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Analysis

# External validity of artefactual field experiments: A study on cooperation, impatience and sustainability in an artisanal fishery in Colombia

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ABSTRACT

This paper contributes to the experimental analysis of sustainable behavior in artisanal fisheries and the external validity of economic experiments. We run a standard one-shot public goods experiment and two time preferences experiments with fishermen from Tasajera. It is a small fishing community located in the Caribbean coast of Colombia, which depends mainly on the fishery resources of the Ciénaga Grande de Santa Marta for its livelihood. To investigate the external validity of the experiments, we related the fishermen's individual decisions in the experiments to some indices measuring the ecological impact of fishing activities among the same group of fishermen. We found that fishermen's contributions to the public good and their levels of impatience are not robustly correlated to their real fishing behavior. We argue that the link between fishermen's behavior in the field experiments and real life could be associated to various factors, such as the specific context in which fishermen live, and the way in which cooperation in real life is measured.



## 1. Introduction

The conservation of common pool resources (CPRs) such as forests, pastures or fisheries, depends on several factors such as the type and the size of the resource, the characteristics of the resource users or the institutions (rules) that govern these resources (Agrawal, 2001; Baland and Platteau, 1996; Basurto et al., 2013; Basurto and Ostrom, 2009; Ostrom, 1990). There is plenty of empirical evidence that subjects do not always follow the theoretical assumption of self-interest (Hardin, 1968; Olson, 1965), and instead, they cooperate voluntarily to achieve a successful exploitation of the resources. Higher cooperation leads to more sustainable resource use (Basurto et al., 2013; Orensanz et al., 2013; Ostrom, 1990; Ostrom et al., 1999; Ostrom et al., 1992; Schlager, 1994).

Besides the ability to engage in cooperation, the level of patience or impatience of actors, in our case fishermen, is another important factor that can affect sustainability. Thus, according to standard economic theory on fisheries (Clark, 1973; Sumaila and Walters, 2005) when fishermen are impatient (i.e., they have high discount rates) and prefer to receive a smaller benefit immediately rather than to wait for a larger benefit in the future which is less certain, it is more likely that they overexploit fishery resources and behave therefore unsustainably. Only some authors argue in favor of a disinvestment hypothesis that states myopic resource users might not have the means to invest in resource technology and therefore, behave more sustainably (Farzin, 1984).

In the last decades, laboratory experiments in economics have been an important tool to study human behavior and cooperation among subjects in different settings (Falk and Heckman, 2009; Levitt and List, 2007). In particular, economic field experiments with users who share a real natural resource have increased our knowledge regarding how they make decisions and self-organize to extract those resources in a sustainable way (Cárdenas, 2000, 2011; Cárdenas and Carpenter, 2008; Cárdenas and Ostrom, 2004; Janssen and Anderies, 2011; Muradian and Cárdenas, 2015; Ostrom, 2006), thus avoiding the circumstance of being trapped in the "tragedy of the commons" (Hardin, 1968).

In fisheries, scholars have used economic field experiments to explore different factors such as communication, impatience, reciprocity, rules, and regulations affecting the likelihood of successful cooperation in the management of CPRs (Aswani et al., 2013; Castillo et al., 2011; Fehr and Leibbrandt, 2011; Lopez et al., 2012; Teh et al., 2011; Vélez and Lopez, 2013; Vélez et al., 2009, 2012).

Results from economic experiments are often used for policy recommendations. However, unless a clear link is established we cannot draw conclusions for resource governance in real life (Levitt and List, 2007; Ostrom, 2006). Nevertheless, there are only a few studies about the external validity of experiments on cooperation in commons resource management. To our knowledge, up to date, there are only six studies: four of them found evidence of external validity (Carpenter and Seki,

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2011; Fehr and Leibbrandt, 2011; Gelcich et al., 2013; Rustagi et al., 2010) and the other two studies did not (Gurven and Winking, 2008; Hill and Gurven, 2004).

In order to contribute to the experimental analysis of cooperation in artisanal fisheries and the debate on the external validity of economic experiments, we did a similar study to that of Fehr and Leibbrandt (2011). These authors examined the role of cooperativeness and impatience on the sustainable exploitation of a CPR with open access by combining laboratory experiments with field data. They found that shrimpers who were more patient and cooperated more intensively in the experiment also used more sustainable fishing instruments. Motivated by these findings and taking into account that cooperation and impatience are important factors for resource conservation, we investigate the degree to which experimental measures of cooperation and impatience are correlated to real life sustainable behavior. In case a clear correlation could be found, then those experiments could be used for the quick assessment of the sustainability or at least collective action potential of the community (Aswani et al., 2013). It also could be used as a robust tool for testing different policy alternatives (Cárdenas, 2004). However, it could also be that the link between cooperation and time preferences on the one hand and sustainable behavior on the other hand is not as straightforward. Then those experiments would have to be used with a lot more care, when linking them directly to sustainable behavior.

The study was carried out in Tasajera, a small fishing community located in the Caribbean coast of Colombia, which depends mainly on fishery resources from Ciénaga Grande de Santa Marta (CGSM) for their livelihood. For measuring the ecological impact of fishermen on the CGSM, we gained access to primary information on real fishing behavior over various years collected by a beach recorder of the Institute for Marine and Coastal Research (INVEMAR).[1] These data, together with an evaluation on the ecological impact of fishing activities in the CGSM, made by a group of experienced fishermen and scientists – either working in scientific research on CGSM's fishery or involved in its management – allowed us to build two fishing impact indices for each fisherman: one based on experienced fishermen's scores and other based on scientists' scores.

A standard one-shot public goods experiment (PGE) and two time preferences experiments (TPE) were run with the 152 fishermen whose ecological impact had been calculated by us. The first TPE was similar to the one conducted by Fehr and Leibbrandt (2011) with the only difference being that we used Coca Cola instead of chocolate pralines, which were neither common nor available. The second TPE was framed as a bonus for participating in the experiments. In this experiment, we adapted the payoff table of Harrison et al. (2002) to the context of Tasajera. Fishermen had to choose between five payoff alternatives, which had two future payment options. It allowed us to have a measure of fishermen's impatience through their propensity to discount future payoffs, which provides a more precise measurement than a dichotomous choice. Additionally, the preference for the Coca Cola could eventually be influenced by some "visceral factors" such as cravings, hunger, among others (Frederick et al., 2002).[2]

The paper is structured as follows: in the next section, we introduce Tasajera and an overview of the CGSM fishery. In Section 3, we describe the field data used in this study. In Section 4, we present our experimental design. In Section 5, we present the main results of this research and relate them to those found in the other studies on external validity of experiments on cooperation in CPRs, and finally we offer some conclusions.

## 2. Research Setting

Tasajera is made up of about 8000 inhabitants (SISBEN, 2012), where the majority of its members live in conditions of extreme poverty. Fishery resources from CGSM are the main source of food and income for this community. CGSM is an artisanal, multi-gear and multi-species fishery (Ibarra et al., 2014; INVEMAR, 2013), with around 3500 fishermen (Blanco et al., 2007), of which an average of 950 are active daily in the lagoon (INVEMAR-SIPEIN, 2012). Fishing in this lagoon is carried out all year round and it is done exclusively by men.

CGSM is situated in the center of a bigger region (about 4900 $km^2$) known as Eco-region Ciénaga Grande de Santa Marta,[3] and it is one of the most important in Colombia due to its large size (450 $km^2$) (Gónima et al., 1996), and its ecological and social value[4] (Vilardy and González, 2011). Given its importance, currently the protection of this lagoon resides in several government agencies. However, de facto, it is under an open-access regime since no State entity or organization nor the community itself regulates the fishery. The CGSM has seen strong fluctuations in the fishing productivity over time, with some species at risk of a critical reduction or collapse, as well as a critical deterioration in the fishermen's quality of life (Ibarra et al., 2014; INVEMAR, 2002).

## 3. Field Data

The conservation and sustainable use of CGSM's fishery resources largely depends on the use of appropriate fishing gear and methods. It is also important to fish in sites distant from the key nursery areas and the transit corridors of species. From our conversations with many of Tasajera's fishermen, we realized that they are aware of the negative impacts that they might have on the fishery resources by the actions mentioned above. However, several studies have found that some of the major commercial fish species of the CGSM are at risk of being over-exploited, because they are caught below their average permitted size (before they reach their sexual maturity), which is a result of fishermen using nets with small mesh sizes (Ibarra et al., 2014; Ibarra et al., 2013; Narváez et al., 2008; Rueda, 2007; Rueda and Defeo, 2003; Rueda et al., 1997).

Based on this, and taking advantage of the fact that we had reliable information that allowed us to evaluate the fishermen's fishing behavior; we built fishing impact indices for each fisherman, which gave us a measure of their cooperation for sustaining the fishery resources of CGSM over an extended time period (see Appendix A). Nevertheless, as non-biologists, we did not know what type of fisherman behavior would be considered sustainable. Therefore, we asked fishery biologists working on the CGSM, first in a qualitative and then in a standardized way, how to classify what signifies sustainable fishing behavior. This data provided us with information about what scientists understand as being sustainable fishing. However, there could be a strong misunderstanding about what signifies sustainable behavior between the scientists and the fishermen, who are actually making the decisions. If there were a strong difference between the two opinions, then comparing the experimental behavior with the scientific expert based indicator would not provide reasonable results. The fisherman would base his decisions on what he believes is sustainable. Therefore, we also asked fishermen to classify the various gear, methods and spots. We abstained from asking each individual fisherman about his opinions on sustainability, because he might have classified his own behavior as being sustainable. We observed this trend when comparing fishermen and

[1] This is an entity of mixed character (i.e. public and private). It is responsible for doing basic and applied research on the natural renewable resources in Colombia and the environment of coastal and oceanic ecosystems.

[2] According to Frederick et al. (2002) these visceral influences, which are linked to the attractiveness of the good or activity, could affect the intertemporal choice of the subjects, and can give rise to behaviors that look extremely impatient.

[3] This Eco-region includes 570 $km^2$ of marine area and 730 $km^2$ of an estuarine system of coastal lagoons, connecting creeks and mangrove swamps.

[4] The CGSM was declared as Fauna and Flora Sanctuary in 1977. Likewise, it was designated as a Ramsar site in 1998 and Biosphere reserve in 2000. Furthermore, it is the main source of both food and income for about 25,000 people who live in seven small surrounding villages, including Tasajera (SISBEN, 2007).