 | 41000 |
| 8 | 33880 | 35500 | 36880 | 38000 | 38880 | 39500 | 39880 | 40000 |
| 9 | 32880 | 34500 | 35880 | 37000 | 37880 | 38500 | 38880 | 39000 |
| 10 | 31880 | 33500 | 34880 | 36000 | 36880 | 37500 | 37880 | 38000 |
| 11 | 30880 | 32500 | 33880 | 35000 | 35880 | 36500 | 36880 | 37000 |
| 12 | 29880 | 31500 | 32880 | 34000 | 34880 | 35500 | 35880 | 36000 |
| 13 | 28880 | 30500 | 31880 | 33000 | 33880 | 34500 | 34880 | 35000 |
| 14 | 27880 | 29500 | 30880 | 32000 | 32880 | 33500 | 33880 | 34000 |
| 15 | 26880 | 28500 | 29880 | 31000 | 31880 | 32500 | 32880 | 33000 |
| 16 | 25880 | 27500 | 28880 | 30000 | 30880 | 31500 | 31880 | 32000 |
| 17 | 24880 | 26500 | 27880 | 29000 | 29880 | 30500 | 30880 | 31000 |
| 18 | 23880 | 25500 | 26880 | 28000 | 28880 | 29500 | 29880 | 30000 |
| 19 | 22880 | 24500 | 25880 | 27000 | 27880 | 28500 | 28880 | 29000 |
| 20 | 21880 | 23500 | 24880 | 26000 | 26880 | 27500 | 27880 | 28000 |
| 21 | 20880 | 22500 | 23880 | 25000 | 25880 | 26500 | 26880 | 27000 |
| 22 | 19880 | 21500 | 22880 | 24000 | 24880 | 25500 | 25880 | 26000 |
| 23 | 18880 | 20500 | 21880 | 23000 | 23880 | 24500 | 24880 | 25000 |
| 24 | 17880 | 19500 | 20880 | 22000 | 22880 | 23500 | 23880 | 24000 |
| 25 | 16880 | 18500 | 19880 | 21000 | 21880 | 22500 | 22880 | 23000 |
| 26 | 15880 | 17500 | 18880 | 20000 | 20880 | 21500 | 21880 | 22000 |
| 27 | 14880 | 16500 | 17880 | 19000 | 19880 | 20500 | 20880 | 21000 |
| 28 | 13880 | 15500 | 16880 | 18000 | 18880 | 19500 | 19880 | 20000 |
| 29 | 12880 | 14500 | 15880 | 17000 | 17880 | 18500 | 18880 | 19000 |
| 30 | 11880 | 13500 | 14880 | 16000 | 16880 | 17500 | 17880 | 18000 |
| 31 | 10880 | 12500 | 13880 | 15000 | 15880 | 16500 | 16880 | 17000 |
| 32 | 9880 | 11500 | 12880 | 14000 | 14880 | 15500 | 15880 | 16000 |