



COLLECTIVE ACTION FOR THE MANAGEMENT OF THE FISHERY IN THE CIÉNAGA GRANDE DE SANTA MARTA, NORTHERN COLOMBIA

by

Luz Elba Torres Guevara

A thesis submitted in partial fulfilment
of the requirements for the degree of

**Doctor of Philosophy
in Economics**

Approved Dissertation Committee

Prof. Dr. Achim Schlüter
Jacobs University Bremen
Leibniz Center for Tropical Marine Ecology

Prof. Dr. Karen Smith Stegen
Jacobs University Bremen

Prof. Dr. María Claudia López
Michigan State University

Date of Defense: December 11, 2015

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

Statutory Declaration

I, Luz Elba Torres Guevara, hereby declare that I have written this PhD thesis independently, unless where clearly stated otherwise. I have used only the sources, the data and the support that I have clearly mentioned. This PhD thesis has not been submitted for conferral of degree elsewhere.

I confirm that no rights of third parties will be infringed by the publication of this thesis.

Bremen, December 14, 2015

Signature

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

Abstract

This dissertation investigates factors influencing collective action in the management of Ciénaga Grande de Santa Marta (CGSM) fishery. CGSM is an estuarine lagoon located in the Caribbean coast of Colombia and it is one of the most important fisheries in the country with around 3.500 active fishermen. Its social and ecological importance is remarkable and this is the reason why it was declared a Fauna and Flora Sanctuary in 1977, a Ramsar Site in 1998, and a UNESCO Biosphere Reserve in 2000. Nevertheless, since 1956 CGSM has been degraded by several anthropogenic activities. For example, the construction of a highway along the northern part of the lagoon resulted in a considerable catch reduction, which has deteriorated its inhabitants' quality of life.

The dissertation is organized in three papers. The first paper, *Collective action in a tropical estuarine lagoon: adapting Ostrom's SES framework to Ciénaga Grande de Santa Marta, Colombia*, investigates why collective action for a sustainable use of CGSM's fishery resources has not taken place. For this purpose, we adapted and implemented Ostrom's diagnostic Social-Ecological System (SES) framework (2009) to this coastal ecosystem. We found that the most important factors that explain the lack of collective action for the management of the fishery in this lagoon are a) fishermen's fear of indiscriminate and strong violence that illegal armed groups have inflicted on them since the 1960s, b) the economic development in the Colombian Caribbean region, and c) the socioeconomic condition of its inhabitants.

The second paper, *Understanding artisanal fishermen's behavior: the case of Ciénaga Grande de Santa Marta, Colombia*, investigates the influence of socioeconomic and perceptual factors on fishing behavior of CGSM's fishermen and how that behavior may be impacting CGSM fishery resources by looking at two different points of view, a group of experienced fishermen and a group of experts with extensive knowledge on the fishery. To achieve this we used survey data,

interviews and data which had already been collected in the area by the Institute of Marine and Coastal Research “José Benito Vives de Andrés” (INVEMAR), to build individual and composite indicators. These indicators allow us to investigate the ecological impact of fishing spots and fishing gear/methods used by fishermen from CGSM. The estimations suggested that having a higher degree of education, sharing household expenses with other family members, and spending more hours fishing, lead to an ecologically sustainable fishing behavior, whereas the perception that the government is responsible for CGSM conservation leads fishermen to exhibit an ecologically unsustainable fishing behavior.

The third paper, *External validity of field economic experiments: a study on cooperation and impatience in an artisanal fishery in Colombia*, examines if fishermen’s contributions to a one-shot public goods experiment together with their decisions in two time preference experiments can predict the level of ecological impact they exert on CGSM’s fishery resources in real life. Therefore, it examines the external validity of these experiments. The results show that fishermen’s contribution 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 field experiments and real life might be associated with factors such as the specific context in which fishermen live, and in which way the cooperation in real life operates.

Acknowledgements

First of all, I would like to thank my supervisors Prof. Dr. Achim Schlüter and Prof. Dr. María Claudia López not only for their guidance, patience, friendship, feedback and their constant and unconditional support during these years but also for the faith that they have had in me from the very beginning. Secondly, I would like to express my special gratitude to Prof. Dr. Thomas Wilke, Prof. Dr. Bernd Werding and Dr. Alexandra Hiller from the Center of Excellence in Marine Sciences (CEMarin) for believing in this project and introducing me in the fascinating world of marine sciences. I am also thankful to all my friends from CEMarin in Santa Marta for their friendship and for sharing with me all their knowledge, I learnt a lot from you. Likewise, I would like to thank Dr. Marion Glasser and Dr. Achim Meyer at Center for Tropical Marine Ecology (ZMT) for agreeing to be part of the PhD Panel and for their valuable feedback at the different stages of this research. A special thanks to Prof. Dr. Karen Smith Stegen at Jacobs University for accepting to join my dissertation committee.

I also would like to express my special gratitude to the researchers and staff from the Institute of Marine and Coastal Research “José Benito Vives de Andrés” (INVEMAR). In particular, I want to thank Efraín Vilorio, Diana Bustos and Myriam Vargas for their valuable support at different stages of my fieldwork. I am greatly indebted to Vladimir Carbonó, the INVEMAR’s field assistant in Tasajera, for his outstanding support and the numerous fishers from the Ciénaga Grande de Santa Marta who unconditionally shared with me their knowledge on the fishery in this lagoon. I also want to take this opportunity to thank all the people who help me in the field, especially to Luz Garda López, Joaquin Revollo, and Maria Eugenia Pertuz in Ciénaga for gave me the opportunity to be part of this wonderful family; to Nelson Velasquez in Tasajera for his valuable support during all my fieldwork, and Yasmiris, Claribeth, Jesús y Valentina also in Tasajera for all your love and care.

Likewise, I would like to thank to my friends and colleagues at ZMT, especially to Esteban and my coworkers from the working group of Institutional and Behavioral Economics. I appreciate so much the financial support provided by CEMarin for doing my PhD, and the generous support from the ZMT for doing all the fieldwork of this research, without their support this research would not have been possible.

I am in debt with my friend Roger Madrigal, whose words, advices and generosity were keys in different moments of this process, which means a lot to me. I will always be grateful with my friend Adriana Rinthá for her friendship, advices, support and cares during these years in Bremen. I am also very thankful with Ullmann family in Bremen for being my second home in Germany. I will never forget how special you have been with me. I will always be grateful to my friends from Bogota for their encouragement for doing this PhD and their support when I need it. Gina thanks for your sincere friendship and unconditional support during all these years.

Last, but not least, I would like to express all my love and deepest gratitude to my family Rosalba, Pedro, Paola, Johana and Bruno, for their love, patience and endless support and encouragement. I dedicate this work to them.

Contents

ABSTRACT	V
ACKNOWLEDGEMENTS.....	VII
I. PREAMBLE	1
1 GENERAL INTRODUCTION	3
1.1 Presentation	3
1.2 Research Problem	6
1.3 Main Goal & Research Questions	10
1.4 Theoretical Background.....	10
1.5 Shortcomings of the Literature and Contributions of this Dissertation	23
1.6 Research Methods.....	25
II. MANUSCRIPTS	27
2 COLLECTIVE ACTION IN A TROPICAL ESTUARINE LAGOON: ADAPTING OSTROM’S SES FRAMEWORK TO CIÉNAGA GRANDE DE SANTA MARTA, COLOMBIA.	29
2.1 Abstract.....	29
2.2 Introduction	30
2.3 The SES framework.....	33
2.4 Methods	36
2.5 Results	38
2.5.1 Social, economic, and political settings (S).....	38
2.5.2 Resource systems (RS).....	44
2.5.3 Resource units (RU)	46
2.5.4 Governance system (GS)	47
2.5.5 Actors (A)	50
2.6 Discussion.....	52
2.7 Conclusion	57
3 UNDERSTANDING ARTISANAL FISHERMEN’S BEHAVIOR: THE CASE OF CIÉNAGA GRANDE DE SANTA MARTA, COLOMBIA.....	60
3.1 Abstract.....	60
3.2 Introduction	61
3.3 Study Site and Overview of the Fishing Practices.....	63
3.4 Methods	66
3.4.1 Survey.....	66
3.4.2 Evaluation of ecological impact of fishing in CGSM.....	67
3.4.3 Construction of individual and composite indicators to evaluate the ecological impact of fishing in CGSM.....	69

3.5	Results and Discussion	71
3.5.1	<i>Fishermen's and experts' views on the fishing spots and fishing gears/methods.....</i>	<i>71</i>
3.5.2	<i>Socioeconomic and perceptual variables affecting fishermen's fishing behavior.....</i>	<i>74</i>
3.5.3	<i>Factors influencing fishermen's fishing behavior.....</i>	<i>77</i>
3.6	Conclusions and Implications for CGSM Management	81
4	EXTERNAL VALIDITY OF FIELD ECONOMIC EXPERIMENTS: A STUDY ON COOPERATION AND IMPATIENCE IN AN ARTISANAL FISHERY IN COLOMBIA.....	85
4.1	Abstract.....	85
4.2	Introduction	86
4.3	Research Setting	89
4.4	Field Data	90
4.5	The Experiments.....	96
4.5.1	<i>Experimental Procedure.....</i>	<i>96</i>
4.5.2	<i>Experimental Design.....</i>	<i>97</i>
4.6	Results and Discussion	100
4.6.1	<i>Predicting Fishermen's Cooperation with the Public Goods Experiment</i>	<i>100</i>
4.6.2	<i>Predicting Fishermen's Cooperation with the Time Preferences Experiments.....</i>	<i>104</i>
4.6.3	<i>Concerning the Results to Other Studies.....</i>	<i>109</i>
4.7	Conclusions	114
III.	CONCLUDING REMARKS	117
5	CONCLUDING REMARKS & OUTLOOK.....	119
5.1	Summary of the Main Research Findings & Conclusions.....	119
5.2	Strengths of this Study.....	122
5.3	Limitations of this Study	124
5.4	Future Research Directions.....	125
IV.	APPENDICES	127
	Appendix A: Open Questions Based on the SES Framework	129
	Appendix B: Interview Guides	141
	Appendix C: Survey Questionnaire	151
	Appendix D: Forms Evaluation Ecological Impact of Fishing.....	163
	Appendix E: Instructions of the Experiments.....	177
	BIBLIOGRAPHY	193

List of Tables

Table 1.1 Second-tier variables of a social-ecological system in the SES framework.....	16
Table 2.1. Second-tier variables of a social-ecological system in the SES framework	35
Table 2.2. Second-to fifth-tier variables used to analyse the SES Ciénaga Grande de Santa Marta.....	36
Table 2.3. Main factors affecting collective action according to the SES diagnostic	53
Table 3.1. Wilcoxon Test for Fishing spots and Fishing gears/methods scores (<i>p</i> -values)	74
Table 3.2. Summary of variables used as explanatory variables to model fishermen's behavior	76
Table 3.3. Determinants of fishermen's fishing behavior (OLS).....	79
Table 4.1. Summary of variables used in the estimations	95
Table 4.2. Payoff table for the two-week time horizon.....	99
Table 4.3. Determinants of fishermen's fishing behavior (OLS) based on experienced fishermen's opinion	107
Table 4.4. Determinants of fishermen's fishing behavior (OLS) based on experts' opinion	108
Table 4.5. Summary of main characteristics of the studies on external validity of CPR.....	110

List of figures

Figure 1.1. Revised social-ecological system (SES) framework with multiple first-tier variables	15
Figure 2.1. Tasajera and Ciénaga Grande de Santa Marta, Colombia.	31
Figure 2.2. Revised social-ecological system (SES) framework with multiple first-tier variables.	34
Figure 2.3. Fishermen’s opinions about responsibility for the changes in and the conservation of Ciénaga Grande de Santa Marta (CGSM)	41
Figure 3.1. Tasajera and Ciénaga Grande de Santa Marta, Colombia.	64
Figure 3.2. Methodology to build individual and composite indicators evaluating fishing ecological impact in CGSM.	70
Figure 3.3. Radar graphs for fishing zones and fishing gears/methods	72
Figure 4.1. Distribution of the fishing impact index.....	93
Figure 4.2. Distribution of contributions in the Public Goods Experiment	101
Figure 4.3. Contribution to the public goods experiment (PGE) and fishing impact indices.....	103
Figure 4.4. Fishermen’s preferences in the experiments	105
Figure 4.5. Impatience and fishing impact indices.	105

I. Preamble



Ciénaga Grande de Santa Marta, Colombia, 2011. Photos: Luz Elba Torres Guevara

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

1 General Introduction

1.1 Presentation

This dissertation aims to contribute to the understanding of the factors that influence collective action for a sustainable exploitation of natural common pool resources (CPRs)¹. In particular, it attempts to contribute to the knowledge about the conditions that promote or hinder the cooperation among artisanal fishermen who exploit CPRs in developing countries.

The literature on collective action and the commons has identified a large number of factors affecting the likelihood that users of common resources develop and sustain institutions² that allow them to use and manage the resources sustainably (e.g. Ostrom 1990, Ostrom, Gardner, and Walker 1994, Baland and Platteau 1996, Wade 1988, Agrawal 2001, NRC 2002, Ostrom 2005, Ostrom and Nagendra 2006). Nevertheless, there still no consensus concerning these factors. In order to contribute to this debate, I analyse the factors that affect collective action for sustainably managing the fishery resources of the Ciénaga Grande de Santa Marta (CGSM), an estuarine lagoon located in the Caribbean Coast of Colombia.

The CGSM is the largest (450km²) and most important coastal lagoon in Colombia. However, since the end of the 1950's, it has been systematically degraded due to several anthropogenic activities (e.g. overfishing, pollution, road development). Given its ecological, economic and social importance, since the mid-1970s the government has developed various management plans. Nevertheless, the poor implementation of these plans, the ineffective management of financial resources, the top-down nature of governance, among other factors, has led to a further deterioration of this ecosystem, which threatens its sustainability over time.

¹ Common pool resources are defined as those resources (natural or man-made) where the subtractability occur and the exclusion through physical and institutional means is difficult and especially costly (Ostrom 1990)

² Institutions are the rules and patterns of behavior used by individuals to organize all forms of repetitive and structured interactions at all scales (Ostrom 2005)

This dissertation presents the results of three studies that analyse the factors affecting cooperation among CGSM's fishermen from different methodological perspectives. In the first study, I use Ostrom's diagnostic Social-Ecological System (SES) framework (2009), which provides information at the community level regarding the factors affecting collective action for sustainable use of the CGSM's fishery resources. Then, in the second study, I analyse individual fishermen's fishing behavior. For that, I use survey data and develop some fishing impact indicators for each fisherman surveyed, which are built using a database of information about their fishing behavior between 2006 and 2010, and an evaluation of the ecological impact of fishing on CGSM, conducted by a group of experienced fishermen and experts. The data about fishermen fishing behavior was got from SIPEIN (INVEMAR's³, Fisheries Information System), a system of data collection and processing of fishing information for the CGSM that INVEMAR has been collecting since 1993.

Finally, in the third study, I use economic experiments to investigate the role of cooperativeness and impatience in the exploitation of CGSM's fishery resources and analyse the external validity of these experiments. For this last study, the diagnosis made to this ecosystem using the SES framework, together with the results of the second study, gave me the background and the necessary data to analyse and understand fishermen's decisions, which are characterized as being context-dependent (Levitt and List 2007, de Oliveira, Croson, and Eckel 2009).

The results of this research are organized in the next three related papers, namely:

- *Collective action in a tropical estuarine lagoon: Adapting Ostrom's SES framework to Ciénaga Grande de Santa Marta, Colombia.*

Authors: Luz Elba Torres Guevara, Achim Schlüter & María Claudia López.

Submitted to: *International Journal of the Commons*

Author's version of the manuscript published in *International Journal of the Commons* (Torres-Guevara, L.E, et al., 2016).

³ The Institute for Marine and Coastal Research - INVEMAR is the institute responsible in Colombia to make basic and applied research on the natural renewable resources and the environment of coastal and oceanic ecosystems.

- *Understanding artisanal fishermen's behavior: the case of Ciénaga Grande de Santa Marta, Colombia*

Authors: Luz Elba Torres Guevara, María Claudia López & Achim Schlüter.

It will be submit to *Sustainability*

- *External validity of field economic experiments: A study on cooperation and impatience in an artisanal fishery in Colombia.*

Authors: Luz Elba Torres Guevara & Achim Schlüter.

Submitted to *Ecological Economics* (Under review)

The present dissertation is organized in three parts. The current **Part I (Preamble)** provides a general introduction to this study. The following paragraphs are organized as follows: Section 1.2 explains the research problem that motivated this study. Section 1.3 presents the main goal and research questions that drive each of the studies. Section 1.4 briefly reviews the theory of collective action and CPRs, Ostrom's SES framework, the literature on fishermen fishing behavior, and experimental research for the study of cooperation in CPRs dilemmas. Section 1.5 presents the main shortcomings of the existing literature and how this dissertation helps to overcome some of them. Section 1.6 describes the different methods used in the data collection and analysis. Section 1.7 presents an outline of the main findings of this research.

Part II (Papers) presents the three research papers that compose this dissertation. The first paper presents the results of the application of the SES framework in the CGSM. The second analyses from two points of views, those of experienced fishermen and experts, the influence of some socioeconomic and perceptual factors on fishermen's fishing behavior, and how that behavior may be impacting the fishery resources. Finally, the third paper, presents the results of the economic experiments (a one-shot public goods and two time preference) ran with CGSM's fishermen. Finally, **Part III (Concluding Remarks)** presents a summary of the research findings, a concluding discussion of these results, and some reflections on the limitations of this research.

1.2 Research Problem

Coastal and marine ecosystems provide a wide range of ecological, economic, and social benefits to humans, especially to the coastal communities who depend on their resources for their survival and well-being. Nevertheless, these ecosystems are being seriously degraded, which threatens the food security of millions of people worldwide. Anthropogenic activities such as population growth, land use change, pollution, overfishing, use of destructive fishing methods, and illegal fishing have been stated as the main drivers of degradation in these ecosystems (UNEP 2006).

Given the importance of artisanal fisheries for both food security and rural poverty reduction (FAO 2007, 2014), it is crucial to reduce the pressures on these ecosystems. One option to achieve this is through collective action, which allows people a joint management to regulate and to properly use the fishery resources. A little more than four decades of empirical research on commons management, starting with Hardin's influential 1968 article in *Science* on the "Tragedy of the Commons", has produced a rich body of literature on the drivers of successful collective action. Thus, nowadays, scholars from different disciplines have identified a large list of possible influencing factors affecting the emergence of collective action (Ostrom 1990, Schlager, Blomquist, and Tang 1994, Schlager 1994, Agrawal 2001). However, this subject is still an ongoing discussion in the literature.

In order to contribute to this literature, I investigate the conditions affecting collective action for the sustainable use and management of the CGSM's fishery resources. The CGSM is located in the center of a bigger region (about 4900 km²) known as the Eco-region Ciénaga Grande de Santa Marta⁴ (Eco-region CGSM), which is one of the largest coastal wetlands in Latin America (UNESCO-MAB 2000). The CGSM has one of the highest rates of primary productivity in the world, as well as a wide diversity of fauna and flora (Gónima, Mancera, and Botero 1996, Gocke et al. 2003). Its artisanal fishery is one of the most important in Colombia with 3.500 fishermen (Blanco, Narváez, and Vilorio 2007), of which on average 950 are active daily in the lagoon

⁴ This Eco-region includes 570 km² of marine area and 730 km² of an estuarine system of coastal lagoons, connecting creeks, and mangrove swamps.

(INVEMAR-SIPEIN 2012). In addition, the CGSM is the main source of food and income for about 25.000 people who live in seven small surrounding villages (SISBEN 2007, 2012). Three of them are stilt villages —Buenavista, Nueva Venecia and Bocas de Aracataca— and the other four —Pueblo Viejo (urban area), Isla del Rosario, Palmira and Tasajera— are located on a highway that connect two important cities in the Caribbean Coast: Ciénaga and Barranquilla.

The ecological and socioeconomic relevance of this lagoon and the whole Eco-region has been recognized nationally and internationally. The Colombian government has established two protected areas in the Eco-region, the first of which began in 1964, by declaring the Salamanca Island —a sand bar that separates the CGSM from the Caribbean Sea— a National Natural Park. Then, in 1977, it established the Fauna and Flora Sanctuary of Ciénaga Grande de Santa Marta⁵. At the international level, the Eco-region CGSM was recognized as a wetland of global importance, and was designated a Ramsar Site⁶ in 1998. Then, in 2000, it was declared a Biosphere Reserve⁷ by the UNESCO's Man and the Biosphere Programme (Vilardy and González 2011).

As a result of these designations, this Eco-region —including the CGSM— is under a special environmental protection regime, which is described in the Management Plan for the Fauna and Flora Sanctuary, and the Management Plan for the Ramsar Site and Biosphere Reserve. Additionally, all of the region's fishing activities and fishery management are regulated by several laws, agreements, resolutions, and decrees.⁸ Although several governmental agencies at national, regional, and local levels are responsible for the management and protection of the CGSM and the whole Eco-region

⁵ In Colombia, a fauna and flora sanctuary is an area dedicated to preserve species or communities of vegetable and wild animals, to conserve genetic resources of the national flora and fauna (Decree 2811 of 1974).

⁶ A Ramsar site is a wetland that has been recognized by The Ramsar Convention, given its international importance for conserving biological diversity and because it contains representative, rare or unique wetland types (<http://www.ramsar.org>).

⁷ A Biosphere Reserve is a site “established by countries and recognized under UNESCO's Man and the Biosphere (MAB) Programme to promote sustainable development based on local community efforts and sound science” (<http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/>)

⁸ The General Fishing Statute (Law 13/1990) and its Regulatory Decree 2256/1991 are the most important. There are also other regulations defined in the General Environmental Law of Colombia. (Law 99/1993) and the Resolution No. 00185/ 1996 of the National Institute of Fishery and Aquaculture, which defined the fishing gears that can be used in the CGSM.

CGSM, de facto it is under an open access regime⁹, where nowadays nobody controls the access to the lagoon or regulates the fishery there

Additionally, since 1956, the CGSM has been harshly degraded by many anthropogenic activities, mainly associated with the economic development of the Colombian Caribbean Region. According to several studies (i.e. Botero and Mancera 1996, Botero and Salzwedel 1999, INVEMAR 2002, Vilardy and González 2011), the following activities are largely responsible for the degradation of this lagoon. First, the construction of a highway between 1956 and 1960 along the Salamanca Island closed the natural connection between the Caribbean Sea and the CGSM and replaced it with a smaller channel¹⁰. Second, the reduction of water flow from the rivers that provide freshwater to the lagoon. Third, the practice of intensive agriculture which has caused contamination, and finally, the use of illegal fishing gears and methods and overfishing.

As a result of all these activities, the CGSM suffered a drastic change in its hydrological balance, which produced a massive mortality of mangrove forest (about 360 km²), the loss of some species of mollusks and fishes, the massive die-offs of large amounts of fish on repeated occasions, and a drastic reduction of fishing productivity. These changes, in turn, considerably affected the quality of life of people who depend on the CGSM's fishery resources (Botero and Mancera 1996, Vilardy and González 2011). Due to the importance of this ecosystem, several scholars have done numerous studies about the CGSM, however, most of them are related to the physical and biological aspects (e.g. population dynamics of fish, crustaceans and mollusks, communities of flora and fauna, and the hydrology of the system). Only few studies have included social issues such as rural development, business promotion, and socioeconomic aspects of the dwellers (Vilardy and González 2011).

⁹ It refers to those CPRs where no property rights that define who can use it and how its uses are regulated (Dietz et al. 2002)

¹⁰ The original channel had 2.000 m wide, and the new channel, called Boca de la Barra, has only 80–100 meters wide (Botero and Mancera 1996, INVEMAR 2002, Aguilera D. 2011).

Since the 1970's, efforts to rehabilitate the CGSM¹¹ have been implemented by several agencies (public, private, national and international). Various strategies, including environmental management plans, civil engineering works, monitoring of the water conditions and fishing activities, reforestation plans, and projects to generate alternative sources of income to the fishermen (Botero and Salzwedel 1999, INVEMAR 2002, Blanco, Vilorio, and Narvaez 2006, Bautista et al. 2010, Vilardy and González 2011) have been tried in the region. However, despite all these efforts, today the CGSM continues to face serious problems, which threaten its long-term sustainability.

Apart from this, during a first explorative fieldwork that I carried out in June 2011, I learned that fishermen were organized in numerous groups (more than 50), which were created to access external aid of the entities that arrived to this zone to develop projects. However, they were not organized to manage the CGSM's fishery. This finding, together with the fact that this lagoon is the main, and often only, source of food and income of many fishermen and their families, and the fact that despite being a protected area, the CGSM operates as a *de facto open access regime*, were the main motivations for doing this research. Taken together, this situation constituted a really interesting puzzle to understand. Furthermore, taking into account that the findings of this research might contribute new insights about the factors affecting both collective action for the management of CPRs, as well as individual fishermen's fishing behavior, garnered my interest in carrying out this study.

Summing all of this, we can conclude that despite a long history of deterioration of the CGSM's resources, no change in behavior has taken place, and furthermore, that a continuous unsustainable use of the resource threatens the livelihoods of the fishermen who depend on the lagoon's fishery.

¹¹ Among the national agencies are: Ministry of Environment and Sustainable Development, the Special Administrative Unit of the Network of National Natural Parks of Colombia, and Corporación Autónoma Regional del Magdalena. Some of the international entities are: the German Technical Cooperation Agency and the United Nations Office on Drugs and Crime.

1.3 Main Goal & Research Questions

With the purpose of figuring out this puzzle, and to understand the relationship between the CGSM's fishermen and this ecosystem, this research aims to investigate the factors that affect the cooperation among CGSM's fishermen, and how these factors have influenced fishermen to overexploit the fishery resources.

The research questions that this research aims to answer are:

- Why has collective action for a sustainable use of the fishery resources of the CGSM not taken place?
- Which socioeconomic and perceptual factors influence fishermen's fishing behavior, and how does their behavior impact the CGSM's fishery resources?
- How do fishermen's cooperative behavior, and their levels of impatience, affect the CGSM's fishery resources?

1.4 Theoretical Background

After my first fieldwork in this zone, I wanted to understand the puzzling situation regarding the CGSM's fishermen, and why they are not organized in exploiting the fishery resources of this lagoon in a sustainable way, particularly since, for many of them, the CGSM is their only source of food and income. In the first study, I attempt to solve this puzzle by using collective action theory. In particular, I focused on the literature on collective action for the management of natural CPRs. In addition, I used the SES framework, which is heavily influenced by collective action theory, to do a diagnosis of this ecosystem. This literature was fundamental for (1) the design of the instruments used for data collection—a survey and three questionnaires to guide the informal and semi-structured interviews—, and (2) to analyse the absence of collective action between CGSM's fishermen for the management of the CGSM fishery. It is important to stress that the survey included specific questions for each one of the studies that compose this dissertation.

Then, based on these findings, for the second study, I focused on understanding the individual fishing behavior of CGSM's fishermen. To achieve this, I used literature related to fishing behavior of artisanal fishermen. Specifically, I used empirical literature regarding studying the factors which influence sustainable or unsustainable fishing behavior. Likewise, I used fishing literature to define some criteria that allowed me to evaluate fishermen's fishing behavior. This literature, together with the previous literature on collective action were essential for (1) the development of questions — relevant for this study— that were included in the survey, (2) the design of three questionnaires that I used to evaluate the ecological impact of fishing on the CGSM, and (3) to examine the factors influencing fishing behavior of the CGSM's fishermen.

Finally, in the third study, I analyse the individual cooperative behavior of fishermen in the management of the fishery resources of the CGSM. To do so, I used literature in experimental economics for the study of CPRs. In particular, I used some empirical literature about public goods and time preference experiments since these experiments are appropriate to analyse the management of shared natural resources. This literature was the basis for the design of the experiments. Likewise, I used empirical literature on the external validity of experiments in CPRs, which, together with the experimental literature, were fundamental for the analysis of the results. In the following paragraphs, I briefly review this literature.

- ***Collective Action & Common Pool Resources Theory***

Collective action refers to “activities that require the coordination of efforts by two or more individuals. As such, collective action involves group actions intended to further the interests or well-being of the members” (Sandler 1992: xvii). It occurs in different settings. Thus, for instance, people can share responsibilities to maintain parks, schools or management CPRs such as fisheries, forests and irrigation systems. Collective action for the management of natural CPRs has been widely studied by scholars of the commons, given their importance for many rural communities worldwide who depend on these resources for their livelihoods and food security (Wade 1988, Ostrom 1990, Baland and Platteau 1996).

According to the literature on collective action, people who share CPRs face social dilemmas or collective action problems. More explicitly, these are, “situations in which each member of a group has a clear and unambiguous incentive to make a choice that –when made by all members– provides poorer outcomes for all than they would have received if none had made the choice.” (Dawes and Messick 2000:111). The collective action problem has been the subject of enormous literature due to its relevance for social life. The reasons that determine the success or the failure of collective action in the management of CPRs have been studied from diverse scientific disciplines such as economics, psychology, game theory, sociology, and political science.

One of the first authors who analysed how to overcome these dilemmas was Mancur Olson (1965). According to this author, the rational self-interest of individuals would not allow people that share natural resources to exploit those resources in a sustainable way, therefore, according to Olson, it is necessary to establish some type of coercion that persuades them to act in the pursuit of common interest. A few years later, Garret Hardin (1968) also predicted the eventual overexploitation and massive degradation of common natural resources. According to him, the “freedom in the commons brings ruin to all” (Hardin 1968:1247). To avoid this situation, (the ‘Tragedy of the Commons’), this author recommended their privatization or the management of those resources by the State.

For many years, these ideas influenced the policies related to the management of natural resources. However, currently, it is well known that these strategies do not always work, and sometimes the results of such strategies have been counterproductive (Ostrom 1990, Gibson, Lehoucq, and Williams 2002, Dietz, Ostrom, and Stern 2003, Poteete and Ostrom 2008). Moreover, many scholars have identified numerous cases where resource users of CPRs have avoided the tragedy by developing institutions which regulate who can access the resource, what can be harvested, who can participate in key decisions, among others, which have allowed them to exploit the resources in a sustainable way over long periods of time (e.g. Ostrom 1990, Schlager, Blomquist, and Tang 1994, Baland and Platteau 1996, Agrawal 2002, Ostrom and Nagendra 2006, Poteete and Ostrom 2008). However, there is also evidence that some communities have failed and

overexploited their natural resources (e.g. Freire and García-Allut 2000, Acheson 2006, Basurto and Ostrom 2009).

According to Ostrom (1990), the rules that some communities have used to successfully manage their CPRs year after year varies largely from one to another. Therefore, it is not possible to make a generalization about these rules. Nevertheless, based on her extensive knowledge about the management of CPRs by local communities, and the analysis of successful cases of collective action that have been studied by several scholars in different settings and places worldwide, she proposed eight *design principles*¹² which characterize robust and long-term institutions for managing CPRs. These principles are: 1) clearly defined boundaries, 2) congruence between appropriation, provision rules, and local conditions, 3) collective-choice arrangements, 4) monitoring, 5) graduated sanctions, 6) conflict-resolution mechanisms, 7) minimal recognition of rights to organize, and 8) nested enterprises for those CPRs that are part of larger systems.

Afterwards, Agrawal (2001) synthesized the most important findings of the extensive empirical work on common property that has been done during the 1980's and 1990's. To do this, he used several studies where scholars had compared large samples of cases. Nevertheless, he focused his analysis on three studies: Wade (1988), Ostrom (1990), and Baland and Platteau (1996), given they had produced theoretical generalizations about the conditions that allow groups to self-organize and manage their common resources successfully. Based on these studies, and other findings that had been reported in a larger set of studies of the commons, he identified 33 conditions that are critical for the sustainability of CPRs, which were grouped in four categories according to 1) *the resource system characteristics* (e.g. size, boundaries, mobility, storage), 2) *the group features* (e.g. size, share norms, social capital, leadership), 3) *the institutional arrangements* (e.g. rules, graduated sanctions, accountability), and 4) *the external environment* (e.g. technology, articulation with external markets, graduated changes, State).

¹² According to Ostrom (1990:90) a design principle is “an essential element or condition that helps to account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of appropriators to the rules in use”.

Based on these factors identified by Agrawal (2001) and several empirical studies on the local governance of CPRs and social-ecological systems (SESs)¹³ that were done after (e.g. Wade 1988, Ostrom 1990, Baland and Platteau 1996, Anderies, Janssen, and Ostrom 2004, Janssen, Anderies, and Ostrom 2007), in 2007, Elinor Ostrom proposed a framework to study the governance of complex SESs. Below, I am going to explain it in more detail, given the importance of this framework for this research.

- ***The Social-Ecological System Framework***

The SES framework is a multitier framework that provides a general list of concepts that permits one to perform a diagnosis of any type of SES. Since its first publication, it has been updated (Ostrom 2009, McGinnis 2010, Ostrom 2011, McGinnis and Ostrom 2014) and enriched through the provision of clear criteria for ordering concepts into tiers, refining the existing concepts, adding new concepts, defining outcome metrics, and representing the dynamics in the framework (Hinkel, Bots, and Schlüter 2014). It also has been used as a guide for model-based analyses of the dynamics of SES (Schlüter et al. 2014) and adapted for analysing environmental governance in a large-scale SES (Cox 2014).

¹³ A social-ecological system is “an ecological system intricately linked with and affected by one or more social systems” (Anderies, Janssen, and Ostrom 2004:3) .

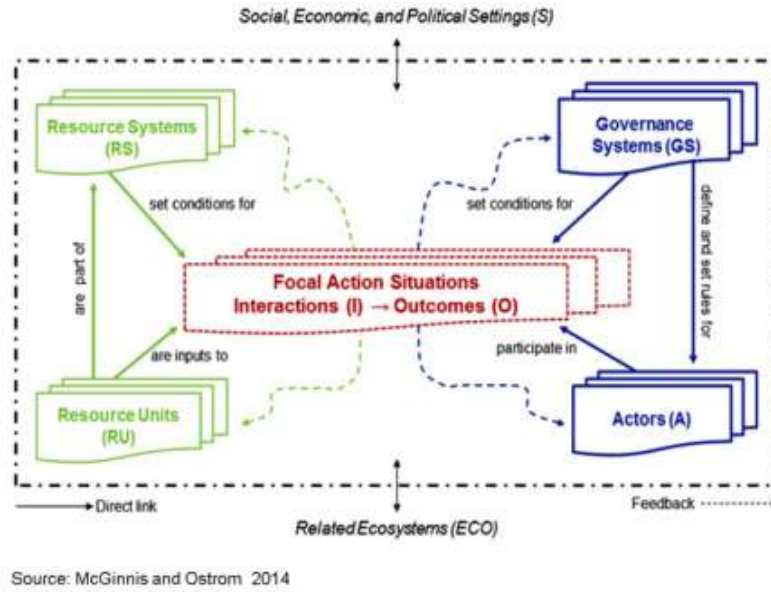


Figure 1.1. Revised social-ecological system (SES) framework with multiple first-tier variables

In its first level (see Figure 1.1), Ostrom's SES framework is composed of eight broad variables, which, according to Ostrom (2007), are the starting point to study a linked SES. Each of these highest-tier variables can be unpacked in new categories, which in turn can be unpacked again into other sub-categories and so on, depending on the SES studied and the aim of the study (see Table 1.1). Besides, other ecological, social, and governance systems can exist, interwoven with the analysed system (McGinnis and Ostrom 2014).

This framework has a special feature, namely, it enables the use of different theories and methods from diverse disciplines to understand the functioning of complex SESs. In addition, as a generic framework, it provides a common frame that can be used to analyse collective action in diverse ecosystems, which allows for comparisons to be made among them. Due to this distinctive feature, it is possible to collect data on a common set of variables that affect these ecosystems, which is essential for making cross-sectional analyses (Poteete and Ostrom 2004), which develops a better understanding about how the characteristics of the resource system can affect collective action, and helps us to comprehend why some resource users are capable of self-organizing and managing the resources sustainably, while others do not (Poteete, Janssen, and Ostrom 2010).

Table 1.1 Second-tier variables of a social-ecological system in the SES framework

SOCIAL, ECONOMIC, AND POLITICAL SETTINGS (S)	
S1 Economic development. S2 Demographic trends. S3 Political stability. S4 Other governance systems. S5 Markets. S6 Media organisations. S7 Technology.	
RESOURCE SYSTEMS (RS)	GOVERNANCE SYSTEMS (GS)
RS1 Sector (e.g. water, forests, pasture, fish)	GS1 Government organisations
RS2 Clarity of system boundaries	GS2 Nongovernment organisations
RS3 Size of resource system	GS3 Network structure
RS4 Human-constructed facilities	GS4 Property-rights systems
RS5 Productivity of system	GS5 Operational-choice rules
RS6 Equilibrium properties	GS6 Collective-choice rules
RS7 Predictability of system dynamics	GS7 Constitutional-choice rules
RS8 Storage characteristics	GS8 Monitoring and sanctioning rules
RS9 Location	
RESOURCE UNITS (RU)	ACTORS (A)
RU1 Resource unit mobility	A1 Number of relevant actors
RU2 Growth or replacement rate	A2 Socioeconomic attributes
RU3 Interaction among resource units	A3 History or past experiences
RU4 Economic value	A4 Location
RU5 Number of units	A5 Leadership/entrepreneurship
RU6 Distinctive characteristics	A6 Norms (trust-reciprocity) /social capital
RU7 Spatial and temporal distribution	A7 Knowledge of SES/mental models
	A8 Importance of resource (dependence)
	A9 Technologies available
INTERACTIONS (I) → OUTCOMES (O)	
I1 Harvesting	O1 Social performance measures (e.g., efficiency, equity, accountability, sustainability)
I2 Information sharing	O2 Ecological performance measures (e.g., overharvested, resilience, biodiversity, sustainability)
I3 Deliberation processes	
I4 Conflicts	O3 Externalities to other SESs
I5 Investment activities	
I6 Lobbying activities	
I7 Self-organizing activities	
I8 Networking activities	
I9 Monitoring activities	
I8 Evaluating activities	
RELATED ECOSYSTEMS (ECO)	
ECO1 Climate patterns. ECO2 Pollution patterns. ECO3 Flows into and out of focal SES.	

Source: McGinnis and Ostrom 2014

The SES framework has been applied in diverse settings such as the forest (Fleischman et al. 2010), pastures (Baur and Binder 2013), water and irrigation systems (Meinzen-Dick 2007, Cox and Ostrom 2010, Madrigal B., Alpízar, and Schlüter 2011, Bal, Ast,

and Bouma 2011, Epstein et al. 2013), marine ecosystems (Madrigal, Schlüter, and Lopez 2013), protected areas (Dumyahn and Pijanowski 2011) and nature-based tourism (Blanco 2011). Particularly, with regard to fisheries, it has been used to analyse cooperation among fishermen to sustainably manage those resources, using different methodological approaches, which range from case studies (Basurto and Ostrom 2009, Basurto, Gelcich, and Ostrom 2013, Aswani et al. 2013, Ernst et al. 2013) to large-scale studies (Gutiérrez, Hilborn, and Defeo 2011, MacNeil and Cinner 2013, Cinner et al. 2012).

- ***Fishing behavior of artisanal fishermen & Sustainable fishing***

How to achieve the sustainability of fisheries¹⁴ is another issue that has interested scholars for several years now. Nowadays, it is widely recognized that to accomplish this goal, it is necessary to take into account the fundamental components of sustainability, namely, the ecological, social, economic and institutional aspects (Charles 1994, Goodland 1994). For sustainable fishing this means “utilizing fishery resources in a manner that ensures long-range benefits through high productivity of the resources while maintaining high diversity of the marine ecological communities, and socioeconomic stability for those who derive their livelihood from these living marine resources” (Ehrhardt 2005:167)

It is also well-known that the conservation and sustainable exploitation of fisheries depends largely on the decisions made by fishermen, which can be influenced by several factors such as weather, seasonal dynamics, abundance, management regulations, available technology, and the socio-economic conditions in which they live (Béné and Tewfik 2001b, Wilen et al. 2002, Salas and Gaertner 2004). In the case of artisanal fisheries, the next factors have been identified by numerous scholars, policy makers, and stakeholders worldwide as the main drivers that contribute to the overexploitation and unsustainable use of fishery resources: poor governance, failure of entities and policies, use of inappropriate incentives that promote unsustainable

¹⁴ It refers to the “management of present day fisheries such that future generations may profit from these resources in the same manner we profit today. (Ehrhardt 2005:167)

practices, strong demand for limited resources, poverty, a lack of alternative employment, and the complexity and lack of data (Bodiguel, Gréboval, and Maguire 2009).

In the literature on artisanal fisheries there are varied studies that analyse fishermen's behavior from different perspectives. Some studies have analysed the influence of socioeconomic factors on the status of coastal and marine ecosystems. Cassels, Curran, and Kramer (2005) examined the impact of migration on the status of coral reefs in North Sulawesi, Indonesia by comparing fishing behavior between migrant and non-migrant families. They found that it is more likely that migrants live in villages with poorer environmental quality. Nevertheless, when these families are integrated into the new communities through intermarriage between a migrant and a non-migrant, or they gain kinship and social ties, they exhibit a similar behavior as compared to non-migrants with respect to the extraction of fishery resources. Cinner and McClanahan (2006) examined the influence of some socioeconomic factors on the conditions of artisanal multi-species coral reef fisheries in six sites in Papua New Guinea. They found that distance to fish markets, fishing pressure, and the size of the fishing grounds seems to affect the conditions of fish catch (e.g. length of the fish)

Other studies have identified the biological, socioeconomic, and physical factors (e.g., diving skills) defining fishermen's strategies. Salas (2000) investigated the fishing strategies of three small-scale fisheries with similar regulations and environmental conditions in Yucatán (Mexico). She found that fishermen develop different fishing strategies based on results of the previous trip, the weather conditions, the boat size and motor power, and fishermen's experience and age, which in turn produce differences in terms of revenues. Salas, Sumaila, and Pitcher (2004) developed a model to study the factors affecting daily fishermen's decisions about selecting target species in three small-scale fishing communities of Yucatán (Mexico). They established that fishermen take into account information on resource availability and previous revenues to select or shift target species.

Others researchers have explored the factors affecting the fishermen's fishing effort¹⁵ and the selection of fishing sites. Béné and Tewfik (2001a) examined the biological, economic, and social conditions that influenced the fishing effort allocation between two target stocks among artisanal fishermen from the Turks and Caicos Islands (British West Indies). They found that fishermen's decisions are influenced by several aspects, such as seasonal dynamics, fishermen's skills and diving abilities, and higher labor intensity. Guest (2003) studied the factors affecting the fishing effort of artisanal shrimpers who exploit a resource under an open access regime in Ecuador. He established that fishermen's behavior is influenced for both economic (e.g., profits or prices) and noneconomic factors (e.g., the custom of not fishing on Sunday, or the presence of pirates).

Abernethy et al. (2007) used the theory of the ideal free distribution¹⁶ to investigate the factors that influence decisions of artisanal fishermen from Anguilla (British West Indies) regarding the selection of fishing sites. They found that contrary to the predictions of this theory, fishermen did not distribute themselves based on the resource abundance; they got different profits per unit effort¹⁷, and the lack of knowledge about the resources prevented fishermen from choosing other fishing sites with higher rewards. Furthermore, fishermen's socioeconomic and physical characteristics not only prevented them from changing the fishing method, but also enabled some fishermen to have a better performance than others, despite using the same fishing method.

Some scholars have also studied the relationship between some fishermen's socioeconomic characteristics and the use of destructive fishing gears. Silva (2006) studied the relationship between household characteristics, marine protected area (MPA) activities, and household choice of destructive fishing gears in six MPA sites of

¹⁵ "It represents the amount of fishing gears of a specific type used on the fishing grounds over a given unit of time e.g., hours trawled per day, number of hooks set per day, or number of hauls of a beach seine per day." (FAO 1997:70)

¹⁶ According to this theory "fishers have 'ideal' knowledge of the distribution of their target species and are 'free' to move between fishing grounds without constraint over their movement, or their ability to extract resources. As a result, [the theory predicts that] ...fishers will distribute themselves so that the average reward, or catch, should be equal for all fishers, and fishing pressure should increase with resource availability" (Abernethy et al. 2007:1596)

¹⁷ It refers to the catch value per unit weight (kg) minus the total cost of the trip, divided by the total time (including time spent fishing, collecting bait, and preparing the gear).

Tanzania. She found that households with higher levels of male education and higher asset wealth are less likely to use destructive fishing gears. She also found that MPA activities are not related to choice of fishing gears. Cinner (2010) studied the relationship between the use of destructive fishing gears and thirteen socioeconomic factors in three peri-urban marine protected areas in East Africa. He found that fishermen characterized by having lower expenses, being younger, and with a lower likelihood to own capital in the fishery, are more likely to use destructive fishing gears.

Other researchers have analysed the influence of socioeconomic factors on the way in which artisanal fishermen perceive their coastal environment, and how they use fishery resources. Cinner and Pollnac (2004) analyzed the impact of wealth, age, migration status, and education on people's perceptions of coastal resources, in a small fishing village in Mexico. They established that perceptions of natural resources are different among members of fishing communities, depending on their socioeconomic status. Thus, poorer people associated the crisis in the fishery to fishing activities, while wealthier ones related it to practices such as tourism, shipping activities, or conservation interventions.

There are other studies that have used hypothetical scenarios of declining catches to examine fishermen's readiness to stop fishing. Cinner, Daw, and McClanahan (2008) examined both the willingness to stop fishing, and the influence of some socioeconomic conditions on the decisions of a group of artisanal fishermen from Kenya. They found that in case of a severe decline in fishery resources, the poorest households would be less likely to stop fishing. Likewise, they found that some factors such as age, health, changes in fishing regulations, and the loss of opportunities in previous jobs can lead fishermen out of the fishery. Daw et al. (2012) studied how socioeconomic factors at individual, household, and site-scale affected the fishermen's readiness to stop fishing in five western Indian Ocean countries. They found that at site-level, the readiness to exit was less in places with higher levels of socioeconomic development, which seemed to be associated to diverse factors such as market access or government subsidies. At the household and individual level, their findings showed that when the family has more

livelihood activities, and their catches have lower values, they are more willing to stop fishing.

In sum, the literature shows that fishermen's fishing behavior may be influenced by several factors. Thus, some of them are related to biological and environmental aspects, others are associated more to the particular traits of fishermen and their socioeconomic characteristics and yet others are related to the particular governance system the fishermen are operating in.

- ***Experimental Economics & Common Pool Resources***

Experiments are another important tool used to understand how to foster collective action, and the institutional conditions for increasing collective action, and efforts to engage a more sustainable use of resources (Ostrom, Gardner, and Walker 1994, Poteete, Janssen, and Ostrom 2010). They have been used widely within CPRs research because they allow the researchers to create specific conditions to study a theoretical situation, thus avoiding other variables that would affect their analysis (Ostrom 2006). More specifically, the researcher can “(1) control the number of participants, (2) the positions they may hold, (3) the specific actions they can take, (4) the outcomes they can affect, (5) how actions are linked to outcomes, (6) the information they obtain, and (7) the potential payoffs” (Ostrom, Gardner, and Walker 1994:99).

The Public Goods Game, in particular, is a well-known research tool for studying collective action problems (see Ledyard 1995, Sally 1995, Chaudhuri 2011, for a survey) given it simulates the dilemma that users of common resources face between the individual benefits and the collective welfare. Besides, according to Bardhan, Bowles, and Gintis (1999), contributing to a public good is analytically equivalent to individuals restraining the use of the resources from a common pool resource.

Traditional game theory predicts that no matter what the others do, people will try to free-ride on other group members. Nevertheless, there is a large body of experimental literature that shows that this prediction is not always certain, and in many cases, people contribute to sustain public goods or CPRs (see e.g. Ostrom, Walker, and Gardner 1992,

Andreoni 1995, Ledyard 1995, Cárdenas 2000, Chaudhuri 2011, Cárdenas 2011). In fact, several studies have found that subjects contribute an average of 40 to 60 percent of their endowment to a public good, either in one-shot experiments or with repetition (Ledyard 1995, Dawes and Thaler 1988, Isaac and Walker 1988, Ostrom 2000). With that in mind, and taking into account that the CGSM is a CPR with free access where fishermen face a social dilemma (CPR problem) every day, I used a one-shot standard public goods experiment to investigate the cooperative behavior of the CGSM's fishermen for sustaining fishery resources of CGSM.

Time preference experiments are also used to analyse people's behavior to sustain CPRs. These experiments allow measuring subjects' inter-temporal choices. This refers to, "decisions involving tradeoffs among costs and benefits occurring at different times" (Frederick, Loewenstein, and O'Donoghue 2002:351). One way to get the people's time preference (i.e. their preference for immediate utility over delayed utility) is through their discount rates, given that they allow measuring people's willingness to trade present benefits for potentially larger gains in the future (Frederick, Loewenstein, and O'Donoghue 2002). In the fisheries context, fishermen's discount rates are associated with the level of exploitation that they exert on the resources. Thus, fishermen with higher discount rates overexploit the resource, while fishermen with low discount rates exploit it sustainably (Clark 1973, Sumaila and Walters 2005, Sumaila 2004). Taking this into account, and my particular interest in investigating the factors affecting cooperation among fishermen that sustain the CGSM's fishery resources, I ran two time preference experiments.

In recent years, some scholars began to study the external validity (i.e., relate subject's behavior in the experiments with their actions in real life) of these experiments, since, only if external validity is given, can we draw conclusions for resource governance in real life (Levitt and List 2007, Ostrom 2006). Nevertheless, in the literature on experimental economics, there are still very few studies about external validity of experiments on cooperation in common resources management. Some of them have found evidence of external validity (Rustagi, Engel, and Kosfeld 2010, Carpenter and Seki 2011, Fehr and Leibbrandt 2011, Gelcich et al. 2013) whereas other studies did not

(Gurven and Winking 2008, Hill and Gurven 2004). Thus, taking into account the importance of this issue, and taking advantage of the fact that I had data to analyse the external validity of my experiments, I made a comprehensive comparative analysis between my results and the findings from the other studies on external validity.

1.5 Shortcomings of the Literature and Contributions of this Dissertation

Thanks to the extensive research on collective action for the local governance of CPRs that has been developed in the last three decades (Wade 1988, Ostrom 1990, Ostrom, Gardner, and Walker 1994, Baland and Platteau 1996, Agrawal 2001, NRC 2002, Poteete, Janssen, and Ostrom 2010), we have gained a greater understanding about the conditions that facilitate or hinder collective action among CPRs resource users. However, there is still a considerable debate about this subject. The SES framework is the most relevant tool developed for studying the governance of CPRs, given that it allows understanding and analysing the interactions and outcomes of linked SES, which is crucial to achieve a sustainable use of the resources. Nevertheless, it is still in process to be adapted and applied to different contexts (McGinnis and Ostrom 2014). The first paper of this dissertation, *Collective action in a tropical estuarine lagoon: Adapting Ostrom's SES framework to Ciénaga Grande de Santa Marta, Colombia* contributes to this literature on collective action for managing CPRs and social-ecological systems in three different ways, namely:

- a) Theoretically, it provides new information about the factors affecting collective action between CPRs' resource users, based on a sound understanding of a particular case study.
- b) Methodologically, it contributes to the improvement of the SES framework by adapting the framework to the study of coastal artisanal fisheries in developing countries, and developing new variables within the social, economic, and political settings.
- c) In formulating a diagnosis of the collective action problems in the CGSM, using the Social-Ecological System Framework.

The factors influencing the fishing behavior of artisanal fishermen have been studied from different perspectives. Thus, examples from the literature demonstrate the influence of socioeconomic factors on (1) the quality of coastal and marine ecosystems (Cassels, Curran, and Kramer 2005, Cinner and McClanahan 2006), (2) the fishing strategies developed by fishermen (Guest 2003, Béné and Tewfik 2001a, Abernethy et al. 2007, Salas 2000, Salas, Sumaila, and Pitcher 2004), or (3) the use of destructive fishing gears (Silva 2006, Cinner 2010). However, there are no studies that have examined the fishing decisions of artisanal fishermen, and the impacts of such decisions on the ecological sustainability of fishery resources by comparing experienced fishermen's and experts' points of views regarding the fishing spots visited and the fishing gears and methods used by fishermen. So, the second paper, *Understanding artisanal fishermen's behavior: the case of the Ciénaga Grande de Santa Marta, Colombia*, contributes to this literature in two ways:

- a) Theoretically, it contributes to the on-going debate regarding the factors affecting fishing decisions of artisanal fishermen in developing countries and to what extent they behave in an environmentally sustainable or unsustainable way.
- b) It provides new information about the reasons behind the fishing decisions of CGSM's fishermen, which will be useful for the entities responsible for the conservation of the CGSM.

The experimental analysis of cooperation between users of CPRs has been widely studied for several decades. Therefore, there is a huge body of literature that analyses the factors affecting people's decisions. Nevertheless, the studies about the external validity of experiments on cooperation in common resources management are scarce. The third paper of this dissertation, *External validity of field economic experiments: a study on cooperation and impatience in an artisanal fishery in Colombia*, contributes to this literature in two ways:

- a) It provides new evidence to the experimental analysis on factors influencing cooperation between people who share natural CPRs, by examining individual behavior of the CGSM's fishermen.

- b) It contributes to the emerging body of empirical literature on the external validity of CPRs experiments.

1.6 Research Methods

In this research I have used diverse methodological approaches according to the research question, which guide each of the studies that compose this dissertation. So, I combined qualitative and quantitative methods, which according to Ostrom (2006) allows scholars to learn more about a specific issue than a single method is used.

To investigate why collective action in the management of the CGSM's fishery has not taken place (Paper 1), I used the case study as a research strategy. This approach, used widely to study collective action in the commons, allows making a close examination of the variables under study, therefore it is possible not only to identify and unravel the relationship between these variables, but also to trace the causal processes behind them, which supports theory development and conceptual refinements (Poteete, Janssen, and Ostrom 2010). To answer the above research question, I adapted and implemented Ostrom's diagnostic Social-Ecological System (SES) framework (2009) to this coastal ecosystem. In particular, I developed new variables within the social, economic, and political settings of the SES framework. The information for this research was collected mainly through several formal and informal interviews that I conducted with fishermen, community leaders, key informants and experts (scientists) with strong knowledge about the fishery in the CGSM. Likewise, I conducted a survey with 172 of the CGSM's fishermen.

Then, to analyse the relationship between the socioeconomic and perceptual factors of the CGSM's fishermen and the impact that they cause on the fishery resources of this lagoon (Paper 2), I used econometric estimations. To achieve this, I first evaluated, with the help of a group of experienced fishermen, and a group of experts who have extensive knowledge regarding different issues related to the fishery in this lagoon, the ecological impact of fishing on the CGSM. Then, with this evaluation, and a database that contained individual information (from 2006 to 2010) on the fishing behavior of the same fishermen that I had surveyed, I developed some indicators evaluating fishermen's

fishing behavior for each of them, based on fishing spots visited and fishing gears/methods used by them. Finally, I used Ordinary Least Square regressions to predict the factors that lead the CGSM's fishermen to exhibit an ecologically sustainable or unsustainable fishing behavior.

Finally, I used field experiments to investigate how fishermen's cooperative behavior and impatience are affecting the CGSM's fishery resources (Paper 3). This method, based on game theory, allows testing different economic theories through the hypothesis modeling, and in a controlled setting. For this study, I ran a one-shot public goods experiment and, two time preference experiments with the same fishermen that had been surveyed. Then, I used Ordinary Least Square regressions to analyse the relationship between the fishing impact indicators developed previously and 1) individual contributions in the public good and 2) individual decisions in the time preference experiments

II. Manuscripts



Ciénaga Grande de Santa Marta, Colombia, 2011. Photos: Luz Elba Torres Guevara

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

2 Collective action in a tropical estuarine lagoon: adapting Ostrom's SES framework to Ciénaga Grande de Santa Marta, Colombia.

Authors: Luz Elba Torres Guevara, Achim Schlüter & María Claudia López

2.1 Abstract

This paper contributes to the social-ecological systems literature by adapting and implementing Elinor Ostrom's Social-Ecological System (SES) framework in the context of Ciénaga Grande de Santa Marta (CGSM), an estuarine lagoon on the Caribbean coast of Colombia. The ecological importance of CGSM and its species is undeniable. This paper aims to understand why collective action for sustainable use of CGSM's fishery resources has not taken place. In order to respond to that question, we particularly focused on variables within the social, economic, and political settings of the SES framework and created new variables in the subsequent tiers that are pertinent for this case study. The results show that the fishermen's fear of the indiscriminate and strong violence that illegal, armed groups have inflicted on them since the 1960s, the economic development in the Colombian Caribbean region, and the socioeconomic condition of its inhabitants help explain the lack of collective action.

Key words

Social-Ecological Systems (SES) framework, Common-pool resources, Collective action, Ciénaga Grande de Santa Marta, Conflict, Fisheries, Colombia.

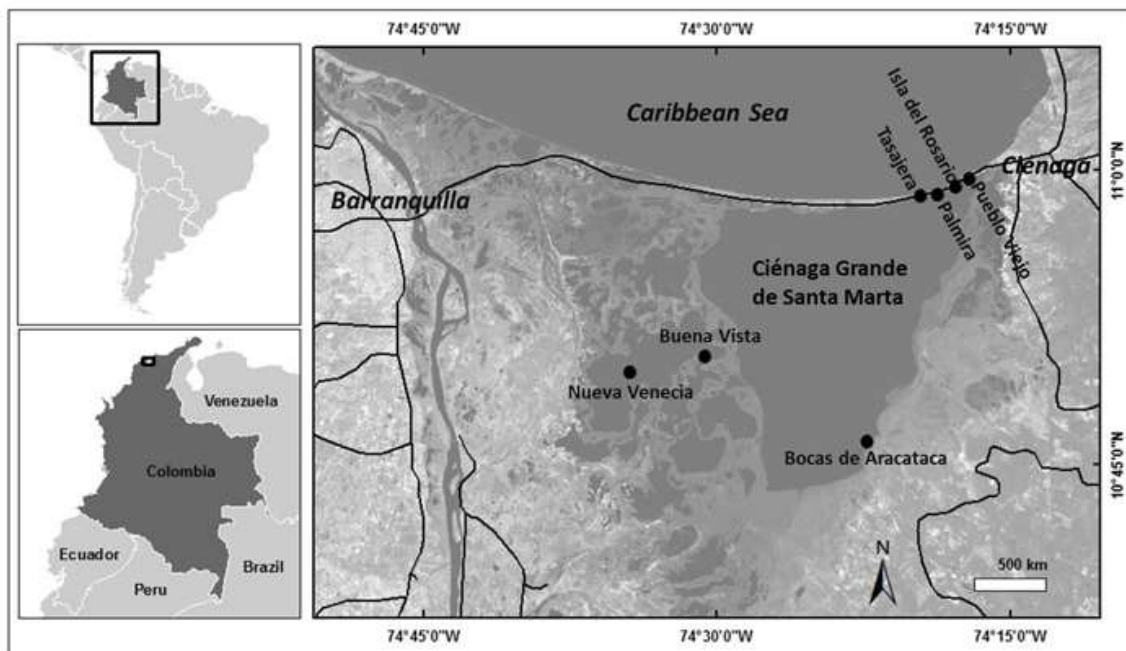
2.2 Introduction

Artisanal fishing is the main source of livelihood for millions of households in coastal areas of developing countries and plays a crucial role in food security and poverty alleviation (FAO and World Fish Center 2008). Thus, successful governance of fisheries is critical for millions of inhabitants around the world. Scholars of the commons have studied the management of common-pool resources (CPRs), including fisheries (Wade 1988, Ostrom 1990, Ostrom, Gardner, and Walker 1994, Baland and Platteau 1996, Agrawal 2001, Ostrom and Nagendra 2006), showing that solutions that work in one scenario may fail in another context. Some studies have reported cases of communities that have succeeded in managing their fisheries (Ostrom 1990, Schlager 1994, Ostrom et al. 1999, Basurto, Gelcich, and Ostrom 2013, Orensanz et al. 2013), while other studies have reported cases in which communities have failed to do so (Hilborn, Orensanz, and Parma 2005, Medina, Guzman, and Mair 2007, Basurto, Gelcich, and Ostrom 2013, Orensanz et al. 2013).

A fishery is a resource system that is composed of resource units that are mobile, thus they lack storage capacity and therefore represent a bigger challenge to management than other types of resources (Schlager, Blomquist, and Tang 1994). However, in the fisheries management literature, it is possible to identify some key factors that influence a sustainable management of these systems, such as a high dependence on the resource, the presence of property rights, the possibility for communities to develop their own rules to govern access to and use of the fishing grounds, moderate or high levels of trust and reciprocity, local leadership, and local ecological knowledge of the resource (Ostrom 1990, Schlager, Blomquist, and Tang 1994, Basurto, Gelcich, and Ostrom 2013, Frey and Rusch 2013, Orensanz et al. 2013). However, other factors such as open-access regimes, big fisheries, large groups of users with severe heterogeneity of interests, the lack of rules or norms to manage the resource, and top-down management are stated as responsible for institutional and ecological failure of a system (Ostrom 1990, Schlager, Blomquist, and Tang 1994, Acheson 2006, Basurto, Gelcich, and Ostrom 2013). Additionally, when the fishery is very large, it is difficult to control its

use, and therefore the costs of defining and monitoring its boundaries can be very high (Poteete, Janssen, and Ostrom 2010).

This paper examines Ciénaga Grande de Santa Marta (CGSM), an estuarine lagoon located in the Caribbean coast of Colombia (see Figure 2.1). CGSM is located in the center of a bigger region (about 4900 km²) known as Eco-region Ciénaga Grande de Santa Marta¹⁸ (Eco-region CGSM); it is separated from the Caribbean Sea by a 212 km² sand bar called Salamanca Island, declared as a Natural National Park in 1964 (Leal-Flórez 2007, Vilardy and González 2011). The Magdalena River and the rivers originating in the mountain system Sierra Nevada de Santa Marta (SNSM) are responsible for providing the fresh water necessary to maintain CGSM's hydrological regime and fishing productivity (Leal-Flórez 2007, Vilardy and González 2011).



Source: Map produced by Dr. Guiying Le. Center for Global Change and Earth Observations. Michigan State University.

Figure 2.1. Tasajera and Ciénaga Grande de Santa Marta, Colombia.

¹⁸ This eco-region includes 570 km² of marine area and 730 km² of an estuarine system of coastal lagoons, connecting creeks, and mangrove swamps.

This estuarine lagoon is important due to its large size (450 km²), its wide diversity of fauna and flora, and because it has one of the highest rates of primary productivity in the world (Gónima, Mancera, and Botero 1996, Gocke et al. 2003). CGSM is the main source of both food and income for about 25.000 people who live in seven small surrounding villages: four located on the highway that connects Ciénaga and Barranquilla—Isla del Rosario, Palmira, Tasajera, and Pueblo Viejo (urban area)—with approximately 22.000 inhabitants (SISBEN 2012) and three stilt villages located within CGSM—Nueva Venecia, Buena Vista, and Bocas de Aracataca—with a population of about 2.400 (SISBEN 2007, 2012).

Given the social and ecological importance of CGSM, it was declared a Fauna and Flora Sanctuary in 1977, a Ramsar Site in 1998, and a UNESCO Biosphere Reserve in 2000. Due to all these designations, CGSM is under a special environmental protection regime described in the Management Plan for the Fauna and Flora Sanctuary and the Management Plan for the Ramsar Site and Biosphere Reserve. In addition, it is regulated by several agreements, resolutions, and decrees existing in Colombia for the exploitation and management of fishery resources. Despite this, no State entity or organisation currently regulates, for instance, who can fish in the lagoon, which fishing gear and methods can be used, or where fishermen can or cannot fish. So, although de jure the protection of CGSM and the whole Eco-region CGSM resides in several government designations, de facto it is under an open access regime where property rights have not been allocated.

The ecological importance of CGSM and its species is undeniable. This paper aims to understand why collective action for a sustainable use of CGSM's fishery resources has not taken place. In order to answer this question, we used an updated version of Ostrom's diagnostic Social-Ecological System (SES) framework (2009). Due to the characteristics and context of this particular ecosystem, we found it necessary to stress the importance of the social, economic, and political settings (the S variables in the SES framework; see Figure 2.2). In order to accomplish that, we subdivided the economic development (S1), the demographic trends (S2), and the political stability (S3) into new variables to better answer the question motivating this study. The inclusion of these new

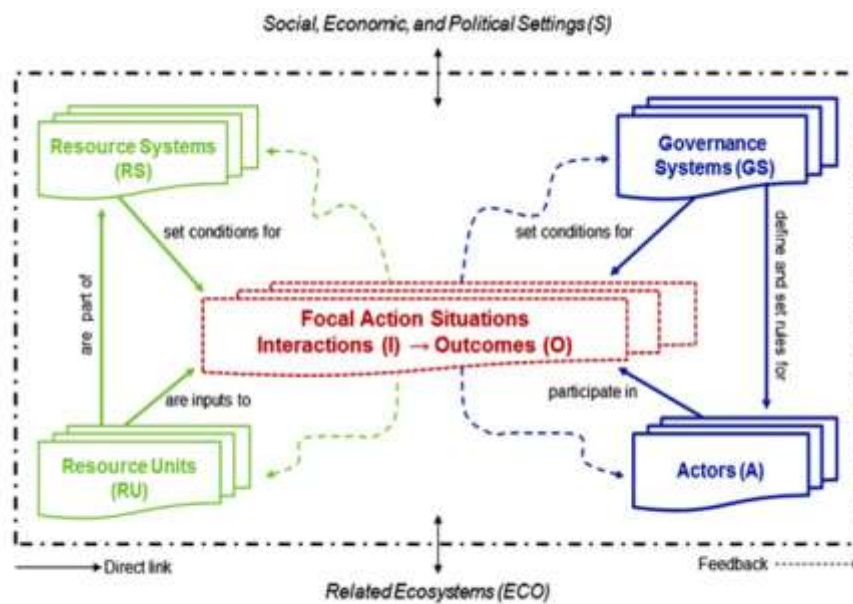
variables is an important contribution to the application of the SES framework, because it shows how the system itself can not be explained comprehensively without taking into consideration the context (geographic, social, economic, political) in which the system is embedded.

The paper is structured as follows: First, we introduce the SES framework and the variables that were added for this particular case. Second, we describe the methods applied. Third, we present the results of the application of the SES framework. Fourth, we provide a discussion of the results. The last section contains our conclusion.

2.3 The SES framework

The SES framework is generic and provides a common frame that can be used to study different characteristics of a social-ecological system, which permits not only making comparisons among them but also the study of a system over time. Since its first publication (Ostrom 2007), the SES framework has been updated (Ostrom 2009, McGinnis 2010, Ostrom 2011, McGinnis and Ostrom 2014), and enhanced through the provision of clear criteria for ordering concepts into tiers, refining the existing concepts, adding new concepts, defining outcome metrics, and representing the dynamics in the framework (Hinkel, Bots, and Schlüter 2014). It also has been used as a guide for model-based analyses of the dynamics of SESs (Schlüter et al. 2014) and adapted for analysing environmental governance in large-scale SESs (Cox 2014). The SES framework has been applied to diverse settings (see e.g. Meinzen-Dick 2007, Cox and Ostrom 2010, Fleischman et al. 2010, Baur and Binder 2013, Madrigal, Schlüter, and Lopez 2013). Particularly, with regard to fisheries, it has been instrumental in the analysis of sustainability and cooperation among fishermen, using different methodological approaches which range from case studies (Basurto and Ostrom 2009, Aswani et al. 2013, Ernst et al. 2013) to large-scale studies (Gutiérrez, Hilborn, and Defeo 2011, Cinner et al. 2012, MacNeil and Cinner 2013).

According to Ostrom (2007), the starting point to study a linked SES is to develop a conceptual map that captures the highest-tier variables proposed in the SES framework (see Figure 2.2). On this level, the framework is composed of the resource system, the resource units generated by that system, the governance system, the actors in that system, and the focal action situations—interactions and outcomes. These components affect and are affected by the particular social, economic, and political settings and by characteristics of other related ecosystems. Furthermore, other ecological, social, and governance systems can exist interwoven with the system analysed (McGinnis and Ostrom 2014). On the second-highest tier, the SES framework divides these categories into new sub-categories (see Table 2.1), which in turn can be subdivided again into other sub-categories and so on, depending on the social-ecological system being studied and the goal of the research.



Source: McGinnis and Ostrom 2014

Figure 2.2. Revised social-ecological system (SES) framework with multiple first-tier variables.

Table 2.1. Second-tier variables of a social-ecological system in the SES framework

SOCIAL, ECONOMIC, AND POLITICAL SETTINGS (S)			
S1 Economic development*. S2 Demographic trends*. S3 Political stability*. S4 Other governance systems. S5 Markets. S6 Media organisations. S7 Technology.			
RESOURCE SYSTEMS (RS)		GOVERNANCE SYSTEMS (GS)	
RS1	Sector (e.g. water, forests, pasture, fish)	GS1	Government organisations*
RS2	Clarity of system boundaries*	GS2	Non-government organisations*
RS3	Size of resource system*	GS3	Network structure
RS4	Human-constructed facilities	GS4	Property-rights systems
RS5	Productivity of system*	GS5	Operational-choice rules
RS6	Equilibrium properties	GS6	Collective-choice rules*
RS7	Predictability of system dynamics*	GS7	Constitutional-choice rules
RS8	Storage characteristics	GS8	Monitoring and sanctioning rules*
RS9	Location		
RESOURCE UNITS (RU)		ACTORS (A)	
RU1	Resource unit mobility*	A1	Number of relevant actors
RU2	Growth or replacement rate	A2	Socioeconomic attributes
RU3	Interaction among resource units	A3	History or past experiences
RU4	Economic value	A4	Location
RU5	Number of units	A5	Leadership/entrepreneurship*
RU6	Distinctive characteristics	A6	Norms (trust-reciprocity) /social capital*
RU7	Spatial and temporal distribution*	A7	Knowledge of SES/mental models*
		A8	Importance of resource (dependence)*
		A9	Technologies available
INTERACTIONS (I) → OUTCOMES (O)			
I1	Harvesting	O1	Social performance measures
I2	Information sharing		(e.g., efficiency, equity, accountability, sustainability)
I3	Deliberation processes	O2	Ecological performance measures
I4	Conflicts*		(e.g., overharvested, resilience, biodiversity, sustainability)
I5	Investment activities	O3	Externalities to other SESs
I6	Lobbying activities		
I7	Self-organizing activities		
I8	Networking activities		
I9	Monitoring activities		
I8	Evaluating activities		
RELATED ECOSYSTEMS (ECO)			
ECO1 Climate patterns. ECO2 Pollution patterns. ECO3 Flows into and out of focal SES.			

*Subset of variables found to be associated with the lack of self-organisation in the SES Ciénaga Grande de Santa Marta. Source: McGinnis and Ostrom 2014

In order to analyse the CGSM fishery through the SES framework, we had to further investigate the social, economic, and political settings (S), a set of variables that has not been widely developed in other applications of the SES framework. In our particular

case, the study of these settings is crucial to determine the context of our SES, and to explain why collective action has not emerged in this system. These second-tier variables are outside the core of the variables analyzed in the SES (see Figure 2.2). Particularly, we subdivided economic development (S1), demographic trends (S2), and political stability (S3) into third-, fourth-, and fifth-tier variables (see Table 2.2). This, helps to explain how all these aspects have shaped the governance of the CGSM fishery, because external factors such as the Colombian conflict or the economic development of the region have affected people's capacity to organise and to trust each other. In the following sections, we will explain in detail each of the variables.¹⁹

Table 2.2. Second-to fifth-tier variables used to analyse the SES Ciénaga Grande de Santa Marta

SOCIAL, ECONOMIC, AND POLITICAL SETTINGS (S)	
S1 – Economic development	
S1.1	Road development
S1.2	Farming and livestock development
S1.3	Agro-industrial development
S2 – Demographic trends	
S2.1	Forced displacement of civilians
S3 – Political stability	
S3.1	Internal armed conflict
S3.1.1	Military and police forces
S3.1.2	Illegal armed groups
S3.1.2.1	Guerrillas
S3.1.2.2	Paramilitaries
S3.1.2.3	Emerging Criminal Bands (BACRIM)
S3.2	Common crime
S3.3	Drug trafficking
S3.4	Political violence
S3.5	Corruption

2.4 Methods

The three authors visited CGSM and in particular Tasajera in June 2011. During this visit we organized a small workshop with fishermen to inquire about social, economic and ecological problems affecting CGSM. This information collected together with an exhaustive literature review focusing on the region allowed us to have a first

¹⁹ It is important to note that although we used all the variables of the SES framework to study the fishery, in this paper we will focus only on the variables that helped us answer our research question.

approximation of the fishery's and inhabitants' problems. With that information and the second-tier variables of the SES framework (Ostrom 2009), we elaborated 250 open questions (see appendix A), which were answered mainly through informal interviews conducted in August 2011 by the first author. In total, she conducted 75 interviews: 70 fishermen, 3 community leaders, and 2 key informants (locals other than fishermen with a very good knowledge about CGSM's history).

Fishermen were contacted initially at the Mercadito, the main market for fish in this area. In that first interaction she introduced herself and our research. If they were available she interviewed them there; otherwise she scheduled a convenient time for the interview in their homes. Some questions were answered by many interviewees and others by only a few until saturation was reached. In the case of the fishermen from the stilt villages, she interviewed some of them in the Mercadito and visited their communities to conduct focus groups based on the questions we had identified as essential for that particular group. The community leaders and key informants were identified with the help of fishermen and researchers who had worked previously in the area. Those interviews gave us a better understanding of CGSM, its problems and history, and enabled us to refine questions for our diagnosis.

To explain the lack of governance in CGSM and its consequences, we elaborated a new set of questions that resulted in two questionnaires (see appendix B); the first contained 110 questions and was answered by fishermen, community leaders, and key informants (interviewees responded to only some questions, according to their knowledge about CGSM), and the second one had 40 questions and was answered by experts in different themes related to CGSM (e.g. population dynamics, fishing gear, and fishing practices). These experts were identified with the help of researchers at the Institute for Marine and Coastal Research (INVEMAR) working in the region,²⁰ and then through snowball sampling. The first author conducted the semi-structured interviews between November and December 2012 with 45 fishermen, 3 community leaders, 7 key informants, and 15 experts. This new information allowed us to do a more detailed analysis, focusing our

²⁰ INVEMAR is an entity of mixed character (i.e. public and private). It is responsible in Colombia for doing basic and applied research on the natural renewable resources and the environment of coastal and oceanic ecosystems.

attention upon those aspects that we had already identified as relevant to explain the lack of governance in the SES.

For aspects of the diagnostic framework, which are better assessed for a higher number of respondents, we conducted a survey with 172 fishermen in February 2013²¹ (see appendix C). They were selected from SIPEIN (INVEMAR's Fisheries Information System), a database consisting of 1014 fishermen who landed fish at the Tasajera fish market between 1999 and 2010. The inclusion criterion for selecting 172 fishermen out of the 1014 was the number of available data points. This criterion enabled us (1) to guarantee that each selected fisherman had sufficient data entries and (2) to select particularly active fishermen of the lagoon, who can be assumed to be the most important fishermen for a diagnosis of sustainable governance of the SES. The questionnaire included questions about individual and household sociodemographic aspects, environmental awareness, social capital, trust, reciprocity, collective action, and external aid received.²²

2.5 Results

In this section we present the results of the application of the SES framework in CGSM. Likewise, we show how its utilisation helps us explain why collective action to manage the fishery in CGSM is limited and its users remain trapped in the tragedy of the commons. We start by presenting the social, economic, and political settings (S) and the different variables that were added within these settings to better understand this SES. Then, we will focus only in those tiers of the SES framework that were relevant for our study.

2.5.1 Social, economic, and political settings (S)

CGSM has many special designations that are supposed to protect this important ecosystem, but none of the State authorities responsible for the management of CGSM's

²¹ The first author administered the survey with the support of two survey takers, previously trained and with extensive fieldwork experience with rural communities.

²² Previous to the survey administration, we tested the questionnaire in seven pilots.

fishery resources are effectively there. Sadly, this situation gets even worse when we look at the social and economic situations of the inhabitants of the fishing communities that depend on CGSM's fishery resources. In fact, according to the experts interviewed, the lack of basic services (e.g. electricity, drinking water, sanitation), illiteracy and low levels of education, lack of schools and teachers—mainly in the stilt villages—make the living conditions in these communities precarious and very difficult. This situation has also been stated in official reports. Thus, according to the Administrative Department of National Statistics (DANE),²³ in the villages located on the main road, 58% of households fall under the category of having “unsatisfied basic needs”²⁴ (NBI) and 28% of people live in conditions of “misery”. In the stilt villages, 73% of households have NBI and 50% of the inhabitants live in conditions of misery (DANE (2012)).

The absence of government agencies to protect the ecosystem and guarantee to these communities access to basic human rights like education, primary health care, adequate access to food, and other basic services, undermines the possibility for its inhabitants to be empowered enough to address their own problems, including the possibility of managing their fishery. To make the situation worse, there are other factors we discuss below that make this particular case study even more complex.

2.5.1.1 Economic development (S1)

According to several studies (e.g. Botero and Mancera 1996, Botero and Salzwedel 1999, INVEMAR 2002, Aguilera D. 2011, Vilarly and González 2011) and experts interviewed, *in the last five decades Eco-region CGSM has been severely degraded by many anthropogenic activities associated mainly with the economic development (S1) of the Colombian Caribbean region.* Below is a list of the most important events:

²³ The Administrative Department of National Statistics (DANE) is the public entity responsible for producing the official statistics in Colombia (<http://www.dane.gov.co>).

²⁴ In Colombia, the indicator of unsatisfied basic needs (NBI) takes into account several aspects. The households are classified as poor or suffering from NBI if they are, at least, in one of these situations: they live in a house made with materials considered unfit for human accommodation; there are more than three persons per room; there is no toilet nor aqueduct; the drinking water is obtained from a river or spring, rain water, or container truck; there are more than three people per employed member and the head of household has a maximum of two years of approved primary education; there is at least one school-aged child (between 6 and 12) relative of the head of household but he/she does not attend school. When a household has two or more of these situations, the household members are considered to live in a state of misery (DANE 2012)

- a) The construction of the highway along Salamanca Island to connect Ciénaga and Barranquilla, two important cities on the Caribbean coast (S1.1). This construction, done between 1956 and 1960, closed the natural connection between the Caribbean Sea and CGSM, which was 2.000 m wide, and replaced it with a new channel called Boca de la Barra, which is only 80–100 m wide (Botero and Mancera 1996, INVEMAR 2002, Aguilera D. 2011).
- b) The construction during the late 1970s of an unpaved road parallel to the Magdalena River, which interrupted the flow of fresh water from the river to CGSM (S1.1).
- c) The reduction of water flow from the Magdalena River to the lagoon, caused by the construction during the late 1960s and early 1970s of dikes and berms along its eastern bank and its distributaries to prevent flooding of agricultural and livestock lands (S1.1).
- d) The high sediment load from SNSM's rivers and the Magdalena River and its distributaries, due to deforestation and erosion in their watersheds and expansion of livestock and agricultural areas for large crops such as cotton and bananas (S1.2).
- e) The deviation of the freshwater flow from SNSM's rivers by ranchers and owners of extensive banana and oil palm plantations for irrigation systems (S1.3).

As a result of the development of road infrastructure in the Caribbean region and the increase of agriculture and livestock areas adjacent to CGSM (S.1), the lagoon suffered a drastic change in its hydrological balance. It has caused hypersalinisation which in turn provoked (1) the massive mortality of almost 70% of its mangroves (about 360 km²) between 1956 and 1995 (Botero and Mancera 1996), (2) the loss of some species of mollusks and fishes, (3) a drastic reduction in fishing productivity (Bautista et al. 2010), and (4) the massive die-offs of fish on repeated occasions (Mancera and Vidal 1994, Epstein, Calix, and Blanco 1995).

The majority of the fishermen surveyed (81%) also believe CGSM has suffered negative changes, due mainly to the road development, the closure of the natural connections between the CGSM and the Caribbean Sea, the overfishing, and the use of nets with small mesh sizes. As shown in Figure 2.3, 39% of the fishermen surveyed

believe the State is responsible for the changes in CGSM, and within this group, 60% think that it is the State's responsibility to conserve CGSM. It is important to note that 31% of the fishermen believe that fishermen themselves are responsible for the changes in CGSM. The reasons they mentioned to justify that claim are the use of nets with small mesh size and the utilisation of illicit fishing methods such as *zangarreo*,²⁵ the pollution of the lagoon due to their inadequate management of wastes, and constant fishing that does not allow the lagoon time to recover. Interestingly, 55% of all the fishermen surveyed mentioned that the fishermen should help in the conservation of CGSM.

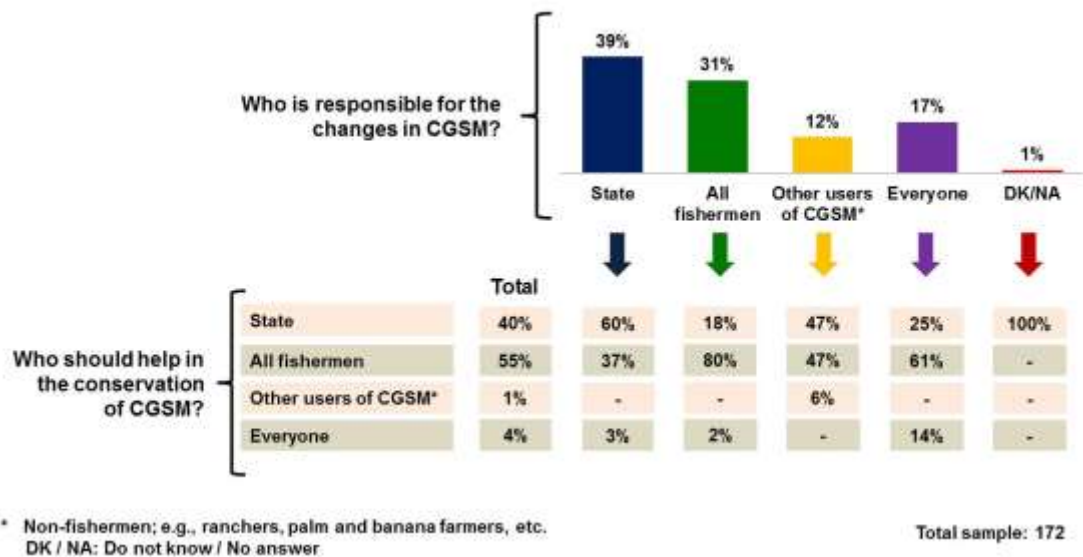


Figure 2.3. Fishermen's opinions about responsibility for the changes in and the conservation of Ciénaga Grande de Santa Marta (CGSM)

The hydrological changes led to many internal conflicts within the different groups originally from the region. Our findings suggest that deviation of the water from SNSM's rivers generated many conflicts (I4) among fishermen, farmers, and ranchers. The relationships among these three groups became very tense, which has led to violent conflict resolution. A comment from a Tasajera fisherman (2012) reflects this situation:

²⁵ *Zangarreo* is an active fishing method that involves one or more fishermen and consists of setting a gill net around mangroves and stirring up the muddy bottom to produce murky water, which causes asphyxia in the fish by clogging the gills.

“Where there are cattle, people are not allowed to enter to fish [on the banks of the swamps]. If they see a fisherman around, they will shoot him.”

In order to assess the fishermen’s trust in farmers and ranchers, we also asked them to grade on a scale from 1 to 10 the level of trust they have in farmers and ranchers (1 meant that they distrust totally, and 10 that they trust completely). Fifty percent (50%) of fishermen distrust totally, 35% preferred not to answer, 10% graded between 2 and 5, and the rest (5%) graded between 6 and 10.

2.5.1.2 Demographic trends (S2) & Political stability (S3)

Colombia has been experiencing an internal armed conflict since the 1960s (S3.1). This conflict is complex and involves several actors: the government and its military and police forces (S3.1.1), illegal groups—the guerrilla groups (S3.1.2.1) on the far left (the Revolutionary Armed Forces of Colombia [FARC], the National Liberation Army [ELN], and the Popular Liberation Army [EPL]), the right-leaning paramilitary groups (S3.1.2.2), the United Self-Defenses of Colombia (AUC)²⁶ (S3.1.2.2), the drug traffickers (S3.3), and the Emerging Criminal Bands (BACRIM) (S3.1.2.3)—and in the middle of all this confrontation, the civil population (Yaffe 2011).

Eco-region CGSM has been severely affected by the violence. According to Vilardy and González (2011), the armed groups have been present in the region since the 1960s. The first violent groups to arrive were the security groups of the drug producers and traffickers (S3.3). Then, in the 1980s, FARC (S3.1.2.1) and AUC (S3.1.2.2) came to the region. Later, in the mid-1990s, ELN (S3.1.2.1) settled in the area and began to exert control over the fishing gear used in the lagoon, especially not allowing the use of the encircling gill net (known as *boliche*). These activities together with the struggle among the armed groups to control this territory, which is strategic for smuggling of weapons and drugs, increased violence in the region. As a result of these struggles, the guerrillas (S3.1.2.1) were thrown out almost entirely and the paramilitaries (S3.1.2.2) began to control the area, which included subordinate self-defense groups (S3.1.2.2), control of

²⁶ Later became paramilitaries.

drug trafficking (S3.3), making political deals to control the public entities in the region (S3.4, S3.5), and the intimidation and murder of civilians to instill fear.

The most violent actions against the rural population were five massacres committed between January 1999 and November 2000 in the stilt villages and two communities near CGSM, Piñón and Pivijay (Vilardy and González 2011). The massacres were committed with the accusation that fishermen and peasants were sympathetic to the guerrillas (S3.4). This caused a massive displacement (S2.1) of more than 1,000 fishermen to the villages located on the highway that connects Ciénaga and Barranquilla (Aguilera 2011, Vilardy and González 2011). During our visits to these villages, we found that many of these displaced people have not returned to their home villages for fear of being killed.

According to Vilardy and González (2011), paramilitaries (S3.1.2.2) were responsible for extortions, selected murders, enforced disappearances, and threats against public servants (S3.4) in this region for various years. Additionally, they controlled the production and trafficking of drugs in the area (S3.3). In 2002, they began a peace process with the government that finished with the demobilisation of all their members by 2006. However, it was reported in our interviews that paramilitary groups (S3.1.2.2) are reorganizing, extorting and threatening civilians, and exerting control in some areas around the lagoon.

At the end of 2012, there was a new threat of massacre against civilians in Nueva Venecia. In addition, we were told that some people who expressed in meetings their disagreement with the deviation of fresh water from the SNSM's rivers were killed. This generated great fear among people. Researchers working in the area confirmed that many fishermen do not participate in meetings for fear of being killed. Additionally, some of the interviewers told us "informally" that BACRIM (S3.1.2.3), had appeared in the area. They consist of demobilised paramilitaries, ex-members of AUC and other illegal armed groups, and youth who have access to weapons (Sánchez 2011). Apparently, they also control the drug trafficking and trade of weapons, carry out extortions, kidnappings, tortures, murders, threats to politicians and civil population,

etc. (Vilardy and González 2011, Latorre and Arregocés 2014). Besides this, according to the police, the inhabitants of Isla del Rosario, Palmira, and Tasajera are victims of common crimes (S3.2) since some delinquents come to these communities to hide, taking advantage of the absence of police.

For all the reasons described above, fishermen's willingness to gather, to create any type of association among themselves or with other users of the lagoon, or simply to participate in any collective activity is very limited. The risk of being murdered if one of the illegal armed groups in the region perceives them as collaborators with opponent groups has generated fear in the population. This conflict has weakened the social fabric and therefore people prefer not to be involved in activities with other persons due to a breakdown of trust.

2.5.2 Resource systems (RS)

2.5.2.1 Clarity of the system boundaries (RS2) & Size of the resource system (RS3)

As we mentioned earlier, CGSM is an estuary receiving salt water from the Caribbean Sea through the Boca de la Barra and fresh water from the Magdalena River and SNSM's rivers (Vilardy and González 2011), therefore the ecological boundaries of the system cannot be clearly defined (RS2). In addition, the size of the resource system (RS3) is large from the perspective of the particular ecosystem users. In fact, according to many fishermen interviewed, the decision to attend meetings to discuss issues related to CGSM is not easy because they lose one day of work and they do not have enough money to pay the expenses of food and transportation, which are really high for people living in the stilt villages.

In addition, according to key informants, the fact that fishermen from other municipalities located far away from CGSM (e.g. Barranquilla, Soledad, Sabanagrande) can fish in the lagoon without any restriction affect not only local fishermen's interest in conserving the lagoon but also the possibilities to organize the fishery. The following comments of a key informant evidence this situation:

The attitude that people have created is ... “I cannot conserve because what I conserve someone else will take, therefore we will finish it anyway”. ... The philosophy that people have in their minds is why should we keep this for tomorrow if tomorrow the neighbor is going to steal from us, then we finish this off right away and we take advantage of this today; tomorrow we will see what to do. (Key informant, 2012)

2.5.2.2 Productivity of system (RS5) & Predictability of the system dynamics (RS7)

The fishery in CGSM was historically one of the most productive resource systems (RS5) on the Colombian Caribbean coast due to the magnitude of fish and shellfish caught (Botero and Salzwedel 1999). According to the National Institute of Renewable Natural Resources and Environment, between 1970 and 1975 CGSM met 70% of the local demand for fish on the Caribbean coast and the excess supplied markets in neighboring coastal cities and inland areas (PROCIENAGA 1995). However, due to the severe hydrological changes, the catches of the main commercial species sharply declined. In fact, the Autonomous Regional Corporation of Magdalena (CORPAMAG)²⁷ stated in one of its reports (CORPAMAG 1993) that between 1969 and 1982 the fish caught in CGSM went from 27.000 ton/year to 1600 ton/year (Botero and Botero 1989).²⁸

In 1992, the Project to Rehabilitate the Ciénaga Grande de Santa Marta (PROCIENAGA)²⁹ was launched. Its main goal was the “definition and execution of an environmental management plan for the improvement of the ecological, social, and economic conditions of the region” (Botero and Salzwedel 1999, p. 249). Between 1996 and 1998, this project re-opened six pre-existing channels (Clarín, Alimentador, Almendros, Torno, Aguas Negras, and Renegado) that provided fresh water to the

²⁷ CORPAMAG is the government agency in charge of environmental management and control in the Department of Magdalena.

²⁸ According to CORPAMAG (1993), although these data can be underestimated due to the lack of complete information about the fishing products mobilized from CGSM in that period, the reduction in the volume of fish caught was evident.

²⁹ PROCIENAGA was a Colombo-German megaproject. Through several agreements, participants in the project included CORPAMAG, INVEMAR, German Agency for Technical Cooperation, Colombian Administrative Department of Science, Technology and Innovation, and the Regional Council for Economic and Social Planning. This 10-year project ended in 2002 (PROCIENAGA 1995).

lagoon from the Magdalena River. It reduced the salinity in the soils and water of the lagoon, which in turn allowed the recovery of some areas of mangrove and an increase in the fish catches (INVEMAR 2003). However, the lack of maintenance of these channels by CORPAMAG has again produced changes in the hydrological regime of the lagoon and the reduction in fishing resources (Ibarra et al. 2014).

Additionally, other factors such as overfishing and use of illegal fishing gear and methods, together with all the other aspects already mentioned in the regional economic development (S1) setting, have produced constant fluctuations in the fishing productivity over time (INVEMAR 2002, Ibarra et al. 2013, Ibarra et al. 2014). The continuous variations in the species abundance together with the reduction in the fish sizes were widely mentioned by fishermen interviewed. These changes do not allow fishermen to make accurate predictions (RS7) about the future productivity of their fishing system (RS5). This is another challenge fishermen are encountering if they try to organise and draft rules to manage their fishery. The following interviewee comments support that point:

One cannot predict when there will be scarcity or abundance of fish. It is random. (Tasajera fisherman, 2011)

Before there were more fish, you arrived and caught right away. Now we have to look for them, they are smaller. (Tasajera fisherman, 2012)

2.5.3 Resource units (RU)

2.5.3.1 Resource unit mobility (RU1) & Spatial and temporal distribution (RU7)

Due to the nature of this lagoon, species are continuously mobile, which is well known by the fishermen (RU1). In fact, according to Santos-Martínez and Acero (1991) and Sánchez-Martínez and Rueda (1999), CGSM is used mainly by juveniles of different species of fish (RU7). Approximately 60% of native fishes in CGSM are visitors and the rest (40%) are residents (Santos-Martínez and Acero 1991, Sánchez-Ramírez 1996, Bateman 1998). Nowadays 109 species are commercially exploited in CGSM, of which 94 are fishes, 4 are mollusks, 9 are crustaceans, and 2 are reptiles. Among all these

species, 56 have marine affinities, followed by freshwater (30) and estuarine (23) species (Ibarra et al. 2014). This connection to the sea and the exchange of fish was used by various fishermen to explain that CGSM has an endless reservoir of fish for them to exploit. So, some fishermen may believe there is no need to develop rules to manage the CGSM fishery, given that apparently resource units keep entering the system. Some fishermen's opinions show these thoughts:

If La Barra does not close, the Ciénaga is not exhausted. The Ciénaga depends on the rivers. The river is a necessary thing for the Ciénaga. (Tasajera fisherman, 2012)

The Ciénaga will not have fish deprivation because the ocean maintains the fish population. (Tasajera fisherman, 2012)

The sea throws fish outside [into the Ciénaga]. Some fish also enter through the rivers, so there [are] always fish. (Palmira fisherman, 2012)

2.5.4 Governance system (GS)

2.5.4.1 Government organisations (GS1) & Monitoring and sanctioning rules (GS8)

Even though Eco-region CGSM is under a special protection regimen issued by the Colombian government, we did not find any government entity (GS1) supervising the access and/or use of the fishery during our visits. This observation was corroborated in the interviews with fishermen and experts. As stated before, the absence of state agencies in this area is reflected not only in the lack of management of CGSM, but more importantly in the lack of primary services for the population. The situation is aggravated since the central government agencies responsible for the fisheries management have changed several times during the last few decades in addition to their limited staff (Vilardy and González 2011). This situation is further aggravated by threats some of the public servants receive from the illegal armed groups in the area.

Nowadays there are only two government entities that are permanently in the area: National Natural Parks of Colombia and INVEMAR, but neither is charged with monitoring or controlling the fishery. This lack of formal monitoring and sanctioning

processes (GS8), together with blame that the State disrupted the lagoon, was mentioned by all the experts and most of the fishermen interviewed. Here are two examples of their comments:

As the Ciénaga is so extensive and there is no control and monitoring, all the fishermen do whatever they want. (Bocas de Aracataca fisherman, 2011)

The Ciénaga belongs to everybody and nobody. Anybody can arrive there and do what he wants and nobody says anything. (Expert, 2012)

Due to the absence of government agencies in the region, the community distrusts the State. To assess this aspect, we asked fishermen to grade on a scale from 1 to 10 the level of trust they have in the local government (1 meant that they did not trust at all and 10 that they trusted completely). The results show that only 4% trust completely (scores 9 and 10), while 62% do not trust at all (scores 1 and 2). The rest of opinions were divided: 9% scored 3 and 4, 14% scored 5 and 6, and 11% scored 7 and 8.

2.5.4.2 Non-government organisations (GS2)

Due to the critical reduction of the fishing productivity of CGSM and the extreme poverty of its dwellers, in 1994 some government agencies together with PROCIENTAGA and representatives of various fishery resources users of CGSM initiated a discussion process (1) to identify the problems and conflicts that were affecting the fishing activity and (2) to find solutions to overcome the crisis (Botero and Salzwedel 1999). As a result of this process, they agreed to approximately 50 fishery management rules, which were to be implemented by June 1995 and were supposed to be the basis for developing a Fishery Management Program (PROCIENTAGA 1994). However, during the first half of 1995 a massive die-off of fish created substantial food scarcity for people, who then ignored the whole management process. The following comment from an expert who worked in CGSM at that time shows the situation in that moment:

Beginning in the 1990s [1993–1994], before the massive die-off of fish [1994–1995], due to a reduction in the resources, fishermen began to self-organize to look for alternatives In that moment they created an Assembly of Fishing Communities to both conserve the Ciénaga and look for other economic alternatives. ... At that time they reached some agreements, but the massive die-off of fishes impeded fishermen in complying with them and they caught everything they found. (Expert, 2012)

Following this event, many entities (public, private, national, and international) arrived in Tasajera to develop all kinds of projects (e.g. socioeconomic, basic services, social relief, environmental, infrastructure) to both help the rehabilitation of CGSM and improve the fishermen's livelihoods. Many of these projects required people to be organised in order to get the financial aid (Botero and Salzwedel 1999, Vilarly and González 2011). The agencies, then, created groups without giving people the opportunity to self-organise, which did not allow them to generate a sense of ownership of their organisations, to decide with whom they wanted to be organised, or to have any particular reason to belong to a particular organisation other than to get the financial aid.

According to some of our key informants and community leaders interviewed, after participating in several projects aiming to ameliorate life conditions of the people in CGSM (e.g. reconstruction of the social fabric, aquaculture, strengthening social organisations, conflict resolution, home improvement), people decided to create a higher-level organisation that grouped all the small groups created by the different entities in order to have a greater capacity for negotiation with these donor agencies and get more external aid. Thus, in 1996 they formed the Association of Community Organisations of the Ciénaga Grande de Santa Marta (ASOCOCIENAGA), which grouped 58 small organisations from the seven communities that depend on CGSM. This organisation, in fishermen's and experts' opinions, worked relatively well while the individuals in charge of the projects accompanied them. Once they left, groups had difficulties due to problems of accountability, lack of interest, and individualist behavior. The lack of rotation of the board of directors, the inappropriate management of the projects' information, and the same groups of people participating in all the projects, undermined the trust of fishermen in this association. As a result, some of them

decided to organise new groups independent from ASOCOCIENAGA. This situation was aggravated by the violence of the 1999 and 2000 massacres and subsequent fear to organise. The following quotes show this situation:

In the massive die-offs of fish we were organized but the groups were divided and they did not stay together. The groups think different things. There was a lot of disagreement; it was not possible to get only one conclusion. (Tasajera fisherman, 2012)

People do not trust in those who lead projects because they use them to get the money but then they do not give them anything or very little. (Expert, 2012)

2.5.4.3 Collective choice rules (GS6)

During our visits to CGSM, we confirmed that there is no committee or community council left where fishermen discuss or create rules to manage their fishery. This is due in part to several factors mentioned earlier. The violence perpetrated by armed groups generates great fear among fishermen, and they prefer to avoid meetings or any other activity that puts them or their families at risk. Additionally, a small group of fishermen surveyed (15%) believe the lagoon has enough fish for all of them and therefore they do not perceive any incentives to engage in collective action to manage the fishery. Moreover, another group of fishermen surveyed (40%) believes the State should take the lead in the conservation of the lagoon.

2.5.5 Actors (A)

2.5.5.1 Importance of resource (A8)

The artisanal fishery in CGSM is one of the largest in Colombia with 3500 fishermen (Blanco, Narváez, and Vilorio 2007), of which on average 950 are active daily in the lagoon (INVEMAR-SIPEIN 2012). Fishermen depend mainly on the fishery or related activities such as buying fish or shellfish for resale, or cleaning canoes, nets, or fish in the Mercadito. Sixty-six percent (66%) of fishermen surveyed stated that they are fishermen because there is no alternative employment in the region. Apparently the

strategic location of CGSM should allow fishermen to go fishing either in the lagoon or the Caribbean Sea; however, the canoes and fishing gear used to fish in the sea are different from those used in CGSM. For this reason, most surveyed fishermen (88%) depend only on CGSM (A8), while the rest (12%) benefit from fishing in both places.

2.5.5.2 Leadership (A5) & Norms (Trust-Reciprocity)/Social capital (A6)

In this SES, the lack of leadership (A5) is critical, and is due to very low levels of education, pressures from illegal armed groups on civilians, and the external aid that came with the projects. In fact, we found that fishers do not trust their traditional leaders mainly for two reasons: *i)* they are not fishers or they stopped fishing many years ago *and ii)* the leaders do not share the information related to the projects. All these factors together with the threats and murders of any potentially new leaders have strongly disaffected the people's desire to participate in self-organizing activities. Comments from fishermen and leaders illustrate their difficult situation:

There are many threats and therefore people are afraid. What most affects the possibility of working together is the violence ... the threats are common throughout the area, including the stilt villages. (Key informant, 2012)

The members of armed groups infiltrate the fishermen's meetings. This severely limits the fishermen. Fishermen are afraid because in the last three years at least 10 community leaders have been killed. (Expert, 2012)

To evaluate how much fishermen trust their traditional leaders, we asked them to grade on a scale from 1 to 10 the level of trust they have in them (1 meant that they did not trust at all and 10 that they trusted completely). The results show that only 4% trust completely in their leaders (scores 9 and 10), while 53% do not trust them at all (scores 1 and 2). The opinions of the remaining fishermen were divided: 13% scored 3 and 4, 23% scored 5 and 6, and 7% scored 7 and 8.

Many of the facts that we have described so far shape the social capital (A6) in this SES. Another way to evaluate it is through community activities, and as we expected they are uncommon. In fact, according to the survey results, 79% of the fishermen did not participate in any community activity in 2011. This lack of desire to participate in

community activities is confirmed by the fact that 90% of the fishermen stated that people are only willing to participate in community activities when there is a payment.

2.5.5.3 Knowledge /Mental models (A7)

Taking into account that fishermen's perceptions about the fishery resources of CGSM are key to understanding their behavior and their interest in self-organising to regulate the fishery, we evaluated their perceptions about the current and future availability of fishery resources. We found that the majority (81%) believe the resources are beginning to become scarce, 15% believe there are a lot of resources for all, and only 4% said the resources have always been scarce. Likewise, 73% believe that if CGSM's fishermen continue fishing at the current rate, there will not be enough fish to feed their families in the future.

This situation is the result of the lack of information fishermen have about the ecological conditions of CGSM. Very few fishermen know the results of the monitoring of the water's quality, mangroves, and fishery in CGSM that INVEMAR has recorded since 1993. Even worse, Vilardy and González (2011) reported that CGSM is one of the ecosystems in Colombia where many biological studies are carried out, but most of the researchers do not disseminate the results of their studies to the fishermen of the region.

2.6 Discussion

With our study, we wanted to understand why collective action for a sustainable use of fishery resources of CGSM has not taken place. In Table 2.3, we summarise the main results from the utilisation of the SES framework and its adaptation.

The socioeconomic conditions of CGSM inhabitants are very extreme. The State has abandoned them in all aspects of their lives. The daily difficulties for CGSM dwellers are aggravated by the Colombian civil conflict (S3) and the presence of drug traffickers (S3.3). The latter have dramatically affected the fishermen's desire and capability to organise, or even to express their own opinions. It was also found that some of the fishermen live in constant fear that something may happen to them or their families.

Thus, one of the social consequences of the conflict is that it has destroyed many manifestations of social capital (A6), such as the creation of social networks, participation in community activities or the possibility of having leaders (A5). The literature on collective action (Agrawal 2002, Poteete and Ostrom 2004, e.g. Poteete, Janssen, and Ostrom 2010) talks about the importance of social capital as a crucial factor for the emergence of leadership and the creation of rules and norms. Clearly, social capital in CGSM has been minimized and exists only as interactions among family members and friends.

Table 2.3. Main factors affecting collective action according to the SES diagnostic

INFLUENCING FACTORS
<ul style="list-style-type: none"> ✧ Political instability of the region caused by the presence of different armed groups (S3). ✧ Great fear by fishermen of the violence exerted by armed groups in this region (S3). ✧ Precarious living conditions of dwellers that depend on CGSM (S). ✧ Weakening of social capital from constant armed conflict (A6). ✧ Highway and road development in the Caribbean region that altered the hydrological regime of CGSM (S1). ✧ Expansion of farming, livestock, and agro-industrial sectors in the region (S1), which has caused a severe degradation to CGSM and generated conflicts (I4) among different actors present in Eco-region CGSM. ✧ Limited knowledge that fishermen have about CGSM (A7), which in turn does not allow them to make predictions (RS7) about its future productivity (RS5). ✧ Belief of some fishermen (A7) that the lagoon will always have fish. ✧ Belief that because the State (GS1) caused the deterioration of the ecosystem, it should also do something to protect it. ✧ High dependence on the fishery resources (A8) due to the lack of income alternatives. ✧ Coercion toward the new generation of leaders (A5). ✧ Distrust (A6) of fishermen in past/traditional leaders (A5). ✧ Lack of formal and informal monitoring and sanctioning processes regarding the fishery in CGSM (GS8). ✧ Absence of State agencies that control the fishery in the lagoon and protect the people (GS1). ✧ Lack of a committee or community council where fishermen collectively can create, change, or discuss rules regarding the fishery in CGSM (GS6). ✧ Effects generated by the external aid of NGOs (GS2) and State agencies (GS1). ✧ Unclear boundaries (RS2) due to the connections between CGSM, the Caribbean Sea, and SNSM's rivers. ✧ Continuous mobility of species (RU1) and their spatial distribution (RU7). ✧ Size of the lagoon (RS3), which is very large in terms of transportation for the fishermen given the technology that they use.

As stated in the literature, the lack of basic human rights such as education, peace, health coverage, and water and sewage systems affect people's ability to sustainably use the fishery resources of this lagoon over time (Ratner, Åsgård, and Allison 2014). Therefore it is fundamental to solve the human-rights problems in the region before any type of collective action can emerge. The absence of State authorities (GS1) not only prevents citizens from having some of their basic needs, it also allows illegal groups to become established, leaving citizens at the mercy of those armed actors (S3.1.2, S3.2, S3.3). According to the fishermen, the presence of State agencies (including military and police forces) would facilitate conditions to work again on the development of a fishery management plan for CGSM. These results are consistent with the findings by Botero and Salzwedel (1999) and Vilardy and González (2011), who stated that one of the core problems in CGSM has been the deficient actions of entities responsible for the protection of the population and management of the lagoon.

In ecological terms, the literature on consequences of armed conflict on the environment reports two types of findings. On one hand, it can be "positive" when the conflict leads to a natural regeneration of the resources due to its inaccessibility (Adhikari and Adhikar 2010). On the other hand, it can be negative, thus the conflict drives resource destruction or loss of biodiversity (Hanson et al. 2009). In the case of CGSM, we found that the guerillas in the mid-1990s prohibited the use of *boliche* in the lagoon. According to the interviews, this imposed rule reduced the pressure on the fishery resources of CGSM when it was going through a critical period. The rule, however, did not last and we do not have any ecological evidence to assess its benefits. Additionally, we found that when the paramilitaries (S3.1.2.2) left the area in 2006, many fishermen, particularly in Tasajera, began to again use the *boliche* and other unsustainable fishing methods such as *zangarreo*. This increased the pressure on the resource and generated several strong conflicts (I4), especially between Tasajera's and the stilt villages' fishermen.

Researchers have shown that the more predictable a resource is, the easier it is for its users to engage in collective action (Agrawal 2001, di Gregorio et al. 2008). In our study, we showed that external variables had severe ecological and social consequences

and therefore may explain the lack of cooperation in CGSM. The road development (S1.1), the increase in farming and livestock (S1.2), and the intensive agro-industrial activities (S1.3) in the overall region have produced dramatic changes in the ecosystem and unpredictability of the resource flow (RS7), escalating fishermen's distrust of the government and other local groups.

Additionally, studies done on fish population in the region are not available to fishermen; therefore, for them the actual biological health of the system is unknown. This lack of a common understanding of the systems among resource users of CPRs has also been stated in the literature as a factor that could affect collective action, given that resource users find it so difficult to agree on a joint strategy that allows them to conserve the resources (Poteete, Janssen, and Ostrom 2010). In the case of CGSM, this situation has led fishermen to have diverse mental models (A7) regarding the health of the ecosystem and its productivity (RS5), which are not informed by the scientific studies conducted in the lagoon. Basurto and Ostrom (2009) show that the lack of significant knowledge about the resource prevents fishermen from making predictions about the dynamic of the system, which in turn affects their possibility of self-organization.

The commons' literature argues that when users depend largely on a CPR, they invest time and effort to create new institutions to govern it (Wade 1994, Dietz, Ostrom, and Stern 2003, Chhatre and Agrawal 2008). However, it is also claimed that collective action occurs among resource users when they perceive that the resource is moderately scarce (Wade 1994, Araral 2009). As shown in the results section, most of CGSM's fishermen depend on the resources (A8), and they are aware that the productivity of the system (RS5) is declining, but they do not have enough resources and leadership to organize themselves. Moreover, since some fishermen still believe CGSM will always have fish (A7), the odds of reaching an agreement is not easy.

The presence of respected and recognized leaders by the community is another factor identified in the literature as a facilitator of collective action among resource users of a CPR (Wade 1994, Baland and Platteau 2000, Vedeld 2000, Onyx and Leonard 2011).

However, as described in section 4, in CGSM, many factors, including the inadequate management of the resources and information of some projects, the lack of accountability, the untrustworthy reputation of leaders (A5), and the murder of some of the new leaders, have totally restrained people's interest to lead or participate in any community activity. Yet again these important factors link back to the political instability (S3) and the armed conflict (S3.1).

The existence of monitoring and sanctioning and other operational rules that allow resource users to maintain their resources is crucial to facilitate cooperation (Ostrom, Gardner, and Walker 1994, Ostrom and Nagendra 2006). Nevertheless, in CGSM, the lack of State authorities (GS1) to protect the ecosystem and more important to protect the community itself from illegal armed actors (S3.1.2), common crime (S3.2), and drug traffickers (S3.3) leaves the community in an even more vulnerable situation. This lack of protection and the lack of support by the government to the inhabitants of the region in general and to fishermen and other resource users to self-organize a council where fishermen can collectively decide how to manage CGSM's fishery (GS6) and agree on monitoring and sanctioning processes (GS8) have totally discouraged CGSM's fishermen.

Another factor discussed is the strong presence of external aid in the CGSM, which links the factors non-government organisations (GS2), leadership and entrepreneurship, (A5) and trust (A6). According to the literature, external aid can lead to the Samaritan's Dilemma, which hinders in the long term collective action due to the resources that people receive (Gibson et al. 2005). The severe ecological, social, and economic problems of CGSM generated a huge influx of development assistance. We observed that people were organised to obtain money from external donors, resulting in 58 community groups. These groups were mostly single-issue organisations that disappeared or became inactive after the project ceased to exist. None of the projects has led to the organisation of a self-sustaining fishery organisation that can regulate fishery activities at a community level.

Regarding the system boundaries (RS2), one could argue that they are as clear as they can be in a fishery context, the lagoon having only one outflow of 100 meters to the

Caribbean Sea, and that resource mobility (RU1) is rather limited in a fishery context, which should both favor collective action (Wade 1994, Wilson, Yan, and Wilson 2007, Poteete, Janssen, and Ostrom 2010). However, given that some fishermen consider CGSM as an endless reservoir of fishes due to its connection to the sea, some of them seem to believe that there is no need to create rules to manage the fishery. In addition, the fishery being “open” to other fishermen implies that local fishermen do not see the benefits of taking care of the fish in the lagoon. Obviously, not being sure if the benefits of conserving the lagoon can be gained by those who have engaged in it makes collective action more difficult (Schlager, Blomquist, and Tang 1994, Ostrom 2009). Finally, related to the size of the resource system (RS3) and its impact on collective action, the 450-km² lagoon definitely does not qualify as a global CPR (Ostrom et al. 1999). However, considering the means of transportation available and the high personal costs to get to meetings due to long distances, CGSM is relatively large for organizing collective action.

2.7 Conclusion

In this paper, we used and adapted the SES framework proposed by Ostrom (2009) to investigate the factors that seem to affect collective action for a sustainable fishery in CGSM. As shown in many other studies (Ostrom 1990, Baland and Platteau 1996, Agrawal 2001), collective action is affected by multiple factors; however, in our study we are finding that the social, economic, and political settings used in the Ostrom SES framework seem to have influenced in a negative way all the other variables of the SES and therefore have had an immense influence in the lack of collective action in CGSM.

Regarding the application of the SES framework in CGSM, we realised it is a powerful tool that facilitates a systematic diagnosis of an SES. However, for the particular case of CGSM, we stressed the importance of the external social, economic, and political settings described in the SES as opposed to other articles in the literature that rely on variables that form the core framework. Our work complements the literature by focusing on this setting and creating new variables on the third, fourth, and fifth tiers within economic development (S1), demographic trends (S2), and political stability (S3)

to be able to better explain how these external variables impact the SES, and its management. Without the two dominating factors—violence (political stability S3) and economic development (S1)—it would be impossible to comprehend the situation of this SES. This research is unique for two reasons: (1) to our knowledge this is the first study where the second-tier variables of the social, economic, and political settings have been developed, and (2) we are not aware of any other study using the SES where armed conflict explains and affects so strongly all the other variables of the system. We conclude with this single case study that many social-ecological systems are heavily influenced by these “S” variables and therefore that further research should take them more deeply into consideration.

The region suffers from a high level of poverty and the lack of basic infrastructure, but this situation is aggravated by armed conflict and decisions made by the Colombian government. According to our findings, the way armed conflict has impacted the social interactions in the region helps to explain the lack of collective action among fishermen. Moreover, it has incentivised an individualist behavior driven by the fear of others in the community and the illegal armed groups. As shown in this paper, the social, economic, and political conditions of the region have harmed the CGSM population in such a way that they do not have secure human rights. Many fisheries described in the literature have failed to be managed in a successful way because the causes of poverty and insecure livelihoods do not reside in the fisheries themselves but are external (Allison et al. 2012); this also seems to be the case in CGSM. Here, these external factors are strongly associated with a failure in the State’s responsibility not only to protect the fishermen and their families (Ratner, Åsgård, and Allison 2014) but also to protect this important ecosystem.

Additionally, decisions from the Colombian government that aimed to promote development in the Caribbean region originated profound ecological disruptions in the ecosystem. Unfortunately, fishermen from CGSM saw their fishery affected in the long run without any type of compensation, any economic alternatives, or even a management plan for their fishery and this important ecosystem. According to our findings, the Colombian government has regulations on paper that may help the

ecological sustainability of CGSM but, in reality, does not exert any type of control in the fishery.

The Colombian government has the obligation to help these communities first by being present and guaranteeing that human rights are secure to all its inhabitants, which means among other things to improve their living conditions, and second by empowering them through social inclusion and capacity building. Likewise, given the high levels of insecurity in this region and the extreme poverty in which CGSM's fishermen live, the government must also tackle the problem of crime and violations to their human rights. Otherwise, CGSM's fishermen cannot organize to create sustainable use of the fishery resources of the lagoon over time .

Acknowledgements

We thank INVEMAR's researchers, especially Efraín Vilorio and Myriam Vargas for providing outstanding support for this research. We appreciate very much comments from Ana Maria Roldan on an early version of this manuscript. We are very thankful to CGSM's fishermen, in particular fishermen from Tasajera, because without their help this research would not have been possible. We would like also to express our gratitude to INVEMAR's field assistants in CGSM, in particular to Vladimir Carbonó for his valuable and constant support. Likewise, we want to thank Rubén Vásquez and Alexander Acuña for all their assistance in the field when we conducted the survey. Special thanks to Micaela Kulesz for her support and discussion in the early stages of this paper. We also appreciate the comments we received in an early version of this paper from participants in the WOW5 Conference at Indiana University. We value the editing work done by Joanna Broderick. Finally, we would like to thank two anonymous reviewers who have contributed valuable comments. This research was funded and supported by the Center for Tropical Marine Ecology (ZMT) and the German-Colombian Center of Excellence in Marine Sciences (CEMarin).

3 Understanding artisanal fishermen's behavior: the case of Ciénaga Grande de Santa Marta, Colombia.

Authors: Luz Elba Torres Guevara, María Claudia López & Achim Schlüter

3.1 Abstract

In this paper we built individual and composite indicators to investigate the ecological impact of fishing spots and fishing gear/methods used by fishermen from Ciénaga Grande de Santa Marta (CGSM), an estuarine lagoon located in the Caribbean Coast of Colombia. CGSM is one of the most prominent fisheries in the country because of its social and ecological importance. We also investigated the influence of socioeconomic and perceptual factors on fishermen's fishing behavior and how that behavior may be impacting the fishery resources by looking at two different points of view, a group of experienced fishermen and a group of experts with extensive knowledge of that fishery. We found differences between the indicators done with experts' opinions as compared to indicators built with experienced fishermen's opinions. Additionally, we found that having a higher degree of education, sharing household expenses with other family members, and spending more hours fishing lead to ecologically sustainable fishing behavior, whereas the perception that the government is responsible for CGSM conservation leads fishermen to exhibit ecologically unsustainable fishing behavior.

Keywords: Artisanal fishing, fishermen's behavior, ecological sustainability, Colombia.

3.2 Introduction

The relevance of artisanal fisheries to poverty alleviation and food security is undeniable (FAO 2014, 2007). However, despite their ecological, economic and social importance, such fisheries are being threatened by several external factors such as pollution and increasing demands, as well as by internal factors such as overfishing, and use of destructive fishing gears and practices (Kittinger et al. 2013, Cinner 2010). As a result of these disturbances both ecosystems and fishing communities have been seriously affected, and their future livelihoods are in peril.

A sustainable fishery requires to take into account conservation and environmental aspects, as well as social, economic and institutional dimensions associated to the fishery activity (FAO 1991). Therefore any management approach oriented to fisheries should include the fundamental components of sustainability: ecological, social, economic, and institutional (Charles 1994, Goodland 1994). Additionally, it is crucial to understand fishermen's behavior and how that behavior is influenced and may be influencing all components of sustainability (Wilen et al. 2002, Charles 1995, Hilborn and Walters 1992, Cinner and Pollnac 2004, Salas and Gaertner 2004).

Scholars from diverse disciplines have investigated different socioeconomic conditions influencing the long-term sustainability of artisanal fisheries, but the findings are far from conclusive. For example Silva (2006) determined that fishermen with higher levels of education and greater wealth were less likely to use destructive fishing gears. Whereas, Cinner (2010) found that fishermen who used destructive fishing gears, were younger with lower fortnightly expenditures, and less likely to own capital in the fishery. Cinner and Pollnac (2004) established that natural resources' perceptions are different among members of fishing communities, depending on their socioeconomic status. Thus, poorer fishermen associated the fishery crisis to fishing activities while wealthier ones related it to practices such as tourism, shipping activities or conservation interventions. Cinner and McClanahan (2006) established that factors such as the size of the fishing grounds, fishing pressure and distance to fish markets can affect catch characteristics such as fish diversity or length of the fish. Cassels, Curran, and Kramer

(2005) found that is more likely that migrants live in villages with poorer environmental quality. They also found that migrants exhibit a similar behavior as compared to non-migrants with respect to the extraction of fishery resources, when they are integrated into the new communities through intermarriage between a migrant and a non-migrant, or they gain kinship and social ties.

Other studies have examined factors influencing fishing strategies, finding that aspects such as fishermen's age and experience, wealth, boat size and motor power, information on resource availability, and results and revenues of the previous trip can influence fishermen's decisions (Salas 2000, Salas, Sumaila, and Pitcher 2004). Other researches have explored factors affecting fishermen's fishing effort and the selection of fishing sites. They have found that fishermen's decisions are influenced by several factors such as seasonal dynamics, knowledge about the resources, fishermen's skills, labor intensity needed, profits, the custom of not fishing on Sunday, and presence of pirates (Guest 2003, Béné and Tewfik 2001a, Abernethy et al. 2007).

Another literature has used hypothetical scenarios of declining catches to examine fishermen's readiness to stop fishing. Cinner, Daw, and McClanahan (2008) have found that poorest households would be less likely to stop fishing when resources are scarce, whereas Daw et al. (2012) found that households with more diversified activities and lower value catches would be more willing to stop fishing when resources diminish.

The research took place in the Ciénaga Grande de Santa Marta (CGSM), a coastal lagoon located in the Caribbean coast of Colombia. We used survey data and developed individual and composite fishing impact indicators for each fisherman that participated in the survey. To build these indicators, we used a database with information about their fishing behavior and their fishing techniques between 2006 and 2010. In particular, we used data about fishing spots visited and fishing gears and methods used. This information was then combined with an evaluation of the ecological impact of fishing on CGSM, made by a group of experienced fishermen and experts, which included an assessment of fishing spots and fishing gears/ methods. Then, we investigated the influence of socioeconomic and perceptual factors on fishermen's fishing behavior

and how that behavior may be impacting the fishery resources by looking at two different points of view, the indicators built with the assessment done by a group of experienced CGSM's fishermen and the ones done by group of experts with an extensive knowledge of that fishery.

We have seen no study analysing fishing decisions of artisanal fishermen and their impacts on the ecological sustainability of their fishery resources by comparing experienced fishermen's and experts' opinions. This research is key to comprehend if fishing practices specifically fishing location and fishing gears/methods considered ecologically sustainable by fishermen are assessed in the same way by the experts. Additionally, by including two measures of ecological sustainability, we acknowledge that it is difficult to assess only with one measure.

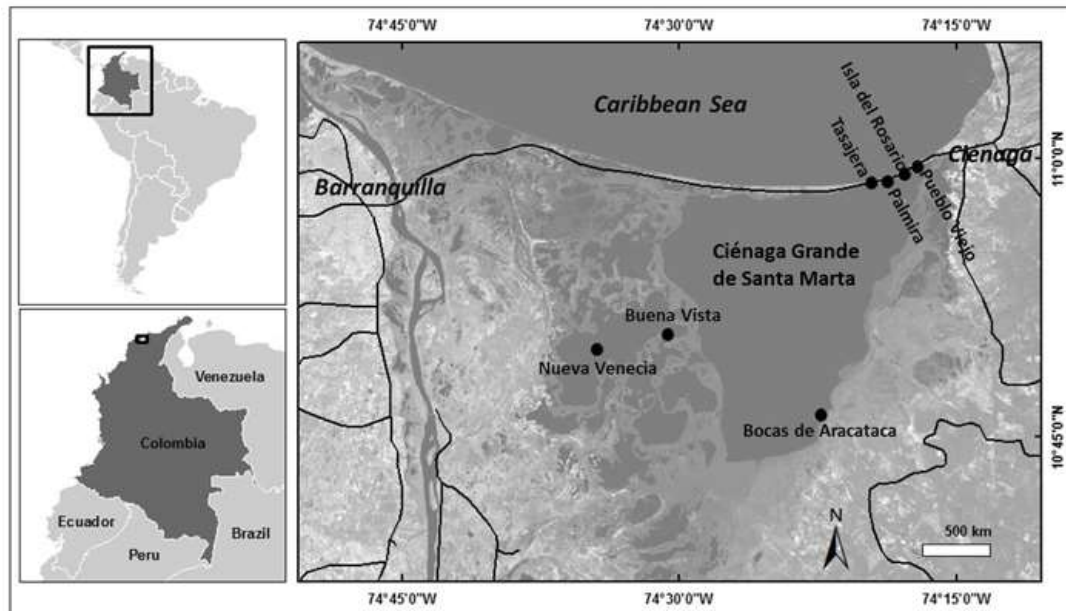
Finally, the study contributes to the literature on fishermen socioeconomic and perceptual factors influencing fishing behavior by introducing new variables into the analysis such as whether fishermen support others living outside of their households or if they share household expenses with others in the household. The results of the study show that fishermen with a higher level of education who share household expenses with other family members and who spend more hours fishing tend to exhibit ecologically sustainable fishing behavior, whereas the perception that the government is responsible for CGSM conservation leads fishermen to exhibit ecologically unsustainable fishing behavior.

The paper is structured as follows: in section 2 we introduce CGSM including an overview of its fishing practices. In section 3 we describe the methods used for the collection, processing and analysis of data. In section 4, we present and discuss the main findings, and finally in section 5 we offer some concluding remarks.

3.3 Study Site and Overview of the Fishing Practices

CGSM is an estuarine lagoon situated in the center of a larger region (about 4900 km²) known as Eco-region Ciénaga Grande de Santa Marta (Eco-region CGSM) and

separated from the Caribbean Sea by a 212 km² sand bar called Salamanca Island (see Figure 3.1). CGSM is one of the most important coastal lagoons of Colombia due to its large size (450 km²) (Gónima, Mancera, and Botero 1996), and its ecological and social value (Botero and Salzwedel 1999, Blanco, Vilorio, and Narvaez 2006, Bautista et al. 2010, Vilardy and González 2011). However, despite its importance, since the end of the 1950s, the CGSM has been impacted by several anthropogenic activities (e.g. armed conflict, road and channel construction, pollution by intensive agriculture and overfishing), which together with extreme poverty conditions, lack of government presence and the subsequent poor implementation of management schemes have reduced its fishery resources and deteriorated people's quality of life (Vilardy and González 2011, INVEMAR 2002, Botero and Mancera 1996). Torres, Schlüter, and Lopez (in revision) found that the strong violence inflicted on the population since the 1960s by illegal armed groups, and the economic development in the Colombian Caribbean Region help to explain the lack of collective action among fishermen to manage fishery.



Source: Map produced by Dr. Guiying Le. Center for Global Change and Earth Observations. Michigan State University.

Figure 3.1. Tasajera and Ciénaga Grande de Santa Marta, Colombia.

The living conditions in the area are very harsh. According to data from DANE (2012)³⁰ 73% of households in the stilt villages have unsatisfied basic needs³¹ (NBI) and 50% of its inhabitants live under conditions of misery. For the villages located on the main road, 58% of households have NBI and 28% live under conditions of misery. In addition, these communities have been and continue to be victims of the armed conflict that Colombia has experienced since the 1960s, and nowadays they face problems such as common crime, corruption, and the lack of true community leaders (Torres, Schlüter, and Lopez in revision).

CGSM is characterized by a *de facto* open access regime where property rights have not been allocated. About 25.000 people living in seven small communities near the lagoon rely on fishery for subsistence. Moreover due to the fact that fishery operates as open access, fishermen from other communities also fish in CGSM imposing additional pressure on its resources. According to Blanco, Narváez, and Vilorio (2007) CGSM is one of the largest fisheries in Colombia with 3.500 active fishermen fishing in the lagoon every day. Fishing is a year-round activity done only by men. The main products extracted from the lagoon are five fish species, two crabs and shrimps, although it is reported that 109 species are commercially exploited in the lagoon (Ibarra et al. 2014, Rueda and Defeo 2003b, Rueda and Defeo 2003a). Fishermen use one or several types of fishing gears/methods during their daily work, depending on species targeted and the period of the year³². The most common gears are: cast nets, fixed gill nets (trammels), encircling gill nets (*boliche*), long lines and seine nets; crab traps and shrimp nets (Ibarra et al. 2014, Rueda and Defeo 2003a, Blanco, Narváez, and Vilorio 2007).

³⁰ The National Administrative Department of Statistics (DANE) is the public entity responsible for producing the official statistics in Colombia (<http://www.dane.gov.co>).

³¹ In Colombia, the indicator of unsatisfied basic needs (NBI) takes into account several aspects. The households are classified as poor or suffering from NBI if they are, at least, in one of these situations: they live in a house made with materials considered unfit for human accommodation; there are more than three persons per room; there is no toilet nor aqueduct; the drinking water is obtained from a river or spring, rain water, or container truck; there are more than three people per employed member and the head of household has a maximum of two years of approved primary education; there is at least one school-aged child (between 6 and 12) relative of the head of household but he/she does not attend school. When a household has two or more of these situations, the household members are considered to live in a state of misery (DANE 2012)

³² CGSM has dry-and-wet seasons well defined, separated by two transition periods. The dry season goes from March to June with a transition period in July and August. The wet season goes from September to December with a transition period in January and February (Sánchez-Martínez and Rueda 1999).

3.4 Methods

For this study we collected data through (1) a survey carried out with CGSM's fishermen containing socioeconomic information and their perceptions about the fishery resources and its management; (2) workshops and interviews with experienced fishermen and experts who evaluated the ecological impact of fishing in CGSM. Additionally, we used SIPEIN³³'s database (INVEMAR's³⁴, Fisheries Information System), with individual data on fishing spots visited and fishing gears used from 2006 to 2010 by the same fishermen that were surveyed.

The evaluation of the ecological impact of fishing consists of the development of four individual indicators and two composite indicators evaluating fishermen's fishing behavior based on fishing spots visited and fishing gears/methods used by them. To build these indicators we used the assessment made by experienced fishermen and experts separately, together with information from SIPEIN's database. Afterwards, we used the indicators to examine the socioeconomic and perceptual factors affecting their fishing decisions regarding spots visited and gears/methods used.

3.4.1 Survey

In February 2013³⁵, we conducted a survey with 172 CGSM's fishermen, who were selected from SIPEIN's database. The database provided information from 1014 fishermen that landed fish at Tasajera's fish market between 1999 and 2010. However, some of these fishermen had very few data points over that period of time³⁶, thus we used three criteria to select the fishermen that would participate in the study³⁷: *i)* those who had a minimum of five data entries in 2009 and five in 2010; *ii)* individuals who also had information for at least three other years between 1999 and 2008; and *iii)* those with at least 15 data entries in total between 1999 and 2008. These inclusion criteria enabled us *i)* to select active fishermen and *ii)* to guarantee that each selected fisherman had sufficient data to evaluate his behavior. Thus, 245 fishermen met the criteria to be

³³ SIPEIN is a system of data collection and processing of fishing information for CGSM.

³⁴ The Institute for Marine and Coastal Research - INVEMAR is an entity of mixed character (i.e. public and private). It is responsible in Colombia for doing basic and applied research on the natural renewable resources and the environment of coastal and oceanic ecosystems.

considered in the study, once in the field it was possible to contact and survey only 172 of them.

The questionnaire included 107 questions about individual and household socio-demographic aspects, perceptions about the fishery resources and their management, social capital, trust, reciprocity, and external aid received³⁸. The questions were developed based on common pool resources literature (e.g. see Ostrom 2007, 2009, Schlager, Blomquist, and Tang 1994, Agrawal 2001), fishermen's behavior literature (Salas 2000, Guest 2003, Cinner 2010), the World Values Survey, and our previous fieldwork carried out in this community. For this particular paper we used the data that allowed us to identify socioeconomic and perceptual factors that might be influencing fishermen's fishing behavior. The data is presented in the results and discussion section.

3.4.2 Evaluation of ecological impact of fishing in CGSM

The evaluation process consisted of four stages. In the first stage, we elaborated a list of all fishing spots and gears (with their respective methods) registered in SIPEIN database. In total we identified 116 fishing spots visited by fishermen. Additionally, we found seven different gears, namely, five types of nets, long lines and crab traps. One of the nets, the gill net, is used with two methods—encircling and fixed—, thus we established eight different fishing methods. For the nets we identified 36 different mesh sizes.

In stage two, we defined six fishing zones according to their ecological characteristics and importance with support of a few experts with an extensive knowledge of CGSM: protected areas, natural nursery areas, mouths of rivers and streams, mangrove roots and

³⁵ The first author administered the survey with the support of two survey takers, previously trained and with extensive fieldwork experience with rural communities.

³⁶ The difference in the number of data entries of each fisherman is due to the way the information was obtained. INVEMAR collects the data five days a week in five fish landing sites where fishermen used to sell the fishing products. At each site, the information is obtained by a resident trained by the institute for this job. They choose the fishermen unsystematically and filled out some forms with the fishing information.

³⁷ These criteria were defined based on a careful and detailed revision of the data available for each one of the fishermen.

³⁸ Previous to the survey administration, we tested the questionnaire in seven pilots.

other vegetation, Boca de la Barra and water mirrors away from the mangrove. Then, with the help of some experts and several fishermen, we classified all the 116 fishing spots identified in stage one into one of these six zones.

With regards to the fishing gears and methods, with experts support together with fishing literature (Bjordal 2009, Blaber et al. 2000, Rueda and Defeo 2003a), we defined three criteria normally used to evaluate the ecological impact of fishing gears/methods on the ecosystem, namely, impact on the habitat, efficiency and selectivity of fishing gears and target species impact. To reduce the amount of fishing nets to be evaluated, we defined based on literature (Santos-Martínez et al. 1998, INVEMAR 2002, Rueda and Defeo 2003a, Narváez B., Herrera P., and Blanco R. 2008, López, Ciales, and García 2001) and experts' knowledge, two groups of mesh sizes for each method: ecologically unsustainable (nets with the smallest mesh size) and ecologically sustainable (nets with the largest mesh size). For the shrimp nets, we defined only one group since mesh size did not vary much, moreover these were considered unsustainable because shrimps inside CGSM are juveniles (López, Ciales, and García 2001). Additionally, for each fishing gear we evaluated jointly two aspects (1) fishing method and (2) mesh size, caliber of hooks for the long lines, and size of the entrance gap for the crab traps.

Due to the diversity of fishing resources in CGSM, we considered only the main fishing resources extracted for the evaluation. Thus, in the third stage, we selected five types of fish and three invertebrates³⁹, based on CGSM's fishing reports (Cadavid et al. 2012, INVEMAR 2012) and experts' knowledge.

Based on the previous three stages, we created two questionnaires allowing us to collect experienced fishermen's and experts' opinions about the ecological impact of fishing on the main CGSM's fishery resources and its habitat condition. These questionnaires included questions for each one of the fishing zones identified earlier as well as questions regarding the different fishing gears and methods. We decided to obtain both

³⁹ Given the fishery in the CGSM is multispecies; we did not evaluate the impact of the fishing on each species in particular. Instead, we asked fishermen and experts who participated in the evaluation to consider all the species jointly (see Appendix A).

fishermen's and experts' opinion separately in order to determine if there were differences between what they considered ecologically sustainable or unsustainable, in terms of fishing spots and fishing gears (see Appendix D), but also because experienced fishermen were evaluating 116 fishing spots, whereas experts were evaluating six fishing zones.

The first author gathered experienced fishermen's and experts' opinions by conducting several workshops and individual interviews in Tasajera and Santa Marta in March 2013. She collected data from 25 experienced fishermen⁴⁰ and 25 experts, both groups were selected using convenience and snowball sampling. For this last stage of the evaluation (stage four), experienced fishermen and experts graded on a scale from one to five, where one meant low impact and five meant high impact 1) ecological impact of fishing in each one of the fishing spots (graded by fishermen) or zones identified previously (graded by experts), and 2) ecological impact caused by the fishing gears/methods on the main CGSM's fishery resources defined previously and its habitat condition. This evaluation, allowed us to obtain scores to assess fishermen's fishing behavior, thus to evaluate each data point that we had in SIPEIN database for each one of the fishermen.

3.4.3 Construction of individual and composite indicators to evaluate the ecological impact of fishing in CGSM

Based on the results of the evaluation achieved by experienced fishermen and experts, we first built individual indicators for fishing spots and fishing gears/methods and then composite indicators (see Figure 3.2). To build individual indicators based on experts' opinion, we first computed a simple average with the scores they provided for each one of the fishing zones (6). Then we repeated the same procedure for each fishing gear/method (13) evaluated. To build the individual indicators based on experienced fishermen's opinion, we repeat the same process with their scores. Afterwards, we merged these scores with the information we had in SIPEIN and calculated four individual indicators for each one of the 172 fishermen: two for fishing spots: one based

⁴⁰ Some of the fishermen who participated in this evaluation had also participated in the survey.

on experienced fishermen's scores and other based on experts; and two for fishing gears/methods: one based on experienced fishermen's scores and the other one based on experts.

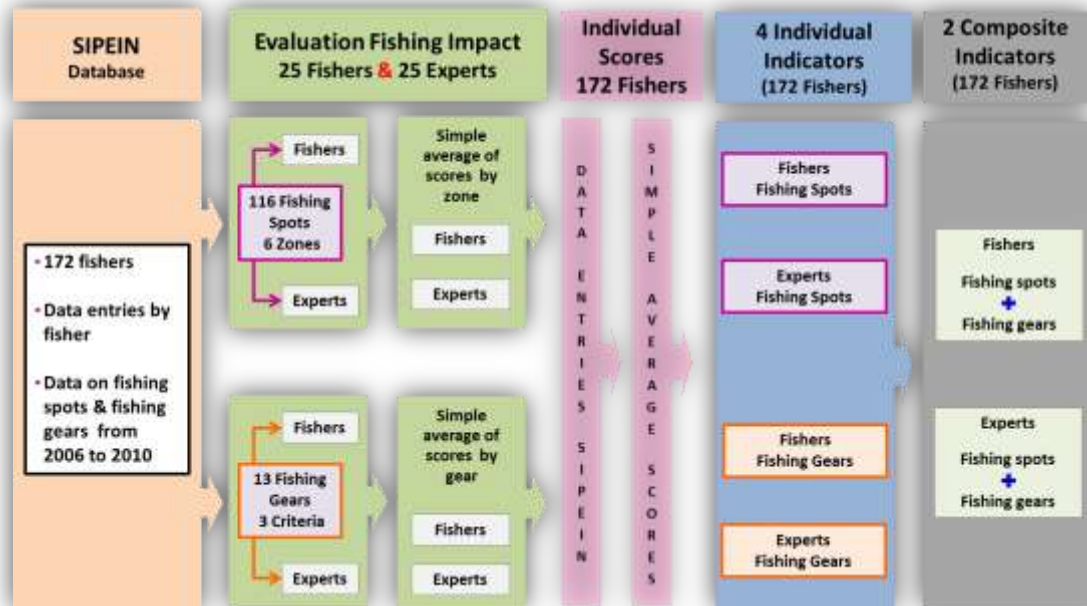


Figure 3.2. Methodology to build individual and composite indicators evaluating fishing ecological impact in CGSM.

To build the composite indicators, we first assigned to each individual indicator (fishing spot and fishing gear/method) a weight using the equal weighing method (Nardo et al. 2008)⁴¹. Then, we aggregated them using the linear aggregation method (Nardo et al. 2008)⁴². We got two composite indicators for each fisherman, one based on experienced fishermen's opinion and another one based on experts' opinions.

⁴¹ We used this method because we did not have information that allowed us to determine which of the components —fishing spot or fishing gear/method— was more important.

⁴² This method consists of the summation of the weighted individual indicators, and according to Nardo et al. (2008) it is the most appropriate when the individual indicators have the same measurement unit.

3.5 Results and Discussion

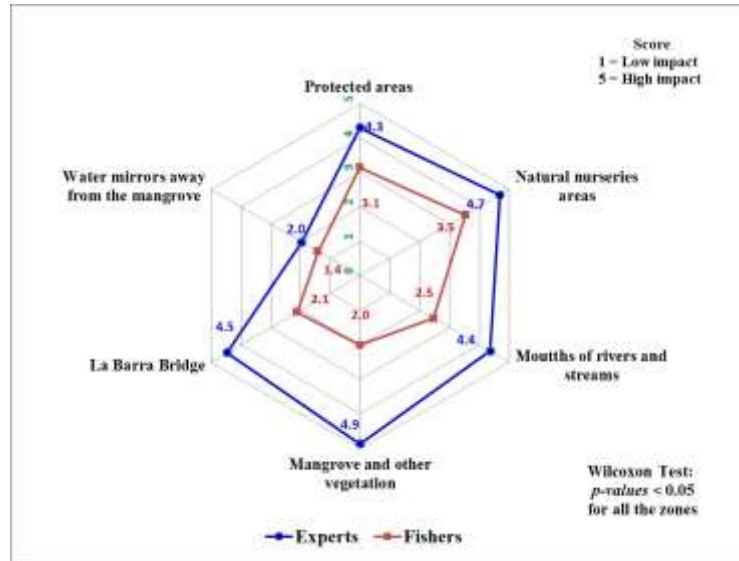
3.5.1 Fishermen's and experts' views on the fishing spots and fishing gears/methods

We started our analysis by investigating if experienced fishermen's and experts' scores are similar. Figures 3.3a and 3.3b provide a first insight of the differences and similarities between them regarding the ecological impact caused in CGSM both by the different fishing spots and gears/methods commonly used by fishermen.

Figure 3.3a presents the average scores obtained from experienced fishermen and experts for each fishing zone evaluated. The patterns are similar, which suggests that experienced fishermen and experts seem to have a common understanding about the ecological importance of the different zones evaluated, although they differed dramatically in relation to the way they assess the impact caused by fishing in all areas. Moreover, in all cases, the experienced fishermen scores are lower than the experts, thus they believe CGSM's fishermen are impacting the ecological sustainability of CGSM less than what the experts think.

Figure 3.3b illustrates the average scores obtained from experienced fishermen and experts for each of the fishing gears/methods evaluated. As in the previous figure, the patterns are similar, showing that there is a relatively good match between experienced fishermen's and experts' opinions. Unlike the previous figure, many of the scores are very similar, but always higher for experts with the exception of *cast net 1*. The difference in the scores of this net is explained by the fact that although experienced fishermen and experts agree that the mesh size of this gear is small, allowing it to catch juveniles from different species, from the experts' point of view this gear causes lower impacts than other gears for three reasons: 1) fishing power of the cast net is relatively low 2) the gear does not harm the fish and then it can be returned to the water, and 3) the size of catch depends largely on the skills, knowledge and working capacity of the fisherman, since this gear requires a great deal of effort for its operation.

a) Average scores for fishing spots by zones



b) Average scores for fishing gears/methods by sizes

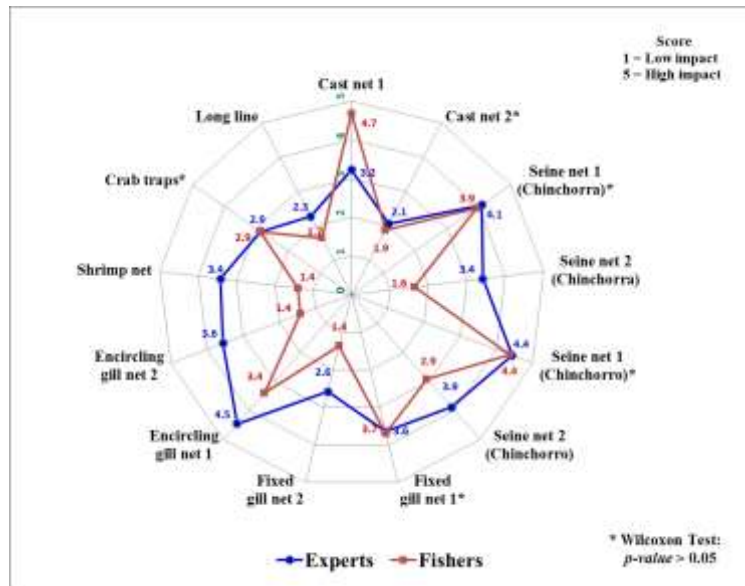


Figure 3.3. Radar graphs for fishing zones and fishing gears/methods

Figures 3.3a and 3.3b. The radar graphs show the average scores given by experienced fishermen and experts that evaluated the fishing impact on CGSM, according to the fishing spots visited (Figure 3.3a) and the fishing gears/methods (Figure 3.3b) used by CGSM's fishermen

a) Zones for fishing spots: 1) Protected areas of National Natural Parks (Vía Parque Isla de Salamaca and Santuario de Flora y Fauna Ciénaga Grande de Santa Marta), 2) natural nursery areas, 3) mouths of rivers and streams, 4) mangrove roots and other vegetation, 5) mouth of La Barra (La Barra Bridge), and 6) water mirrors away from the mangrove.

b) Fishing gears/methods: 1) Cast net 1 [0.25"-2.25"]; 2) Cast net 2 [2.50"-3.00"]; 3) Seine net 1 (*Chinchorra*) [1.50"-2.50"]; 4) Seine net 2 (*Chinchorra*) [2.75"-3.50"]; 5) Seine net 1 (*Chinchorra*) [0.75"-1.00"]; 6) Seine net 2 (*Chinchorra*) [1.01"-2.00"]; 7) Fixed gill net 1 [1.25"-2.50"]; 8) Fixed gill net 2 [2.75"-4.00"]; 9) Encircling gill net 1 (*Boliche*) [1.25"-2.50"]; 10) Encircling gill net 2 (*Boliche*) [2.75"-4.00"]; 11) Shrimp net [0.50"-1.00"]; 12) Crab traps with entrance gap of 23 cm; and 13) Long lines with hooks calibers 10 to 12.

With respect to similar scores of experienced fishermen and experts, for the *Cast net 2*, both groups agreed that it catches bigger fish and allows juveniles to scape, therefore it does not have a high impact on the fishery. Regarding *Seine net 1 (Chinchorra)* and *Seine net 1 (Chinchorro)* experienced fishermen and experts agreed that these fishing gears are very aggressive. These nets are trawl gears which remove sediments from the bottom and catch a large variety of species and sizes of fish and other organisms living in the bottom of the lagoon. Regarding *fixed gill net 1*, they also agreed that this gear is aggressive and catches juveniles and other species as well as it produces *ghost fishing*⁴³ when they are lost. Finally, with respect to crab traps, both groups agreed that this gear has a high impact because fishermen use juveniles as bait. In addition, the oxide of the traps pollutes the lagoon.

As described, experienced fishermen's scores are in almost all cases lower than experts' ones (in all six fishing zones and eight out of 13 fishing gears/methods). This can be explained by the fact that most fishermen get their main livelihood out of the lagoon and that they cannot grade their fishing practices as strongly as groups of non-direct users. Experts, on the other hand, determined the scores based on their knowledge, but also with some bias towards CGSM conservation. As shown in Table 3.1, the Wilcoxon matched-pairs signed-rank test (two tails) shows that there is statistically significant evidence (at 1% level) that fishermen and experts differ in their opinions about all fishing zones and in eight out of thirteen fishing gears evaluated.

⁴³ Ghost fishing refers to fishing gears lost or abandoned that continues to catch fish and other species. (FAO 2005)

Table 3.1. Wilcoxon Test for Fishing spots and Fishing gears/methods scores (*p*-values)

#	Description	<i>p</i> -value
<i>Fishing spots by zones</i>		
1	Protected areas of National Natural Parks	0.0000 ***
2	Natural nursery areas	0.0000 ***
3	Mouths of rivers and streams	0.0000 ***
4	Mangrove roots and other vegetation	0.0000 ***
5	Mouth of La Barra (La Barra Bridge)	0.0000 ***
6	Water mirrors away from the mangrove.	0.0000 ***
<i>Fishing gears/methods</i>		
1	Cast net 0.25" – 2.25"	0.0000 ***
2	Cast net 2.50" – 3.00"	0.3820
3	Seine net (Chinchorra) 1.50" – 2.50"	0.2984
4	Seine net (Chinchorra) 2.75" – 3.50"	0.0000 ***
5	Seine net (Chinchorro) 0.75" – 1.00"	0.3998
6	Seine net (Chinchorro) 1.01" – 2.00"	0.0002 ***
7	Fixed gill net 1.25" – 2.50"	0.8232
8	Fixed gill net 2.75" – 4.00"	0.0000 ***
9	Encircling gill net (Boliche) 1.5" – 2.50"	0.0000 ***
10	Encircling gill net (Boliche) 2.75" – 4.00"	0.0000 ***
11	Shrimp net 0.50" – 1.00"	0.0000 ***
12	Crab traps - Entrance gap 23 cm	0.9380
13	Long line - Hooks calibers 10 to 12	0.0000 ***

Notes: ***99% significance

3.5.2 Socioeconomic and perceptual variables affecting fishermen's fishing behavior

Based on our knowledge of the community and the literature on socioeconomic factors and perceptions that are determinant in explaining fishermen's fishing behavior (Nazarea et al. 1998, Cinner and Pollnac 2004, Cinner 2010, Pollnac 2000, Cassels, Curran, and Kramer 2005) we identified different variables that may help to explain the fishing behavior of CGSM fishermen⁴⁴. The variables are: years of schooling (number in years), whether fisherman has to support others living outside his household economically (dummy variable), whether he shares household expenses with others in

⁴⁴ We are aware that age is an important factor that has been identified in literature, however we did not ask for age in our survey.

his household (dummy variable), average daily hours fishing (in hours), whether he is paying a loan (dummy variable), whether he has other job alternatives (dummy variable), his perception of CGSM's fishery resources (dummy variable) and his perception about of who should conserve the lagoon (dummy variable). Table 3.2 provides an overview of the variables identified⁴⁵.

A striking fact is that fishermen only attend school for 3.8 years on an average to get a formal education. In fact, we found that the illiteracy rate in fishing communities that depend on the CGSM's fishery is very high. According to official data from 2007, the illiteracy rate in the population of over 15 years old persons in the stilt villages was 48.02% compared to 15.28% in the villages located on the highway (SISBEN 2007). This result is consistent with our previous findings on the lack of social services in the area and the extreme poverty (Torres, Schlüter, and Lopez in revision). This situation reflects the fact that fishermen who catch fish in the lagoon, do not have many choices to earn their living and have to work on average 12.7 hours per day.

Most fishermen (81.4%) believe that fishery resources are becoming scarce, whereas 15.1% consider there are still a lot of resources, and 3.5% think they have been always scarce. 55.2% affirm that fishermen should help to conserve the lagoon, whereas 40.1% consider that it is the government's responsibility to do that and 4.7% believe it is the responsibility of other CGSM's users.

⁴⁵ To be sure that all these variables were relatively independent, we examined the correlations among them. We found that correlation coefficients were low (<0.24), so no variables were removed from the analysis

Table 3.2. Summary of variables used as explanatory variables to model fishermen's behavior

Variables	Description	N	%	Mean	SD
<i>Socioeconomic variables</i>					
Years of schooling	Number of years of formal education			3.76	3.95
Fisherman has to economically support others living outside of his household (Dummy)	Fisherman has to economically supports others living outside of his household (Dummy) 0 = No 1 = Yes	53	30.81		
Fisherman shares in paying for household expenses (Dummy)	Other family members help fisherman with the household expenses. (Dummy) 0 = No 1 = Yes	74	43.02		
Daily hours fishing	Average daily work time (Including time to sell)			12.66	2.93
Fisherman is paying a loan (Dummy)	Fisherman is paying a loan (Dummy) 0 = No 1 = Yes	59	34.30		
Fisherman has other job alternatives	Fisherman has other job alternatives. (Dummy) 0 = No 1 = Yes	59	34.30		
<i>Perception variables</i>					
Fishery resources have always been scarce or they are beginning to become scarce* (Fishermen's perception)	Fishermen perceive there are a lot of resources for all.	26	15.1		
	Fishermen perceive resources have always been scarce	6	3.5		
	Fishermen perceive resources are beginning to become scarce.	140	81.4		
	Groups for regression analysis: 0 = Fishermen perceive there are a lot of resources for all. 1 = Fishermen perceive resources have always been scarce or they are beginning to become scarce.	146	84.9		
Government is who should help to the conservation of CGSM* (Fishermen's perception)	Fishermen consider they should help to conserve the CGSM.	95	55.2		
	Fishermen consider the government should help to conserve the CGSM.	69	40.1		
	Fishermen consider other CGSM's users (different to the fishermen and government) should help to conserve the CGSM.	8	4.7		
	Groups for regression analysis: 0 = Fishermen consider they should help to conserve the CGSM. 1 = Fishermen consider the government and other users of CGSM (different to the fishermen) should help to the conservation of the lagoon	77	44.8		

Total sample: 172 fishermen

CGSM: Ciénaga Grande de Santa Marta

N = Number of responses. SD = Standard deviation.

* Due to the low number of data in one of the answer choices of these variables, we grouped the data as a dummy variable, for the regression analysis.

3.5.3 Factors influencing fishermen's fishing behavior

To predict the factors influencing fishermen's fishing behavior in CGSM, we developed six OLS models using individual and composite indicators created for the 172 fishermen as the dependent variables. The independent variables used are the ones described earlier and found in Table 3.2. Table 3.3 contains the results of each of the OLS models. Models 1, 3 and 5 are based on indicators built using the experienced fishermen's scores and Models 2, 4 and 6 are based on the experts' scores. Models 1 and 2 examine the socioeconomic and perceptual variables influencing fishermen's fishing behavior regarding fishing spots and Models 3 and 4 with regard to fishing gears/methods commonly used by them. In Models 5 and 6, we investigated fishermen's fishing behavior as a whole by using as dependent variable the composite indicators built using the experienced fishermen's opinion and experts' opinion, respectively.

Based on these models, we first of all analysed factors leading to CGSM's fishermen to behave ecologically sustainable, and then the factors explaining ecologically unsustainable behavior.

3.5.3.1 Factors influencing an ecologically sustainable fishing behavior

According to our results, three factors seem to lead to ecologically sustainable fishing behavior among CGSM's fishermen, namely, higher levels of education, to share household expenses with other family members and to spend more hours fishing in the lagoon. We have partial evidence that other job alternatives, may be also leading to sustainable fishing behavior. We will now discuss each of these factors.

From Models 2, 3, 5 and 6 in Table 3.3, we can see that **education** is statistically significant at the 1% level, indicating that fishermen with more years of education tend to use fishing gears/methods and fishing spots with less impact on CGSM. However, the influence of this factor in fishermen's fishing behavior varies depending on the indicator analysed —fishing spots, fishing gears/methods or both— and the evaluator. Thus, when fishermen's fishing behavior is evaluated using the indicators built based on experienced fishermen's scores, we found that education does not influence their

behavior regarding fishing spots they visit (Model 1) but influences the fishing gears/methods that they use (Model 3). In contrast, when we use the indicators built based on the experts' scores, education is an important determinant of fishermen's fishing behavior with respect to fishing spots visited (Model 2) but not in regard to fishing gears/methods used (Model 4). Nevertheless, when we use the composite indicators (Models 5 and 6), education is an important determinant of fishermen's fishing behavior. Our results are consistent with Cassels, Curran, and Kramer (2005) findings in coastal communities of North Sulawesi (Indonesia) and with Silva (2006) study with artisanal fishermen in Marine Protective Areas in Tanzania. Both studies found that there is a relationship between lower levels of education and the use of destructive fishing gears.

To share in paying for household expenses seems to be another important determinant of sustainable fishing behavior among CGSM's fishermen. As we can see in Table 3.3, this variable is significant at 10% level in Model 2, at 5% level in Models 3, 4 and 5, and at 1% level in Model 6. This means that those fishermen, who share their household expenses with other family members, may be impacting less CGSM's fishery since they do not have to get all their income from the lagoon. Nevertheless, when fishermen's fishing behavior is evaluated using the indicator built based on experienced fishermen's scores for fishing spots this variable does not influence their behavior (Model 1). This result confirms fishermen's statements gathered from our conversations. If there are more people at home that share their households' expenses, they will be able to rest on Sundays which also provides some time for the lagoon to recover. This is a variable that has not been discussed in other studies, and in that sense we believe it is an important contribution from our study.

Table 3.3. Determinants of fishermen's fishing behavior (OLS)
Dependent variable: Individual indicators and Indices (1= low impact / 5= High impact)

Indicators/Indices	INDIVIDUAL INDICATORS				COMPOSITE INDICATORS	
	FISHING SPOTS		FISHING GEARS		FISHING SPOTS & FISHING GEARS	
Evaluator	Experienced Fishermen	Experts	Experienced Fishermen	Experts	Experienced Fishermen	Experts
Model	1	2	3	4	5	6
<i>Socioeconomic variables</i>						
Years of schooling	-0.0025 (0.0018)	-0.0226 *** (0.0063)	-0.0701 *** (0.0165)	-0.0048 (0.0062)	-0.0363 *** (0.0086)	-0.0137 *** (0.0045)
Fisherman has to economically support others living outside of his household (Dummy)	0.0093 (0.0178)	0.0401 (0.0646)	0.3014 * (0.1573)	0.0414 (0.0553)	0.1553 * (0.0832)	0.0407 (0.0403)
Fisherman shares in paying for household expenses (Dummy)	-0.0106 (0.0185)	-0.1177 * (0.0649)	-0.3521 ** (0.1501)	-0.1406 ** (0.0597)	-0.1814 ** (0.0803)	-0.1292 *** (0.0435)
Average daily hours fishing	-0.0106 *** (0.0032)	-0.0545 *** (0.0110)	-0.1080 *** (0.0269)	-0.0185 * (0.0103)	-0.0593 *** (0.0142)	-0.0365 *** (0.0080)
Fisherman is paying a loan (Dummy)	0.0315 (0.0204)	0.0624 (0.0651)	0.2413 (0.1513)	0.0630 (0.0591)	0.1364 * (0.0819)	0.0627 (0.0481)
Fisherman has other job alternatives (Dummy)	-0.0349 ** (0.0173)	-0.0845 (0.0601)	-0.1327 (0.1390)	-0.0980 ** (0.0508)	-0.0838 (0.0745)	-0.0912 ** (0.0406)
<i>Perception variables</i>						
Fishery resources have always been scarce or they are beginning to become scarce (Dummy)	0.0289 (0.0178)	0.1414 ** (0.0590)	-0.0382 (0.1855)	0.0063 (0.0549)	-0.0047 (0.0957)	0.0739 (0.0508)
Government is who should help to conserve of CGSM (Dummy)	0.0398 ** (0.0175)	0.1648 *** (0.0578)	0.2899 ** (0.1410)	0.1391 *** (0.0535)	0.1649 ** (0.0758)	0.1520 *** (0.0416)
Constant	1.3717 *** (0.0466)	2.8927 *** (0.1536)	3.7881 *** (0.3779)	3.7307 *** (0.1546)	2.5799 *** (0.1986)	3.3117 *** (0.1203)
R ²	0.1541	0.2619	0.2163	0.1241	0.2200	0.2820

Notes: ***99% significance **95% significance *90% significance. Robust standard errors are in parentheses

To **fish more hours per day** is the third factor that appears to influence fishermen to behave in an ecologically sustainable way. In fact, we found that in all six models this variable is statistically significant. In Models 1, 2, 3, 5 and 6 this variable is significant at the 1% level, and in Model 4 it is marginally significant at the 10% level. This suggests that those fishermen who fish for more hours a day exhibit a behavior more ecologically sustainable than those who spend less hours. There are several factors that might explain this result. The time-spent fishing might be associated with a preference to fish certain target species, to go farther to fish, to possess an outboard engine, and to the availability of certain species according to the period of the year. Salas and Gaertner (2004) identified some of these factors as crucial to study the dynamics of artisanal fishermen. According to these authors, different artisanal fishermen tend to develop diverse strategies in response to the changing conditions of the fisheries.

The last characteristic that seems to be important, at least in some models to explain the behavior of ecologically sustainable fishermen, is to have other job alternatives. Table 3.3 shows that this variable is significant at the 5% level in Models 1, 4 and 6, indicating that those fishermen who have alternative sources of income, different from the fishery in the CGSM, might cause lower impacts on this ecosystem. However, the influence of this factor on fishermen's fishing behavior also varies depending on the aspect analysed and the evaluator. A plausible explanation for this result is that fishermen will not overexploit the lagoon, if they can earn money from other activities than fishery. In contrast, the lack of opportunities can create a high dependence on the fishery resources, which in turn may compromise resource sustainability (Allison and Ellis 2001).

3.5.3.2 Factors influencing ecologically unsustainable fishing behavior

Based on our results, one factor leads CGSM's fishermen to behave in an ecologically unsustainable way, namely, fishermen that believe the government should be responsible for the CGSM's conservation.

The variable **government should help to conserve the CGSM**, is significant at the 1% or 5% in all models. These results suggest that regardless of the aspect evaluated (fishing spots, fishing gears/methods or both) or the evaluator (experienced fishermen or experts), fishermen considering that conservation of CGSM is a government or other users responsibility (45% of fishermen surveyed), are exerting a bigger impact on the lagoon. A plausible explanation is that between 1956 and 1960 the government built a highway that closed the natural connection between the Caribbean Sea and the CGSM, which produced a drastic change in its hydrological balance. This jointly with the construction of other dirt roads, and the deviation of the rivers that provided fresh water to the lagoon for irrigation purposes generated several negative changes in the ecosystem and its population. (Botero and Mancera 1996, Bautista et al. 2010, Mancera and Vidal 1994, Vilaridy and González 2011, INVEMAR 2002, Torres, Schlüter, and Lopez in revision). This kind of behavior is explained by *responsibility alleviation* effect developed by Charness (2000). According to this author “a shift of responsibility to an external authority dampens internal impulses towards honesty, loyalty, or generosity.” (Idem, p. 375).

The other three variables that we included in our models, namely, *fishermen has to economically support others living outside of his household*, *fishermen is paying a loan and believe that fishery resources have been always scarce or they are beginning to become scarce*, do not explain fishermen’s fishing behavior in most of models. In addition, the level of significance in models where these variables are correlated is only at the 5% or 10% level. Therefore, we do not have strong evidence allowing us to conclude that these variables are negatively affecting the fishermen’s fishing behavior.

3.6 Conclusions and Implications for CGSM Management

In this study we analysed the socioeconomic and perceptual factors leading to CGSM’s fishermen to exhibit a fishing behavior ecologically sustainably or unsustainably, by looking at their behavior from two different points of view, a group of

experienced CGSM's fishermen and a group of experts with an extensive knowledge in that fishery. We found evidence that fishermen and experts do not coincide when asking to assess the ecological impact of fishing spots and gears/methods in CGSM, moreover experienced fishermen scores are always lower than experts scores for the case of fishing zones, and in eight out of thirteen fishing gears/methods. This result is not surprising as fishermen do not have other means to survive different from extracting resources from CGSM.

We assessed fishermen's fishing behavior using three measures, one evaluated their behavior regarding fishing spots visited, another evaluated the fishing gears and methods used, and a third measure evaluated fishermen's behavior as a whole combining the above two measures. This allowed us to determine (1) the factors that make CGSM's fishermen behave in an environmentally sustainable or unsustainable manner with respect to the fishing spots that used to visit and the use of particular fishing gears or methods, and (2) the aspects affecting sustainability of CGSM's fishery resources in which fishermen and experts are agree or in disagree. This is fundamental to reach an agreement among fishermen and other stakeholders in the conservation of this lagoon, which in turn is crucial to develop a management fishery plan for this lagoon, and to achieve that fishermen comply with the regulations agreed in the plan.

Our findings suggest that socioeconomic factors and fishermen's perception about the responsibility for its conservation may influence their fishing behavior when it is measured with the indicators that we calculated. However, the influence of these factors on fishermen's decisions about the fishing spots that they visit or the fishing gears/methods that they use varies depending on the point of view from which these factors are analyzed. In summary, to have more education, to share household expenses with other family members, and to spend more hours fishing lead to a behavior that impact less the lagoon, and therefore being more ecologically sustainable. While to consider that government should be responsible for CGSM conservation, may lead fishermen to behave in an ecologically unsustainable way. It is import to stress that we

include in our analysis of factors affecting fishermen's fishing behavior two variables that had not been analysed in previous studies, namely, *fisherman has to economically support others living outside of his household* and *fisherman shares in paying for household expenses*. We found a weak evidence that the first variable influence fishermen's behavior but the second variable showed a strong relationship with fishermen's behavior.

In this study we assess how fishing practices, in particular with respect to fishing location and to fishing gear and methods may be affecting the ecological sustainability of CGSM. However, we are aware that to achieve a sustainable use of CGSM's fishery resources, it is not enough to accomplish its ecological sustainability, there are other factors of sustainability that should be taken into consideration: social, economic and institutional sustainability (Charles 1994). Sadly, CGSM had faced difficulties that have affected its social, economic and institutional sustainability over time.

Regarding the *social sustainability*, which refers to the use of resources in "ways which increase equity and social justice, while reducing social disruptions" (Goodland 1994:277), we found that most of the fishermen live under poverty, moreover they lived in a region that have been affected by the Colombian armed conflict. With respect to the *economic sustainability* which refers to "maintenance of capital or keeping capital intact", and includes the human-made, natural, social, and human capital (Goodland 1994:277), we found the in the Eco-region CGSM the economic development of the Caribbean region have affected seriously CGSM's fishery resources, which in turn have deteriorated severely the living conditions of communities that depend on this lagoon.

Finally, in relation to *institutional sustainability*, which is "related in particular to the manageability and enforceability of fishery regulations" (Charles 1994: 205), we found that although the Eco-region CGSM is under a special regimen of environmental protection and it is regulated by several Colombian laws, decrees, agreements, and resolutions, does not have any governmental agency present in CGSM controlling the

access or monitoring the fishery. Additionally, the absence of strong community ties and social networks as well as the distrust of fishermen in traditional leaders and fishermen that use illicit fishing gears, as a result of the multiple socioeconomic and political factors affecting CGSM's fishing communities (Torres, Schlüter, and Lopez in revision) have generated a great apathy among fishers to participate in any community activity oriented to the conservation of the natural resources or create voluntary any type of association that allow them to manage the fishery resources of CGSM in a sustainable way.

Acknowledgements

We thank INVEMAR's researchers, especially Efraín Vilorio, Myriam Vargas and Diana Bustos for providing outstanding support for this research. We are grateful to CGSM fishermen, in particular fishermen from Tasajera, without whose help this research would not have been possible. We would like to express our gratitude to INVEMAR's field assistants in CGSM, in particular Vladimir Carbonó for his valuable and constant support. Likewise, we want to thank Rubén Vásquez and Alexander Acuña for all their assistance in the field when we conducted the survey. Special recognition to Mabelin Villareal and Dora Suárez for their statistical support. This research was funded and supported by the Center for Tropical Marine Ecology (ZMT) and the German-Colombian Center of Excellence in Marine Sciences (CEMarin).

4 External validity of field economic experiments: a study on cooperation and impatience in an artisanal fishery in Colombia

Authors: Luz Elba Torres Guevara & Achim Schlüter

4.1 Abstract

This paper contributes to the experimental analysis of cooperation in artisanal fisheries and the external validity of economic experiments. We run a standard, one-shot public goods experiment, and two time preference 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.

Keywords:

Field economic experiments, External validity, Replication, Artisanal fisheries, Cooperation, Impatience, Colombia

4.2 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 (Ostrom 1990, Baland and Platteau 1996, Agrawal 2001, Basurto and Ostrom 2009, Basurto, Gelcich, and Ostrom 2013). Particularly, with regard to fisheries, there is empirical evidence that subjects do not always follow the theoretical assumption of self-interest (Olson 1965, Hardin 1968), and instead, they cooperate voluntarily to achieve a successful exploitation of the resources (Ostrom 1990, Basurto, Gelcich, and Ostrom 2013, Ostrom et al. 1999, Orensanz et al. 2013, Schlager 1994, Ostrom, Walker, and Gardner 1992).

Besides the ability to engage in cooperation, the level of patience or impatience of fishermen is another important factor that can affect the sustainability of fisheries over time. 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 the fishery resources.

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 subjects 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, Cárdenas and Ostrom 2004, Ostrom 2006, Cardenas and Carpenter 2008, Cárdenas 2011, Janssen and Anderies 2011), thus avoiding the circumstance of being trapped in the “tragedy of the commons” (Hardin 1968).

Particularly in fisheries, scholars have used economic field experiments to explore different factors such as communication, impatience, reciprocity, rules, regulations affecting the likelihood of successful cooperation in the management of CPRs (Velez and Lopez 2013, Lopez et al. 2012, Velez, Stranlund, and Murphy 2012, 2009, Fehr and Leibbrandt 2011, Castillo et al. 2011, Teh, Teh, and Sumaila 2011). They have found that, for instance, face-to-face communication, costly sanctioning, the ability to engage in rule formation, and the existence of clear expectations about the contribution of others, are important factors that seem to promote cooperation between fishermen.

To obtain external validity of economic experiments, researchers relate subjects' behavior in experiments with their actions in real life. In the last years, the relevance of this issue has become widely recognized, because unless it is established we cannot draw conclusions for resource governance in real life (Levitt and List 2007, Ostrom 2006). Nevertheless, there are only few studies about the external validity of experiments on cooperation in common resources management. To our knowledge, up to date, there are only six studies: four of them found evidence of external validity (Rustagi, Engel, and Kosfeld 2010, Carpenter and Seki 2011, Fehr and Leibbrandt 2011, Gelcich et al. 2013) 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 in the exploitation of a CPR with open access by combining laboratory experiments with field data. They found that shrimpers who were less impatient and cooperated more in the experiment used fishing instruments that were less likely to exploit the fishing grounds. Motivated by these findings and taking into account that cooperation and impatience are important factors for resource conservation, we investigate how fishermen's cooperative behavior and impatience are affecting the fishery resources in Colombia. The study was carried out in Tasajera, a small fishing

community located in the Caribbean coast, which depends mainly on the fishery resources from Ciénaga Grande de Santa Marta (CGSM) for their livelihood.

Tasajera is particularly suited for replicating the study of Fehr and Leibbrandt (2011) for three reasons. **First**, because similar to the shrimpers from Brazil, Tasajera's fishermen also face a CPR dilemma every day, given that there is free access to the CGSM. **Second**, because we had primary information on their real fishing behavior over various years as CGSM's fishermen. These data, together with an evaluation on the ecological impact of fishing activities (hereafter fishing impact indices) in the CGSM, made by a group of experienced fishermen and experts, allowed us to build two fishing impact indices for each fisherman: one based on experienced fishermen's scores and other based on experts' scores. It gave us a measure of their cooperativeness in sustaining the CGSM fishery (Torres, Schlüter, and Lopez In preparation). Thirdly, we had survey data on some of their socioeconomic characteristics, their perception on fishery resources of the CGSM, and their beliefs as to who should lead the conservation of this lagoon.

In Tasajera, we ran the two experiments done by Fehr and Leibbrandt (2011): a time preference experiment (TPE), a public goods experiment with some small modifications explained below. We also conducted an additional time preference experiment (TPE). These researchers first ran a TPE with pralines (chocolate bonbons which are very popular in Brazil), while in our case, we used Coca Cola because it is very appetizing in this community and pralines are not common in Tasajera. Next, Fehr and Leibbrandt ran an unframed, standard one-shot public goods experiment (PGE) with 117 shrimpers who were organized in groups of three people. We used the same experimental design of these authors, but we organized groups of five because we invited the 160 fishermen that we had surveyed. Finally, we ran the additional TPE, which was framed as a bonus for participating in the experiments. In this experiment, we adapted the payoff table of Harrison, Lau, and Williams (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 we believe may provide a more precise measurement, since the preference for the Coca Cola could eventually be influenced by some “visceral factors” such as cravings, hunger, among others (Frederick, Loewenstein, and O'Donoghue 2002)⁴⁶. With regard to the data on fishermen's day to day behavior with respect to the fishery, we used a different measure from Fehr and Leibbrandt (2011). Thus, while they used the fishermen's shrimp traps and their corresponding hole sizes, we used the fishing impact indices mentioned above.

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.

4.3 Research Setting

Tasajera is made up of about 8,000 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 (INVEMAR 2013, Ibarra et al. 2014), with around 3,500 fishermen (Blanco, Narváez, and Vilorio 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.

⁴⁶ According to Frederick, Loewenstein, and O'Donoghue (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.

CGSM is situated in the center of a bigger region (about 4900 km²) known as *Eco-region Ciénaga Grande de Santa Marta*⁴⁷, and it is one of the most important in Colombia due to its large size (450 km²) (Gónima, Mancera, and Botero 1996), and its ecological and social value⁴⁸ (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 regulates the fishery. In addition, since the 1960's, the entire Eco-region has been seriously affected by both violence that illegal armed groups have exerted on this zone, and the economic development in the Colombian Caribbean region (Vilardy and González 2011, Botero and Mancera 1996, Torres, Schlüter, and Lopez in revision). These factors have contributed to 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 (INVEMAR 2002, Ibarra et al. 2014).

4.4 Field Data

The conservation and sustainable use of CGSM's fishery resources largely depends on the use of appropriate fishing gears 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 (Narváez B., Herrera P., and Blanco R.

⁴⁷This Eco-region includes 570 km² of marine area and 730 km² of an estuarine system of coastal lagoons, connecting creeks and mangrove swamps.

⁴⁸ The CGSM was declared as Fauna and Flora Sanctuary in 1977. Likewise, it was designated as 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 2012, 2007).

2008, Rueda, Mancera, and Mendo 1997, Rueda 2007, Rueda and Defeo 2003a, Ibarra et al. 2014, Ibarra et al. 2013).

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 (for details see Torres, Schlüter, and Lopez In preparation). Nevertheless, as non-biologists, we did not know what type of fisherman behavior would be considered sustainable. Therefore, we asked fishery biologists working in the CGSM, first in a qualitative and then in a standardized way, how to classify what signifies sustainable fishing behavior and how to assess each individual fisherman. There could be a strong misunderstanding about what signifies sustainable behavior between the experts and the fishermen, who are actually taking the decisions. In case there would be 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, gears, methods and spots. Apart from the general trend that experts, in comparison to fishermen, value any type of behavior as being less sustainable, the various gears, methods, and places were ranked rather similarly. To the construction of these indices, we used two sources of data:

1. A database from SIPEIN (INVEMAR's Fisheries Information System). It is a system of data collection and processing of fishing information that belongs to INVEMAR⁴⁹. This Institute has been collecting fishing information on the CGSM since 1993⁵⁰. For our study, we used data from 2006 to 2010 regarding the fishing

⁴⁹ INVEMAR (Instituto de Investigaciones Marinas y Costeras) is an entity of mixed character (i.e. public and private). It is responsible in Colombia for doing basic and applied research on the natural renewable resources and the environment of coastal and oceanic ecosystems.

⁵⁰ The information gathered is on topics such as catch, fishing gears and methods, mesh sizes, and fishing spots, among others. The data are collected five days a week, in five fish landing sites where fishermen used to sell the fishing products. At each site, the information is collect by a resident trained by

spots, and characteristics of the fishing gears and methods used by fishermen who later participated in our experiments.

2. An evaluation of the ecological impact of fishing activities in the CGSM. For this evaluation, conducted on March 2013, we asked 25 experienced CGSM fishermen and 25 experts in different topics related to the CGSM to grade on a scale from 1 to 5 (where one means low impact and five means high impact) the following aspects:

- a) The ecological impact of seven different fishing gears⁵¹ (with their respective methods), on the most important CGSM's fishery resources.
- b) The ecological impact of fishing on 116 fishing spots regularly visited by fishermen.

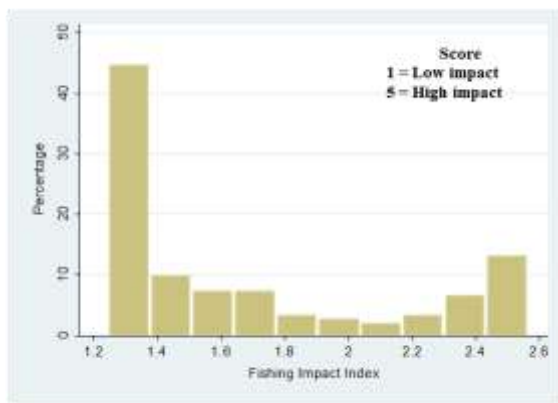
We built for each fisherman two fishing impact indices (one based on experienced fishermen's scores and another one based on experts' scores) with an identical range from [1, 5]. To build them, we first developed individual indicators for both fishing spots and fishing gears, and then we aggregated them to get the indices⁵². Figure 4.1 displays the distribution of these indices based on experienced fishermen's scores (Figure 4.1a) and experts' scores (Figure 4.1b). The average scores of the indices are 1.67 and 2.86 respectively. (See sections 3.4.2 and 3.4.3 for a detailed description of the development of the individual indicators and indices).

INVEMAR for this job. They choose unsystematically the fishermen and fills out some forms with the fishing information.

⁵¹ Cast net, gill net (encircling and fixed), Chinchorro (large seine net), Chinchorra (small seine net), long line, shrimp net, and crab traps.

⁵² The indices or composite indicators are a single index, which compiles individual indicators. In addition, it may measure multidimensional concepts that cannot be captured by a single indicator (Nardo et al. 2008)

a) Fishing Impact Index built based on
experienced fishermen's scores



b) Fishing Impact Index built based on
experts' scores

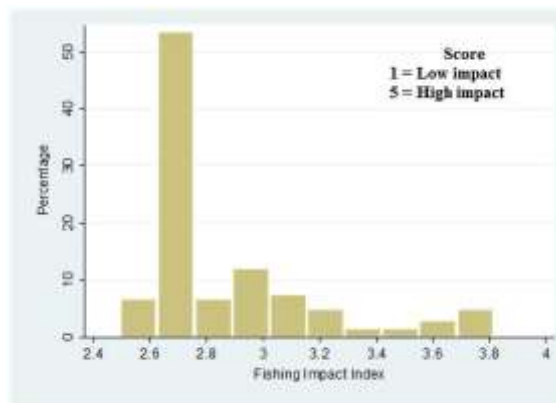


Figure 4.1. Distribution of the fishing impact index.

Note: The indices are organized into small groups for illustrative purposes.

Given the fishing characteristics of CGSM (multi-gear and multi-species), the use of these indices as a measure of Tasajera fishermen's cooperativeness to maintain their main source of income and livelihood has some advantages compared to the measure of the hole size of shrimp traps used by Fehr and Leibbrandt (2011). **First**, the indices take into account all of the fishing gears and methods used by fishermen, instead of using only one fishing instrument. This is particularly important in our case because fishermen in Tasajera generally use more than one fishing gear or method over the year, or jointly during a normal fishing day. Also, one particular gear might have been chosen due to many reasons, for example, inheritance or current availability. Therefore, it might not indicate the general sustainability orientation of a fisherman. Examining the many choices a fisherman makes will better reflect the general trait of the individual, which is assumed to exist, similarly when analyzing his experimental behavior.

Second, to build the fishing impact indices we used real and reliable data on daily fishing habits of fishermen for a long period of time. These data included information about both fishing spots visited, as well as fishing instruments used by fishermen from 2006 to 2010. It enabled us to consider not only those aspects related to the fishery

process (periods of abundance or scarcity of the species, period of the year⁵³), but also fishermen's behavior according to their needs over time. For example, a fisherman may have a particularly high need and therefore chooses a detrimental mesh size or visits a particularly high yielding spot, when otherwise he behaves more sustainably. Finally, the **third** advantage of using the indices in comparison to a single measure is that they take into account not only the impact of fishing instruments, but also the impact of fishing activities on certain fishing spots. This is very important to the ecological sustainability of the CGSM. Thus, to go fishing, for instance, to nursery areas or transit corridors of species can reduce the future yield, since in these areas the majority of the species are juveniles or they are in transit to spawning in safer places.

In addition to the data used to build the fishing impact indices, we got individual information for the same group of fishermen that participated in the experiments through a survey conducted in February 2013⁵⁴. It allowed us to get data on their socioeconomic characteristics and their perception about the CGSM's fishery resources and who should help in the conservation of this lagoon. We use these variables as control variables in our models. Table 4.1 presents some summary statistics of these variables. We chose these variables based on our knowledge about this community, and some studies on artisanal fishermen's behavior which demonstrate the link between those variables and sustainable behavior (Allison and Ellis 2001, Cinner and McClanahan 2006, Cinner and Pollnac 2004, Silva 2006). With respect to these variables, it is worth noting that all of our participants in the experiments were men and full-time fishers. On average, they have 31.5 years of experience as fishers, work 12.7 hours per day, and had 4.1 years of formal education.

⁵³ The CGSM has well-defined dry-and-wet seasons, separated by two transition periods. The dry season goes from March to June with a transition period to rain in July and August. The wet season goes from September to December with a transition period to low water in January and February. (Sánchez-Martínez and Rueda 1999).

⁵⁴ The survey was administered for the first author, with the support of two survey takers, previously trained and with extensive fieldwork experience in rural communities. It contained questions about individual socioeconomic aspects, household economic activities, environmental awareness, social capital, trust, reciprocity, collective action, and external aid received. See Torres, Schlüter, and Lopez (In preparation) for further analysis of the data survey.

Table 4.1. Summary of variables used in the estimations

Variables	Description	N	%	Mean	SD
Years of schooling	Number of years of formal education			4.09	3.96
People who fisherman maintains	Number of people who depend economically on the fisherman in his home.			4.14	2.32
Fisherman shares in paying for household expenses	Other family members help fisherman with the household expenses. (Dummy) 0 = No 1 = Yes	62	40.79		
Average daily hours fishing	Average daily work time (Including time to sell)			12.72	2.85
Years in occupation	Years fishing professionally			31.54	11.57
Fisherman is paying a loan	Fisherman is paying a loan. (Dummy) 0 = No 1 = Yes	51	33.55		
Fisherman has other job alternatives	Fisherman has other job alternatives. (Dummy) 0 = No 1 = Yes	54	35.53		
Fishermen perceive resources have always been scarce or they are beginning to become scarce* (Fishermen's perception)	Fishermen perceive there are a lot of resources for all.	24	15.79		
	Fishermen perceive resources have always been scarce	3	1.97		
	Fishermen perceive resources are beginning to become scarce.	125	82.24		
	Groups for regression analysis: 0 = Fishermen perceive there are a lot of resources for all. 1 = Fishermen perceive resources have always been scarce or they are beginning to become scarce.	128	84.21		
Government is who should help to the conservation of CGSM* (Fishermen's perception)	Fishermen consider they should help to conserve the CGSM.	83	54.60		
	Fishermen consider the government should help to conserve the CGSM.	63	41.45		
	Fishermen consider other CGSM's users (different to the fishermen and government) should help to the conservation of the CGSM.	6	3.95		
	Groups for regression analysis: 0 = Fishermen consider they should help to the conservation of the CGSM 1 = Fishermen consider the government and other users of the CGSM (different to the fishermen) should help to the conservation of the lagoon.	69	45.39		

Total fishermen that participated in the experiments: 152

N = Number of responses. SD = Standard deviation.

* Due to the low number of data in one of the answer choices of these variables, we grouped the data as a dummy variable, for the regression analysis.

4.5 The Experiments

4.5.1 Experimental Procedure

We conducted four laboratory sessions in a school of Tasajera during the weekend of October 19 and 20 of 2013. We invited the same fishermen that we surveyed in February 2013⁵⁵, with 40 fishermen for each session, although, some of them did not show up. We sampled a total of 152 subjects. The first author visited each fisherman at his home and invited him to participate in the experiments. Fishermen took part in three experiments: one standard PGE and two TPE, all ran in the same session. We previously told fishermen that the session would last about three hours⁵⁶. To enhance understanding of the experiments, we split up the group into two smaller groups in each one of the sessions.

The first author and a native, previously trained Spanish-speaking assistant led both sessions simultaneously, following the same order. At the beginning of the session, we implemented the TPE with Coca Cola. Afterwards, fishermen played the PGE and finally, an additional TPE. We followed a simple design, and we used clear visual instructions to facilitate fishermen's understanding of the experiments, and the consequences of their decisions. We conducted each experimental session in the same order, and we assigned each fisherman a code for both identifying him during the session, and to ensure his anonymity for the laboratory experiments⁵⁷. All the fishermen's questions were answered in public and communication among fishermen during the experiments was not allowed. We provided the fishermen a complimentary snack and soft drink at the end of the session.

⁵⁵ It is important to point out that since we wanted to compare fishermen's behavior in the real life with their decisions in the experiments; we invited only those fishermen of which we had enough information in the SIPEIN database. Therefore, we could not make a random selection of them and we have a subject selection bias.

⁵⁶ In order to avoid fishermen losing their entire working day, each of them had the opportunity to choose in which of the four sessions they wanted to participate in the experiments.

⁵⁷ We wrote the code on a sticker and then it was stuck on the fishermen's shirts.

4.5.2 Experimental Design

4.5.2.1 The Public Goods Experiment

We ran a laboratory PGE with Tasajera's fishermen. We assigned them randomly to groups of five persons. The participants did not know to which group of five they belonged. We played the experiment for one period, which allowed us to have a measure of their voluntary cooperation without the effects that might come from repeated interaction or reputational concerns. The experiment was framed in abstract and neutral terms as a transfer of money from a private account to a group account. Each fisherman received an endowment of 10 tokens, and each token equaled \$1,000 pesos⁵⁸. Each fisherman had to individually decide how many out of 10 tokens he wanted to keep for himself in his private account, and how many tokens he wanted to transfer to the group account. Each token contributed to the public good earned a return of 0.5 to all fishermen in the group. Tokens in the group account were multiplied by the factor 1.5 and then equally distributed among the five group members. Thus, if the five fishermen in the group contributed their 10 tokens to the group account each of them earned 15 points, but if none of them contributed, each of them only earned 10 tokens. The payoff function was:

$$\prod_i (x_i, x_j) = (10 - x_i) + \left[\left\{ 1.5 \times \left(\sum_{j \neq i} x_j + x_i \right) \right\} / 5 \right]$$

Where x_i is individual i 's contribution to the public good, and x_j is the sum total of the other four players' contributions. At the start of the session, the experimenter read the instructions aloud and answered all the fishermen's questions in public (see instructions in Appendix E)⁵⁹. Then, after several examples and answering all the fishermen's questions, the experimenter asked some test questions aloud in order to guarantee that all

⁵⁸ The Colombian currency is called pesos. \$1,000 pesos is about US\$0.53, using the exchange rate of October 19, 2013 of 1 US dollars equals 1,879.48 Colombian pesos.

⁵⁹ The experimental instructions were first wrote in Spanish and then translated to English.

of the fishermen had completely understood the structure of the experiment. Afterwards, each fisherman received two envelopes, one marked as a private account, which contained his endowment (10 tokens), and the other marked as a group account, which was empty. Fishermen could transfer tokens from the private account to the group account. Fishermen took their decisions in private in a special place built in front of the classroom for this purpose. We did not inform the fishermen about the identity and individual contribution decisions of their group members. We paid each fisherman his earnings in private and in cash at the end of the session. Individual earnings ranged between \$5,700 pesos and \$18,900 pesos, with an average of \$12,580 pesos (about US\$ 6.71)⁶⁰.

4.5.2.2 The Time Preferences Experiments

- ***The experiment with the Coca Cola***

To get a measure of the level of impatience of Tasajera's fishermen, we ran the first TPE with Coca Cola. Nevertheless, we always made sure that enough plain water was available during the session. Thus, we reduced the risk that subjects ask for the Coca Cola only because they were thirsty⁶¹. Fishermen had to indicate whether they preferred one Coca Cola before starting the experimental session or two Coca Colas at the end of the session, when they would receive their earnings from the PGE.

- ***The Experiment with the Bonus (Discount Rates)***

Given the TPE with Coca Cola only provides a very rough measurement of impatience, we ran a more standard TPE. For that, we adapted the payoff table of Harrison, Lau, and Williams (2002) to the context of Tasajera. Thus, in our case, we had only five alternatives for fisherman, of which one alternative was randomly chosen for payment.

⁶⁰ A day's wage in this zone varied between \$15,000 –\$20,000 pesos (US\$7.98 – US\$10.64) at the time of the experiments.

⁶¹ Given the temperature in Tasajera is around 35 °C we kept both Coca Cola and the water in a cooler before to be distributed to the fishermen.

The question that we used to elicit individual discount rates was do you prefer \$10,000 pesos⁶² payable in one week or \$10,000 pesos + \$X, payable in two weeks. In our experiment the \$X varied from \$0 to \$10,000 pesos to reflect monthly interest rates from 0% to 400%, respectively (see Table 4.2). We used these high interest rates because in pre-tests we found out that those rates are appropriate ones to allow for substantial variation.

Table 4.2. Payoff table for the two-week time horizon

Payoff alternative	Payment option A (1 week)	Payment option B (2 weeks)	Weekly interest rate	Monthly interest rate
1	\$10,000 pesos	\$10,000 pesos	0%	0%
2	\$10,000 pesos	\$12,500 pesos	25%	100%
3	\$10,000 pesos	\$15,000 pesos	50%	200%
4	\$10,000 pesos	\$17,500 pesos	75%	300%
5	\$10,000 pesos	\$20,000 pesos	100%	400%

We used two future payments in order to reduce the likelihood that fishermen perceive differences between the payments regarding the transaction costs and the risk associated with future payment (Harrison, Lau, and Williams 2002). In addition, we described the payment as a bonus (show up fee) to participate in the experimental session (see instructions in Appendix E), which would be paid in the next weeks directly in their houses by the experimenter⁶³. The advantage of this is that fishermen did not change their behavior simply because they were being observed, and made their decisions using their normal decision making process (Harrison and List 2004).

To assure fishermen understand the experiment, we explained it individually and we read each of the payment alternatives, instead of providing a payoff table. Once the

⁶² \$10,000 Colombian pesos are about US\$5.32, using the same exchange rate of October 19, 2013 mentioned before.

⁶³ Given the experimenter has been working with this community since 2011, she is known as a trustworthy person among fishermen. We could confirm somehow this impression while we ran the experiment, since all fishermen appeared confident that they would receive their money in the next weeks at their houses.

experimenter was sure the fisherman had understood the experiment, he made his decision. The first author and three field assistants collected fishermen's decisions simultaneously using different classrooms to guarantee the confidentiality of the fishermen's decisions. We calculated the fishermen's discount rates by finding the point at which they switch from choosing the sooner to the later payment.

4.6 Results and Discussion

In this section, we first examine the correlation between the results of the field experiments and individual levels of exploitation of CGSM's fishery resources, measured through the indices. Then, we discuss our findings in light of other studies that compare real life behavioral data with experimental data. Similar to Fehr and Leibbrandt (2011), we used the outcomes of the PGE and the two TPEs to predict fishermen's cooperativeness in maintaining the CGSM fishery. Based on this, we hypothesize (1) that fishermen who contribute more in the PGE and therefore show a higher level of cooperation, exert a lower impact on the CGSM (i.e., the value of their fishing impact indices are low), and (2) that fishermen who are impatient in the TPE (Coca Cola & Bonus) have higher impacts on the CGSM (i.e., the value of their fishing impact indices are high).

4.6.1 Predicting Fishermen's Cooperation with the Public Goods

Experiment

According to our results, only a small group of fishermen behaved selfishly and did not contribute (9.2%), or contribute only one token (4.6%) to the public good, while 21.7% contribute five tokens, and 34.2% contribute more than five tokens (see Figure 4.2). These results contrast with shrimpers' contributions analyzed by Fehr and Leibbrandt (2011) in Brazil. In their case, 15.8% of shrimpers did not contribute to the public good, 11.4% contributed only one unit, 21.1% contributed five units (tokens), and only 18.4% contributed more than five units.

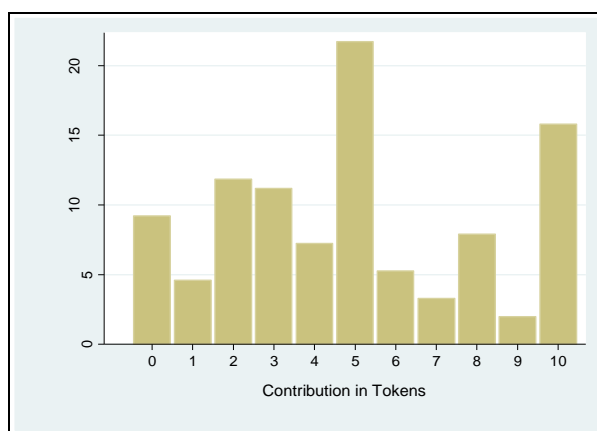


Figure 4.2. Distribution of contributions in the Public Goods Experiment
Total fishermen: 152.

Overall, the mean contribution to the group account was in our PGE 4.93 tokens (SD 3.14), while in the case of shrimpers it was 3.63 tokens (SD 2.69). Nevertheless, our results are in line with previous one-shot public goods field experiments. In fact, Hill and Gurven (2004) reported a mean contribution of 4.8 points out of 10 (SD 0.22) among Aché Indians of Paraguay. Hopfensitz and Miquel-Florensa (2014), in an experiment with small-scale coffee farmers in Colombia reported a mean contribution of 5.76 points out of 10 (SD 2.63). Coleman and Lopez (2013) in an experiment with subjects in Colombia that had been affected by armed conflict, found that about 63 percent of the time participants contributed to the public good, regardless if they had participated in economic and social development programs to reduce violence.

Figure 4.3, shows the relationship between contributions to the PGE and the average of the fishing impact indices calculated based on the opinion of experienced fishermen (Figure 4.3a) and experts (Figure 4.3b). As we can see, independently of the index used, the relationship between the indices and their contributions to the PGE is almost null. Likewise, if we grouped fishermen according to their contributions to the public good in low (0 – 1 token, N = 21), medium (2 – 4 tokens, N = 46) and high level (5 – 10 tokens, N = 85)⁶⁴, we obtain similar results (Figure 4.3c). Pearson correlation analysis between

⁶⁴ We used the same categories used by Fehr and Leibbrandt (2011) to made the groups.

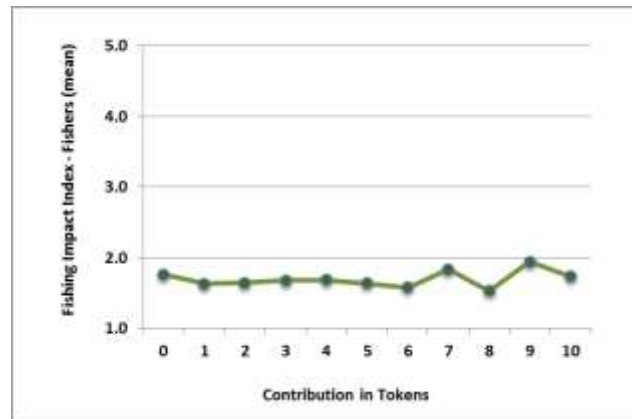
contributions in PGE (0,1,...,10) and the indices confirmed these results (fishermen's opinion: $r = 0.0128$ $p = 0.8758$ and experts' opinion: $r = -0.0379$ $p = 0.6430$).

We also investigated whether contributions in the PGE can predict the level of impact that fishermen cause on the fishery resources of CGSM, using Ordinary Least Squares (OLS) regressions. To analyze these correlations we used the fishing impact indices calculated based on the experienced fishermen's scores (Table 4.3) and experts' scores (Table 4.4) as dependent variables in the models. We found that independent of the index, the contributions in the PGE fail to predict the level of impact that fishermen exert on this ecosystem (Table 4.3, Model 1: $t = 0.15$, $p = 0.883$; Table 4.4, Model 1: $t = -0.51$, $p = 0.610$). We tested if these results were robust to the inclusion of several control variables such as years of schooling, number of people that fisherman maintain or average daily hours fishing and we got similar results (Table 4.3, Model 4: $t = 0.00$, $p = 1.000$; Table 4.4, Model 4: $t = -0.65$, $p = 0.515$). In Models 7 and 8 in Tables 4.3 and 4.4, we added the impatience measured by the TPE with Coca Cola (Models 7) and the TPE with the bonus (Models 8) as other control variables. However, these do not affect the significance of the contributions in the PGE. Therefore, the results remain insignificant⁶⁵.

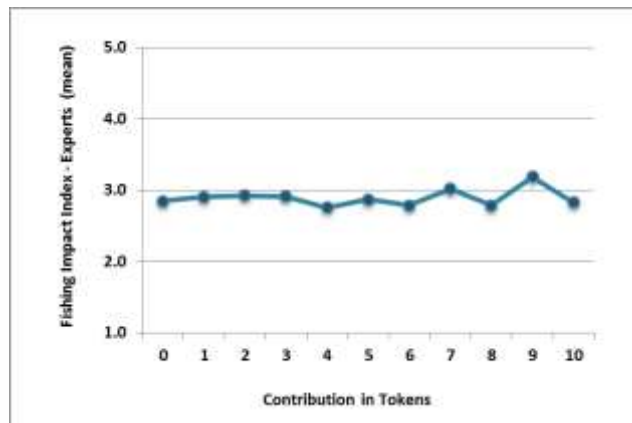
Overall, in contrast to the findings of Fehr and Leibbrandt (2011), we did not find evidence to confirm our hypothesis that fishermen who contribute less to the public good exert higher impacts on the CGSM and fishermen who contribute more have lower impacts on this lagoon. A likely explanation of this lack of correspondence between the behavior in the experiment and the real fishing behavior of fishermen is the use of the index as a measure of cooperation to maintain the CGSM. Thus, while Fehr and Leibbrandt (2011) used the hole size of the shrimp traps, our index included several aspects of fishing activity. In Section 5.3, where we discuss our findings in light of other studies, we analyse this aspect in more detail.

⁶⁵ We ran some models to investigate if the socioeconomic and perceptual variables may predict fishermen's decision in the PGE, but none of them had a significant correlation.

a) Contributions PGE & Index (Experienced Fishermen's opinion)



b) Contributions PGE & Index (Experts' opinion)



c) Contributions PGE by groups & Indices

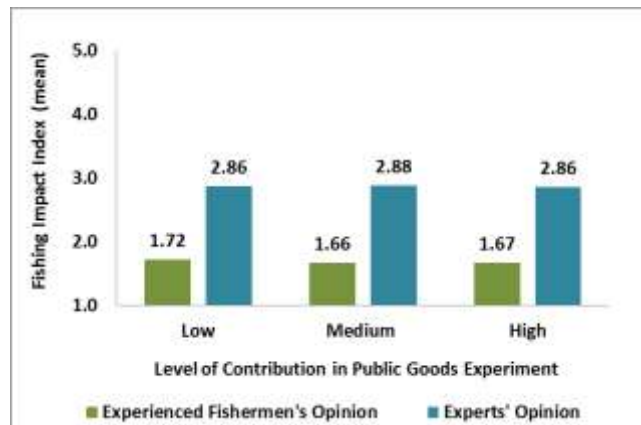


Figure 4.3. Contribution to the public goods experiment (PGE) and fishing impact indices
Level of contributions: Low = 0-1 Tokens; Medium: 2-4 Tokens; High: 5-10 Tokens.
Fishing impact index: 1 = Low impact 5 = High impact

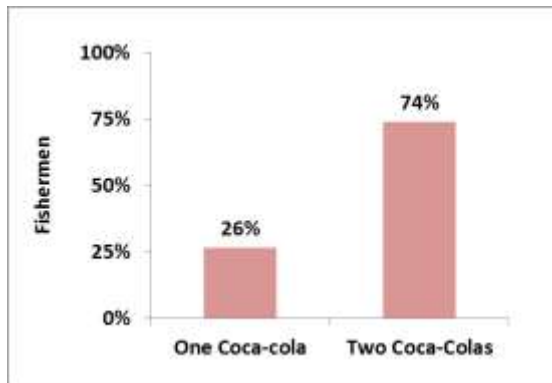
4.6.2 Predicting Fishermen's Cooperation with the Time Preferences Experiments

As we mentioned earlier, we used two TPE (Coca Cola & Bonus) to get an individual measure of fishermen's impatience. Figure 4.4 displays the fishermen's preference for Coca Cola (Figure 4.4a) and the distribution of estimated discount rates (Figure 4.4b). It can be seen that 74% of fishermen in our study were patient and preferred two Coca Colas at the end of the session, which is similar to the findings of Fehr and Leibbrandt (2011) who found that 61% of shrimpers were patient and preferred three pralines at the end of the experimental session. We found that 42% of fishermen who were patient in the TPE with Coca Cola (112 subjects out of 152) had low discount rates (25% and 50%), 38% had high discount rates (100% or above), 8% has a discount rate of 75%, and the rest (12%) were eliminated because they gave inconsistent responses. Likewise, we can observe that 46% of fishermen had low discount rates (25% and 50%), which is consistent with Teh, Teh, and Sumaila (2011) who found that 42% of small-scale fishermen of Sabah and Fiji had low discount rates (i.e., those who chose the smallest future payment), and Akpalu (2008) who found that 39% of fishers in Ghana had discount rates below 100%.

In sum, our results from the experiment to estimate fishermen's discount rates somehow confirmed our findings in the experiment with Coca Cola. A large group of CGSM's fishermen are patient, which could facilitate the implementation of a fishery management plan in the CGSM. However, this is a delicate suggestion, and rests on their willingness to carry out actions with the long term in mind, thereby allowing a better management of fishery resources, or better compliance with fishing regulations⁶⁶.

⁶⁶ Akpalu (2008) found that impatient fishermen of Ghana had a higher likelihood of violating fishing regulations, and the individual discount rates were associated with the intensity of violation, as measured by the mesh size regulation.

a) Distribution of preference for Coca Cola



b) Distribution of estimated discount rates

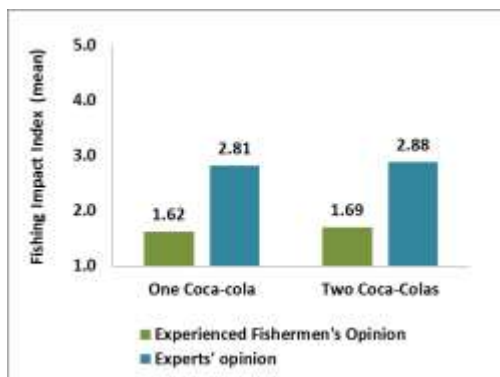


Figure 4.4. Fishermen's preferences in the experiments

Total fishers: 152 for the TPE with Coca Cola. In the case of TPE with the bonus, the final sample consists of 134 observations. 18 subjects gave inconsistent responses, so we did not include these observations.

Figure 4.5 shows a first insight into the relationship between fishermen's impatience and the level of impact that they cause on the CGSM. As we can observe in Figure 4.5a, the average scores of indices from fishermen who are impatient and prefer one Coca Cola immediately are similar to the average scores of indices from fishermen who are patient and prefer two Coca Colas at the end of the experimental session. Figure 4.5b shows similar results: fishermen with the lowest discount rates (i.e., patient fishermen) have almost the same average scores of indices that fishermen who have the highest discount rates (i.e., impatient fishermen).

a) Coca Cola & Fishing Impact Indices



b) Bonus & Fishing Impact Indices

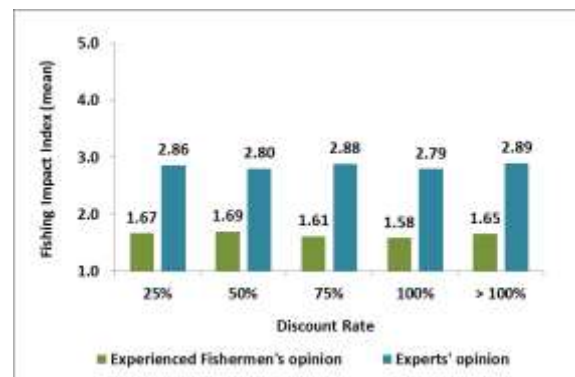


Figure 4.5. Impatience and fishing impact indices.

Fishing impact index: 1 = Low impact 5 = High impact

We also used OLS regressions to analyse the relationship between impatience and the scores of fishing impact indices calculated based on the experienced fishermen's scores (Table 4.3) and experts' scores (Table 4.4). For the regressions, the variable *Impatience (Coca Cola)* was coded as a dummy variable (0 = Prefers one Coca Cola immediately and 1 = Prefers two Coca Colas after). The variable *Impatience (Bonus)* was coded as a percentage, and corresponds to the discount rate calculated for each fisherman.

In Models 2 and 3 of Tables 4.3 and 4.4, we investigated whether the impatience in the TPE with Coca Cola (Models 2) and the TPE with the bonus (Models 3) have any effect on the scores of the indices. We found no effect of the impatience on the scores of the indices. Nevertheless, when we added control variables, Models 5 and 6 in the same Tables (4.3 and 4.4), we observe that there is a small significant positive relationship (at the 10% level) between fishermen who are impatient and prefer one Coca Cola immediately and the fishing impact index calculated based on experts' opinion (Table 4.4, Model 5). Thus, fishermen who are impatient have a higher fishing impact index (coefficient = 0.0878 points, $t = 1.79$, $p = 0.075$) than fishermen who are patient and prefer two Coca Colas at the end of the experimental session. This result continues being significant (at 10% level) and robust to the inclusion of the contributions in the PGE as a control variable (coefficient = 0.0856 points, $t = 1.73$, $p = 0.086$) in the Model 7 of Table 4.4. In Model 8 of Tables 4.3 and 4.4, which focuses on the TPE with bonus, where we added the contribution to the PGE and other control variables, we still find no correlation between the level of impatience for the bonus and the scores of the fishing impact indices⁶⁷.

⁶⁷ We also investigated which of the socioeconomic and perception variables predicted fishermen's decisions in both TPEs. We observed that *years in occupation* and *fishery resources are scarce* were the only variables that significantly (at the 5% level) predict decisions in the experiments with Coca Cola and the bonus, respectively.

Table 4.3. Determinants of fishermen's fishing behavior (OLS) based on experienced fishermen's opinion

Dependent variable	Fishing impact index estimated with fishermen's opinion							
Models	1	2	3	4	5	6	7	8
Contribution in PGE (in tokens)	0.0018 (0.0124)			0.0000 (0.0110)			0.0014 (0.0110)	-0.0070 (0.0116)
Impatience (Coca Cola dummy)		0.0728 (0.0843)			0.1112 (0.0735)		0.1121 (0.0735)	
Impatience (Bonus %)			-0.0788 (0.1197)			-0.0915 (0.1115)		-0.0824 (0.1151)
Years of schooling				-0.0203 ** (0.0082)	-0.0220 *** (0.0082)	-0.0209 ** (0.0098)	-0.0220 *** (0.0084)	-0.0205 ** (0.0099)
People who fisherman maintains				-0.0124 (0.0149)	-0.0132 (0.0144)	-0.0094 (0.0164)	-0.0131 (0.0145)	-0.0100 (0.0165)
Fisherman shares in paying for household expenses (Dummy)				-0.2169 *** (0.0678)	-0.2210 *** (0.0667)	-0.2181 *** (0.0732)	-0.2220 *** (0.0678)	-0.2140 *** (0.0738)
Average daily hours fishing				-0.0555 *** (0.0136)	-0.0576 *** (0.0136)	-0.0499 *** (0.0162)	-0.0575 *** (0.0135)	-0.0506 *** (0.0160)
Years in occupation				0.0012 (0.0031)	0.0005 (0.0031)	0.0007 (0.0032)	0.0005 (0.0031)	0.0007 (0.0032)
Fisherman is paying a loan (Dummy)				0.1687 ** (0.0718)	0.1601 ** (0.0711)	0.1701 ** (0.0786)	0.1600 ** (0.0716)	0.1697 ** (0.0786)
Fisherman has other job alternatives (Dummy)				-0.0549 (0.0654)	-0.0469 (0.0660)	-0.0843 (0.0672)	-0.0467 (0.0661)	-0.0852 (0.0670)
Fishery resources have been always scarce or they are beginning to become scarce (Dummy)				-0.0219 (0.0845)	-0.0278 (0.0848)	-0.0535 (0.0901)	-0.0278 (0.0851)	-0.0535 (0.0909)
Government is who should help to the conservation of GCSM (Dummy)				0.2168 *** (0.0646)	0.2151 *** (0.0641)	0.1984 *** (0.0694)	0.2146 *** (0.0643)	0.2017 *** (0.0690)
Constant	1.6627 *** 0.0679	1.6182 *** 0.0729	1.6964 *** 0.0934	2.4447 *** (0.2141)	2.4295 *** (0.2144)	2.4620 *** (0.2876)	2.4214 *** (0.2115)	2.4959 *** (0.2768)
Observations	152	152	134	152	152	134	152	134
R²	0.0002	0.0051	0.0033	0.2926	0.3038	0.2548	0.3039	0.2572

Notes: *** 99% significance ** 95% significance * 90% significance. Robust standard errors are in parentheses.

Table 4.4. Determinants of fishermen's fishing behavior (OLS) based on experts' opinion

Dependent variable	Fishing impact index estimated with experts' opinion							
Models	1	2	3	4	5	6	7	8
Contribution in PGE (in tokens)	-0.0037 (0.0073)			-0.0045 (0.0069)			-0.0034 (0.0069)	-0.0094 (0.0072)
Impatience (Coca Cola dummy)		0.0718 (0.0525)			0.0878 * (0.0490)		0.0856 * (0.0495)	
Impatience (Bonus %)			0.0070 (0.0747)			0.0272 (0.0663)		0.0395 (0.0661)
Years of schooling				-0.0103 ** (0.0048)	-0.0118 ** (0.0047)	-0.0107 ** (0.0055)	-0.0116 ** (0.0048)	-0.0101 * (0.0055)
People who fisherman maintains				0.0128 (0.0113)	0.0126 (0.0109)	0.0188 (0.0120)	0.0123 (0.0110)	0.0181 (0.0121)
Fisherman shares in paying for household expenses (Dummy)				-0.1267 *** (0.0470)	-0.1330 *** (0.0466)	-0.1172 ** (0.0497)	-0.1306 *** (0.0472)	-0.1117 ** (0.0498)
Average daily hours fishing				-0.0354 *** (0.0090)	-0.0367 *** (0.0087)	-0.0340 *** (0.0105)	-0.0369 *** (0.0087)	-0.0350 *** (0.0107)
Years in occupation				0.0007 (0.0021)	0.0001 (0.0020)	0.0005 (0.0022)	0.0001 (0.0020)	0.0005 (0.0023)
Fisherman is paying a loan (Dummy)				0.0906 * (0.0522)	0.0837 (0.0530)	0.0535 (0.0546)	0.0840 (0.0531)	0.0529 (0.0542)
Fisherman has other job alternatives (Dummy)				-0.0816 * (0.0451)	-0.0748 * (0.0450)	-0.0845 * (0.0471)	-0.0753 * (0.0448)	-0.0857 * (0.0466)
Fishery resources have been always scarce or they are beginning to become scarce (Dummy)				0.0721 (0.0542)	0.0677 (0.0543)	0.0436 (0.0541)	0.0677 (0.0543)	0.0437 (0.0543)
Government is who should help to the conservation of CGSM (Dummy)				0.1704 *** (0.0450)	0.1674 *** (0.0445)	0.1252 *** (0.0464)	0.1687 *** (0.0444)	0.1296 *** (0.0461)
Constant	2.8832 *** (0.0480)	2.8118 *** (0.0428)	2.8402 *** (0.0537)	3.2162 *** (0.1649)	3.1790 *** (0.1476)	3.1768 *** (0.1811)	3.1984 *** (0.1598)	3.2223 *** (0.1956)
Observations	152	152	134	152	152	134	152	134
R²	0.0014	0.0105	0.0001	0.2866	0.2994	0.2503	0.3005	0.2600

Notes: *** 99% significance ** 95% significance * 90% significance. Robust standard errors are in parentheses.

In summary, we do not find strong evidence to support our hypothesis that impatient fishermen have higher impacts on the CGSM. We found only a very weak correlation between impatience and fishermen's fishing behavior when using several controls and the indices estimated based on the scores of experts (Models 5 and 7 of Table 4.4). These results contrast with the results of Fehr and Leibbrandt (2011) who found significant evidence that shrimpers who were impatient (those who preferred two pralines immediately over three at the end of the experimental session) used smaller hole sizes in their shrimp traps.

4.6.3 Concerning the Results to Other Studies

As stated in the introduction, only some studies have found evidence of external validity of economic experiments, measured as the correspondence between the behavior in the experiment and the behavior in real life, while others have not. Table 4.5 shows a summary of the main characteristics of these studies.

Regarding studies with external validity, Rustagi, Engel, and Kosfeld (2010) combined experimental measures of conditional cooperation and survey measures on costly monitoring with forest growth data for 49 forest user groups in Ethiopia. They found that groups with larger proportion of conditional cooperation had more productive forests and they were more likely to invest in forest patrols in order to promote cooperation by sanctioning free riders. Carpenter and Seki (2011) examined two groups of artisanal shrimpers in Japan, where one of the groups pooled their income and operating costs and the other group did not. They compared cooperation of poolers and non-poolers in a public goods experiment with a voluntary contribution mechanism and payment to show disapproval with the contribution of the other members of the group. They found that poolers had higher levels of cooperation than non-poolers.

Table 4.5. Summary of main characteristics of the studies on external validity of CPR

	Hill & Gurven (2004)	Gurven & Winking (2008)	Rustagi et al. (2010)	Carpenter and Seki (2011)	Fehr & Liebbrandt (2011)	Gelcich et al. (2013)	Torres et al. (2015)
Subjects	Ache Indians: hunters and gathers	Tsimane forager-horticulturalists	Forest users	Artisanal shrimpers	Artisanal shrimpers and fishers	Artisanal benthic fishers	Artisanal fishermen
Place	Forest areas of Eastern of Paraguay	Lowlands of Bolivia	Bale region of Ethiopia	Toyama Bay in the west coast of the Honsyou Island, Japan	Northeastern Brazil	Coast of Chile	Caribbean Coast of Colombia
Property regime	Forest reservations with legal land access	Indigenous territory with Collective property rights.	Secure tenure rights to use and manage the forests as a common property	Collective property rights through Fishery Cooperative Associations	Lake under open access regime	Unionized fishers: Territorial user rights areas on the coast Non-unionized fishers: open access areas	Coastal lagoon under a <i>de facto</i> open access regime
Type of analysis	Individual behavior	Individual behavior	Group behavior: - 49 Forest user groups	Group behavior: - Poolers - Non-poolers	Individual behavior	Group behavior: - High performance unions - Low performance unions - Non-unionized fishers	Individual behavior
Experiments	PG - Round 1: anonymous - Round 2: public - Framed as a play money UG - Round 1: anonymous - Round 2: public	DG - One-shot UG - One-shot TPPG - One-shot	PG - One-shot with conditional cooperation - No frame	PG - VCM - Rounds 1 to 5: VCM - Round 6-10: VCM + Social disapproval - Framed as a fishery situation	PG - One-shot - No Frame TP - Chocolate bonbons	CPR - 20 rounds - Framed as a fishery situation	PG - One-shot - No Frame TP1 - Coca Cola TP2 - Discount rates - Framed as a bonus to participate
Real life indicator	- Observations of food production and sharing patterns	- Observations of prosocial behavior in everyday life: well labor contribution, time spent in social visitation and social group size, food sharing, beer provision and consumption and contribution to a village fest	- Survey measures on costly monitoring - Number of young trees per hectare	- Fishing productivity	- Size of holes of shrimp traps	- Membership of a fishers' union - Union's performance in comanagement: high and low. - Co-management performance index: indirect measure of cooperation.	- Fishing impact indices
Evidence of external validity	No	No	Yes	Yes	Yes	Yes	No
PG: Public Goods Experiment / UG: Ultimatum game / DG: Dictator game / TPPG: Third Party Punishment Game / TP: Time Preferences Experiment / PG-VCM: Public Goods Experiment with Voluntary Contribution Mechanism / CPR: Common Pool Resources Experiment							

Fehr and Leibbrandt (2011) conducted laboratory experiments and field observations of shrimpers and fishermen in Brazil. They found that subjects who were more cooperative and patient in the experiments were less likely to overexploit the CPR. Gelcich et al. (2013) investigated two groups of artisanal fishermen in Chile, comparing nonunionized fishermen's behavior and the performance of unionized's fishermen with their behavior in the experiments. They found that fishermen of high-performance unions were more cooperative among them, while fishermen of low-performance unions were less cooperative. Likewise, they found that fishermen that were not unionized did not cooperate at all.

The two studies that did not find evidence of external validity were carried out with indigenous communities in South America. One of them was done by Hill and Gurven (2004). They related measures of real life cooperativeness with experimental measures of the Ache Indians, a tribal group that lives in the forested areas of Paraguay and has a well-known tradition of extensive food sharing, as well as high levels of cooperative food acquisition. Nevertheless, there was no correlation between subjects' behavior in the experiments and their behavior in real life. The second study was developed by Gurven and Winking (2008). They studied the Tsiname, an indigenous group of forager-horticulturalists of lowland Bolivia. They compared the subjects' behavior in various experiments with their prosocial behavior in their daily life. They found that there was no correlation between their real-life forms of cooperation and their levels of contribution in the experiments.

There are three main reasons that in our opinion, might explain why some studies have found a relationship between subject's behavior in the experiments on cooperation in CPRs and their actions in real life, and others studies did not. The **first reason** is related to the experimental setup. As shown in Table 4.5, two of the studies with evidence of external validity (Carpenter and Seki 2011, Gelcich et al. 2013) compared the behavior between groups of resource users, not of individuals. In these experiments, cooperators and non-cooperators played the game separately. Therefore, there was a clear signaling

to all participants about the cooperativeness of their fellow players. In addition, fishermen have been associated in cooperatives for several years, which have allowed them to establish not only patterns of understanding, but also to develop a group identity. In the case of Rustagi, Engel, and Kosfeld (2010), the experiments were done with subjects that are part of a participatory forest management program and have been organised in small forest user groups since 2000, which have formal rights to manage their forests blocks as commons. Therefore, they know more or less what to expect from their group members. This should have influenced subjects' decisions in the experiment, in particular to the conditional cooperators within the groups.

In contrast, Hill and Gurven (2004) and Gurven and Winking (2008) —who did not find evidence of external validity— compared the contributions of each individual, and cooperators and non-cooperators played the game together. Therefore, conditional cooperators could not anticipate either high or low contribution levels, due to group composition and previous experience with those group members. In our experiment, cooperators and non-cooperators played together, similar to Hill and Gurven (2004)

The **second reason** is the indicator that is used to measure cooperation in real life. Carpenter and Seki (2011) use people's preferences to solve problems collectively or individually as a real life indicator. Thus, according to these authors, fishermen established the pooling arrangement since 1960 as response to several economic problems that they were facing in that moment. Gelcich et al. (2013) take as a proxy if people are living in a cooperative or non-cooperative environment. Thus, one group was formed by subjects from fishermen's unions with territorial user rights areas and a comanagement system since 1997. The other group was formed by nonunionized fishermen who fished exclusively in open-access areas, and they did not participate in the comanagement system. Both studies find a significant relationship, namely, both real life measurements assess cooperation behavior directly.

The studies of Rustagi, Engel, and Kosfeld (2010), Fehr and Leibbrandt (2011), and our study instead observed sustainable resource use as an indicator of cooperation. Nevertheless, we must stress that while these studies use only one feature as a measure of sustainability and associated it with cooperation, we use an index that includes several components related to the fishing activity during five years. In fact, Rustagi, Engel, and Kosfeld (2010) use the number of young trees per hectare that each group had in their forest blocks in 2005. The data was obtained from an assessment that is carried out once every five years by the forest administration.

Fehr and Leibbrandt (2011) use the hole size of the shrimp traps as an indicator of cooperation, which are manufactured by the fishermen making holes in used PET bottles. To get the data, they measured five to ten holes in one to two bottles that fishermen brought to a meeting in which they participated, and then they estimated an average hole size for each fisherman. Nevertheless, this measure of cooperativeness could be biased not only due to the reduced number of hole sizes measured—as these authors state— but also because fishermen could have inherited the traps from somebody, or asked someone else to make the holes in the bottles, or brought the only available bottles that they had in that moment to the meetings. In our case, we built two fishing impact indices, which evaluate fishermen's fishing behavior along five years based on the different fishing gears and methods used, and the fishing spots visited.

In contrast, Hill and Gurven (2004) use data about the food production and sharing patterns during five months, and Gurven and Winking (2008) use food production, food-sharing patterns, social visitation, and participation in some communal activities carried out for the community during eleven months. Overall, all those indicators are influenced by many factors (as our regression results show) and cooperative behavior as a trait might be just one of them. System knowledge, environmental awareness, income, or sense of responsibility definitely might also influence sustainable behavior. In fact, for instance, some studies have found that artisanal fishermen who are older, with higher levels of education, and higher asset wealth are less likely to use destructive fishing

gears (Silva 2006, Cinner 2010) . Therefore, it is not wholly surprising that the relationship between experimental behavior and sustainable behavior in real life is not as strong as if we measure cooperation in real life more directly.

The **third reason** is associated to the context. Thus, according to some experimental studies conducted with artisanal fishermen in Colombia (Castillo et al. 2011) and Peru (Lopez and Zuluaga 2013), fishermen's decisions in the experiments are influenced by the context and their own experiences. This coincides with some of the arguments stated by Hill and Gurven (2004) and Gurven and Winking (2008) about the reasons why they did not find external validity in their experiments. In our case, aspects such as the fishermen's fear of the illegal armed groups that are present in the zone, the distrust in the traditional leaders, and perverse effects generated by the external aid (e.g. distrust, individualist behavior), among other factors, might be affecting fishermen decisions. Nevertheless, it is remarkable that while cooperation among CGSM's fishermen is affected by several factors (for details see Torres, Schlüter, and Lopez in revision), including individualistic behavior on behalf of some fishermen, there are still a group of fishermen willing to cooperate.

4.7 Conclusions

In this study, we did a similar study to that of Fehr and Leibbrandt (2011) in Tasajera, a fishing community located in the Caribbean Coast of Colombia. In addition, we ran a standard TPE following a “multiple price list” format, similar to that of Harrison, Lau, and Williams (2002). We ran a one-shot PGE and two TPE with 152 fishermen that exploit the fishery resources of the CGSM. The most important findings of our study are as follows: First, we find no correlation between the fishermen's contributions in the PGE and the fishing impact indices. This finding contrasts with the results of Fehr and Leibbrandt (2011), who showed that shrimpers who contribute more to the public good use shrimp traps with bigger holes, allowing the small and infertile shrimps to escape.

Nevertheless, we also find that a large group of fishermen contribute to the PGE, which is in line with the findings of these authors.

Second, the evidence about the effect of the impatience on the fishing impact indices is weak. Only when we use the fishing impact indices estimated based on experts' scores, the TPE with Coca Cola is positive and significant, which suggests that impatient fishermen have higher impacts on the CGSM. We cannot conclude that there is a relationship between fishermen's behavior in their real life and their behavior in the experiments. Our results are different to the findings of Fehr and Leibbrandt (2011), who found a strong correlation between shrimpers' impatience (measured by preferences for pralines) and the size of the holes in their shrimp traps.

In our view, the fact that some studies find evidence of external validity of economic experiments and others do not, might be associated to diverse factors such as the context in which fishermen live, or the way in which the cooperation in real life is measured. Thus, based on the findings of these studies, we can state there is a strong link between cooperation in real life and field experiments if real life measures are closely linked to cooperative behavior (Carpenter and Seki 2011, Gelcich et al. 2013). In the case of a real life measure that is only partially showing cooperative behavior, the link might be much weaker. Food sharing (Hill and Gurven 2004, Gurven and Winking 2008), might be influenced, for example, by cooking abilities or income. Sustainable behavior (Fehr and Leibbrandt 2011, Rustagi, Engel, and Kosfeld 2010), for example, might not only be influenced by cooperative behavior, but also by time preferences, environmental awareness, resource dependence, among others. Therefore, in some contexts, this link can be strong and in others, it can be weak. Thus, for instance, when groups have a large experience of cooperation they establish patterns of understanding and know what to expect about group members, which favor cooperation among them (Meinzen-Dick et al. 1997). This has definitely not been the case in Tasajera. Finally, our results confirm the importance of taking into account the context in which CPR's users live, which

should achieve a better understanding of their exploitation and conservation decisions of the resources upon which they depend (Anderies et al. 2011).

Acknowledgments

We thank INVEMAR's researchers, especially Efraín Vilorio for his continuous support for this research. We are very thankful to Tasajera's fishermen who kindly volunteered to participate in the experiments. We would also like to express our gratitude to INVEMAR's field assistants in CGSM, in particular to Vladimir Carbonó for his valuable and constant support. Likewise, we want to thank Myriam Vargas, Keila Guillen, Ana Milena Vides, Yenifer Martínez and Erika Amaya, for all their assistance in the field when we ran the experiments. We would like to thank María Claudia López for her helpful suggestions regarding design of this research and her comments on an earlier version of this manuscript. We also thank Micaela Kulesz for her valuable support in the field, comments and discussions. We appreciate very much comments from Juan Camilo Cárdenas on an early version of this manuscript. Special thanks to Mabelin Villareal and Dora Suárez for their statistical support. We value the editing work done by Alexandra Ghosh. Finally, we appreciate the comments we received in an early version of this paper from participants in the WOW5 Conference at Indiana University. This research was funded and supported by the Center for Tropical Marine Ecology (ZMT) and the German-Colombian Center of Excellence in Marine Sciences (CEMarin).

III. Concluding Remarks



Ciénaga Grande de Santa Marta, Colombia, 2011. Photos: Luz Elba Torres Guevara

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

5 Concluding Remarks & Outlook

5.1 Summary of the Main Research Findings & Conclusions

The main purpose of this dissertation was to investigate the factors affecting cooperation among CGSM's fishermen, and how these have influenced fishermen to overexploit the fishery resources. For this purpose we carried out three studies with fishermen depending on the resources provided by the lagoon.

The first study, *Collective action in a tropical estuarine lagoon: adapting Ostrom's SES framework to Ciénaga Grande de Santa Marta, Colombia*, examined why collective action for a sustainable use of fishery resources of CGSM has not taken place. To this end, we adapted and implemented the SES framework created by Ostrom (2009) to this particular ecosystem. Overall, we found that external factors associated with the social, economic, and political settings described in the SES framework, have influenced negatively the other variables of this system. The combination of these factors has hindered collective action between fishermen to sustainably manage the CGSM fishery. In particular, we found three main factors that explain the lack of collective action among fishermen in this lagoon: (1) fishermen's fear due to the indiscriminate and strong violence that illegal armed groups have inflicted on them, as a result of the internal armed conflict that Colombia has been experiencing since the 1960s, (2) the economic development in the Caribbean region, which caused a drastic change in the CGSM's hydrological balance mainly due to the development of road infrastructure and the increase of agriculture and livestock areas adjacent to CGSM and (3) the precarious living conditions of CGSM's fishermen due to the extreme poverty and the lack of basic infrastructure.

In the second study, *Understanding artisanal fishermen's behavior: the case of Ciénaga Grande de Santa Marta, Colombia*, we investigated the influence of socioeconomic and perceptual factors on fishermen's fishing behavior and how that behavior may be

impacting the fishery resources by looking at two different points of view, a group of experienced fishermen and a group of experts with extensive knowledge on the fishery. For that, we used survey data and interviews to build individual and composite indicators which gave us a measure of the ecological impact of fishing spots and fishing gear/methods used by CGSM's fishermen. We found evidence that experienced fishermen and experts differed in relation to the way they assess the impact caused by fishing in all fishing zones and in eight out of thirteen fishing gears/methods evaluated. Likewise, we observed that experienced fishermen scores are always lower than experts' scores in all fishing zones, and in twelve out of the thirteen fishing gears/methods assessed. Finally, we established that fishermen with higher levels of education, who share household expenses with other family members and spend more hours fishing daily, tend to be more ecologically sustainable. In contrast, fishermen considering the conservation of CGSM a governmental responsibility tend to exhibit ecologically unsustainable fishing behavior.

In the third study, *External validity of field economic experiments: a study on cooperation and impatience in an artisanal fishery in Colombia*, we analysed how fishermen's cooperative behavior and impatience are affecting CGSM's fishery resources. For that, we examined the correlation between fishermen's decisions in three economic experiments—one public goods and two time preference experiments—and their individual levels of exploitation of CGSM's fishery resources, which were measured through some indices of ecological impact of the fishing in CGSM. We found that a large group of fishermen were not selfish and contributed to the public good, although we did not find a relationship between the fishermen's contributions in the public good and their real fishing behavior measured through the fishing impact indices. We also found that a large group of fishermen are patient (i.e. they have low discount rates), but we did not find a strong correlation between the fishermen's levels of impatience and their real fishing behavior as fishermen. We consider that this lack of correlation between fishermen's behavior in field experiments and real life (external

validity) might be associated with factors such as the context in which fishermen live, or the way in which the cooperation in real life is measured.

Based on our findings, we can conclude the following:

1. The SES framework is a powerful tool that facilitates a systematic diagnosis of an SES. However, as opposed to other articles in literature relying on variables that form the core framework, for the particular case of CGSM those core tiers were not enough to answer our research question. Our study required to use the social, economic, and political settings described in the framework and few studied in the SES literature. We create new variables on the third, fourth, and fifth tiers within economic development, demographic trends, and political stability to be able to better explain how these external variables impact the SES, and its management.
2. We found that external factors associated with the social, economic and political settings of this SES (e.g. armed conflict, violence, extreme poverty, absence of the State and economic development) have affected CGSM's fishermen in diverse forms and have hindered their engagement in collective action to manage and exploit the CGSM's fishery resources in a sustainable way.
3. In the literature, the studies determining the impact that fishermen have on the fishery resources are usually conducted either with fishermen's or with experts'. In this dissertation we expand the literature by assessing both points of view. We found that experienced CGSM's fishermen and experts do not coincide when asked to assess the ecological impact of fishing spots and fishing gears/methods in CGSM, moreover experienced fishermen scores are always lower than experts scores for the case of fishing zones, and in eight out of thirteen fishing gears/methods evaluated.
4. CGSM's fishermen tend to behave in an ecologically sustainable way when they have higher levels of education, share the household expenses with other family

members and spend more hours fishing daily. In contrast, fishers behave in an ecologically unsustainable way when they believe the government is responsible for CGSM's conservation.

5. In an experimental setting there is evidence that a large group of CGSM's fishermen are willing to cooperate with others in a public goods game. There is also a group of patient fishermen that potentially might be willing to carry out actions in the long term, thus allow them to better manage of the fishery resources, or better comply with fishing regulations.
6. The fact that some studies find a correlation between fishermen's behavior in field experiments and the real life and others do not, might be associated with factors such as the context in which fishermen live, and/or the way in which cooperation in real life is measured.

5.2 Strengths of this Study

Many rural communities around the world live in the middle of civil conflicts. How people lives and their resources are impacted by conflict are crucial research questions, but very difficult to answer since researchers are not immune to the conflict. A big strength of this study is that I was able to do my research in CGSM, a region of Colombia where extortions, selected murders, common crime and threats against civilians are part of the daily life of CGSM inhabitants. I was able to face all the risks that this research entailed including life threats, but also to gain the trust and support of CGSM's fishermen, community leaders and key informants. For this dissertation I had the support through the participation of more than 200 CGSM fishermen. The field work was done between 2011 and 2013.

A second strength of this study is that CGSM and its environmental and social problems is a topic that is right now in the focus of discussions in Colombia. Many studies are

being conducted in the region, and finally it seems that they are getting the attention of the general public, for example the fact that there are illegal constructions of interconnected dikes that are drying out small lagoons, streams and wells that normally provide fresh water to the lagoon (El Espectador, Redaccion Medio Ambiente 2015, Forest B. 2015). The timing of this dissertation is perfect to contribute to this debate. This study brings new information allowing public servants and academics to think about CGSM's conservation priorities.

A third strength is the use of different research methods. Thus, to investigate the collective action in CGSM fishery (paper 1), I started by doing a qualitative diagnosis of the ecosystem based on several interviews, focus groups and a comprehensive document analysis. Then, I developed and conducted a survey in order to collect data that allowed us to do quantitative analyses. To investigate the factors affecting fishermen's fishing decisions (paper 2) I developed quantitative indicators allowing us to evaluate the ecological impact of fishing in CGSM. I also used econometric estimations. Finally, I used economic field experiments and econometric estimations to analyse how fishermen's cooperative behavior and impatience are affecting the CGSM's fishery resources (paper 3). This combination of methods for gathering the data and to analyze it, allowed us to get a holistic approach of the current situation of CGSM.

A fourth strength is associated to the data obtained on fishing behavior of CGSM's fishermen. Our particular interest to investigate the collective action for the management of the fishery in CGSM, led us to work with INVEMAR. This Research Institute has been doing both scientific research about different biophysical aspects of this ecosystem and collecting fishing information for more than one decade. To be able to use their SIPEIN database has been a unique opportunity, this database contains fishermen's fishing information from 1999 to 2010. At the same time, it represented an enormous interdisciplinary challenge because it implied not only to work with fishery scientists but also to learn about fisheries in ecological terms what is normally beyond the scope of a

social scientist. As a result, I have learned fishery concepts and understood the particularities of CGSM's fishery.

The fifth strength of this study is its contribution to the scientific development of the literature on governance of natural CPRs and fishing behavior of artisanal fishermen. In particular the adaptation of the SES framework to analyse how the armed conflict, political instability and the socioeconomic conditions of resource users of CPRs can affect the resource governance outcomes, is a valuable contribution given these aspects have not been studied extensively in the context of the SES and CPRs literature. Likewise, the analysis of fishing decisions of artisanal fishermen and their impact on the ecological sustainability of their fishery resources by comparing experienced fishermen's and experts' opinions is an important contribution to the literature on fishermen behavior

Finally, a sixth strength is the contribution of our findings to the existing literature on the CGSM, given that most of the studies are related to the physical and biological aspects of this ecosystem. Studies on social aspects are rare. In addition, we contribute with new information to those working in the CGSM and policy makers responsible for the conservation of this important coastal lagoon.

5.3 Limitations of this Study

The SIPEIN database provides a unique source of data about real fishing behavior of fishermen over time. The existence of this data base was crucial for answering our research questions in paper two and three. According to the beach recorder (INVEMAR's field assistant) all fishermen landing at fish market in Tasajera could be potentially in the database. However, the amount of data entries available for each fisherman has been very heterogeneous. Therefore, we decided not to take a random sample out of this database, but to select only those who had enough data entries (mainly a minimum number of data entries over various years). Therefore, we have a selection

bias of the fishermen who participated in the survey (172) and then were invited to participate in the economic experiments. This is the first limitation of our study.

A second limitation is related to the data used to measure fishermen's cooperation to maintain fishery resources. Fehr and Leibbrandt (2011) used only one fishing instrument (shrimp traps) which does not reflect the variations of fishermen's fishing behavior over time. To avoid this problem, we used information about the fishing spots visited and the fishing gears/methods used by CGSM's fishermen between 2006 and 2010, which was obtained from SIPEIN database. This has the advantage that we could evaluate fishermen's fishing behavior taking into account all the possible changes of behavior that they could have during these five years. Therefore, we got a more reliable description of individual behavior. Nevertheless, we had to face the risk of finding no significant results unlike Fehr and Leibbrandt (2011), due to the high variability of the data. The latter, might explain why we did not find a correlation between fishermen's behavior in the experiments and the real fishing behavior measure through the indicators.

5.4 Future Research Directions

Considering that our study is the first to use the SES framework proposed by Ostrom (2009) to analyse the collective action in a SES where armed conflict explains and affects the other variables of the system, an interesting direction will be to do a similar study in other communities in Colombia or inclusive in other places of the world where the armed conflict had also affected resource users. This would allow making comparisons among case studies and to achieve a better understanding about how this factor affect the likelihood that people engage in collective action for a sustainable use and management of the resources.

A second research direction could be to determine measures of the sustainability of this important ecosystem through the development of indicators for the social, economic and institutional aspects. A research of this type will contribute to the sustainability research.

A third possibility of research could be to identify the actors and mechanisms that can lead to the development of some alliances oriented to improve the living conditions of dwellers of fishing communities and the whole ecosystem. In the same line of argument, it will be interesting to conduct field economic experiments investigating economic and non-economic incentives to improve cooperation among CGSM's fishermen.

IV. Appendices



Ciénaga Grande de Santa Marta, Colombia, 2011. Photos: Luz Elba Torres Guevara

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

Appendix A: Open Questions Based on the SES Framework

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

SOCIAL, ECONOMICAL AND POLITICAL SETTING (S)	
S1 Economic development	<ul style="list-style-type: none"> • ¿Cómo se organiza la vida económica en la región del Magdalena? • Los pescadores tienen opciones de trabajo distintas a la pesca que les permita vivir? Cuáles? ¿Dónde? • ¿Cómo la carretera afecta el recurso y el ecosistema?
S3 Political stability	<ul style="list-style-type: none"> • ¿Cómo se organizan los pescadores? • ¿Qué leyes los organizan? • ¿Cuáles son los requisitos legales para organizarse como grupo?
RESOURCE SYSTEM (RS)	
RS2 Clarity of system boundaries	<ul style="list-style-type: none"> • ¿Cuántos pescadores pescan en la CGSM? • ¿De dónde son los pescadores? • ¿Qué tipo de intercambios se dan entre la CGSM y el mar? • ¿Qué vinculación existe entre los peces de la CGSM y los del mar? • ¿Qué extraen los pescadores de los manglares y que uso le dan? • ¿Qué uso dan los pescadores al delta del Río Magdalena? • ¿Qué vinculación existe entre los bananeros y la CGSM? • ¿Cómo afecta los agroquímicos a los peces de la CGSM?
RS3 Size of resource system	<ul style="list-style-type: none"> • ¿La gente se pone de acuerdo en cosas relacionadas con la CGSM?
RS4 Human-constructed facilities	<ul style="list-style-type: none"> • ¿Qué obras se han construido en la CGSM? • Cierre de la CGSM con el puente
RS5 Productivity of system	<ul style="list-style-type: none"> • Productividad por especie y por arte • Hay sitios de alta productividad en la CGSM y/ o en el mar? • Tipos de artes de pesca: descripción y funcionamiento • Influencia de los diferentes artes de pesca en el medio ambiente • Tipos de peces capturados con cada arte de pesca
RS6 Equilibrium properties	<ul style="list-style-type: none"> • ¿Cómo los pescadores evitan que se acaben los peces en la CGSM? • ¿Cómo los pescadores mantienen el equilibrio en la CGSM? • ¿Cómo los pescadores evitan destruir la CGSM?
RS7 Predictability of system dynamics	<ul style="list-style-type: none"> • ¿Se puede predecir la cantidad de peces que habrá disponible en cada jornada de pesca? ¿Cómo? • ¿Pueden los pescadores influenciar la cantidad de peces disponibles en la CGSM? • ¿Conocen los pescadores cómo funciona la CGSM? • ¿El manejo de los pesca está determinada por la cantidad de peces extraídos por cada pescador? • ¿Existen reglas para determinar la cantidad de peces que se extraen de la CGSM? <ul style="list-style-type: none"> ○ SI ➔ ¿Qué reglas tienen? ○ NO ➔ ¿Qué hacen para organizarse y no extraer demasiado?

RESOURCE SYSTEM (RS)
<p>RS8 Storage characteristics</p> <ul style="list-style-type: none"> • ¿Qué tanto stock de peces tiene la CGSM? • ¿Qué tan vulnerable es la CGSM ante efectos adversos? • ¿Qué tan importante es para los pescadores mantener un stock de peces en la CGSM? • ¿Los pescadores acostumbran almacenar el pescado? Si – NO -- Por qué? • ¿Cómo los pescadores almacenan el pescado? • ¿Es importante para los pescadores almacenar el pescado? • ¿Qué capacidad de almacenamiento tienen los pescadores?
RESOURCE UNITS (RU)
<p>RU1 Resource unit mobility</p> <ul style="list-style-type: none"> • ¿Cuáles son los criaderos naturales de los peces de la CGSM? • ¿Cuáles son los criaderos naturales de los peces del mar? • ¿Los peces que nacen en los manglares pasan por la CGSM en busca del mar?
<p>RU2 Growth or replacement rate</p> <ul style="list-style-type: none"> • ¿Cuál es el ciclo de vida de los peces? • ¿Cuál es la tasa de reproducción y crecimiento de los peces de la CGSM? • Identificación de las principales especies y su etapa reproductiva • ¿Qué tan rápido crecen los peces en la CGSM?
<p>RU3 Interaction among resource units</p> <ul style="list-style-type: none"> • ¿Cómo interactúan las distintas especies de peces y otros animales entre sí? • ¿Quién se come a quién? ¿Esto es importante o no? ¿ Por qué? • ¿Qué importancia tiene el manglar para los peces de la CGSM? • ¿Qué relación existe entre los manglares y la CGSM?
<p>RU4 Economic value</p> <ul style="list-style-type: none"> • ¿Hay especies más rentables que otras? ¿Cuáles? • Identificar los costos e ingresos según arte de pesca empleado • Costos de las faenas de pesca, según lugares y artes
<p>RU5 Number of units</p> <ul style="list-style-type: none"> • ¿Qué efecto tiene sobre la CGSM el pescar los peces pequeños? • Identificar los tamaños promedio de los peces según etapa de la vida: pequeños, juveniles y adultos
<p>RU6 Distinctive markings</p> <ul style="list-style-type: none"> • ¿Quién cultiva peces? Describir a los pescadores • ¿De dónde surge la idea de cultivar peces? • ¿Desde cuándo se cultiva peces en la CGSM? • ¿Qué tipo de peces se cultivan? • ¿Cómo funciona un cultivo de peces? • Número de peces en los estanques • Costos e ingresos de los cultivos de peces
<p>RU7 Spatial & temporal distribution</p> <ul style="list-style-type: none"> • ¿Cuáles son los lugares de pesca a donde van los pescadores? • Productividad de lugares de pesca: ¿Son diferentes o iguales? • ¿Cómo se organizan para ir a pescar a esos lugares? • ¿Cómo los pescadores escogen los lugares donde van a pescar?

RESOURCE UNITS (RU)	
<ul style="list-style-type: none"> • ¿Hay pescadores que van al manglar a sacar los peces bebés? ¿ Por qué? • ¿Hay mujeres pescadoras? ¿Dónde pescan? • ¿Qué influencia tienen las mujeres sobre la CGSM o sobre el mar? • ¿Quién maneja los recursos de la CGSM o del mar de una manera más sostenible: los hombres o las mujeres? ¿Por qué? ¿Cómo? 	
GOVERNANCE SYSTEM (GS)	
<ul style="list-style-type: none"> • ¿Qué REGLAS existen reglas entre los pescadores? <ul style="list-style-type: none"> ✓ SI → <ul style="list-style-type: none"> ○ ¿Qué reglas tienen? ○ ¿Quiénes hacen uso de esas reglas? ○ ¿Quién las creo? ○ ¿Por qué? ¿A raíz de qué? ○ ¿Quién controla que se cumplan? ○ ¿Existen castigos para los que incumplen las reglas? ¿Cuáles? NO → <ul style="list-style-type: none"> ○ ¿Por qué no? • ¿Quién debería hacer las reglas: El Estado o los pescadores? ¿Por qué el Estado ó por qué los pescadores? <ul style="list-style-type: none"> ✓ ¿Qué NORMAS? Cuáles son las normas de comportamiento de un pescador • ¿Qué ESTRATEGIAS? <ul style="list-style-type: none"> ✓ ¿Qué estrategias han adoptado los pescadores para enfrentar situaciones comunes del día a día? Ej. Si llueve siempre va a determinado sitio ✓ ¿Los pescadores solo se basan en su éxito o tiene en cuenta lo que hacen los demás? • ¿Los comerciantes financian las faenas de pesca a los pescadores? • ¿Quién elige qué pescar cuando no se tiene la embarcación o los artes de pesca? • ¿Cómo es el acuerdo entre el pescador y el comerciante? • ¿El comerciante le presta dinero a los pescadores? ¿Bajo qué condiciones? ¿A qué tasa de interés? • ¿Es normal estar endeudado de los comerciantes? • ¿Quiénes son los dueños de las embarcaciones y los artes de pesca? Describirlos <ul style="list-style-type: none"> ✓ ¿Cuántos pescadores son dueños de embarcaciones y artes de pesca? ✓ ¿Cuántos pescadores son dueños de embarcaciones pero no de artes de pesca? • ¿Todos los propietarios de embarcaciones tienen artes de pesca propios? ¿Cuáles? • ¿Cómo se fijan los precios de venta del pescado? 	
GS1 Governing organizations <ul style="list-style-type: none"> • ¿Cuál es la influencia de las organizaciones del gobierno sobre el sistema? ¿Existe o no influencia? • ¿Qué importancia tienen esas organizaciones en la vida de los pescadores? 	
GS3 Network Structure <ul style="list-style-type: none"> • ¿Existen redes de pescadores? No → ¿Por qué? • SI → <ul style="list-style-type: none"> ○ ¿Qué redes existes? ○ ¿Cómo se crean las redes? ○ ¿Quiénes son los líderes? ○ ¿Quiénes son las personas claves en la red? ¿Por qué son claves? 	

GOVERNANCE SYSTEM (GS)
<ul style="list-style-type: none"> ○ ¿Cómo están organizados los pescadores? ○ ¿Quién manda la información a todos los integrantes de la red? ○ ¿Los pescadores tienen una jerarquía dentro de la red? • ¿Todos los pescadores tienen el mismo poder en la red o existe una jerarquía? Si es así: ¿Cómo discuten las jerarquías?
<p>GS4 Property-rights systems</p> <ul style="list-style-type: none"> • ¿Existen derechos privados sobre la CGSM? • ¿Qué tipo de derechos de uso existen? • ¿Los pescadores tienen derechos de propiedad sobre sus casas? • ¿Ser propietario o no de una casa afecta en algo la actividad pesquera? <ul style="list-style-type: none"> ○ ¿Pueden asociarse? ○ ¿Qué puede hacer y qué no, si no es propietario de una casa? ○ ¿Pueden pedir créditos a los bancos si no tienen títulos de propiedad? ○ ¿Pueden alquilar embarcaciones y artes de pesca o no? <ul style="list-style-type: none"> ▪ Identificar tarifas por alquiler de los barcos, artes, gasolina, etc. • ¿Qué derechos tienen los propietarios de los barcos y de los artes de pesca? • ¿Qué derechos tienen los pescadores cuando alquilan los barcos y artes de pesca? • ¿Qué reglas regulan el alquiler de los barcos y artes de pesca? • ¿Puede un pescador alquilar todo lo necesario para ir a una faena de pesca? ¿Bajo qué condiciones? • ¿Por qué unos pescadores pescan en el mar y en la CGSM? ¿Qué relación existe? ¿De qué depende? • ¿Por qué un pescador utiliza determinado arte de pesca?
<p>GS5 Operational rules</p> <ul style="list-style-type: none"> • ¿Qué reglas existen en relación con la actividad pesquera en el día a día? • ¿El libre mercado para la compra y venta del pescado es una regla? • ¿Los pescadores comparten la información acerca de los lugares de pesca más efectivos? ¿Cómo la comparten? ¿Cómo se comportan entre ellos? • ¿Por qué algunos pescadores se organizaron y venden los camarones a sus esposas o familiares y otros no? • ¿De dónde surgió la idea de vender los camarones a sus esposas o familiares? • ¿Qué motivo a estos pescadores a hacer este acuerdo? • ¿Cuántas mujeres hacen actualmente esa labor? • ¿Dónde venden las mujeres el camarón? • ¿Las mujeres están organizadas para la compra, procesamiento y venta del camarón? • ¿Qué reglas existen entre las vendedoras de camarón?
<p>GS6 Collective-choice rules</p> <ul style="list-style-type: none"> • ¿Qué decisiones han tomado los pescadores de manera conjunta? • ¿Cómo decidieron los pescadores de camarón venderle solamente a sus esposas para que ellas lo comercializaran? • ¿El pescador más viejo del grupo es quien toma la decisión final? • ¿Cómo se toman las decisiones? ¿Por votación?
<p>GS7 Constitutional rules</p> <ul style="list-style-type: none"> • ¿Existen reglas diarias acerca de cómo se maneja el recurso? • ¿Cómo se decide sobre las reglas para manejar el recurso? • ¿Quién tiene el derecho a decidir sobre el cambio de las reglas constitucionales?

GOVERNANCE SYSTEM (GS)

GS8 Monitoring and sanctioning processes

- ¿Los pescadores de la CGSM tiene algún tipo de monitoreo?
- ¿Los pescadores del mar tiene algún tipo de monitoreo?
 - ✓ NO → ¿Por qué no?
 - ✓ Si →
 - ¿Quién lo hace? / ¿Cómo se hace?
 - ¿Funciona el monitoreo?
 - ¿Cómo comunican las fallas de los que no cumplen las reglas?
 - ¿Existe monitoreo en turnos?
 - ¿Le pagan a alguien para hacer el monitoreo?
 - ¿De qué forma miden si alguien cumple o no con las reglas?
 - ¿Los pescadores tienen establecido algún tipo de sanción para los que incumplen las reglas? ¿De qué tipo: social, monetaria? ¿De qué tamaño?
 - ¿Existe alguna entidad que haga un monitoreo de la CGSM y del mar?
 - ¿Existe algún sistema de monitoreo oficial de la CGSM o del mar?
 - ¿Está bien organizado? ¿Quién lo hace?

ACTORS (A)

A1 Number of relevant actors

- Número de pescadores con palanca, vela y motor fuera de borda
- Tipos de **pescadores**
 - ✓ Identificarlos y caracterizarlos
 - ✓ Definir sus roles (su función en el ecosistema)
 - ✓ ¿Cómo se pueden distinguir entre ellos?
- Tipos de **usuarios** del sistema
 - ✓ Por artes de pesca
 - ✓ Por propiedad sobre las lanchas y artes de pesca
 - ✓ Por actividad: comerciantes, vendedores de hielo, componedores, etc.
 - ✓ Tipos de poderes e intereses de cada tipo de usuarios
- ¿Cómo se crearon los **grupos / asociaciones** que actualmente existen?
- ¿De dónde surgió la idea de organizarse?
- ¿Cuántos grupos existen?
- ¿Qué tipo de grupos son? ¿Para qué se organizaron?
- ¿Todos los pescadores se conocen y esto les ayuda para asociarse?
- ¿Tienen los pescadores intereses comunes o no?
- ¿Los pescadores organizados usan artes de pesca sostenibles y los no organizados no?
- ¿Algún grupo tienen la posibilidad de elegir dónde pescar?
- ¿Existen jerarquías al interior de los grupos o entre los grupos? ¿Cuáles?
- ¿Hay grupos de pescadores que vienen solo por alguna temporada y luego se van?
 - ✓ ¿Quiénes son?
 - ✓ ¿De qué tamaño son esos grupos?
 - ✓ ¿Tienen reglas entre ellos?
- ¿Qué tipo de **compradores / comerciantes** existen en el mercado?
- ¿De dónde vienen los comerciantes?
- ¿Dónde se comercializa el pescado?

ACTORS (A)
<ul style="list-style-type: none"> • ¿Cómo transportan el pescado los comerciantes? • ¿Cuáles son los principales problemas de los comerciantes? • Identificar la cadena del pescado. • ¿Qué le aporta el comerciante al pescador: es ambientalmente sostenible o no lo que le entrega? Pej. Ojo de malla adecuado?
<p>A2 Socioeconomic attributes</p> <ul style="list-style-type: none"> • Identificar los factores significativos que cambian el comportamiento de una persona • En lo económico <ul style="list-style-type: none"> ✓ ¿Hay pescadores que solo viven de la pesca y no tiene más posibilidades? ✓ ¿Hay pescadores con opciones de ingresos distintos a la pesca? Cuáles opciones? ✓ ¿Qué características hacen que la gente sea diferente? ✓ Identificar las características de las personas que viven solo de la pesca y de quienes tienen otras actividades • En lo social <ul style="list-style-type: none"> ✓ Número de hijos ✓ Nivel educativo ✓ Participación en cursos de capacitación de ONU, otras ONG's
<p>A3 History or past experiences</p> <ul style="list-style-type: none"> • Si existen normas ¿Hay algún vínculo entre las normas anteriores y las actuales? • ¿Qué razones del pasado hicieron que se dé el actual sistema? ¿Qué sentido tiene esto? • ¿Por qué se usa un arte u otro? Por qué los abuelos le enseñaron algo en pasado acerca de estos y por eso no lo usan!! • ¿Cuál es la historia del lugar? • ¿Cómo el pasado ha influenciado en la historia del presente? • Si un pescador llegó a Tasajera u otras comunidades desplazado por la violencia se debe averiguar sus expectativas: <ul style="list-style-type: none"> ✓ ¿Cuánto tiempo quieren quedarse? ✓ ¿Qué expectativas tienen? • ¿Cuáles son los problemas fuertes en la zona?
<p>A5 Leadership / Entrepreneurship</p> <ul style="list-style-type: none"> • Liderazgo de los pescadores <ul style="list-style-type: none"> ✓ ¿Quién es el líder en Tasajaera? ✓ ¿Cómo llegó a ser líder? ✓ ¿Qué han logrado los pescadores? • Entrepreneur <ul style="list-style-type: none"> ✓ ¿Existe un espíritu empresarial entre los pescadores que ayuda al desarrollo del sistema ✓ ¿Existen innovaciones institucionales? ✓ ¿Cuáles son las nuevas reglas? ✓ ¿Se necesita a alguien que invente nuevas reglas? Ejemplo: El señor entrevistado en el mar en tasajera
<p>A6 Norms (trust-reciprocity) / social capital</p> <ul style="list-style-type: none"> • ¿Existe reciprocidad entre los pescadores? • ¿Qué pasa con los pescadores que no son recíprocos/solidarios? • ¿Cuánta confianza se tiene la gente? • ¿Cómo manejan esa confianza? Ej. Préstamo de la lancha a un desconocido

ACTORS (A)
<p>A7 Knowledge of SES /mental models</p> <ul style="list-style-type: none"> • ¿Qué saben los pescadores sobre el sistema en el cual ellos operan? • ¿Cuál es la idea que tienen los pescadores acerca del funcionamiento del sistema (CGSM)? • ¿Qué hacen los pescadores para cuidar la CGSM? <ul style="list-style-type: none"> ✓ ¿Qué influencia tienen los pescadores sobre el sistema? ¿Es positiva o negativa? • ¿El pescador conoce qué artes de pesca afectan la sostenibilidad de la CGSM? <ul style="list-style-type: none"> ○ Si sabe que un arte afecta la CGSM, por qué lo usa? • ¿Cómo ellos se explican el mundo? • ¿Qué modelos mentales usan los pescadores para explicar su realidad? <ul style="list-style-type: none"> ○ ¿Cómo funciona el ecosistema para ellos? ○ ¿Cómo se manejan los recursos en la CGMR? • ¿Qué importancia tiene los manglares para la CGSM?
<p>A8 Importance of resource (dependence)</p> <ul style="list-style-type: none"> • ¿Qué tanto dependen los pescadores del recurso CGSM? Ej. Los dueños de las lanchas. • ¿Existen contratos entre los pescadores y compradores de pescado? • ¿Quién hace las instituciones (reglas) y las impone? • ¿Cuánto se paga y cuándo se paga es definido por quién? • ¿Qué tanto dependen los pescadores de los dueños de las lanchas y los artes de pesca? • ¿A quién favorecen más / menos las reglas que tienen los pescadores? • ¿Cómo eligen los pescadores si pescan en el mar o en la CGSM? • ¿Se tiene en cuenta el monto de inversión necesario para hacer una faena de pesca al momento de decidir dónde pescar?
<p>A9 Technologies available</p> <ul style="list-style-type: none"> • Artes de pesca y su funcionamiento • ¿Qué pescan con cada arte y en qué momento del año? • ¿Qué tan sostenibles son? ¿En qué forma son sostenibles: económicamente y ambientalmente? • ¿En qué momentos del año es mejor determinados artes? • Costos / Inversiones / mano de obra / Rendimientos por arte • Distintos barcos • Ventajas / desventajas de usar cada arte y su impacto sobre la laguna
INTERACTIONS (I)
<p>I1 Harvesting</p> <ul style="list-style-type: none"> • Tipos de pescadores que existen: con o sin motor, por artes, por tipos de barcos, etc. • La mayoría de pescadores tienen motor o no?? • Cantidad de peces que sacan • Tipos de embarcaciones
<p>I2 Information sharing</p> <ul style="list-style-type: none"> • ¿Los pescadores se comparten información?
<p>I3 Deliberation processes</p> <ul style="list-style-type: none"> • Existen procesos formales e informales para organizarse y pescar. • ¿Tienen problemas de decisiones colectivos? • ¿Pueden o no resolver sus problemas de decisión colectiva? • ¿Cómo los pescadores se dan cuenta de que se está acabando el recurso?

INTERACTIONS (I)	
<ul style="list-style-type: none"> • ¿Los pescadores se reúnen para ver qué es lo que debe hacer la comunidad para resolver sus problemas? • ¿Qué problemas tienen los pescadores con la CGSM? • Los pescadores identifican en grupo sus problemas y le buscan alternativas? 	
I4 Conflicts	
<ul style="list-style-type: none"> • Conflictos que se presentan entre los pescadores. • ¿De qué tipo? y ¿Por qué? 	
I5 Investment activities	
<ul style="list-style-type: none"> • Inversión en compra de motores, equipo de pesca, etc. 	
I6 Lobbying activities	
<ul style="list-style-type: none"> • ¿Los pescadores acuden a los políticos para hacer las reglas como ellos quieren? • ¿En qué medida ellos influyen en los políticos que hacen las reglas formales? • ¿Hay grupos distintos que tienen diferentes poderes? • ¿Los pescadores hacen algún esfuerzo para cambiar las reglas influyendo sobre los políticos o paramilitares? 	
OUTCOMES (O)	
O1 – O2 Ecological and Social performance measures	
¿Existen reglas que permitan mejorar el sistema?	
<ul style="list-style-type: none"> ✓ Pej. Reglas que digan que no maten a los alevinos y con esto se puede aumentar la eficiencia del sistema económica y ecológicamente. 	
O3 Externalities to other SES	
<ul style="list-style-type: none"> • ¿Cómo lo que sucede con la CGSM afecta el mar y los ecosistemas adjuntos ? • ¿Cómo los a bananeros afectan la CGSM? • ¿Los pescadores conocen las externalidades que causan sus acciones sobre la CGSM? 	
RELATED ECOSYSTEMS	
<ul style="list-style-type: none"> • Describir los ecosistemas relacionados con la CGSM y que la afectan fuertemente, tanto a la Ciénaga como a los pescadores 	
* Los manglares * La zona bananera * Rio Magdalena	

PALAFITOS
<ul style="list-style-type: none"> • ¿Quiénes son? • ¿Qué hacen? ¿Solo pescan? • ¿En qué medida son importantes para la Ciénaga? • ¿Qué tanto estos pescadores afectan los recursos de la Ciénaga? • ¿Influyen positiva/negativamente en la CGSM? • ¿Por qué los pescadores no se ponen de acuerdo para manejar el recurso (CGSM)? <ul style="list-style-type: none"> ○ ¿Por qué viven lejos y no se pueden reunir? • ¿Por qué todo el mundo tiene derecho a pescar en la CGSM? • ¿Los pescadores consideran que manejan apropiadamente los recursos de la CGSM? <ul style="list-style-type: none"> ✓ SI: ¿Por qué? ✓ NO: ¿Por qué no son capaces de manejarlos apropiadamente? • ¿Están organizados en grupos? ¿Por qué si o por qué no? • Por qué no se pueden poder de acuerdo para manejar el recurso? • ¿Qué otras opciones de vida tienen a parte de la pesca? • ¿Qué importancia tienen los pescadores de los palafitos sobre la CGSM?

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

Appendix B: Interview Guides

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

❖ **GUIDE TO FISHERMEN, COMMUNITY LEADERS AND KEY INFORMANTS**

QUESTIONS	Link to SES
<ul style="list-style-type: none"> ¿Cuántos pescadores pescan en la CGSM? ¿Ustedes saben de dónde son los pescadores que pescan en la CGSM? 	S2 Demographic trends
<ul style="list-style-type: none"> ¿Ustedes confían en los políticos? SI- NO Explique 	S3 Political stability
<ul style="list-style-type: none"> Ustedes saben cómo es la relación entre los pescadores de la CGSM y los ganaderos, bananeros y palmeros? SI – NO Explique Ustedes saben si alguna vez los pescadores se han puesto de acuerdo con los ganaderos, bananeros o palmeros para cuidar la CGSM y evitar que se acaben los peces? SI – NO Explique 	Related ecosystems
<ul style="list-style-type: none"> ¿Cualquier persona puede venir a vivir en Tasajera/ pueblos cercanos o existe alguna entidad del gobierno encargada de controlar quien puede o no vivir? Existe alguna regla acerca del número de pescadores que pueden pescar en la CGSM o en las ciénagas de Pajarales, La Redonda o La Luna? SI - NO Explique Los pescadores pueden pescar en CUALQUIER LUGAR de la CGSM, o de las ciénagas de Pajarales, La Redonda o La Luna? Los pescadores puede pescar con CUALQUIER ARTE de pesca en cualquiera de las ciénagas? SI - NO Explique ¿Ustedes saben dónde son los criaderos naturales de los peces que se capturan en la CGSM? SI – NO (Hacer una lista de esos lugares) Todos los pescadores van a pescar a esos lugares? SI – NO Qué especies se capturan en estos lugares? / Que artes de pesca usan? Qué métodos emplean? Indagar por el ojo de malla se usan en estos lugares CUALQUIER PERSONA puede pescar en: <ul style="list-style-type: none"> La CGSM / La Ciénaga de Pajarales / La Ciénaga La Redonda / La Ciénaga La Luna SI - NO Explique Ustedes pescan en esas ciénagas? SI - NO Explique 	RS2 Clarity of system boundaries
<ul style="list-style-type: none"> Si se pescan muchos peces en el mar, ¿esto afecta la pesca en la CGSM? Si se pescan muchos peces en la CGSM, ¿esto afecta la pesca en el mar? Si se pescan muchos peces en la CGSM, esto afecta la pesca en: <ul style="list-style-type: none"> La Ciénaga de Pajarales / La Ciénaga La Redonda. / La Ciénaga La Luna. ¿Qué hacen ustedes para evitar que se acaben los peces en la CGSM y en las ciénagas de Pajarales, La Redonda y La una? 	RS6 Equilibrium properties O3 Externalities to other SES
<ul style="list-style-type: none"> Dónde nacen ó donde son los criaderos de los peces que se capturan en : <ul style="list-style-type: none"> La Ciénaga de Pajarales / La Ciénaga La Redonda / La Ciénaga La Luna. De todos los peces que hay en la CGSM cuáles se mueven entre: <ul style="list-style-type: none"> La CGSM y la Ciénaga de Pajarales. (Preguntar las 5 especies más importantes) La CGSM y la Ciénaga La Redonda. (Preguntar las 5 especies más 	RU1 Resource unit mobility RU3 Interaction among resource units

QUESTIONS	Link to SES
<p>importantes)</p> <ul style="list-style-type: none"> ▲ La CGSM y la Ciénaga La Luna. (Preguntar las 5 especies más importantes) • ¿En qué meses del año se pasan de un lugar a otro? 	
<ul style="list-style-type: none"> • Si los pescadores que pescan en la CGSM sacan muchos peces en muy poco tiempo, ¿ustedes saben cuánto tiempo necesita la ciénaga para recuperarse y volver a tener suficientes peces para todos? • Ustedes creen que la CGSM necesita ciertos periodos de descanso durante el año para recuperarse y seguir produciendo peces para todos o esto no es necesario? SI - NO Explique • ¿Usted sabe si alguna de las especies que hay en la CGSM están en peligro? SI – No <ul style="list-style-type: none"> ▲ Cuáles especies están en peligro? /Por qué están en peligro? • Cuáles son las principales especies de peces que se capturan en la CGSM? • Para cada especie identificar: <ul style="list-style-type: none"> ▲ En qué momentos del año se reproducen, según especie? ▲ Épocas del año durante las cuales no se debería pescar porque aun son pequeños? • Los artes de pesca, según tamaño del ojo de malla, se utilizan en momentos particulares del año o todos sin importar el tamaño del ojo de malla se pueden usar todo el año? 	RU2 Growth or replacement rate
<ul style="list-style-type: none"> • De todos los peces que se pueden capturar en la CGSM, ¿cuáles son los que les dejan mayores ganancias? (hacer la lista) <ul style="list-style-type: none"> ▲ Quienes compran esos pescados? (Ej. Distribuidores mayoristas de pescado, hoteles, restaurantes etc.) ▲ ¿De dónde vienen los compradores de ese pescado? ▲ ¿A quiénes le venden el pescado? • ¿Qué es más rentable para ustedes, los peces o los camarones? • ¿Hay pescadores que sólo se dedican a pescar camarones? SI - NO EXPLIQUE 	RU4 Economic value
<ul style="list-style-type: none"> • En su opinión, en los últimos años (10-15) el tamaño de los peces que se capturan en la CGSM ha cambiado? (Son de igual tamaño, son más grandes o son más pequeños) <ul style="list-style-type: none"> ▲ Si el tamaño se ha reducido, ¿por qué creen ustedes que se ha reducido el tamaño de los peces capturados? 	RU5 Size
<ul style="list-style-type: none"> • La CGSM tiene meses durante los cuales la pesca es buena o todos los meses son iguales? <ul style="list-style-type: none"> ▲ ¿Cuáles son los meses buenos? (mencionarlos) <ul style="list-style-type: none"> ✓ ¿Qué hace que esos meses sean buenos? (Ej. Llueve menos, hay menos viento, etc.) ✓ Durante estos meses buenos, ¿hay lugares dentro la CGSM que son mejores para pescar o en toda la CGSM es igual? ¿Cuáles son esos lugares? ▲ ¿Cuáles son los meses malos? <ul style="list-style-type: none"> ✓ ¿Qué hace que esos meses sean malos? (Ej. Llueve más, hay 	RU7 Spatial & temporal distribution

QUESTIONS	Link to SES
<p>más viento, etc.)</p> <ul style="list-style-type: none"> ✓ Durante estos meses malos, ¿hay lugares dentro la CGSM que son mejores para pescar o en toda la CGSM es igual? ¿Cuáles son esos lugares? • ¿Hay lugares en la CGSM donde no se debería pescar? SI – NO Por qué? <ul style="list-style-type: none"> ▲ ¿Cuáles son esos lugares? 	
<ul style="list-style-type: none"> • Existen oficinas de entidades del gobierno o de ONG's donde ustedes puedan solicitar ayudas económicas o tramitar proyectos? SI – NO ¿Cuáles? • Cuando una entidad del gobierno o una ONG llega para realizar algún proyecto o darles alguna ayuda económica: <ul style="list-style-type: none"> ▲ ¿Qué hace la gente? ▲ ¿Cómo se organiza para recibir las ayudas o participar en los proyectos? ▲ ¿Qué hace la gente con los recursos que les entregan? • En su opinión las ayudas que la gente ha recibido en los últimos años ha afectado en algo su comportamiento o la forma de ver la vida y el trabajo? • En los dos últimos años ustedes han recibido algún tipo de ayuda del Gobierno o de alguna otra entidad? SI – NO <ul style="list-style-type: none"> ▲ ¿Qué entidades les dieron la ayuda? Mencionarlas ▲ ¿Qué tipo de ayuda recibieron? ▲ Quiénes recibieron la ayuda y cómo escogieron a los beneficiarios de esta ayuda? ▲ ¿Ustedes tuvieron que hacer algo para recibir esta ayuda? ▲ ¿Ustedes solicitaron la ayuda a través de algún proyecto o ellos llegaron a buscarlos a ustedes? ▲ En caso de haber tramitado algún proyecto, ¿quién hizo el proyecto y lo tramitó? • El manejo de los proyectos y la entrega de las ayudas, ¿ha generado algún tipo de conflicto entre los pescadores? SI – NO Explique <ul style="list-style-type: none"> ▲ En caso afirmativo, ¿esto ha afectado las relaciones personales entre los pescadores? ¿Cómo las ha afectado? (Ej. Peleas, desconfianza, falta de solidaridad, etc.) • Ustedes están asociados a alguno de los grupos comunitarios o de pescadores que existen? SI - NO <ul style="list-style-type: none"> ▲ En caso afirmativo: <ul style="list-style-type: none"> ✓ ¿A cuál grupo pertenecen? / ¿Cuántas personas conforman el grupo? / ¿Quiénes conforman el grupo: familiares, amigos, vecinos? ✓ ¿Ustedes confían en el presidente de su organización y sus compañeros del grupo? ▲ En caso negativo, por qué no confían en ellos? 	<p>GS1 Governing organizations</p> <p>GS2 No government organizations</p>
<ul style="list-style-type: none"> • Cómo describirían ustedes a los habitantes de Tasajera/otras comunidades? (Ej. Trabajadores, solidarios, etc.) 	<p>GS3 Network structure</p>

QUESTIONS	Link to SES
<ul style="list-style-type: none"> Los habitantes de Tasajera/otras comunidades son unidos? SI - NO? <ul style="list-style-type: none"> En caso afirmativo, ¿Para qué tipo de actividades se unen? (para protestar en la carretera, para ir a pescar, para ayudar a alguien enfermo, etc) En caso negativo, por qué creen ustedes que no son unidos? A los pescadores les gusta trabajar en grupo? SI- NO Explique Ustedes saben si los pescadores de los pueblos palafíticos (Bocas de Aracataca, Buenavista y Nueva Venecia) son unidos? SI - NO? <ul style="list-style-type: none"> En caso afirmativo, ¿Para qué tipo de actividades se unen? En caso negativo, por qué creen ustedes que no son unidos? ¿Por qué creen ustedes que los pescadores de los 3 pueblos palafíticos son unidos y los de Tasajera no? (SOLO EN CASO DE QUE ESTE SEA EL RESULTADO DE LAS DOS PREGUNTAS ANTERIORES) 	<p>U2 Socioeconomic attributes of users</p>
<ul style="list-style-type: none"> Si ustedes ven a otro pescador cortando el mangle, haciendo zangarreo o usando redes con un ojo de malla pequeño, qué hacen ustedes? ¿Por qué creen ustedes que ellos hacen esto? Explicar. Los pescadores tienen algún sistema de monitoreo para evitar el uso de artes o métodos de pesca que destruyen la CGSM? SI – NO Explique Ustedes saben dónde pescan los pescadores que viven en los pueblos palafíticos (Bocas de Aracataca, Buenavista y Nueva Venecia)? <ul style="list-style-type: none"> Ustedes saben qué artes de pesca usan ellos? Ustedes pueden pescar en los mismos lugares donde ellos pescan y usar cualquier arte de pesca? SI – NO Explique. Ustedes saben si los pescadores de los pueblos palafíticos tienen algún sistema de monitoreo para evitar el uso de artes o métodos de pesca que puedan destruir la CGSM o las ciénagas de Pajarales, La Redonda o La Luna? SI – NO Explique Cuándo ustedes salen a pescar, ustedes se encuentran con funcionarios del gobierno (Ej. Policía, PNN, MMA) vigilando la CGSM? SI – NO Explique ¿Qué pasa si usted los encuentran? 	<p>GS8 Monitoring and sanctioning processes</p>
<ul style="list-style-type: none"> Existe algún reglamento pesquero (oficial o no) para la CGSM? SI – NO explique 	<p>GS7 Constitutional rules</p>
<ul style="list-style-type: none"> Alguna vez los pescadores que pescan en la CGSM se han reunido, por su propia cuenta, para discutir acerca de cómo evitar que los recursos pesqueros de la CGSM se acaben? SI - NO Explique ¿Alguna vez ustedes se han puesto de acuerdo con los pescadores de los pueblos palafíticos (Bocas de Aracataca, Buenavista y Nueva Venecia) para hacer alguna actividad de manera conjunta? SI - NO Explique Alguna vez los pescadores que pescan en la CGSM se han reunido con los dueños de los cultivos de peces, por su propia cuenta, para discutir acerca de cómo evitar que los recursos pesqueros de la CGSM se acaben? SI - NO Explique ¿Alguna vez ustedes se han puesto de acuerdo con los dueños de los cultivos de peces para hacer alguna actividad de manera conjunta? SI - NO Explique 	<p>U1 Number of users</p>

QUESTIONS	Link to SES
<ul style="list-style-type: none"> Si alguna entidad organiza un curso o taller sobre conservación del medio ambiente o sobre la pesca en la CGSM, usted asistiría? SI – NO <ul style="list-style-type: none"> En caso afirmativo: Asistiría a pesar de que no le den ninguna ayuda económica por participar en el taller? SI – NO Explique En caso negativo. ¿Por qué no asistiría? SI – NO Explique 	U2 Socioeconomic attributes of users
<ul style="list-style-type: none"> ¿En tasajera/otros pueblos existen líderes comunitarios? SI – NO Explique La gente confía en ellos? SI - NO Por qué? Cómo se organizan los grupos para trabajar en los proyectos que desarrollan las distintas entidades? 	U5 Leadership / Entrepreneur
<ul style="list-style-type: none"> ¿Por qué los pescadores que pescan en la CGSM no se organizan para explotarla de una manera sostenible? Los pescadores se ayudan entre sí? <ul style="list-style-type: none"> ¿Cómo se ayudan? ¿En qué tipo de situaciones se ayudan? 	U6 Norms and social capital
<ul style="list-style-type: none"> Todos sabemos que Tasajera/otras comunidades es una comunidad de pescadores con muchas necesidades. En su opinión: <ul style="list-style-type: none"> ¿Quién es el responsable de esto? ¿Quién debería ayudarles a mejorar sus condiciones de vida? ¿Cómo deberían ayudarles? Ustedes saben si la CGSM tiene actualmente algún tipo de problema? (Ej. Contaminación) Ustedes creen que los recursos pesqueros de la CGSM se pueden acabar pronto o no? Explique Si por alguna razón la CGSM no produjera más peces y camarones, que creen ustedes que pasaría la CGSM? En su opinión, la CGSM es una laguna muy fuerte que aguanta de todo y se recupera fácilmente o por el contrario es muy frágil y necesita de ciertos cuidados? Explique. 	U7 Knowledge of SES /mental models
<ul style="list-style-type: none"> En Tasajera/otras comunidades existe alguna red de trabajo colaborativo entre los pescadores? SI - NO ¿De qué tipo? 	GS3 Network Structure
<ul style="list-style-type: none"> ¿Quién es el dueño de la CGSM o de la Ciénaga de Pajarales, La Redonda o La Luna? ¿Cualquier persona puede pescar en cualquier lugar de la CGSM? SI - NO <ul style="list-style-type: none"> En caso afirmativo: El hecho de que cualquier persona pueda pescar en la CGSM tiene algo que ver con la falta de interés de los pescadores por organizarse para explotar la CGSM de una manera sostenible? 	GS4 Property right system
<ul style="list-style-type: none"> ¿Los pescadores que pescan en la CGSM se pelean por cosas relacionadas con la pesca? SI - NO Explique ¿Los pescadores que viven en la carretera se pelean con los pescadores de los pueblos palafíticos? SI - NO Explique 	I4 Conflicts among users

❖ **GUIDE TO EXPERTS**

QUESTIONS
<ul style="list-style-type: none"> • ¿Cuáles son las PRINCIPALES PROBLEMÁTICAS de Tasajera/otras comunidades? Mencíónelas • Cree usted que ESTAS PROBLEMÁTICAS DISCUTIDAS AFECTAN DE ALGUNA MANERA LA ACCIÓN COLECTIVA en Tasajera y otras comunidades? ¿Cómo?
<ul style="list-style-type: none"> • ¿Qué ENTIDADES han desarrollado proyectos con los pescadores de la CGSM? • ¿Qué AYUDAS / PROYECTOS han desarrollado con los pescadores de la CGSM? • ¿Qué IMPACTO ha tenido en los PESCADORES las AYUDAS ECONÓMICAS que han recibido por parte del gobierno y las ONG's? (P.ej. rivalidad entre ellos por manejar los recursos, conflictos, dependencia, mendicidad, etc.) Explique • Usted sabe si LOS PESCADORES que pescan en la CGSM SE HAN ORGANIZADO ALGUNA VEZ para explotar la CGSM? <ul style="list-style-type: none"> • SI => Explique • NO => Por qué no? En caso de que no se hayan organizado preguntar si LAS AYUDAS que los pescadores han recibido TIENE ALGO QUE VER CON QUE ELLOS NO SE HAYAN ORGANIZADO para explotar la CGSM?
<ul style="list-style-type: none"> • Usted conoce si actualmente alguna ENTIDAD ESTÁ REALIZANDO ALGÚN PROYECTO con los pescadores de la CGSM? SI – NO ¿Cuál? • ¿Qué tipo de SITUACIONES SE HAN GENERADO ENTRE LOS PESCADORES a raíz de los proyectos? (Ej. Conflictos) • ¿Cómo los PROYECTOS HAN INFLUENCIADO LA CAPACIDAD ORGANIZATIVA de los pescadores?
<ul style="list-style-type: none"> • Existe alguna REGLA O NORMA SOBRE LA PESCA EN LA CGSM? <ul style="list-style-type: none"> • SI => Explique • NO => Por qué no? • Existe alguna regla hacer de CÓMO LOS PESCADORES DETERMINAN: <ul style="list-style-type: none"> ✓ ¿QUIÉN TIENE DERECHO A PESCAR? ✓ ¿DÓNDE SE PUEDE PESCAR? • Cómo se puede REGULAR LA PESCA en la cgsM? • ¿Qué tipo de NORMAS Ó REGLAS SE DEBERÍAN ESTABLECER para regular la pesca en la CGSM? • ¿PRIVATIZAR LA LAGUNA sería una opción para regular la pesca?
<ul style="list-style-type: none"> • ¿Usted sabe si los PESCADORES que explotan la CGSM ESTÁN ORGANIZADOS para evitar la sobrepesca? <ul style="list-style-type: none"> ○ SI => Explique ○ NO => A QUÉ SE DEBE ESTA FALTA DE ORGANIZACIÓN DE LOS PESCADORES? (política, corrupción, etc) • ¿Los grupos al margen de la ley (GUERRILLA, PARAMILITARES) afectan o HAN AFECTADO EL INTERÉS DE LA GENTE POR TRABAJAR CONJUNTAMENTE y lograr una explotación sostenible de la CGSM? Si – No. Explique
<ul style="list-style-type: none"> • ¿Cuál HA SIDO EL ROL DEL GOBIERNO en la CGSM? • Existen ENTIDADES del gobierno que hagan algún tipo de CONTROL Y VIGILANCIA de la CGSM ¿Cuáles? ¿Qué hacen? • ¿Cómo afecta LA VIGILANCIA / LA FALTA VIGILANCIA el comportamiento de los pescadores? (Ej. No se organizan) • Por qué los PESCADORES NO HAN ESTABLECIDO NINGÚN MECANISMO DE

QUESTIONS	
CONTROL entre ellos para evitar la sobrepesca en la CGSM?	
<ul style="list-style-type: none"> Los pescadores conocen el IMPACTO QUE CAUSAN LOS DIFERENTES ARTES Y MÉTODOS DE PESCA que usan a la CGSM? <ul style="list-style-type: none"> SI => Si ellos conocen el impacto de métodos como el boliche, por qué lo usan? POR QUÉ ELLOS NO CONTROLAN ENTRE ELLOS MISMOS el uso de artes de pesca que afectan la CGSM? 	
<ul style="list-style-type: none"> ¿Las ORGANIZACIONES COMUNITARIAS FUNCIONAN apropiadamente o no? <ul style="list-style-type: none"> SI – NO ¿Por qué? Los PESCADORES SE PREOCUPAN POR CUIDAR LA CGSM? <ul style="list-style-type: none"> SI- NO. Explique ¿Cómo calificaría usted la CAPACIDAD ORGANIZATIVA DE LOS PESCADORES que explotan la CGSM? <ul style="list-style-type: none"> MALA => ¿POR QUÉ NO SE ORGANIZAN SOLOS SIN LA AYUDA DE UNA ENTIDAD? 	
<ul style="list-style-type: none"> Ustedes han organizado TALLERES O CURSOS con los pescadores de la CGSM sobre CONSERVACIÓN DEL MEDIO AMBIENTE o sobre la PESCA en la Ciénaga? SI – NO. <ul style="list-style-type: none"> ✓ SI => ¿Qué tanta ACOGIDA tuvo? ¿De qué depende que ASISTAN MUCHOS O POCOS pescadores a los talleres o cursos? (Ej. costos transporte) 	
De acuerdo con algunos estudios la PRODUCTIVIDAD de la CGSM se ha reducido en los últimos años.	
<ul style="list-style-type: none"> ¿Cree usted que los PESCADORES SON CONSCIENTES de esto? SI – NO. <ul style="list-style-type: none"> SI => ¿POR QUÉ CREE USTED QUE ELLOS NO SE HAN ORGANIZADO PARA EVITAR QUE SE SIGA REDUCIENDO la productividad? NO => ¿POR QUÉ NO SON CONSCIENTES DE ESTA REDUCCIÓN? 	
La CGSM es explotada por cerca de 5.000 PESCADORES.	
<ul style="list-style-type: none"> En su opinión, ¿QUÉ IMPACTO TIENE ESTO SOBRE LA CAPACIDAD ORGANIZATIVA DE LOS PESCADORES? Explique 	
En los últimos 20 años la POBLACIÓN DE TASAJERA SE HA DUPLICADO (1993: 4087 => 2007: 7438). En su opinión,	
<ul style="list-style-type: none"> El hecho de que haya MÁS HABITANTES en Tasajera HA AFECTADO SU CAPACIDAD DE ORGANIZACIÓN para realizar actividades conjuntas o EXPLOTAR LA CGSM SOSTENIBLEMENTE? Si – No. Explique 	
De acuerdo con algunos estudios, en los últimos años la CGSM HA SUFRIDO DRÁSTICOS CAMBIOS EN SUS CONDICIONES HIDROLÓGICAS. En su opinión,	
<ul style="list-style-type: none"> ¿Qué EFECTOS HA GENERADO ESTOS CAMBIOS entre los distintos usuarios de la CGSM?. Explorar las relaciones entre: <ul style="list-style-type: none"> ✓ Pescadores vrs. Ganaderos ✓ Pescadores vrs. Palmicultores / Bananeros ✓ Pescadores pueblos de la carretera vrs. pescadores de los pueblos palafíticos ¿Existe alguna RELACIÓN ENTRE ESOS CAMBIOS Y LA FALTA DE ORGANIZACIÓN de los pescadores para explotar la CGSM? SI – NO. Explique. 	
<ul style="list-style-type: none"> ¿Usted sabe si existe un LÍMITE EN EL NÚMERO DE EMBARCACIONES que pueden pescar en la CGSM o cualquier persona puede llegar a pescar allí, sin restricción alguna? Cuando la PESCA EN LA CGSM ES MALA, usted sabe QUE HACEN LOS 	

QUESTIONS	
	<p>PESCADORES para conseguir los recursos necesarios para su subsistencia? (Ej. Van a pescar al mar o a la Ciénaga de Pajarales, etc.) Explique</p> <ul style="list-style-type: none"> De acuerdo con algunos pescadores, la introducción del BOLICHE A LA CGSM GENERÓ CONFLICTOS ENTRE LOS PESCADORES de los pueblos de la carretera y los de los pueblos palafíticos. En su opinión, <ul style="list-style-type: none"> ✓ ¿Qué CONSECUENCIAS DEJÓ ESOS CONFLICTOS ENTRE LOS PESCADORES? Explique ✓ ¿AFECTÓ ESTO SU DISPOSICIÓN PARA TRABAJAR EN GRUPO ó ellos NUNCA HAN HECHO COSAS JUNTOS? Explique
	<ul style="list-style-type: none"> ¿Existe alguna relación entre el TAMAÑO DE LA CGSM Y LA FALTA DE ORGANIZACIÓN de los pescadores para explotarla sosteniblemente? Si – No. Explique.
	<ul style="list-style-type: none"> Usted sabe si los DUEÑOS DE LOS CULTIVOS de peces alguna vez han intentado ponerse de acuerdo con los pescadores en temas relacionados con la pesca en la CGSM? Si – No. Explique
	<ul style="list-style-type: none"> ¿Cree usted que ESTAS PROBLEMÁTICAS DISCUTIDAS AFECTAN LA ACCIÓN COLECTIVA? ¿Cómo?
	<ul style="list-style-type: none"> UNODC <ul style="list-style-type: none"> ○ Cómo funciona la ayuda/ los proyectos en la CGSM? ○ En que se asemejan y en qué se diferencian los pueblos de la carretera de los pueblos palafíticos? (homogeneidad vr. Heterogeneidad) ○ Cómo se organiza la gente cuando llegan las ayudas? Qué proceso se sigue? Quién los organiza? Cómo seleccionan los integrantes de sus grupos?
	<ul style="list-style-type: none"> BANCO AGRARIO <ul style="list-style-type: none"> ✓ Líneas de crédito – requisitos

Appendix C: Survey Questionnaire

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

PRESENTACIÓN

Buenos días/tardes. Mi nombre es _____. Como le comentaron el día que programaron esta cita, estamos haciendo una encuesta con el fin de conocer cómo funciona la pesca en la Ciénaga Grande de Santa Marta, y por eso su opinión es muy importante para nosotros. Así que le agradecemos nuevamente haber aceptado nuestra invitación para participar en esta investigación.

Esta encuesta hace parte de un estudio que está desarrollando el Centro de Ecología Marina Tropical en asocio con el INVEMAR, y su fin es netamente académico. Por lo tanto, le garantizamos que la información que usted nos va suministrar hoy es totalmente anónima y nunca será utilizada de manera individual.

No existen respuestas correctas o incorrectas. Nosotros solo queremos conocer su opinión acerca de algunos temas relacionados con la pesca en la Ciénaga Grande de Santa Marta.

INFORMACIÓN OPERATIVA

Encuesta No.		
Fecha de la encuesta:		
Lugar:		
Nombre del pescador/embarcación en SIPEIN:		
Código del pescador/embarcación en SIPEIN:		
Nombre del encuestado:		
Teléfono del encuestado:		
Dirección de la casa:		
Encuestador:	1. Rubén Vásquez	
	2. Alexander Acuña	
	3. Luz Elba Torres	

RESULTADO DE LA VISITA (Marque X)	
Encuesta completa	<input type="checkbox"/>
Encuesta incompleta	<input type="checkbox"/>
Nadie en el hogar	<input type="checkbox"/>
Rechazo	<input type="checkbox"/>

Hora de inicio (Usar reloj de 24 horas)	
Hora de finalización (Usar reloj de 24 horas)	

ENCUESTADOR:

- ❖ Todas las preguntas de selección son de **RESPUESTA ÚNICA**, a menos que se indique lo contrario
- ❖ CGSM significa Ciénaga Grande de Santa Marta

ARTE DE PESCA	AÑO DESDE QUE LO USA



A. INFORMACIÓN GENERAL

A continuación le voy a hacer algunas preguntas sobre Usted y su hogar.

A1. ¿De dónde es usted? (NO LEER LAS OPCIONES)		A2. ¿Hace cuánto tiempo vive en Tasajera? (NO LEER LAS OPCIONES)	
Tasajera	1	Toda la vida	1
Buenavista	2	Entre 1 y 10 años	2
Nueva Venecia	3	Entre 11 y 20 años	3
Bocas de Aracataca	4	Entre 21 y 30 años	4
Pueblo Viejo	5	Entre 31 y 40 años	5
Isla de Rosario	6	Entre 41 y 50 años	6
Palmira	7	Más de 50 años	7
Otro lugar. ¿Cuál?	8		

A3. ¿Cuántas personas residen en la casa donde Usted vive?		A4. ¿Cuántos grupos de personas, que cocinan por separado, hay en la casa donde Usted vive?	
---	--	--	--

A5. De todas las personas que residen en la casa donde Usted vive, ¿Cuántas dependen económicamente de Usted?	
--	--

A6. Además de las personas que tiene bajo su cargo en su casa, Usted sostiene económicamente a alguien más?	1. SI		Hacer A7	A7. ¿Cuántas personas más?	
	2. NO		Pase a A8		

A8. ¿Alguna(s) de las personas que vive en su casa le ayuda con sus gastos de sostenimiento o con los gastos de sostenimiento de su hogar?	1. SI		Hacer A9
	2. NO		Pase a A10

A9. ¿Quién le ayuda al sostenimiento de su hogar? (COMPLETAR EL SIGUIENTE CUADRO)					
#	1. PARENTESCO CON EL PESCADOR (Ej. Hija, Yerno, no pariente, nieto, hermano, mamá, etc.)	2. ¿QUÉ ACTIVIDAD REALIZA? (Ej. Pescador en la CGSM o el mar, albañil, celador, madre comunitaria, vendedora de fritos, comercializador(a) de pescado, componedor de pescado, etc.)	3. TIPO DE APOORTE 1. En dinero 2. En especie	4. FRECUENCIA DE LOS APORTES AL HOGAR USAR CODIGO	5. MONTO DE LOS APORTES (EN EL CASO DE LOS APORTES EN ESPECIE, PREGUNTAR POR UN VALOR APROXIMADO)
1.					\$
2.					\$
3.					\$
4.					\$

CODIGO FRECUENCIA DE LOS APORTES AL HOGAR
1. Diaria 2. Semanal 3. Quincenal 4. Mensual 5. Trimestral 6. Semestral 6. Anual

A10. La casa donde usted vive es: (LEER LAS OPCIONES)						
Propia con título	Propia sin título	En arriendo	En subarriendo	En usufructo	Propiedad colectiva	Otra. ¿Cuál?
1	2	3	4	5	6	7

A11. ¿Cuál fue el último año de estudios que Usted cursó? (ANOTAR EL AÑO Y NIVEL)	
--	--

B. ACTIVIDAD ECONÓMICA DEL HOGAR

Ahora le voy a hacer algunas preguntas relacionadas con su trabajo:

B1. ¿Desde hace cuántos años que Usted es pescador?		B2. ¿Usted se dedica exclusivamente a la pesca?	1. SI		2. NO	
--	--	--	-------	--	-------	--

B3. ¿Usted pesca solo?	1. SI		Pase a B5	B4. ¿Siempre va a pescar con las mismas personas?	1. SI		2. NO	
	2. NO		Hacer B4					

B5. La canoa que usa actualmente para pescar es:	1. Propia		Pase a B7
	2. Alquilada		Hacer B6

B6. ¿Cuánto paga por el alquiler de la canoa? (ANOTAR VALOR Y UNIDAD DE TIEMPO)	\$		Pase a B12
--	----	--	------------

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

3

B7. Aparte de la canoa que usa para pescar, ¿Usted es dueño de otras canoas?	1. SI	Hacer B8 a B11	B8. ¿Cuántas canoas más tiene Usted?
	2. NO	Hacer B9 a B11	

SOLO PARA PROPIETARIOS DE EMBARCACIONES			
B9. ¿Cuál es el nombre de la embarcación (es)?	B10. ¿Cuál es el uso más común?		B11. Si la fuera a vender ¿Cuánto le darían?
	1. La usa para pescar en la CGSM 2. La usa para pescar en el MAR 3. La alquila (Pregunter valor)	1. Tipo de Uso (USAR CÓDIGO)	
1.		\$	\$
2.		\$	\$
3.		\$	\$
4.		\$	\$
5.		\$	\$

B12. ¿Cuál es el nombre de la embarcación (s) o del propietario (s) de la embarcación que Usted actualmente usa para pescar en la CGSM?	B13. ¿Desde cuándo usa esa (s) embarcación (es)? ANOTAR MES/AÑO	Si la respuesta es una FECHA POSTERIOR A ENERO DE 2006 Hacer B14
1.		
2.		
3.		

B14. ¿Cuál es el nombre de la embarcación (es) que usaba antes para ir a pescar? EMPEZAR POR LA MAS RECIENTE (TRATAR DE OBTENER INFORMACION PARA EL PERIODO 2006-2012)			
1. Nombre de la embarcación o del propietario si no tiene nombre la canoa	2. TIPO TENENCIA USAR CÓDIGO	3. PERÍODO EN EL QUE USÓ LA (S) EMBARCACIÓN (ES)	
		1. DESDE (Mes / Año)	2. HASTA (Mes / Año)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

CÓDIGOS TIPO DE TENENCIA DE LA EMBARCACION	
1. Único propietario	5. Alquilada
2. En asocio con otro pescador	6. Prestada (sin pago)
3. En asocio con otros pescadores	7. Otra ¿Cuál? _____
4. En asocio con un NO pescador (RENTISTA)	8. Otra ¿Cuál? _____

B15. Ahora quiero que me cuente algunos detalles sobre la embarcación(es) que Usted USA ACTUALMENTE para pescar.

1. NOMBRE DE LA EMBARCACION (ES)	2. TIPO TENENCIA USAR CÓDIGO	3. TIPO (Marque x)		4. M. PROPULSION (Marque x)			5. DIMENSIÓN	
		1. Madera	2. Fibra	1. P / V	2. F / B	3. POTENCIA (No. HP)	1. No.	2. Und.

CÓDIGOS TIPO DE TENENCIA DE LA EMBARCACION	
1. Único propietario	5. Alquilada
2. En asocio con otro pescador	6. Prestada
3. En asocio con otros pescadores	7. Otra ¿Cuál? _____
4. En asocio con un NO pescador (RENTISTA)	8. Otra ¿Cuál? _____

Ahora le voy a hacer algunas preguntas relacionadas con los ARTES DE PESCA que usa para pescar:

ENCUESTADOR: Indagar por los artes que usa para pescar y completar los siguientes cuadros, según arte utilizado.

B16. REDES DE ENMALLE (TRASMALLO O MANTA)							
1. NÚMERO DE PAÑOS (MANTAS) DE LA RED	2. TAMAÑO DEL OJO DE MALLA Pulgadas	3. LA USA PARA PESCAR EN: 1. La CGS 2. El Mar	4. DIMENSION		5. MÉTODO 1. Fija o parada (CGSM) 2. Boliche (CGSM) 3. Zangarreo (CGSM) 4. Lanceo (Boliche mar)	6. TIPO DE PROPIEDAD USAR CÓDIGO	7. SOLO PARA PROPIETARIOS Si la fuera a vender ¿Cuánto le darían?
			M: Mallas Br: Brazas (182,88 Cm) Mts: Metros	1. Alto			
							\$
							\$
							\$
							\$
							\$
							\$
							\$
							\$
							\$
							\$

TIPO DE PROPIEDAD DE LOS ARTES: 1. Único propietario 2. En asocio con otro pescador 3. No propietario

B17. RED CAMARONERA							
1. CANTIDAD DE REDES	2. TIPO DE PROPIEDAD USAR CÓDIGO	3. TAMAÑO OJO DE MALLA No. de Pulgadas	4. DIMENSIÓN		5. MÉTODO (Marque X)		6. SOLO PARA PROPIETARIOS Si la fuera a vender ¿Cuánto le darían?
			M: Mallas Br: Brazas (182,88 Cm) Mts: Metros	1. Alto	2. Largo	1. Releo (Foguero)	
							\$
							\$
							\$
							\$
							\$

TIPO DE PROPIEDAD DE LOS ARTES: 1. Único propietario 2. En asocio con otro pescador 3. No propietario

B18. ATARRAYA			
1. CANTIDAD	2. TIPO DE PROPIEDAD USAR CÓDIGO	3. TAMAÑO OJO DE MALLA No. Pulg.	4. SOLO PARA PROPIETARIOS Si la fuera a vender ¿Cuánto le darían?
			\$
			\$
			\$
			\$

TIPO DE PROPIEDAD DE LOS ARTES: 1. Único propietario 2. En asocio con otro pescador 3. Alquilada 4. No propietario

B19. PALANGRE					
1. CANTIDAD	2. TIPO DE PROPIEDAD USAR CÓDIGO	3. NÚMERO DE ANZUELOS	4. CALIBRE (No.)	5. NÚMERO DE CALADAS	6. SOLO PARA PROPIETARIOS Si lo fuera a vender ¿Cuánto le darían?
					\$
					\$
					\$
					\$

TIPO DE PROPIEDAD DE LOS ARTES: 1. Único propietario 2. En asocio con otro pescador 3. No propietario

B20. CHINCHORRO / CHINCHORRA							
1. ARTE (Marque X) C/RRO C/RRA	2. CANTIDAD	3. TIPO DE PROPIEDAD USAR CÓDIGO	4. RED		5. COPO		6. SOLO PARA PROPIETARIOS Si lo fuera a vender ¿Cuánto le darían?
			1. TAMAÑO OJO DE MALLA (Pulgadas)	2. DIMENSION M: Mallas Br: Brazas (182,88 Cm) Mts: Metros	1. TAMAÑO OJO DE MALLA (Pulgadas)	2. DIMENSION (Metros)	
							\$
							\$
							\$
							\$

TIPO DE PROPIEDAD DE LOS ARTES: 1. Único propietario 2. En asocio con otro pescador 3. No propietario

B21. NASAS		
1. CANTIDAD	2. TIPO DE PROPIEDAD USAR CÓDIGO	3. SOLO PARA PROPIETARIOS Si las fuera a vender ¿Cuánto le darían?
		\$
		\$

B22. AROS		
1. CANTIDAD	2. TIPO DE PROPIEDAD USAR CÓDIGO	3. SOLO PARA PROPIETARIOS Si los fuera a vender ¿Cuánto le darían?
		\$
		\$

B23. BUCEO (Marque X)		
1. CARACOL	2. OSTRA	3. ALMEJA

TIPO DE PROPIEDAD DE LOS ARTES: 1. Único propietario 2. En asocio con otro pescador 3. En préstamo (sin pago) 4. No propietario

B24. Ahora vamos a ordenar los artes de pesca que utiliza, DEL MÁS USADO AL MENOS USADO.			
1. Arte	2. USO DE LOS ARTES 1 => Indica el más usado	1. Arte	2. USO DE LOS ARTES 1 => Indica el más usado
Red de enmalle		Red camaronera	
Atarraya		Palangre	
Aros		Chinchorro	
Nasas		Chinchorra	

B25. ¿Cuál es la PRINCIPAL RAZÓN por la cual Usted usa esos artes de pesca? (LEER LAS OPCIONES)	
Por tradición en su familia	1
Solo sabe trabajar con esos artes	2
Son los que sacan más pescado	3
Captura peces grandes y se venden mejor	4
Le gusta trabajar con esos artes porque son más cómodos	5
No dañan la CGSM	6
Otra. ¿Cuál?	7
Otra. ¿Cuál?	8

B26. ¿Usted tiene algunos lugares o puntos que sean sus favoritos para ir a pescar?	1. SI	Hacer B27
	2. NO	Pase a B28

B27. ¿Cómo se llaman esos lugares ó puntos favoritos para ir a pescar? (PREGUNTAR NOMBRE DEL LUGAR)													
1. NOMBRE DEL LUGAR	2. CÓDIGO DE UBICACIÓN 1. CGSM 2. Ciénaga de Pajarales 3. Mar	3. ÉPOCA DEL AÑO EN LA CUAL PESCA ALLÍ (MARCAR X EN LOS MESES)											
		1	2	3	4	5	6	7	8	9	10	11	12
		E	F	M	A	M	J	J	A	S	O	N	D
1.													
2.													
3.													
4.													
5.													
6.													
7.													
8.													
9.													
10.													

B28. ¿Hay lugares o puntos dentro de la CGSM donde NO SE DEBERÍA IR A PESCAR porque esto afecta NEGATIVAMENTE el recurso pesquero (la cantidad de peces)?	1. SI
	2. NO

B29. ¿Dónde pesca Usted normalmente? (LEER LAS OPCIONES)		B30. ¿Cuándo es la temporada de pesca en la CGSM? (ANOTAR CON DETALLE)	
1. En la CGSM	Hacer B30 a B37		
2. En la CGSM y en el MAR	Hacer B30 a B48		

B31. ¿En qué meses del año Usted pesca en la CGSM? (Marque X)												
1	2	3	4	5	6	7	8	9	10	11	12	13
E	F	M	A	M	J	J	A	S	O	N	D	TODO EL AÑO

B32. Cuando Usted pesca en la CGSM, ¿Cuánto es más o menos su ingreso en:		B33. ¿Cuántos días a la semana pesca?	B34. ¿Cuántos días de la semana son:	B35. En promedio, ¿Cuántas horas pesca diariamente?
1. Un día bueno	\$		1. Días buenos	
2. Un día regular	\$		2. Días regulares	
3. Un día malo	\$		3. Días malos	

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

6

B36. Cuando Usted pesca en la CGSM, ¿Cuánto es en promedio su ingreso en: (LEER LAS OPCIONES). <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">1. Un MES bueno</td> <td>\$</td> </tr> <tr> <td>2. Un MES regular</td> <td>\$</td> </tr> <tr> <td>3. Un MES malo</td> <td>\$</td> </tr> </table>	1. Un MES bueno	\$	2. Un MES regular	\$	3. Un MES malo	\$	B37. De los meses en los que usted PESCA EN LA CGSM, ¿Cuántos son: <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">1. MESES buenos</td> <td></td> </tr> <tr> <td>2. MESES regulares</td> <td></td> </tr> <tr> <td>3. MESES malos</td> <td></td> </tr> <tr> <td colspan="2">(El total de meses debe coincidir con la PREG B31)</td> </tr> </table>	1. MESES buenos		2. MESES regulares		3. MESES malos		(El total de meses debe coincidir con la PREG B31)	
1. Un MES bueno	\$														
2. Un MES regular	\$														
3. Un MES malo	\$														
1. MESES buenos															
2. MESES regulares															
3. MESES malos															
(El total de meses debe coincidir con la PREG B31)															

B38. ¿Cuándo es la temporada de pesca en el MAR? (ANOTAR CON DETALLE)	
--	--

B39. ¿En qué meses del año Usted pesca en el MAR? (Marque X)												
1	2	3	4	5	6	7	8	9	10	11	12	13
E	F	M	A	M	J	J	A	S	O	N	D	TODO EL AÑO

B40. Cuando Usted pesca en el MAR, ¿Cuánto es más o menos su ingreso en: <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">1. Un día bueno</td> <td>\$</td> </tr> <tr> <td>2. Un día regular</td> <td>\$</td> </tr> <tr> <td>3. Un día malo</td> <td>\$</td> </tr> </table>	1. Un día bueno	\$	2. Un día regular	\$	3. Un día malo	\$	B41. ¿Cuántos días a la semana pesca?	B42. ¿Cuántos días de la semana son: <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">1. Días buenos</td> <td></td> </tr> <tr> <td>2. Días regulares</td> <td></td> </tr> <tr> <td>3. Días malos</td> <td></td> </tr> </table>	1. Días buenos		2. Días regulares		3. Días malos		B43. En promedio, ¿Cuántas horas pesca diariamente?
1. Un día bueno	\$														
2. Un día regular	\$														
3. Un día malo	\$														
1. Días buenos															
2. Días regulares															
3. Días malos															

B44. Cuando Usted pesca en el MAR ¿Cuánto es en promedio su ingreso en: <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">1. Un MES bueno</td> <td>\$</td> </tr> <tr> <td>2. Un MES regular</td> <td>\$</td> </tr> <tr> <td>3. Un MES malo</td> <td>\$</td> </tr> </table>	1. Un MES bueno	\$	2. Un MES regular	\$	3. Un MES malo	\$	B45. De los meses en los que usted PESCA EN EL MAR, ¿Cuántos son: <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">1. MESES buenos</td> <td></td> </tr> <tr> <td>2. MESES regulares</td> <td></td> </tr> <tr> <td>3. MESES malos</td> <td></td> </tr> <tr> <td colspan="2">(El total de meses debe coincidir con la PREG B39)</td> </tr> </table>	1. MESES buenos		2. MESES regulares		3. MESES malos		(El total de meses debe coincidir con la PREG B39)	
1. Un MES bueno	\$														
2. Un MES regular	\$														
3. Un MES malo	\$														
1. MESES buenos															
2. MESES regulares															
3. MESES malos															
(El total de meses debe coincidir con la PREG B39)															

B46. Del total de sus ingresos, qué porcentaje corresponde a:	1. La pesca en la CGSM	%
	2. La pesca en el MAR	%

B47. ¿Usted cómo decide cuándo ir a pescar a la CGSM y cuándo ir a pescar al MAR? (ANOTAR CON DETALLE)	
---	--

B48. De todo el tiempo que Usted le dedica a la pesca, ¿Qué porcentaje corresponde a la pesca en: <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">1. La CGSM</td> <td style="text-align: center;">%</td> </tr> <tr> <td>2. El mar</td> <td style="text-align: center;">%</td> </tr> <tr> <td>TOTAL</td> <td style="text-align: center;">100 %</td> </tr> </table>	1. La CGSM	%	2. El mar	%	TOTAL	100 %	B49. ¿Usted tiene otras opciones de trabajo distintas a la pesca? <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">1. SI</td> <td></td> </tr> <tr> <td>2. NO</td> <td></td> </tr> </table>	1. SI		2. NO	
1. La CGSM	%										
2. El mar	%										
TOTAL	100 %										
1. SI											
2. NO											

B50. ¿A quién le vende Usted todo lo que pesca? (NO LEER LAS OPCIONES)	
A cualquier persona / comerciante que llegue al mercado de Tasajera a comprar	1
Al dueño de los artes de pesca	2
Al dueño de la embarcación con la cual pesca	3
A las empresas que compran la Jaiba	4
A un comprador /comerciante con el cual tiene un acuerdo para venderle siempre todo lo que pesca	5
Otro. ¿Cuál?	6

B51. ¿Cómo fija Usted el precio al cual vende lo que pesca? (LEER LAS OPCIONES)	
Lo acuerda directamente con la persona / comerciante que llega al mercado de Tasajera a comprar	1
Lo fija el comprador al cual Usted siempre le vende	2
Lo fija la empresa a la cual Usted le vende lo que pesca	3
Lo fija el dueño de los artes /canoas con los cuales Usted pesca	4
Otro. ¿Cuál?	5

B52. ¿Usted está pagando algún crédito (préstamo) en este momento?	1. SI		Hacer B53 a B55
	2. NO		Pase a C1

B53. ¿Cuánto dinero está debiendo?	\$
---	----

B54. Qué tipo de deudas son: (LEER LAS OPCIONES) (MULTIPLE RESPUESTA)	
Crédito para vivienda	1
Crédito para comprar una embarcación	2
Crédito para comprar artes de pesca	3
Crédito de libre inversión (Ej. Compra de electrodomésticos)	4

B55. De las deudas que Usted tiene, ¿Qué porcentaje corresponde a: (LEER LAS OPCIONES)	
Crédito para vivienda	%
Crédito para comprar una embarcación	%
Crédito para comprar artes de pesca	%
Crédito de libre inversión (Ej. Compra de electrodomésticos)	%
TOTAL	100%

C. CONCIENCIA AMBIENTAL

C1. En su opinión, ¿Quiénes deberían ayudar a la conservación de la CGSM? (LEER LAS OPCIONES).	
Todos los pescadores que pescan en la CGSM	1
Las entidades del Estado responsables del Medio Ambiente	2
Otros usuarios de la CGSM, distintos a los pescadores (Ej. Bananeros, palmicultores)	3
Nadie	4
Otros. ¿Quiénes?	5
No sabe	88
No responde	99

C2. En su opinión, ¿Cómo son los recursos pesqueros de la CGSM? (LEER LAS OPCIONES).	
Hay muchos recursos para todos	1
Los recursos están empezando a ser escasos (antes había más)	2
Los recursos siempre han sido escasos	3
No sabe	88
No responde	99

C3. En su opinión, ¿La CGSM ha cambiado en los últimos años? (LEER LAS OPCIONES).	
Sí, los cambios han sido NEGATIVOS	1
Sí, los cambios han sido POSITIVOS	2
No, no ha cambiado	3
No sabe	88
No responde	99

Pase a C6

C4. ¿Quiénes son los responsables de esos cambios en la CGSM? (LEER LAS OPCIONES).	
Los pescadores que pescan en la CGSM	1
Las entidades del Estado responsables del Medio Ambiente	2
Los otros usuarios de la CGSM (Ej. Bananeros, palmicultores)	3
Otros. ¿Quiénes?	4
No sabe	88
No responde	99

C5. ¿Cuál cree Usted que ha sido la principal razón de esos cambios? (ANOTAR CON DETALLE)

C6. Si los pescadores de la CGSM siguen pescando como lo hacen ahora, ¿Cree Usted que en el futuro habrá suficientes peces para seguir manteniendo a su familia?	1. SI	
	2. NO	

C7. ¿Alguna vez ha participado en talleres /cursos donde les expliquen la importancia de cuidar la CGSM?	1. SI		Hacer C8
	2. NO		Pase a C9

C8. INFORMACION DE LOS TALLERES/CURSOS				
1. Año	2. Entidad que dictó el curso/taller	3. ¿Les daban algo por asistir al curso? (Marque X)		
		1. SI		2. NO
		1. En dinero	2. En especie	

C9. ¿Qué hacen ustedes normalmente con la basura? (NO LEER LAS OPCIONES)			
La entregan al camión de la basura	1	La queman	5
La tiran a la calle	2	La entierran	6
La tiran a la CGSM	3	La recoge un servicio informal	7
La tiran a un patio, lote, zanja o baldío (Relleno)	4	Otro. ¿Cuál?	8

C10. Uno de los objetivos de este estudio es identificar aquellos lugares donde NO SE DEBERÍA IR PESCAR porque se puede afectar NEGATIVAMENTE los recursos pesqueros (la cantidad de peces).		
A continuación le voy a leer algunos lugares y Usted deberá decirme SI SE DEBERÍA O NO IR A PESCAR A ESOS SITIOS		
Lugar	1. SI	2. NO
1. Ciénaga de Pajarales		
2. Ciénagas pequeñas (sala cunas)		
3. Los playones		
4. Puente de la Barra (boca de la barra)		
5. En el monte (En el mangle)		
6. Desembocadura (Boca) de los caños /ríos		
7. Áreas protegidas de Parques Nacionales Naturales		
8. Otro ¿Cuál?		
9. Otro ¿Cuál?		

D. CAPITAL SOCIAL

D1. ¿Usted pertenece a alguna organización o asociación?	1. SI	Hacer D2 a D6
	2. NO	Pase a D7

D2. INFORMACION DE LAS ASOCIACIONES A LAS QUE PERTENECE EL PESCADOR. (LEER LAS OPCIONES)		
RESPUESTA MÚLTIPLE: MARCAR TODAS LAS RESPUESTAS DEL PESCADOR		
1. Tipo de asociación		2. Nombre (s) de la Asociación (es)
Asociación de pescadores	1	
Asociación de padres de familia	2	
Cooperativa	3	
Junta de Acción Comunal	4	
Grupo religioso	5	
Otra. ¿Cuál?	6	
Otra. ¿Cuál?	7	
No responde	99	

D3. ¿Cuál fue la principal razón para hacerse miembro de ese (esos) grupo (s)? EXPLORAR LA RAZÓN Y MARCAR LA OPCIÓN MÁS APROPIADA PARA LAS 2 PRINCIPALES ASOCIACIONES A LAS CUALES PERTENECE EL PESCADOR. (NO LEER LAS OPCIONES).		
	1. Nombre Asociación 1	2. Nombre Asociación 2
Fue seleccionado para participar en el proyecto de Guardabosques	1	1
Vino una entidad con proyectos y los organizaron en grupos para ayudarlos	2	2
Para acceder a los recursos que dan los proyectos	3	3
Para acceder a otros beneficios como capacitación, préstamos, etc.	4	4
Fue obligado por el gobierno, líderes, amigos o familiares	5	5
Para recibir apoyos en épocas de bajo ingreso	6	6
Para obtener mejores precios del pescado	7	7
Para mejorar los ingresos porque cada vez son más bajos	8	8
Para conservar el recurso pesquero de la CGSM	9	9
Para ser respetado y reconocido como miembro de la organización	10	10
Para hacer amigos, trabajar con otros pescadores, temor de ser excluido, etc.	11	11

D4. ¿Con qué frecuencia se reúnen? (LEER LAS OPCIONES).		
	1. Asociación 1	2. Asociación 2
Una vez por semana	1	1
Una vez cada 15 días	2	2
Una vez por mes	3	3
Una vez al año	4	4
Dos veces al año	5	5
Cuando el gobierno va a entregar ayudas	6	6
Cuando una ONG va a ejecutar un proyecto	7	7
Nunca	8	8

D5. ¿Quiénes participan o pueden formar parte del grupo? (LEER LAS OPCIONES).		
RESPUESTA MÚLTIPLE: MARCAR TODO LO QUE DIGA		
	1. Asociación 1	2. Asociación 2
Familiares	1	1
Amigos	2	2
Personas del barrio / cuadra	3	3
Cualquier persona	4	4
Otro	5	5
No sabe	88	88
No responde	99	99

D6. ¿Cómo califica el funcionamiento del grupo? (LEER LAS OPCIONES).		
	1. Asociación 1	2. Asociación 2
Pésimo	1	1
Malo	2	2
Regular	3	3
Bueno	4	4
Excelente	5	5
No sabe	88	88
No responde	99	99

D7. ¿En el último año Usted ha participado voluntariamente en alguna actividad comunitaria? (Ej. Arreglar un parque)		
	1. SI	1. ¿Cuál? (ANOTAR CON DETALLE)
	2. NO	1. ¿Por qué NO participa en este tipo de actividades? (ANOTAR CON DETALLE)

D8. Si ocurriera un desastre natural que afectara la CGSM (Ej. Una mortandad de peces), ¿Quién cree usted que se uniría para solucionarlo? (LEER LAS OPCIONES)			
Los pescadores	1	Las organizaciones religiosas que hay en Tasajera	5
Toda la gente de Tasajera	2	Nadie se uniría	6
Toda la gente que depende de la CGSM	3	No sabe	88
Las entidades del gobierno local	4	No responde	99

D9. Si usted tiene un problema, ¿Quién(es) le ayudaría(n)? (LEER LAS OPCIONES). RESPUESTA MÚLTIPLE: MARCAR TODO LO QUE DIGA			
Su familia: padres, pareja, hermanos, hijos, etc.	1	Algún político que Usted conozca	8
Sus amigos	2	La iglesia a la cual Usted pertenece	9
Sus vecinos	3	La Junta de Acción Comunal de su barrio	10
Sus compadres	4	Alguna ONG de las que llegan a Tasajera	11
Sus compañeros de trabajo	5	Alguna entidad de caridad/ humanitaria	12
Otro pescador de Tasajera o pueblos cercanos	6	Alguna entidad el gobierno	13
Los prestamistas de dinero	7	Nadie lo ayudaría	14

E. CONFIANZA Y RECIPROCIDAD

E1. Si usted y su compañera tuvieran que salir de Tasajera por uno o dos días, ¿Con quién dejaría sus hijos? (LEER LAS OPCIONES)			
Con algún familiar	1	Con nadie	5
Con un vecino	2	No tiene hijos	6
Con algún amigo	3	No sabe	88
Con cualquier persona de Tasajera	4	No responde	99

E2. Ahora quiero hacerle algunas preguntas acerca de qué tanto confía usted en diferentes tipos de personas. La idea es que usted CALIFIQUE DE 1 A 10 a las personas que le voy a leer. En este caso, 1 SIGNIFICA QUE USTED DESCONFÍA TOTALMENTE de estas personas y 5 SIGNIFICA QUE USTED CONFÍA PLENAMENTE en estas personas. (MOSTRAR LA TARJETA Y LEER LAS OPCIONES).

1. Tipo de persona	2. Nota (1 a 10)	1. Tipo de persona	2. Nota (1 a 10)
1. Familiares		9. Dueños de los criaderos de peces	
2. Vecinos		10. Comerciantes	
3. Amigos		11. Ganaderos	
4. Pescadores de Tasajera		12. Palmicultores / Empresarios bananeros	
5. Líderes comunitarios de Tasajera		13. Policía Nacional	
6. Pescadores de los pueblos palafíticos		14. Funcionarios del gobierno local	
7. Pescadores de otros pueblos cercanos		15. Funcionarios de ONG's	
8. Pescadores que emplean artes o métodos de pesca ilícitos			

E3. Si se presentara la oportunidad, ¿Cree que la mayoría de gente de Tasajera trataría de aprovecharse de usted o por el contrario la gente sería justa? En este caso Usted debe calificar de 1 a 10. 1 significa que LA GENTE TRATARÍA DE TOMAR VENTAJA DE USTED y 10 significa que LA GENTE SERÍA JUSTA CON USTED. (MOSTRAR LA TARJETA CON LOS NUMEROS).

La gente trataría de tomar ventaja de Usted					La gente sería justa con Usted					No sabe
1	2	3	4	5	6	7	8	9	10	88

E4. ¿Diría usted que la mayoría de veces la gente de Tasajera intenta ayudar a los demás o que principalmente miran por sí mismos? En este caso Usted también debe CALIFICAR DE 1 A 10. Tenga en cuenta que 1 significa que LA MAYORÍA DE LAS VECES LA GENTE MIRA POR SÍ MISMA y 10 significa que LA MAYORÍA DE VECES LA GENTE INTENTA AYUDAR A LOS DEMÁS (MOSTRAR LA TARJETA CON LOS NUMEROS)

La mayoría de veces la gente mira por sí misma					La mayoría de veces la gente intenta ayudar a los demás					No sabe
1	2	3	4	5	6	7	8	9	10	88

E5. En su opinión, ¿Cómo la gente de Tasajera responde a sus obligaciones con los demás? (LEER LAS OPCIONES)	
La gente no cumple sus obligaciones con los demás	1
La gente tiende a cumplir sus obligaciones con los demás	2
La gente en general cumple sus obligaciones para asegurarse que después le cumplan a él.	3
No sabe	88
No responde	99

E6. ¿Usted intercambia información útil para la pesca con alguien? (Ej. Lugares de pesca ó métodos de pesca)	1. SI	1. ¿Con quién intercambia la información? (ANOTAR CON DETALLE)
	2. NO	1. ¿Por qué NO? (ANOTAR CON DETALLE)

F. ACCIÓN COLECTIVA

F1. ¿Qué hace normalmente la gente de Tasajera cuando hay un problema que afecta a toda la comunidad? (LEER LAS OPCIONES Y SI NO ESCOGE UNA DE ESTAS PREGUNTAR SI HACEN ALGO DISTINTO)	
Cada quien trata de solucionar el problema por su lado.	1
Es necesario que alguien externo intervenga y organice la gente para solucionar el problema	2
Se busca a alguien que tenga una buena palanca para que solucione el problema.	3
La gente nombra a un representante que dialogue con las autoridades y solucione el problema.	4
Entre todos solucionamos el problema	5
Otra. ¿Cuál?	6
No sabe	88
No responde	99

F2. Ahora le voy a leer unas frases y Usted tiene que decirme si está DE ACUERDO, NI DE ACUERDO NI EN DESACUERDO, o en DESACUERDO. (LEER LAS OPCIONES) (MARQUE SOLO UNA RESPUESTA PARA CADA AFIRMACIÓN)

	De acuerdo	Ni de acuerdo Ni en desacuerdo	En desacuerdo
1. En Tasajera la gente se INFORMA ADECUADAMENTE para poder participar en cosas que benefician a toda la comunidad.	1	2	3
2. En Tasajera la gente está DISPUESTA A HACER SACRIFICIOS cuando se trata de participar en asuntos que son de beneficio común.	1	2	3
3. La gente de Tasajera PARTICIPA en actividades que benefician a toda la comunidad SI LE PAGAN por su trabajo.	1	2	3
4. La gente de Tasajera NO PARTICIPA en actividades que benefician a toda comunidad porque NO ESTÁN CAPACITADOS para hacerlo.	1	2	3

G. AYUDAS ECONÓMICAS RECIBIDAS

G1. ¿En los últimos CINCO AÑOS usted ha recibido algún tipo de ayuda económica por parte de alguna entidad del gobierno o una ONG?	1. SI	Hacer G2
	2. NO	Pase a G6

G2. ¿Usted recuerda el nombre de las entidades que le entregaron la ayuda económica?	1. SI	Hacer G3
	2. NO	Pase a G4

G3. DESCRIPCIÓN DE LAS AYUDAS QUE HA RECIBIDO EL PESCADOR			
1. AÑO	2. NOMBRE DE LA ENTIDAD	3. QUÉ TIPO DE AYUDA RECIBIÓ	
		1. EN DINERO ¿Cuánto?	2. EN ESPECIE ¿Qué recibió? (Ej. Mercado, materiales)
		\$	
		\$	
		\$	
		\$	
		\$	

G4. ¿Cómo le entregaron a Usted esa ayuda? (LEER LAS OPCIONES)		G5. ¿Usted sabe cómo se consiguieron esas ayudas? (LEER LAS OPCIONES)	
A través de Asococienaga	1	Vino una entidad del Gobierno y las entregó	1
A través de la Junta de Acción Comunal de su barrio	2	Vino una ONG y las entregó	2
A través de una asociación a la cual usted pertenece.	3	ASOCOCIENAGA consiguió los recursos	3
Directamente a usted	4	El presidente de la asociación a la cual pertenece consiguió la ayuda	4
Otra. ¿Cuál?	5	Otra. ¿Cuál?	5
Otra. ¿Cuál?	6	No sabe	88
No sabe	88	No responde	99
No responde	99		

G6. Ahora le voy a leer unas frases y usted tiene que decirme si está DE ACUERDO, NI DE ACUERDO NI EN DESACUERDO o en DESACUERDO o. (LEER LAS OPCIONES) (MARQUE SOLO UNA RESPUESTA PARA CADA AFIRMACIÓN)

	De acuerdo	Ni de acuerdo Ni en desacuerdo	En desacuerdo
1. Es humillante recibir dinero sin haber trabajado por él	1	2	3
2. La gente que no trabaja se vuelve perezosa.	1	2	3
3. Trabajar es un deber con la sociedad.	1	2	3
4. El trabajo siempre debe estar primero así signifique menos tiempo libre.	1	2	3

Appendix D: Forms Evaluation

Ecological Impact of Fishing

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

Socio-ecological analysis of fishery in the Ciénaga Grande de Santa Marta (For fishermen and experts)

(Introduction by researcher)

The Center for Tropical Marine Ecology⁶⁸ (ZMT), together with the Center of Excellence in Marine Sciences⁶⁹ (CEMarin), are carrying out a study to investigate some ecological, social and economic aspects related to the Ciénaga Grande de Santa Marta's (CGSM) multi-specific fishery. The study is based on primary information of fishermen that fish in the CGSM and landed fish at the Tasajera fish market (Municipality of Pueblo Viejo, Magdalena), from 2006-2010. It is complemented with historical fishing data, collected by the Institute for Marine and Coastal Research "José Benito Vives de Andrés"— INVEMAR, and registered in SIPEIN (INVEMAR's Fisheries Information System).

One of the goals of this study is to determine the level of sustainability of the main fishing gears and methods, currently used by fishermen. To do that, we defined three criteria:

1. Impact on the habitat
2. Efficiency and selectivity of the fishing gears and methods
3. Impact on the target species

These criteria help to identify how certain fishing gears and/or fishing methods affect the main CGSM's fishery resources (fish and invertebrates). The main fishery resources selected are:

- Lisa - *Mugil incilis*
- Mojarra lora - *Oreochromis niloticus*
- Mojarra rayada - *Eugerres plumieri*
- Mapale - *Cathorops mapale*
- Chivo cabezón - *Ariopsis bonillai*
- Jaiba azul - *Callinectes sapidus*
- Jaiba roja - *Callinectes bocourti*
- Camarón – Familia Penaeidae: *Litopenaeus schmitti* - *Farfantepenaeus notialis* - *F. subtilis* - *Xiphopenaeus kroyeri*.

The second goal of this study is to establish whether fishing spots commonly visited by the fishermen are appropriate for fishing, or if fishermen's activities generate negative impacts on CGSM's fishery resources and habitat in general.

The first three indicators described below, attempt to address the first goal of this study. The fourth indicator, also discussed in the following pages, addresses the second goal.

The following exercise comprises two parts: the first part consists of an evaluation of the fishing gears and fishing methods, and the second part consists of an evaluation of the fishing spots.

⁶⁸ Leibniz Center for Tropical Marine Ecology (<http://www.zmt-bremen.de>)

⁶⁹ Centro de Excelencia en Ciencias Marinas (<http://www.cemarin.org/>)

PART 1: EVALUATION OF FISHING GEARS / FISHING METHODS

(For fishermen and experts)

This is the first part of the exercise. Here, you have to evaluate, using a scale from 1 to 5, the impact that fishing gears /fishing methods have on the resources, in the CGSM's fishery.

- Cast net / Cast net
- Large seine net / Large seine net
(*Chinchorro*)
- Small seine net / Small seine net
(*Chinchorra*)
- Shrimp net / *Releo*
- Gill net / Fixed and Encircling (*Boliche*)
- Long line / Long line
- Crab traps / Crab traps

For the evaluation of the fishing gears and fishing spots on the CGSM's fishery resources and the habitat in general, the scores are built up as follows:

- ✓ 1 means that the fishing gear/fishing method have a **low impact** on the CGSM's fishery resources and the habitat in general.
- ✓ 5 means that the fishing gear/fishing method have a **high impact** on the CGSM's fishery resources and the habitat in general.

INDICATOR 1: IMPACT OF FISHING GEARS / FISHING METHODS ON THE HABITAT

Please assign a score to the impact that the following fishing gears/ fishing methods have on the **habitat**, according to the different mesh sizes:

Fishing gear	Fishing method	Mesh size (Inches)	Scores 1: Low impact 5: High impact	Brief justification of the grade
CAST NET	CAST NET	0,25 a 2,25		
		2,50 a 3,00		
LARGE SEINE NET (Chinchorro)	LARGE SEINE NET (Chinchorro)	0,75 a 1,00		
		1,01 a 2,00		
SMALL SEINE NET (Chinchorra)	SMAL SEINE NET (Chinchorra)	1,50 a 2,50		
		2,75 a 3,50		
SHRIMP NET	RELEO	0,50 a 1,00		
GILL NET	ENCIRCLING (Bolíche)	1,25 a 2,50		
		2,75 a 4,00		
	FIXED	1,25 a 2,50		
		2,75 a 4,00		

Please assign a score to the impact that the following fishing gears/ fishing methods have on the **habitat**, according to the caliber of the hook and the size of entrance gap for the crab traps.

Fishing gear	Fishing method	Dimension	Scores 1: Low impact 5: High impact	Brief justification of the grade
LONG LINE	LONG LINE	Hook Calibers 10 to 12		
CRAW TRAPS	CRAW TRAPS	30 cm x 30 cm x 50 cm Entrance gap: 23 cm		

INDICATOR 2: EFFICIENCY AND SELECTIVITY OF THE FISHING GEARS / FISHING METHODS

Please evaluate the **efficiency and selectivity** of the next fishing gears / fishing methods, according to the different mesh sizes.

Fishing gear	Fishing method	Mesh size (Inches)	Scores 1: Low impact 5: High impact	Brief justification of the grade
CAST NET	CAST NET	0,25 a 2,25		
		2,50 a 3,00		
LARGE SEINE NET (Chinchorro)	LARGE SEINE NET (Chinchorro)	0,75 a 1,00		
		1,01 a 2,00		
SMALL SEINE NET (Chinchorra)	SMAL SEINE NET (Chinchorra)	1,50 a 2,50		
		2,75 a 3,50		
SHRIMP NET	RELEO	0,50 a 1,00		
GILL NET	ENCIRCLING (Bolíche)	1,25 a 2,50		
		2,75 a 4,00		
	FIXED	1,25 a 2,50		
		2,75 a 4,00		

Please evaluate the **efficiency and selectivity** of the next fishing gears / fishing methods, according to the caliber of the hook and the size of entrance gap for the crab traps.

Fishing gear	Fishing method	Dimension	Scores 1: Low impact 5: High impact	Brief justification of the grade
LONG LINE	LONG LINE	Caliber 10 to 12		
CRAW TRAPS	CRAW TRAPS	30 cm x 30 cm x 50 cm Entrance gap: 23 cm		

INDICATOR 3: IMPACT OF THE FISHING GEARS / FISHING METHODS ON THE TARGET SPECIES

Please assign a score to the impact that the following fishing gears/ fishing methods have on the **target species**, according to the different mesh sizes:

Fishing gear	Fishing method	Mesh size (Inches)	Scores 1: Low impact 5: High impact	Brief justification of the grade
CAST NET	CAST NET	0,25 a 2,25		
		2,50 a 3,00		
LARGE SEINE NET (Chinchorro)	LARGE SEINE NET (Chinchorro)	0,75 a 1,00		
		1,01 a 2,00		
SMALL SEINE NET (Chinchorra)	SMAL SEINE NET (Chinchorra)	1,50 a 2,50		
		2,75 a 3,50		
SHRIMP NET	RELEO	0,50 a 1,00		
GILL NET	ENCIRCLING (Bolíche)	1,25 a 2,50		
		2,75 a 4,00		
	FIXED	1,25 a 2,50		
		2,75 a 4,00		

Please assign a score to the impact that the following fishing gears/ fishing methods have on the **target species**, according to the caliber of the hook and the size of entrance gap for the crap traps.

Fishing gear	Fishing method	Dimension	Scores 1: Low impact 5: High impact	Brief justification of the grade
LONG LINE	LONG LINE	Caliber 10 to 12		
CRAB TRAPS	CRAB TRAPS	30 cm x 30 cm x 50 cm Entrance gap: 23 cm		

PART 2: EVALUATION OF FISHING SPOTS

(Only for experts)

As mentioned before, in this part of the exercise you have to evaluate the fishing impact depending on the location. Here, the scale of the scores, from 1 to 5, has the same meaning as in the first part of the exercise, namely:

- ✓ **1** means that fishing in that spot have a **low impact** on the CGSM's fishery resources and the habitat in general.
- ✓ **5** means that fishing in that spot have a **high impact** on the CGSM's fishery resources and the habitat in general.

In order to facilitate the evaluation, the fishing spots were grouped into six different zones:

1. Protected areas of National Natural Parks: Vía Parque Isla de Salamanca (VIPIS) and Santuario de Flora y Fauna Ciénaga Grande de Santa Marta (SFF-CGSM).
2. Natural nursery areas.
3. Mouths of rivers and streams.
4. Mangrove roots and other vegetation.
5. Boca de la Barra (La Barra Bridge).
6. Water mirrors away from the mangrove.

INDICATOR 4: FISHING IMPACT ACCORDING TO THE FISHING SPOTS, BY ZONES

Fishing spots	Scores 1: Low impact 5: High impact	Brief justification of the grade
PROTECTED AREAS OF NATIONAL NATURAL PARKS (VIPIS & SFF-CGSM)		
NATURAL NURSERY AREAS		
MOUTHS OF RIVERS AND STREAMS		
MANGROVE ROOTS AND OTHER VEGETATION		
BOCA DE LA BARRA (LA BARRA BRIDGE)		
WATER MIRRORS AWAY FROM THE MANGROVE		

Thank you very much for your collaboration!

Socio-ecological analysis of a fishery in the Ciénaga Grande de Santa Marta (Only for fishermen)

(Introduction by researcher)

The Center for Tropical Marine Ecology⁷⁰ (ZMT), together with the Center of Excellence in Marine Sciences⁷¹ (CEMarin), are carrying out a study to investigate some ecological, social and economic aspects related to the Ciénaga Grande de Santa Marta's (CGSM) multi-specific fishery. The study is based on primary information of fishermen that fish in the CGSM, and landed fish at the Tasajera fish market (Municipality of Pueblo Viejo, Magdalena) from 2006-2010. It is complemented with historical fishing data, collected by the Institute for Marine and Coastal Research "José Benito Vives de Andrés"— INVEMAR, and registered in SIPEIN (INVEMAR's Fisheries Information System).

One of the goals of this study is to establish whether fishing spots commonly visited by the fishermen are appropriate for fishing, or if fishermen's activities generate negative impacts on CGSM's fishery resources and habitat in general.

Now, I will read a list of different locations where you usually go to fish. Based on your knowledge about fishing in the CGSM, we would like you to assign a score (from 1 to 5) for each location, and explain briefly the reason for your evaluation.

For this exercise the scores have the following meaning:

- 1 means that any fisher can go fishing to that place and he causes **no damages (low impact)** to the Ciénaga Grande de Santa Marta, in terms of the amount of fish available for fishing
- 5 means that fishing in this spot could cause a **huge damage (high impact)** to the Ciénaga Grande de Santa Marta, and therefore it can affect the amount of fish available for fishing.

ZONES

1. Protected areas of National Natural Parks: Vía Parque Isla de Salamanca (VIPIS) and Santuario de Flora y Fauna Ciénaga Grande de Santa Marta (SFF-CGSM).
2. Natural nursery areas.
3. Mouths of rivers and streams.
4. Mangrove roots and other vegetation.
5. Boca de la Barra (La Barra Bridge).
6. Water mirrors away from the mangrove.

⁷⁰ Leibniz Center for Tropical Marine Ecology (<http://www.zmt-bremen.de>)

⁷¹ Centro de Excelencia en Ciencias Marinas (<http://www.cemarin.org/>)

EVALUATION OF THE FISHING SPOTS

Fishing spot	Zone	Scores 1: Low impact 5: High impact	Brief justification of the grade
AGUAVIVA C/G	6		
AHUYAMA C/G	6		
AHUYAMA C/P	2		
ALFANDOQUE C/P	1		
BARRA VIEJA C/G	5		
BARRAVIEJA	5		
BOCA DE ARACATACA C/G	3		
BOCA DE CAÑO GRANDE C/G	3		
BOCA DEL CAÑO C/P	3		
BOQUERON C/G	3		
BORRERO C/G	5		
BURRO C/G	4		
C. GUAJARO C/P	2		
C. LA AGUJA	1		
C. LOS PATOS	2		
CAIMAN C/G	6		
CHIVATO C/G	6		
CHIVO	6		
CIENAGA DE LA LUNA C/P	2		
COLORAO	6		
CONCHA	2		
CONCHAL C/P	2		
CONGO C/G	4		
CONTRABANDO C/P	2		
CORRALITO C/G	6		
EL AHOGAO	6		
EL CANTIL C/G	6		
EL CANTON	6		
EL CANTON C/G	6		
EL CAÑO LA PUNTA C/P	3		
EL MORRO C/P	2		
EL PLACER C/P	2		
EL POZO	2		
EL VASO C/P	2		
FLAMENCO C/G	6		

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

Fishing spot	Zone	Scores 1: Low impact 5: High impact	Brief justification of the grade
GUARUMA	4		
HOSPITALITOS C/G	4		
JAGUEY C/G	6		
LA 28 C/G	6		
LA BARRA C/G	5		
LA BARRITA C/G	3		
LA BOCA C/G	3		
LA BODEGA C/G	4		
LA CALENTURA	2		
LA CANAL C/G	6		
LA CASITA	6		
LA CRUZ C/G	6		
LA CUBANA C/P	2		
LA CULEBRA C/G	6		
LA LATA C/P	1		
LA LOMA C/G	6		
LA MATA C/P	1		
LA PLAYA	5		
LA RINCONA	3		
LA SOLERA C/P	1		
LA TROJA C/G	2		
LAS GARZAS C/G	6		
LAS MUJERES C/G	6		
LAS PIEDRAS C/P	1		
LOPEZ C/G	6		
LOS BARQUITOS	6		
LOS COLIBRIES C/P	2		
LOS COLORADOS C/G	6		
LOS MEDIOS C/G	6		
LOS MICOS C/G	6		
LOS MUERTOS C/G	6		
LOS MURCIELAGOS	6		
LOS PAJARITOS C/P	2		
LOS PALOS C/P	1		
LOS QUEMAOS C/G	6		
LOS VENADOS C/P	2		
MACHETE C/P	6		
MAHOMA C/G	6		

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

Fishing spot	Zone	Scores 1: Low impact 5: High impact	Brief justification of the grade
MAJAGUALITO C/G	6		
MALAMBOS C/P	2		
MENDEGUA C/P	6		
MOCHILAS C/P	4		
MOLINERO C/G	6		
MONTE NUEVO C/G	6		
OSTION DE LA CRUZ C/G	6		
OSTION GRANDE C/G	6		
OSTIONES C/G	6		
PADILLA	2		
PAJARO C/G	4		
PAJARO C/P	2		
PALENQUE C/G	1		
PALO BLANCO C/G	6		
PALOQUEMAO C/G	6		
PANCU C/G	1		
PEAJE C/G	6		
PLAYITA C/G	5		
PLAYON DE SEVILLANO C/G	3		
PUENTE DE LA BARRA C/G	5		
PUERTO CAIMAN	6		
PUNTA BLANCA C/G	4		
PUNTA BURRO C/G	4		
PUNTA CERRO C/G	4		
PUNTA CHINO C/G	4		
PUNTA DEL CAÑO C/G	6		
PUNTA GRUESA C/G	6		
RASPACHACARA	6		
RINCON GUAPO C/G	6		
RINCONADA C/G	6		
RIO AJI C/G	1		
RIO FRIO C/G	1		
SACO C/P	2		
SALADO C/P	3		
SAN FRANCISCO C/P	4		
SANTA ROSA C/G	6		
TAMACA C/P	1		
TAMBO C/G	6		

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

Fishing spot	Zone	Scores	Brief justification of the grade
		1: Low impact 5: High impact	
TASAJERA C/G	6		
TIGRERA C/P	1		
TROJITA C/G	6		
VERANILLO C/G	6		
ZORRILLA C/P	2		

Thank you very much for your collaboration!

Appendix E: Instructions of the Experiments

*Collective Action for the management of the fishery in the
Ciénaga Grande de Santa Marta, northern Colombia.*

Welcome to the participants

Protocol

Attention:

The phrases in the box must not be read in public; they act as a guide for the person responsible for reading the instructions.

Good morning / Good afternoon. Welcome. First of all I want to thank you for accepting our invitation to participate in this meeting. Before we begin, I want to introduce you to the people who will help us in the meeting.

Each one of the people helping to guide the meeting shall say hello and say his or her full name.

I also want to introduce two colleagues from the university. They are XXXX and XXXX.

Particularly, I want you to remember these 4 people very well because we are going to go to your houses on the weekends to collect information about your decisions in the exercises that we are going to do, and now we will explain.

The four people who will collect the data must remain in front of the classroom for a moment while people recognize them.

Please note that any of us can go to your house during the weekend, on the day and time that we agreed upon when I visited your house to invite you to this meeting. Remember that we wrote down this information on a sheet and stuck it on the wall or on the door of your house.

This meeting will take about 3 hours. So we will be here until roughly 12:30 pm / 5:30 pm.

Today we are going to do three things:

1. **First**, we will do an exercise where you will make a decision.
 - This exercise is similar to the exercises that we are going to do on weekends, in which you will also make some decisions.
 - The reason to do this exercise today is that you can see that the exercises are very easy and in addition that you earn some money.
 - The earnings that you get today will depend on your decision and the decisions of other fishers that are with us today.
2. **Second**, I will explain how you will participate in the economic exercises that we want to do for several weekends.

3. **Third**, we will tell you what you have to do when we will go to your houses on weekends.

But before we begin, I want to clarify some things:

1. **Why do we use money for these exercises?** Money is used in the exercises because it is necessary that people make decisions that have consequences for your pocket, like in real life.
2. **The money you will earn is not mine.** That money is from a project that is being developed by the University in which I am studying.
3. **The amount of money that every one of you earns in the exercises**, as well as the information you will give us, is confidential and I will never report these data in an individual manner. What we will do is analyze all the information that we collected in an aggregate form, and we will make a document where we present the results of all the exercises that we did in Tasajera.
4. **The exercises that we are going to do are totally different from the exercises** that you or perhaps some of the other Tasajera's fishers have participated in before. Thus, it is very important that you make your decisions based only on the instructions that we will give you.
5. **The earnings that you got in the exercises you participated in will be paid in cash.** Later we are going to explain in detail how we are going to pay that money.

For now, to work more comfortably, we will split the group in two. One group stays in this room with me, and the other group will go into the other classroom with Myriam. To know who stays in this classroom and who leaves, one of my classmates will go to each one of your desks with a bag which contains lollipops of two colors: red and green. People who select a red lollipop stay with me in this classroom, and people who select a green lollipop will go to other classroom with Myriam.

Introduction to exercise 1

Protocol

Attention:

The phrases in the box must not be read in public; they act as a guide for the person responsible for reading the instructions.

Again, thank you very much for accepting the invitation to participate in these economic exercises. As we told you the day we visited your home to invite you to this meeting, the economic exercises that you will participate in aim to understand how people make decisions about the use of natural resources that are shared among several people. For instance, the fish you harvest every day from the Ciénaga Grande de Santa Marta.

As we told you before, today we are going to do three things:

1. **First**, we are going to do an exercise where you have to make a decision and depending on your decision and the decisions of other fishers that are with us today, you will earn some money.
2. **Second**, I will explain to you how you will participate in these exercises.
3. **Third**, I will tell you what you have to do when we will go to your houses on weekends.

But before we continue I want to remind you that your participation in these exercises is completely voluntary. So, if you does not want to stay or participate in the exercises that we will make on weekends, you do not have to. However, I want you to know that your participation is very valuable for us. Besides, you will earn money. Thus, I want to ask if everyone wants to participate in the exercises.

The person who reads the instructions must verify that all participants respond affirmatively.

Instructions for exercise 1

I will explain now what the exercise is about. Please pay close attention.

In this exercise you will be part of a group of 5 people but any member of the group will not know who the other members are. The group members could be in this classroom or in the other classroom. Each group is independent and the decisions of the other groups do not affect the decisions of your group.

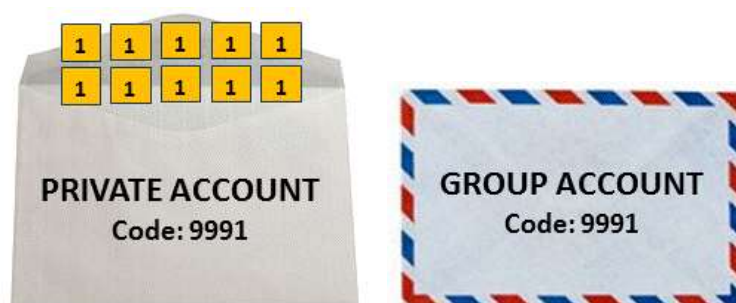
During the exercise you may not speak with other participants. So, if you have a question or do not understand something that we are explaining, please raise your hand, and with pleasure, we will explain again whatever is needed.

It is important that you take into account that during the exercise we shall not speak about pesos but rather about points. Then, your earnings will be calculated in points. However, at the end of

the exercise, we will convert each point into pesos. Thus, for each point that you have earned in the exercise we will pay **you \$1,000 pesos**.

What we will do is give each one of you two envelopes: one white and one grey with red and blue stripes.

Show the envelopes and the tokens to the fishers

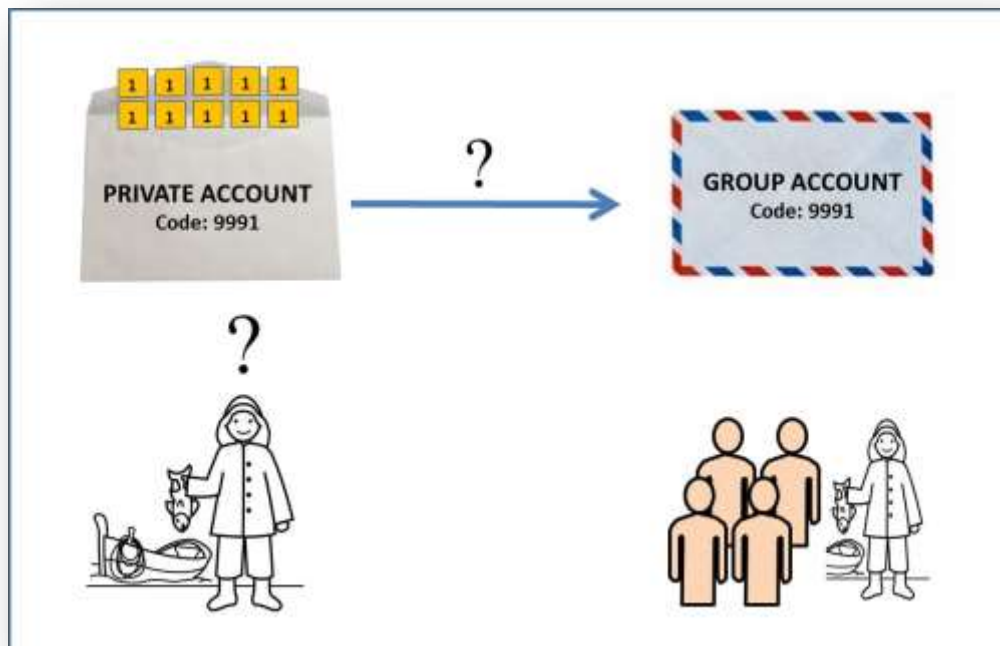


- In the white envelope you will find 10 tokens (fiches), each of them represent one point, and each point is \$1,000 pesos. These points are already yours. We will call this white envelope the **PRIVATE ACCOUNT**.
- In the grey envelope, with red and blue stripes, there is not anything, it is empty. We will call this envelope the **GROUP ACCOUNT**.

Use the poster and the envelopes for the next explanation.

Now, that you have to do privately, without asking your neighbor, is to decide how many of these 10 points that you have in your **PRIVATE ACCOUNT** (what is in the white envelope) you want to transfer to the group account (the grey envelope with red and blue stripes).

Poster 1. Explanation for exercise 1



What happens if you transfer points from the PRIVATE ACCOUNT (white envelope) to the GROUP ACCOUNT (grey envelope with red and blue stripes)?

- **First**, of course, you will have fewer points in your **PRIVATE ACCOUNT**.
- **Second**, for every point you transfer to the **GROUP ACCOUNT**, we will add 0.5 points. For instance, if you transfer your 10 points to the **GROUP ACCOUNT**, we will add 5 points to this account. Thus, in the **GROUP ACCOUNT** there will be 15 points.

What happens if you do not transfer any points to the GROUP ACCOUNT?

- Nothing happens. Simply we do not add anything to the **GROUP ACCOUNT**.

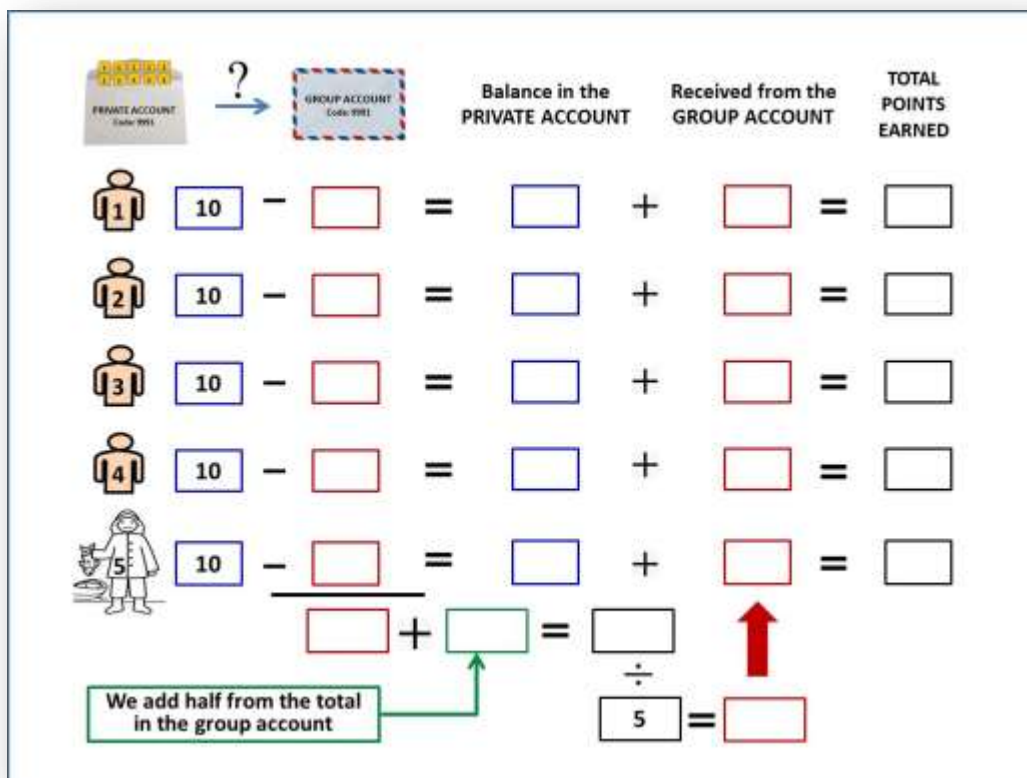
What happens to the points in the GROUP ACCOUNT?

- We will add all the points that are in the **GROUP ACCOUNT**. It includes the points that you and the other four members of your group transferred, as well as the points that we add to it. Remember that we add a half point for each point that is in the **GROUP ACCOUNT**. Then, we will distribute these points equally among the five members of the group.

Let us do some examples to make it clearer.

- *Do the explanation of the examples with poster 1*
- *It is not necessary to read the examples as they are in the text. But, it is necessary that participants understand the examples using the same values that are written in the instructions.*

Poster 2. Explanation for exercise 1



First example:

Imagine two members of your group transfer to the **GROUP ACCOUNT** (grey envelope with red and blue stripes) their 10 points. Another member transfers no points; it means he keeps his 10 points. While another member of your group and you, transfer 5 points. Then, in the **GROUP ACCOUNT** there will be only 30 points. Then, to these 30 points we will add 15 points. In total, we would have 45 points in the **GROUP ACCOUNT**, which we are going to divide equally among the 5 members of the group. It means that each of you will receive 9 points.

What would the earnings be of each member of your group in this example?

- The two members of your group that transferred all their points to the **GROUP ACCOUNT** will earn only the 9 points that they get from the **GROUP ACCOUNT**.

- The member of the group that did not transfer points to the **GROUP ACCOUNT** will earn 19 points. 10 initial points that we gave him, plus 9 points that he gets from the **GROUP ACCOUNT**.
- You, and the other member of your group that transferred only 5 points, will earn 14 points: 9 that you get from the **GROUP ACCOUNT** plus 5 points that each of you decided to keep for yourself.

Note that the member of your group who did not transfer any points to the **GROUP ACCOUNT** earned more points than you and the other member of the group that transferred 5 points (19 points compared to 14 points). In contrast, the members of your group that transferred all 10 points to the **GROUP ACCOUNT** received the smallest earnings.

Are there any questions?

The monitor must ensure that all participants understood. If someone did not understand the explanation, it must be repeated or fishers' doubts confusion be resolved.

You may be thinking it is better transferring no points from the **PRIVATE ACCOUNT** to the **GROUP ACCOUNT**. But this is not necessarily true. We will do another example to make it clear.

Second example:

Imagine all 5 members of your group, including you, decided to transfer no points to the **GROUP ACCOUNT**. It means you did not transfer any points from the white envelope to the grey envelope with red and blue stripes. Then, there will be no points in the **GROUP ACCOUNT**. Conclusion: each participant keeps his 10 points in the **PRIVATE ACCOUNT** (the white envelope). These would be the earnings for each one of you.

Did everyone understand the example?

The monitor must verify that all participants answer affirmatively. If someone did not understand the explanation, it must be repeated or fishers' confusion must be resolved.

Let us make one last example to be sure that all of you have understood the exercise perfectly.

Imagine now all 5 members of your group, including you, decided to transfer their 10 points to the **GROUP ACCOUNT** (grey envelope with red and blue stripes). Then, in the **GROUP ACCOUNT** there will be 50 points. Then, to these 50 points we will add 25 points. In total, we would have 75 points in the **GROUP ACCOUNT**, which we are going to divide equally among the 5 members of the group. It means that each of you will receive 15 points. These would be the earnings for each one of you.

Did everyone understand the example?

The monitor must verify that all participants answer affirmatively. If someone did not understand, the explanation it must be repeated or fishers' confusion must be resolved.

Now, I want to ask you a couple of questions, but I want you to think very well about the answer before you respond. Please do not respond until I ask you.

1. What happens to the points that you transfer from your PRIVATE ACCOUNT to the GROUP ACCOUNT?

- a) We will add a half point for each point in the group account.
 - b) Nothing occurs to the points. They neither increase nor decrease.
- Please raise your hand if you think that we will add a half point for each point in the group account.
 - Please now raise your hand if you think that nothing occurs to the points. They neither increase nor decrease.

All fishers should answer option A. However, in case some fishers chose option B, you must ask them why they think that. It allows us to identify what they did not understand and to resolve the confusion.

2. We will give each one of you 10 points. If you transfer your points to the GROUP ACCOUNT, who receives these points?:

- a) Only you because you transferred the points.
 - b) All members of the group, including you.
- Please raise your hand if you think that only the person who receives these points is the person who transferred the points to the group account.
 - Please now raise your hand if you think that all members of the group, including you, will receive a share of these points.

All fishers should answer option B. However, in case some fishers chose option A, you must ask them why they think that. It allows us to identify what they did not understand and to resolve the confusion.

Before you make your decisions, we will do a summary of everything that we have explained:

- Each point that you will find in the white envelope is equal to \$1,000 pesos.
- If all members of the group keep their 10 points and they do not transfer anything to the **GROUP ACCOUNT**, we cannot add anything to this account because it has no points. It means that each one of you would earn only \$10,000 pesos.
- If all members of your group transfer their 10 points to the **GROUP ACCOUNT**, we will add half of the sum of these points. It means that to the 50 points that your group transferred to the **GROUP ACCOUNT**, we will add 25 points, and we will then divide these 75 points

equally among the 5 members of the group. That is, each one of you will get 15 points. It means that each one of you will earn \$15,000 pesos.

- If all members of your group transfer a different number of points to the **GROUP ACCOUNT**, each one of you will get different earnings.

Is there any question or we can begin the exercise?

Wait for everyone to answer affirmatively. Otherwise, resolve the participants' confusion.

Now that all of you are very clear how this exercise works, we will go to each desk and we will give each of you two envelopes. While we do this, **please do not speak with your neighbors**. As soon as we finish handing out the envelopes, we will call you, one by one, to come to the front of the classroom and make your decision in private. After you make your decision you must return to your desk.

- *The people responsible for handing out the envelopes will be the monitors, and one field assistant that is in the classroom.*
- *At the moment when the envelopes are given to each fisher, the monitor should write down on both envelopes the same number that the participant has stuck on his shirt.*

Now, each one of you will make your decision. Remember that you must decide how many out of 10 points that you have in your **PRIVATE ACCOUNT** (that is in the white envelope) you want to transfer to the **GROUP ACCOUNT** (that is to the grey envelope with red and blue stripes).

Please do not forget the decision is private, and you must not discuss your decision with your neighbor.

- *Begin to call the fishers in the same order that they are seated to make their decisions in the determined location.*
- *As soon as the fisher has made his or her decision, you must collect the two envelopes and put them in order into the box.*
- *After all fishers have made their decisions, you must continue with the explanation.*

Now, we are going to calculate your earnings in this exercise, as soon as we finish this meeting. We need the decisions of the other members of your group, who, as we mentioned at the beginning, can be here or in the other room. We will pay your earnings in cash at the end of the session.

Instructions for exercise 2

Introduction for exercise 2

We want to tell you that we are very happy that you accepted our invitation to come today to this meeting. In gratitude, each of you will receive some additional money, apart from the money that you have already earned in the exercise that we have just made. We will pay you this money in the next weeks, when we will go to your houses.

When exactly you will receive the money depends on each of you, since we will give you the possibility to choose when you want to receive this money. For this reason, we need to speak with you individually. Now, what we will do is go to the other classroom and we will call you one by one, to talk about this. Meanwhile, please you must remain in the classroom.

Does everybody understand what we will do or does anyone have any questions?

- *The monitor must verify that all participants answer affirmatively. If someone did not understand the explanation it must be repeated or fishers' confusion must be resolved.*
- *In this moment, the person responsible for the meeting should go to the other classrooms and begin to collect the fishers' decisions.*
- *At the door of each classroom will be a field assistant organizing the fishers' exit and preventing fishers who have already made their decision from speaking with the fishers that are waiting in the classroom to make their decision.*

----- * * * * -----

Collection of fishers' decisions for exercise 2 (in the new classroom)

Protocol

- *Please read slowly the next text to each fisher. Repeat the explanation if you realize the fisher does not understand what you are reading. Do this every time you consider necessary, until you are sure he understood the explanation.*
- *Before each fisher makes his decision, you have to be sure that he understood the exercise well and that he has a clear idea about the decision he must make.*
- *The questions about the payment alternatives must be read literally to each fisher. See more instructions further down.*

As we told you earlier, we will give you some additional money for participating in this meeting. To collect this money, you have two payment options:

- If you choose **Option A**, you will receive your money in **one week**.
- However, if you choose **Option B** you will receive your money in **two weeks**.

The difference is that if you choose the **Option A**, the amount of money that you will receive will be less than if you choose **Option B**. *Is it all clear so far?*

Verify if the fisher understood the explanation. Otherwise, resolve the fisher's confusion.

Now, I will go on to read five questions (payment alternatives). Each question has two different payment amounts. The first corresponds to **Option A** (i.e. you will receive that amount of money in one week). The second corresponds to **Option B** (i.e. you will receive that amount of money in two weeks). What you have to do is to decide which of these **payment options (A or B)** you prefer. Remember that if you choose **Option A**, the amount of money that you will receive will be less than if you choose **Option B**. *Is it all clear so far?*

Verify if the fisher understood the explanation. Otherwise, resolve the fisher's confusion.

But before you chose **Option A or B** that is more convenient for you, I want to tell you that I can pay you only one of the five payment alternatives that I will read. *Is it all clear so far?*

Verify if the fisher understood the explanation. Otherwise, resolve the fisher's confusion.

To determine which of these payment alternatives I will pay you, we will use the ballots that I have in this bag. These ballots are numbered from 1 to 5.

Remove the ballots from the bag and show the fisher the five ballots in order from 1 to 5. Then put the ballots into the bag and leave the bag in front of the fisher.

If you take a ballot with a number fewer than the payment alternative that you chose, I will pay you \$10.000 pesos in one week. But, in case you take a ballot with the same number or higher than the payment alternative that you chose, I will pay you in two weeks the Option B from the payment alternative that you chose. *Is it all clear so far?*

Verify if the fisher understood the explanation. Otherwise, resolve the fisher's confusion.

In order to know how much would you like to receive as a final payment, I am going to ask you to answer some questions.

















- *Please read the first question to the fisher and wait until he makes his decision. If he does not accept this option, you must read the second question and wait again for his decision. If he does not accept this option, you must read the third question and so on until the fifth question.*
- *As soon as the fisher makes his decision, you do not have to ask more questions. In that moment, you have to show him the card with the payment alternatives and to mark the fisher's decision on it. Then, you must make the draw with the ballots and give him a receipt for the money that he earned.*
- *Please be very careful when you write down the fisher's decision on the format 1. Verify*

carefully before erasing the decision card.

- *Fisher's decision must be erased after he receives the receipt for his earnings and leaves the classroom.*

1. Do you prefer to receive **\$10,000** pesos in one week or **\$10,000** pesos in two weeks?
2. Do you prefer to receive **\$10,000** pesos in one week or **\$12,500** pesos in two weeks?
3. Do you prefer to receive **\$10,000** pesos in one week or **\$15,000** pesos in two weeks?
4. Do you prefer to receive **\$10,000** pesos in one week or **\$17,500** pesos in two weeks?
5. Do you prefer to receive **\$10,000** pesos in one week or **\$20,000** pesos in two weeks?

Exercise 2: Fisher's decision card

	OPTION A One (1) Week	OPTION B Two (2) Weeks
1		
2		  
3		 
4		   
5		 

- *If the fisher always chooses **Option A**, you have to ask him how much money he would have to be offered to have chosen Option B. Use **Form 1 – Numeral 1** to write down his answer. Then, you have to ask him why he took that decision. Use **Form 2** to write down the fisher's answer(s).*
- *If the fisher chose **Option B** from one of the five payment alternatives, you have to make the draw with the ballots after he has taken a decision. Use **Form 2** to write down the fisher's answer(s) and the result of the draw.*

That is all Mr. _____. Now, I want to invite you go to the first floor to enjoy a snack that we have organized for you.

FORM No. 1

Exercise 2: Register of the decision and earning from the fisher

Please fill out the entire form and write legibly in print. Verify always that the code is right.

Date:		Session No.	
Fisher's full name:			
Code (Write down the number that the fisher has stuck on his shirt)			

- 1. Record the fisher's decision. Put an X in form of the alternative chosen by the fisher, according to the option that he had chosen (A or B).**

Payment alternative	OPTION A (1 week)	OPTION B (2 weeks)
1	\$10,000	\$10,000
2	\$10,000	\$12,500
3	\$10,000	\$15,000
4	\$10,000	\$17,500
5	\$10,000	\$20,000

- 2. If the fisher chose only Option A, please ask him:**

For how much money would you have chosen Option B? \$ _____

- 3. If the fisher chose Option B, please record below the result of the draw with the ballots:**

Ballot No.	
-------------------	--

- 4. Earnings in the exercise**

The fisher earned	Payment date
\$	

Fisher's signature

Fingerprint

FORM No. 2.

Exercise 2: Questions for all fishers (independent of their decisions).

Please fill out the entire form and write legibly in print. Verify always that the code is right.

Date:		Session No.	
Fisher's full name:			
Code (Write down the number that the fisher has stuck on his shirt)			

Do not read the options to the fisher. Please put an X in front of the most suitable option (s), according to the fisher's answer.

a) Fisher thought to put the money to work (e.g. buy and sell something), and thus he would earn more money than we are offering him.	
b) Fisher thought he could earn more if he lent this money at interest	
c) Fisher thought that he needed the money now and he could not wait two weeks to receive the money.	
d) Fisher did not think anything (It was random)	
e) Other option. ¿Which? ----- ----- --	
f) Fisher thought how much he would have to pay if he would have borrowed this money for one week. ?	

Bibliography

- Abernethy, Kirsten E., Edward H. Allison, Philip P. Molloy, and Isabelle M. Côté. 2007. "Why do fishers fish where they fish? Using the ideal free distribution to understand the behaviour of artisanal reef fishers." *Canadian Journal of Fisheries and Aquatic Sciences* 64 (11):1595-1604. doi: 10.1139/f07-125.
- Acheson, J. M. 2006. "Institutional Failure in Resource Management." *Annual Review of Anthropology* 35 (1):117-134. doi:10.1146/annurev.anthro.35.081705.123238.
- Adhikari, J. R., and B. Adhikar. 2010. "Political Conflicts and Community Forestry: Understanding the Impact of the Decade-Long Armed Conflicts on Environment and Livelihood Security in Rural Nepal." CAPRI International Workshop on Collective Action, Property Rights, and Conflict in Natural Resources Management, Riem Reap, Cambodia., June 28th to July 1st.
- Agrawal, A. 2001. "Common property institutions and sustainable governance of resources." *World Development* 29 (10):1649-1672. doi: 10.1016/s0305-750x(01)00063-8.
- Agrawal, A. 2002. "Common resources and institutional sustainability." In *The drama of the Commons*, edited by National Research Council, 41-85. Washington: National Academic Press.
- Aguilera D., M. 2011. "Habitantes del agua: El complejo lagunar de la Ciénaga Grande de Santa Marta." [Documento de trabajo]. Banco de la República - Centro de Estudios Económicos Regionales (CEER) Accessed June 08. <http://banrep.dayscript.com/es/contenidos/publicacion/habitantes-del-agua-complejo-lagunar-ci-naga-grande-santa-marta>.
- Aguilera, M. M. , ed. 2011. *La economía de las ciénagas del Caribe Colombiano, Colección de Economía Regional*. Bogotá, Colombia: Banco de la República.
- Akpalu, Wisdom. 2008. "Fishing regulations, individual discount rate, and fisherman behaviour in a developing country fishery." *Environment and Development Economics* 13 (05):591-606. doi:10.1017/S1355770X08004439.
- Allison, E. H., B. D. Ratner, B. Åsgård, R. Willmann, R. Pomeroy, and J. Kurien. 2012. "Rights-based fisheries governance: from fishing rights to human rights." *Fish and Fisheries* 13 (1):14-29. doi: 10.1111/j.1467-2979.2011.00405.x.

- Allison, Edward H., and Frank Ellis. 2001. "The livelihoods approach and management of small-scale fisheries." *Marine Policy* 25 (5):377-388. doi: [http://dx.doi.org/10.1016/S0308-597X\(01\)00023-9](http://dx.doi.org/10.1016/S0308-597X(01)00023-9).
- Anderies, J. M., M. A. Janssen, and E. Ostrom. 2004. "A framework to analyze the robustness of social-ecological systems from an institutional perspective." *Ecology and Society* 9 (1). doi: 18.
- Anderies, John M., Marco A. Janssen, François Bousquet, Juan-Camilo Cardenas, Daniel Castillo, Maria-Claudio Lopez, Robert Tobias, Björn Vollar, and Amber Wutich. 2011. "The challenge of understanding decisions in experimental studies of common pool resource governance." *Ecological Economics* 70 (9):1571-1579. doi: <http://dx.doi.org/10.1016/j.ecolecon.2011.01.011>.
- Andreoni, James. 1995. "Cooperation in Public-Goods Experiments: Kindness or Confusion?" *American Economic Review* 85 (4):891-904.
- Araral, E. 2009. "What Explains Collective Action in the Commons? Theory and Evidence from the Philippines." *World Development* 37 (3):687-697. doi: 10.1016/j.worlddev.2008.08.002.
- Aswani, S., G. G. Gurney, S. Mulville, J. Matera, and M. Gurven. 2013. "Insights from experimental economics on local cooperation in a small-scale fishery management system." *Global Environmental Change* 23 (6):1402-1409. doi: <http://dx.doi.org/10.1016/j.gloenvcha.2013.08.003>.
- Bal, M., J. A. V. Ast, and J. J. Bouma. 2011. "Sustainability of water resource systems in India: role of value in urban lake governance in Ahmedabad." 13th Biennial Conference of the International Association for the Study of the Commons (IASC), Hyderabad, India, January 10th to 14th, 2011.
- Baland, J. M., and J. P. Platteau. 1996. *Halting degradation of natural resources: is there a role for rural communities?* Great Britain: Food and Agriculture Organization of the United Nations.
- Baland, Jean-Marie, and Jean-Phillipe Platteau. 2000. *Halting Degradation of Natural Resources*. Oxford: Oxford University Press.
- Bardhan, Pranab, Samuel Bowles, and Herbert Gintis. 1999. *Wealth Inequality, Wealth Constraints and Economic Performance*. UC Berkeley: Center for International and Development Economics Research-CIDER.
- Basurto, X., S. Gelcich, and E. Ostrom. 2013. "The social-ecological system framework as a knowledge classificatory system for benthic small-scale fisheries." *Global Environmental Change* 23 (6):1366-1380. doi: <http://dx.doi.org/10.1016/j.gloenvcha.2013.08.001>.

- Basurto, X., and E. Ostrom. 2009. "Beyond the Tragedy of the Commons." *Economia delle fonti di energia e dell ambiente* 52 (1):35-60.
- Bateman, N. 1998. "Estructura de la comunidad íctica en las lagunas del delta exterior del río Magdalena, en relación con la reapertura del canal Clarín (Caribe colombiano) " Biología Tesis Pregrado, Facultad de Ciencias. Departamento de Biología., Universidad Nacional de Colombia.
- Baur, I., and C. R. Binder. 2013. "Adapting to Socioeconomic Developments by Changing Rules in the Governance of Common Property Pastures in the Swiss Alps." *Ecology and Society* 18 (4). doi: 10.5751/ES-05689-180460.
- Bautista, P.A., J. M. Betancourt, L. F. Espinosa, A. M. Malagón, D. Mármol, A. M. Orjuela, J. P. Parra, L. V. Perdomo, R. E. Ricardo, M. Rueda, C. A. Villamil, and E. Viloria. 2010. Monitoreo de las condiciones ambientales y los cambios estructurales y funcionales de las comunidades vegetales y de los recursos pesqueros durante la rehabilitación de la Ciénaga Grande de Santa Marta. INVEMAR. Informe Técnico Final. Santa Marta, Colombia.
- Béné, C, and A. Tewfik. 2001a. "Fishing effort allocation and fishermen's decision making process in a multi-species small-scale fishery: analysis of the conch and lobster fishery in Turks and Caicos Islands." *Human Ecology* 29:157-186.
- Béné, Christophe, and Alexander Tewfik. 2001b. "Fishing Effort Allocation and Fishermen's Decision Making Process in a Multi-Species Small-Scale Fishery: Analysis of the Conch and Lobster Fishery in Turks and Caicos Islands." *Human Ecology* 29 (2):157-186. doi: 10.1023/A:1011059830170.
- Bjorndal, Åsmund. 2009. "Regulation of fishing gears and methods." In *A Fishery Manager's Guidebook* edited by Kevern L. Cochrane and Serge M. Garcia, 167-196. Singapore: The Food and Agriculture Organization of the United Nations and Wiley-Blackwell.
- Blaber, S. J. M., D. P. Cyrus, J.-J. Albaret, Chong Ving Ching, J. W. Day, M. Elliott, M. S. Fonseca, D. E. Hoss, J. Orensanz, I. C. Potter, and W. Silvert. 2000. "Effects of fishing on the structure and functioning of estuarine and nearshore ecosystems." *ICES Journal of Marine Science: Journal du Conseil* 57 (3):590-602. doi: 10.1006/jmsc.2000.0723.
- Blanco, E. 2011. "A social-ecological approach to voluntary environmental initiatives: the case of nature-based tourism." *Policy Sciences* 44 (1):35-52. doi: 10.1007/s11077-010-9121-3.
- Blanco, J. A. , J. C. Narváez, and E. A. Viloria. 2007. "ENSO and the rise and fall of a tilapia fishery in northern Colombia " *Fisheries Research* 88:100-108.

- Blanco, J. A., E. A. Vilorio, and J. C. Narvaez. 2006. "ENSO and salinity changes in the Cienaga Grande de Santa Marta coastal lagoon system, Colombian Caribbean." *Estuarine Coastal and Shelf Science* 66 (1-2):157-167. doi: DOI 10.1016/j.ecss.2005.08.001.
- Bodiguel, C., D. Gréboval, and J.J. (eds.). Maguire. 2009. Factors of unsustainability and overexploitation in marine fisheries : views from the southern Mediterranean, West Africa, Southeast Asia and the Caribbean. Rome.
- Botero, J. E., and L. Botero. 1989. "Problemática ambiental del sistema Ciénaga Grande de Santa Marta, Delta Exterior del Río Magdalena." In *Colombia y el agua: tres aspectos. La ciénaga Grande de Santa Marta, la laguna de Sonso, en Buga Colombia y la Conferencia de Mar del Plata*, edited by Jorge Eduardo Botero, Leonor Botero and Anibal Patiño, 9-28. Bogotá: FESCOL.
- Botero, L., and J. E. Mancera. 1996. "Síntesis de los cambios de origen antrópico ocurridos en los últimos 40 años en la Ciénaga Grande de Santa Marta (Colombia)." *Revista de la Academia Colombiana de Ciencias Exactas Físicas y Naturales. Academia Colombiana de Ciencias Exactas Físicas y Naturales*. 20 (78):465-474.
- Botero, L., and H. Salzwedel. 1999. "Rehabilitation of the Cienaga Grande de Santa Marta, a mangrove-estuarine system in the Caribbean coast of Colombia." *Ocean & Coastal Management* 42 (2-4):243-256.
- Cadavid, B.C., P.A. Bautista, L.F. Espinosa, A.J. Hoyos, A.M. Malagón, D. Mármol, A.M. Orjuela, J.P. Parra, L.V. Perdomo, M. Rueda, C.A. Villamil, and E.A. Vilorio. 2012. Monitoreo de las condiciones ambientales y los cambios estructurales y funcionales de las comunidades vegetales y de los recursos pesqueros durante la rehabilitación de la Ciénaga Grande de Santa Marta. INVEMAR. Informe Técnico Final 2011. . Santa Marta. 127 p + anexos.
- Cárdenas, Juan-Camilo, and Elinor Ostrom. 2004. "What do people bring into the game? Experiments in the field about cooperation in the commons." *Agricultural Systems* 82 (3):307-326. doi: <http://dx.doi.org/10.1016/j.agsy.2004.07.008>.
- Cárdenas, Juan Camilo. 2000. "How do groups solve local commons dilemmas? Lessons from experimental economics in the field." *Environment, Development and Sustainability* 2:305-322.
- Cárdenas, Juan Camilo. 2011. "Social Norms and Behavior in the Local Commons as Seen Through the Lens of Field Experiments." *Environmental and Resource Economics* 48 (3):451-485. doi: 10.1007/s10640-010-9452-8.

- Cardenas, Juan Camilo, and Jeffrey Carpenter. 2008. "Behavioural Development Economics: Lessons from Field Labs in the Developing World." *The Journal of Development Studies* 44 (3):311-338. doi: 10.1080/00220380701848327.
- Carpenter, Jeffrey, and Erika Seki. 2011. "Do social preferences increase productivity? Field experimental evidence from fishermen in Toyama Bay." *Economic Inquiry* 49 (2):612-630. doi: 10.1111/j.1465-7295.2009.00268.x.
- Cassels, Susan, Sara R. Curran, and Randall Kramer. 2005. "Do Migrants Degrade Coastal Environments? Migration, Natural Resource Extraction and Poverty in North Sulawesi, Indonesia." *Human Ecology* 33 (3):329-363. doi: 10.2307/4603576.
- Castillo, Daniel, François Bousquet, Marco A. Janssen, Kobchai Worrapimphong, and Juan Camillo Cardenas. 2011. "Context matters to explain field experiments: Results from Colombian and Thai fishing villages." *Ecological Economics* 70 (9):1609-1620. doi: <http://dx.doi.org/10.1016/j.ecolecon.2011.05.011>.
- Charles, Anthony T. 1994. "Towards sustainability: the fishery experience." *Ecological Economics* 11 (3):201-211. doi: [http://dx.doi.org/10.1016/0921-8009\(94\)90201-1](http://dx.doi.org/10.1016/0921-8009(94)90201-1).
- Charles, Anthony T. 1995. "Fishery science: the study of fishery systems." *Aquatic Living Resources* 8 (03):233-239. doi: doi:10.1051/alr:1995023.
- Charness, Gary. 2000. "Responsibility and Effort in an Experimental Labor Market. ." *Journal of Economic Behavior & Organization* 42:375-384.
- Chaudhuri, Ananish. 2011. "Sustaining cooperation in laboratory public goods experiments: a selective survey of the literature." *Experimental Economics* 14 (1):47-83. doi: 10.1007/s10683-010-9257-1.
- Chhatre, A., and A. Agrawal. 2008. "Forest commons and local enforcement." *Proceedings of the National Academy of Sciences* 105 (36):13286-13291. doi: 10.1073/pnas.0803399105.
- Cinner, J. E. 2010. "Poverty and the use of destructive fishing gear near east African marine protected areas." *Environmental Conservation* 36 (4):321-326. doi: 10.1017/S0376892910000123.
- Cinner, J. E., T. Daw, and T. R. McClanahan. 2008. "Socioeconomic Factors that Affect Artisanal Fishers' Readiness to Exit a Declining Fishery." *Conservation Biology* 23 (1):124-130. doi: 10.1111/j.1523-1739.2008.01041.x.
- Cinner, J. E., T. R. McClanahan, M. A. MacNeil, N. A. J. Graham, T.M. Daw, A. Mukminin, D. A. Feary, A. L. Rabearisoa, A. Wamukota, N. Jiddawi, S. J. Campbell, A. H. Baird, F. A. Januchowski-Hartley, S. Hamed, R. Lahari, T.

- Morove, and J. Kuange. 2012. "Comanagement of coral reef social-ecological systems." *Proceedings of the National Academy of Sciences* (109):5219-5222. doi: 10.1073/pnas.1121215109
- Cinner, J. E., and R. B. Pollnac. 2004. "Poverty, perceptions and planning: why socioeconomics matter in the management of Mexican reefs." *Ocean & Coastal Management* 47 (9-10):479-493. doi: <http://dx.doi.org/10.1016/j.ocecoaman.2004.09.002>.
- Cinner, J.E., and T.R. McClanahan. 2006. "Socioeconomic factors that lead to overfishing in small-scale coral reef fisheries of Papua New Guinea." *Environmental Conservation* 33 (01):73-80. doi: doi:10.1017/S0376892906002748.
- Clark, Colin W. 1973. "The Economics of Overexploitation." *Science* 181 (4100):630-634. doi: 10.1126/science.181.4100.630.
- Coleman, Eric A., and Maria-Claudia Lopez. 2013. Reconstructing Cooperation from Civil Conflict: Experimental Evidence from Colombian Development Policy. Manuscript in preparation.
- CORPAMAG. 1993. Proyecto Recuperación y Manejo del complejo deltaico estuarino del Río Magdalena. Santa Marta, Colombia: Departamento Nacional de Planeación. Plan de Acción Forestal para Colombia. Programa de Acción Forestal. PAFC / BID (CO0041).
- Cox, M. 2014. "Understanding large social-ecological systems: introducing the SESMAD project." *International Journal of the Commons* 8 (2):265-276.
- Cox, M., and E. Ostrom. 2010. "Applying A Social-Ecological System Framework to the Study of the Taos Valley Irrigation System Over Time." Paper conference 13th Economics of Infrastructures Conference, Delft University of Technology, Delft, the Netherlands, May 27-28, 2010.
- DANE. 2012. Necesidades Básicas Insatisfechas - NBI, por Total, Cabecera y Resto, según Departamento y Nacional a 30 Junio de 2012. Departamento Administrativo Nacional de Estadística-DANE
- Daw, Tim M., Joshua E. Cinner, Timothy R. McClanahan, Katrina Brown, Selina M. Stead, Nicholas A. J. Graham, and Joseph Maina. 2012. "To Fish or Not to Fish: Factors at Multiple Scales Affecting Artisanal Fishers' Readiness to Exit a Declining Fishery." *PLoS ONE* 7 (2):e31460. doi: 10.1371/journal.pone.0031460.
- Dawes, Robyn M., and David M. Messick. 2000. "Social Dilemmas." *International Journal of Psychology* 35 (2):111-116. doi: 10.1080/002075900399402.

- Dawes, Robyn M., and Richard H. Thaler. 1988. "Anomalies: Cooperation." *The Journal of Economic Perspectives* 2 (3):187-197. doi: 10.2307/1942822.
- de Oliveira, Angela C. M. , Rachel T. A. Croson, and Catherine C. Eckel. 2009. "Are Preferences Stable Across Domains? An Experimental Investigation of Social Preferences in the Field. CBEES Working Paper #2008-3." *Southern Economic Journal* 79 (1).
- di Gregorio, M., K. Hagedorn, M. Kirk, B. Korf, N. McCarthy, and R. Meinzen-Dick. 2008. Property Rights, Collective Action, and Poverty: The Role of Institutions for Poverty Reduction. CAPRI Working Paper No. 81. Washington D.C.: International Food Policy Research Institute.
- Dietz, T., E. Ostrom, and P. C. Stern. 2003. "The struggle to govern the commons." *Science* 302 (5652):1907-1912. doi: 10.1126/science.1091015.
- Dietz, Thomas, Nives Dolšak, Elinor Ostrom, and Paul C. Stern. 2002. "The drama of the commons." In *The drama of the Commons*, edited by National Research Council, 3-36. Washington: National Academic Press.
- Dumyahn, S. L., and B. C. Pijanowski. 2011. "Beyond noise mitigation: managing soundscapes as common-pool resources." *Landscape Ecology* 26 (9):1311-1326. doi: DOI 10.1007/s10980-011-9637-8.
- Ehrhardt, N.M. 2005. "Introduction to the world conference on the "Scientific and technical bases for the sustainability of fisheries"." *Bulletin of Marine Science* 76 (2):167-170.
- Epstein, Graham, Jessica M. Vogt, Sarah K. Mincey, Michael Cox, and Burney Fischer. 2013. "Missing Ecology: Integrating Ecological Perspectives with the Social-Ecological System Framework." *International Journal of the Commons* 7.
- Epstein, P. R., O. Calix, and J. A. Blanco. 1995. "Climate and disease in Colombia." *The Lancet* 346 (8985):1243-1244.
- Ernst, B., J. Chamorro, P. Manríquez, J. M. L. Orensanz, A. M. Parma, J. Porobic, and C. Román. 2013. "Sustainability of the Juan Fernández lobster fishery (Chile) and the perils of generic science-based prescriptions." *Global Environmental Change* 23 (6):1381-1392. doi: <http://dx.doi.org/10.1016/j.gloenvcha.2013.08.002>.
- Falk, Armin, and James J. Heckman. 2009. "Lab Experiments Are a Major Source of Knowledge in the Social Sciences (English)." *Science (Washington, D.C.)* 326 (5952):535-538.
- FAO. 1991. Report of the nineteenth session of the Committee on Fisheries. FAO Fisheries Report. No. 459. Rome, 812 April 1991. 59p.

- FAO. 1997. Technical Guidelines for Responsible Fisheries. No. 4., Fisheries Management. Rome, FAO. 82 p. .
- FAO. 2005. World inventory of fisheries. Ghost fishing. Issues Fact Sheets. Text by Andrew Smith. In *Fisheries and Aquaculture Department [online]*. Rome. Updated 27 May 2005. [Cited 24 August 2015]. <http://www.fao.org/fishery/topic/14798/en>.
- FAO. 2007. Increasing the contribution of small-scale fisheries to poverty alleviation and food security. FAO Fisheries Technical Paper No. 481. Rome, FAO. 125 p.
- FAO. 2014. The State of World Fisheries and Aquaculture. Opportunities and challenges. Rome: Food and Agriculture Organization of the United Nations (FAO).
- FAO, and World Fish Center. 2008. Small-scale capture fisheries: a global overview with emphasis on developing countries: a preliminary report of the Big Numbers Project. In *Working Papers*: The World Fish Center.
- Fehr, Ernst, and Andreas Leibbrandt. 2011. "A field study on cooperativeness and impatience in the Tragedy of the Commons." *Journal of Public Economics* 95 (9–10):1144-1155. doi: <http://dx.doi.org/10.1016/j.jpubeco.2011.05.013>.
- Fleischman, F. D., K. Boenning, G. A. Garcia-Lopez, S. Mincey, M. Schmitt-Harsh, K. Daedlow, M. C. Lopez, X. Basurto, B. Fischer, and E. Ostrom. 2010. "Disturbance, Response, and Persistence in Self-Organized Forested Communities: Analysis of Robustness and Resilience in Five Communities in Southern Indiana." *Ecology and Society* 15 (4):9 [online] URL: <http://www.ecologyandsociety.org/vol15/iss4/art9/>. doi: 9.
- Forest B., Lewis A. 2015. Viaje a la tragedia ambiental en la Ciénaga Grande de Santa Marta. El Tiempo.com. March 25, 2015 <http://www.eltiempo.com/colombia/otras-ciudades/desastre-ambiental-en-la-cienaga-grande-de-santa-marta/15455817>.
- Frederick, Shane, George Loewenstein, and Ted O'Donoghue. 2002. "Time Discounting and Time Preference: A Critical Review." *Journal of Economic Literature* 40 (2):351-401.
- Freire, J., and A. García-Allut. 2000. "Socioeconomic and biological causes of management failures in European artisanal fisheries: the case of Galicia (NW Spain)." *Marine Policy* 24 (5):375-384. doi: [http://dx.doi.org/10.1016/S0308-597X\(00\)00013-0](http://dx.doi.org/10.1016/S0308-597X(00)00013-0).
- Frey, U. J., and H. Rusch. 2013. "Using Artificial Neural Networks for the Analysis of Social-Ecological Systems." *Ecology and Society* 18 (2):40. doi: 10.5751/ES-05202-180240.

- Gelcich, Stefan, Ricardo Guzman, Carlos Rodríguez-Sickert, Juan Carlos Castilla, and Juan Camilo Cárdenas. 2013. "Exploring External Validity of Common Pool Resource Experiments: Insights from Artisanal Benthic Fisheries in Chile." *Ecology and Society* 18 (3). doi: 10.5751/ES-05598-180302.
- Gibson, Clark C., Krister Andersson, Elinor Ostrom, and Sujai Shivakumar. 2005. *The Samaritan's Dilemma: The Political Economy of Development Aid*. Oxford University Press.
- Gibson, Clark C., Fabrice E. Lehoucq, and John T. Williams. 2002. "Does Privatization Protect Natural Resources? Property Rights and Forests in Guatemala." *Social Science Quarterly* 83 (1):206-225. doi: 10.1111/1540-6237.00079.
- Gocke, K., J. E. Mancera, L. A. Vidal, and D. Fonseca. 2003. *Boletín de Investigaciones Marinas y Costeras. Santa Marta, Colombia* 32:125-144.
- Gónima, L. , J.E. Mancera, and L. Botero. 1996. Análisis e interpretación de imágenes de satélite para estudios de vegetación, suelos y aguas en la Ciénaga Grande de Santa Marta. Informe Final. Universidad Nacional de Colombia e INVEMAR.
- Goodland, Robert. 1994. "Environmental sustainability and the power sector. Part I: The concept of sustainability." *Impact Assessment* 12 (3):275-304. doi: 10.1080/07349165.1994.9725867.
- Guest, Greg. 2003. "Fishing Behavior and Decision-Making in an Ecuadorian Community: A Scaled Approach." *Human Ecology* 31 (4):611-644. doi: 10.2307/4603495.
- Gurven, Michael, and Jeffrey Winking. 2008. "Collective action in action: Prosocial behavior in and out of the laboratory." *American Anthropologist* 110 (2):179-190. doi: 10.1111/j.1548-1433.2008.00024.x.
- Gutiérrez, N. L., R. Hilborn, and O. Defeo. 2011. "Leadership, social capital and incentives promote successful fisheries." *Nature* 470 (7334):386-389. doi: <http://www.nature.com/nature/journal/v470/n7334/abs/10.1038-nature09689-unlocked.html#supplementary-information>.
- Hanson, T., T. M. Brooks, G. A. B. Da Fonseca, M. Hoffmann, J. F. Lamoreux, G. Machlis, C. G. Mittermeier, R. A. Mittermeier, and J. D. Pilgrim. 2009. "Warfare in Biodiversity Hotspots." *Conservation Biology* 23 (3):578-587. doi: 10.1111/j.1523-1739.2009.01166.x.
- Hardin, Russel. 1968. "The Tragedy of the Commons." *Science* 162:1243-48.

- Harrison, Glenn W., Morten I. Lau, and Melonie B. Williams. 2002. "Estimating Individual Discount Rates in Denmark: A Field Experiment." *The American Economic Review* 92 (5):1606-1617. doi: 10.2307/3083267.
- Harrison, Glenn W., and John A. List. 2004. "Field Experiments." *Journal of Economic Literature* 42 (4):1009-1055. doi: 10.2307/3594915.
- Hilborn, R, and C J Walters. 1992. "Quantitative fisheries stock assessment: Choice, dynamics and uncertainty." *Reviews in Fish Biology and Fisheries* 2 (2):177-178. doi: 10.1007/BF00042883.
- Hilborn, R., J.M. Orensanz, and A.M. Parma. 2005. "Institutions, incentives and the future of fisheries " *Philosophical Transactions of the Royal Society* 360 (1453):47-57. doi: 10.1098/rstb.2004.1569.
- Hill, K, and M. Gurven. 2004. "Economic experiments to examine fairness and cooperation among the Ache Indians of Paraguay." In *Foundations of human sociality: economic experiments and ethnographic evidence from fifteen small-scale societies*, edited by J. Henrich, R. Boyd, S. Bowles, C. Camerer, E. Fehr and H. Gintis, 382-412. Oxford, UK.: Oxford University Press.
- Hinkel, J., P. W. G. Bots, and M. Schlüter. 2014. "Enhancing the Ostrom social-ecological system framework through formalization." *Ecology and Society* 19 (3). doi: 10.5751/ES-06475-190351.
- Hopfensitz, Astrid, and Josepa Miquel-Florensa. 2014. Investigating social capital in Colombia: Conflict and public good contributions. . TSE Working Paper, n. 14-463, January 31, 2014. .
- Ibarra, K. P., M.C. Gómez, E.A. Vilorio, E. Arteaga, M. Quintero, I. Cuadrado, J.A. Rodríguez, L. Licero, L.V. Perdomo, and M. Rueda. 2014. Monitoreo de las condiciones ambientales y los cambios estructurales y funcionales de las comunidades vegetales y de los recursos pesqueros durante la rehabilitación de la Ciénaga Grande de Santa Marta. INVEMAR. Informe Técnico Final 2013. . Santa Marta. 160 p + anexos.
- Ibarra, K. P., C.A. Villamil, E.A. Vilorio, D. Vega, P. A. Bautista, B.C. Cadavid, J.P. Parra, L.F. Espinosa, M.C. Gómez, C. M. Agudelo, L.V. Perdomo, D. Mármol, and M. Rueda. 2013. Monitoreo de las condiciones ambientales y los cambios estructurales y funcionales de las comunidades vegetales y de los recursos pesqueros durante la rehabilitación de la Ciénaga Grande de Santa Marta. INVEMAR. Informe Técnico Final 2012. . Santa Marta. 130 p + anexos.
- INVEMAR-SIPEIN. 2012. Sistema de Información Pesquera del INVEMAR - SIPEIN. Santa Marta, Colombia: INVEMAR - Programa Valoración y Aprovechamiento de Recursos Marinos y Costero.

- INVEMAR. 2002. Monitoreo de las condiciones ambientales y los cambios estructurales y funcionales de las comunidades vegetales y de los recursos pesqueros durante la rehabilitación de la Ciénaga Grande de Santa Marta: Un enfoque de manejo adaptativo: Informe Técnico Final 1999-2002. Convenios MMA/BID/INVEMAR. Santa Marta, Colombia. 322 p. edited by INVEMAR: Instituto de Investigaciones Marinas y Costeras "José Benito Vives de Andréis".
- INVEMAR. 2003. Monitoreo de las condiciones ambientales y los cambios estructurales y funcionales de las comunidades vegetales y de los recursos pesqueros durante la rehabilitación de la Ciénaga Grande de Santa Marta. Informe 2003. Convenios MMA/BID/INVEMAR. Santa Marta, Colombia. 72p. edited by INVEMAR: Instituto de Investigaciones Marinas y Costeras "José Benito Vives de Andréis".
- INVEMAR. 2012. Informe del estado de los ambientes y recursos marinos y costeros en Colombia: Año 2011. Serie de Publicaciones Periódicas No. 8. Santa Marta, Colombia.
- INVEMAR. 2013. Informe del estado de los ambientes y recursos marinos y costeros en Colombia: Año 2012. Serie de Publicaciones Periódicas No. 8. 169 p. Santa Marta, Colombia.: INVEMAR.
- Isaac, R. Mark, and James M. Walker. 1988. "Group Size Effects in Public Goods Provision: The Voluntary Contributions Mechanism." *The Quarterly Journal of Economics* 103 (1):179-199. doi: 10.2307/1882648.
- Janssen, Marco A., and John M. Anderies. 2011. "Governing the commons: Learning from field and laboratory experiments." *Ecological Economics* 70 (9):1569-1570. doi: <http://dx.doi.org/10.1016/j.ecolecon.2011.03.023>.
- Janssen, Marco A., John M. Anderies, and Elinor Ostrom. 2007. "Robustness of Social-Ecological Systems to Spatial and Temporal Variability." *Society & Natural Resources* 20 (4):307-322. doi: 10.1080/08941920601161320.
- Kittinger, John N., Elena M. Finkbeiner, Natalie C. Ban, Kenneth Broad, Mark H. Carr, Joshua E. Cinner, Stefan Gelcich, Myriah L. Cornwell, J. Zachary Koehn, Xavier Basurto, Rod Fujita, Margaret R. Caldwell, and Larry B. Crowder. 2013. "Emerging frontiers in social-ecological systems research for sustainability of small-scale fisheries." *Current Opinion in Environmental Sustainability* 5 (3-4):352-357. doi: <http://dx.doi.org/10.1016/j.cosust.2013.06.008>.
- Latorre, E., and F. A. Arregocés. 2014. "Caracterización de la formación y estructuración de las bandas criminales en el departamento del Magdalena." *Advocatus* 11 (22):261-279.
- Leal-Flórez, J. 2007. "Impacts of non-native fishes on the fish community and the fishery of the Ciénaga Grande de Santa Marta estuary, northern Colombia. PhD

- Thesis." Doctor in Natural Sciences (Dr. rer. nat.), Faculty of Biology and Chemistry, Bremen University.
- Ledyard, John. 1995. Public goods: a survey of experimental research. In *Handbook of Experimental Economics*, edited by John H. Kagel, Roth, Alvin E. (Eds.). Princeton: Princeton University Press.
- Levitt, Steven D., and John A. List. 2007. "What Do Laboratory Experiments Measuring Social Preferences Reveal About the Real World?" *Journal of Economic Perspectives* 21 (2):153-174.
- López, Ángela C., María M. Ciales, and Camilo B. García. 2001. "Postlarvas y juveniles de camarones *farfantepenaeus* spp y *xiphopenaeus kroyeri* en la Boca de la Barra (Ciénaga Grande de Santa Marta), Caribe colombiano." *Boletín de Investigaciones Marinas y Costeras - INVEMAR* 30:177-198.
- Lopez, Maria Claudia, James J. Murphy, John Spraggon, and John Kevin Stranlund. 2012. "Comparing the effectiveness of regulation and pro-social emotions to enhance cooperation : experimental evidence from fishing communities in Colombia." *Economic inquiry : journal of the Western Economic Association International* 50 (1):131-142.
- Lopez, Maria Claudia, and Paula Andrea Zuluaga. 2013. "La importancia del contexto en los experimentos económicos en campo: Un caso en la Amazonia Peruana." In *Aproximaciones al uso de experimentos en Ciencias Sociales*, edited by Andres Casas y Nathalie Méndez., 143-162. Bogotá. Colombia.: Editorial Javeriana.
- MacNeil, M. A., and J. E. Cinner. 2013. "Hierarchical livelihood outcomes among co-managed fisheries." *Global Environmental Change* 23 (6):1393-1401. doi: <http://dx.doi.org/10.1016/j.gloenvcha.2013.04.003>.
- Madrigal B., R., F. Alpízar, and A. Schlüter. 2011. "Determinants of Performance of Community-Based Drinking Water Organizations." *World Development* 39 (9):1663-1675. doi: <http://dx.doi.org/10.1016/j.worlddev.2011.02.011>.
- Madrigal, R., A. Schlüter, and M. C. Lopez. 2013. "What makes them follow the rules? Empirical evidence from turtle egg harvesters in Costa Rica." *Marine Policy* 37 (0):270-277. doi: <http://dx.doi.org/10.1016/j.marpol.2012.05.009>.
- Mancera, J. E., and L. A. Vidal. 1994. "Florecimiento de microalgas relacionado con mortandad masiva de peces en el complejo lagunar Ciénaga Grande de Santa Marta, Caribe Colombiano." *Boletín de Investigaciones Marinas y Costeras - INVEMAR* 23 (1):103-117.

- McGinnis, M. D., and E. Ostrom. 2014. "Social-ecological system framework: initial changes and continuing challenges." *Ecology and Society* 19 (2):30. doi: 10.5751/ES-06387-190230.
- McGinnis, M.D. 2010. Building a Program for Institutional Analysis of Social-Ecological Systems: A Review of Revisions to the SES Framework. Bloomington: Workshop in Political Theory and Policy Analysis.
- Medina, B., H. M. Guzman, and J. M. Mair. 2007. "Failed recovery of a collapsed scallop *argopecten ventricosus* fishery in Las Perlas Archipelago, Panamá." *Journal of Shellfish Research* 26 (1):9-15. doi: 10.2983/0730-8000(2007)26[9:FROACS]2.0.CO;2.
- Meinzen-Dick, R. 2007. "Beyond panaceas in water institutions." *Proceedings of the National Academy of Sciences* 104 (39):15200-15205. doi: 10.1073/pnas.0702296104.
- Meinzen-Dick, Ruth, Meyra Mendoza, Loic Sadoulet, Ghada Abiad-Shields, and Ashok Subramanian. 1997. "Sustainable water user associations: Lessons from a literature review." In *User organizations for sustainable water services*, ed N. V. Jagannathan A. Subramanian, & R. S. Meinzen-Dick (Eds.). World Bank, Washington, DC, USA.: World Bank Technical Paper 354.
- Nardo, M., M. Saisana, A. Saltelli, S. Tarantola, A. Hoffman, and E. Giovannini. 2008. "Handbook on constructing composite indicators: methodology and user guide." In Paris, France: Organisation for Economic Co-operation and Development (OECD). <http://www.oecd.org/std/42495745.pdf>.
- Narváez B., Juan Carlos, Fabio Andrés Herrera P., and Jacobo Blanco R. 2008. "Efecto de los artes de pesca sobre el tamaño de los peces en una pesquería artesanal del caribe colombiano." *Boletín de Investigaciones Marinas y Costeras - INVEMAR* 37:163-187.
- Nazarea, Virginia, Robert Rhoades, Erla Bontoyan, and Gabriela Flora. 1998. "Defining indicators which make sense to local people: Intra-cultural variation in perceptions of natural resources." *Human Organization* 57 (2):159-170.
- NRC, National Research Council. 2002. *The Drama of the Commons*. . Edited by T. Dietz. E. Ostrom, N. Dolšák, P. Stern, S. Stonich, and E. Weber. Washington, DC: National Academic Press.
- Olson, M. 1965. *The logic of collective action. Public goods and the theory of groups.*: Cambridge University Press, Mass.: Harvard University Press.

- Onyx, J., and R. J. Leonard. 2011. "Complex systems leadership in emergent community projects." *Community Development Journal* 46 (4):493-510. doi: 10.1093/cdj/bsq041.
- Orensanz, J.M., A. Cinti, A.M. Parma, L. Burotto, S. Espinosa-Guerrero, E. Sosa-Cordero, C. Sepúlveda, and V. Toral-Granda. 2013. "Latin-American rights-based fisheries targeting sedentary resources." In *Rights-based management in Latin American fisheries*, edited by J.M. Orensanz and J.C. Seijo. FAO Fisheries and Aquaculture Technical Paper, No. 582.
- Ostrom, E. 1990. *Governing the Commons. The evolution of institutions for collective action*. Cambridge: Cambridge University Press.
- Ostrom, E. 2007. "A diagnostic approach for going beyond panaceas." *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 104 (39):15181 - 15187.
- Ostrom, E. 2009. "A General Framework for Analyzing Sustainability of Social-Ecological Systems." *Science* 325 (5939):419-422. doi: 10.1126/science.1172133.
- Ostrom, E. 2011. "Background on the Institutional Analysis and Development Framework." *Policy Studies Journal* 39 (1):7-27. doi: 10.1111/j.1541-0072.2010.00394.x.
- Ostrom, E., J. Burger, Ch. B. Field, R. B. Norgaard, and D. Policansky. 1999. "Revisiting the Commons: Local Lessons, Global Challenges." *Science* 284:278-282.
- Ostrom, E., R. Gardner, and J. Walker. 1994. *Rules, Games, & Common-Pool Resources*. Michigan: The University of Michigan Press.
- Ostrom, E., and H. Nagendra. 2006. "Insights on linking forests, trees, and people from the air, on the ground, and in the laboratory." *Proceedings of the National Academy of Sciences* 103 (51):19224-19231. doi: 10.1073/pnas.0607962103.
- Ostrom, Elinor. 2000. "Collective Action and the Evolution of Social Norms." *Journal of Economic Perspectives* 14 (3):137-158.
- Ostrom, Elinor. 2005. *Understanding Institutional Diversity*. Princeton: Princeton University Press.
- Ostrom, Elinor. 2006. "The value-added of laboratory experiments for the study of institutions and common-pool resources." *Journal of Economic Behavior & Organization* 61 (2):149-163. doi: <http://dx.doi.org/10.1016/j.jebo.2005.02.008>.

- Ostrom, Elinor, James Walker, and Roy Gardner. 1992. "Covenants With and Without a Sword: Self-Governance is Possible." *The American Political Science Review* 86 (2):404-417.
- Pollnac, R.B. 2000. "Villager's Perceptions of Aspects of the Natural and Human Environment of Balikpapan Bay, Indonesia." *Proyek Pesisir* 3 (2).
- Poteete, A. R., M. Janssen, and E. Ostrom. 2010. *Working Together: Collective Action, the Commons and Multiple Methods in Practice*. Princeton, NJ: Princeton University Press.
- Poteete, Amy R., and Elinor Ostrom. 2004. "Heterogeneity, Group Size and Collective Action: The Role of Institutions in Forest Management." *Development and Change* 35 (3):435-461. doi: 10.1111/j.1467-7660.2004.00360.x.
- Poteete, Amy R., and Elinor Ostrom. 2008. "Fifteen Years of Empirical Research on Collective Action in Natural Resource Management: Struggling to Build Large-N Databases Based on Qualitative Research." *World Development* 36 (1):176-195.
- PROCIENAGA. 1994. Ordenamiento pesquero. Memorias y testimonios de una consulta social. edited by INVEMAR CORPAMAG, CORPES C.A., GTZ. Santa Marta, Colombia.
- PROCIENAGA. 1995. Plan de Manejo Ambiental de la Subregión Ciénaga Grande de Santa Marta 1995-1998. Proyecto de rehabilitación de la Ciénaga Grande de Santa Marta. CORPAMAG, INVEMAR, CORPES C.A., GTZ. Santa Marta, Colombia.
- Ratner, B. D., B. Åsgård, and E. H. Allison. 2014. "Fishing for justice: Human rights, development, and fisheries sector reform." *Global Environmental Change* 27 (0):120-130. doi: <http://dx.doi.org/10.1016/j.gloenvcha.2014.05.006>.
- Redaccion Medio Ambiente, El Espectador. 2015. "Más sorpresas en la Ciénaga. ." *El Espectador*, March 16, 2015, Medio Ambiente.
- Rueda, M., and O. Defeo. 2003a. "Linking fishery management and conservation in a tropical estuarine lagoon: biological and physical effects of an artisanal fishing gear." *Estuarine Coastal and Shelf Science* 56 (5-6):935-942. doi: Doi 10.1016/S0272-7714(02)00298-6.
- Rueda, Mario. 2007. "Evaluating the selective performance of the encircling gillnet used in tropical estuarine fisheries from Colombia." *Fisheries Research* 87 (1):28-34. doi: <http://dx.doi.org/10.1016/j.fishres.2007.06.014>.
- Rueda, Mario, and Omar Defeo. 2003b. "A bioeconomic multispecies analysis of an estuarine small-scale fishery: spatial structure of biovalue." *ICES Journal of*

- Marine Science: Journal du Conseil* 60 (4):721-732. doi: 10.1016/s1054-3139(03)00096-1.
- Rueda, Mario Enrique , Jose Ernesto Mancera, and Jaime Humberto Mendo. 1997. "Estimación del factor de retención de la red bolichera empleada en pesquería en la Ciénaga Grande de Santa Marta, Caribe colombiano." *Revista de la Academia Colombiana de Ciencias Exactas Físicas y Naturales. Academia Colombiana de Ciencias Exactas Físicas y Naturales.* 21 (81): p. 487-495.
- Rustagi, Devesh, Stefanie Engel, and Michael Kosfeld. 2010. "Conditional Cooperation and Costly Monitoring Explain Success in Forest Commons Management." *Science* 330 (6006):961-965. doi: 10.1126/science.1193649.
- Salas, Silvia. 2000. "Fishing strategies of small-scale fishers and their implications for fisheries management." Doctor of Philosophy - PhD PhD, Resource Management and Environmental Studies, British Columbia University.
- Salas, Silvia, and Daniel Gaertner. 2004. "The behavioural dynamics of fishers: management implications." *Fish and Fisheries* 5 (2):153-167. doi: 10.1111/j.1467-2979.2004.00146.x.
- Salas, Silvia, Ussif Rashid Sumaila, and Tony J Pitcher. 2004. "Short-term decisions of small-scale fishers selecting alternative target species: a choice model." *Canadian Journal of Fisheries and Aquatic Sciences* 61:374–383. doi: 10.1139/f04-007.
- Sally, David. 1995. "Conversation and Cooperation in Social Dilemmas: A Meta-Analysis of Experiments from 1958 to 1992." *Rationality and Society* 7 (1):58-92. doi: 10.1177/1043463195007001004.
- Sánchez-Martínez, C., and M. Rueda. 1999. "Variación de la diversidad y abundancia de especies ícticas dominantes en el Delta del Río Magdalena, Colombia." *Revista de Biología Tropical* 47 (4):1067-1079.
- Sánchez-Ramírez, C. 1996. "Variación espacial y temporal de la ictiofauna de Cienaga Grande de Santa Marta, Complejo de Pajarales y cienagas del costado occidental de la Isla de Salamanca, Caribe Colombiano." Biología Tesis de Pregrado, Facultad de Ciencias. Departamento de Biología, Universidad Nacional de Colombia.
- Sánchez, J. E. . 2011. "Bandas criminales: continuación con los mismos medios." *Estudios en Seguridad y Defensa.* 6 (1):36-49.
- Sandler, T. 1992. *Collective Action: Theory and Application.* Ann Arbor: University of Michigan Press.
- Santos-Martínez, A, E. Viloria, C. Sánchez, M Rueda, R. Tijero, M Grijalba, and J.C. Narváez. 1998. Evaluación de los principales recursos pesqueros de la Ciénaga

Grande de Santa Marta y Complejo Pajarales, Caribe Colombiano. Informe Final. Santa Marta: COLCIENCIAS, INVEMAR y GTZ-PROCIENAGA.

- Santos-Martínez, A., and A. Acero. 1991. "Fish community of the Ciénaga Grande de Santa Marta (Colombia): composition and zoogeography." *Ichthyological Exploration of Freshwaters* 2:247-263.
- Schlager, E. 1994. "Fishers' institutional responses to common pool resources dilemmas." In *Rules, Games & Common-Pool Resources*, edited by Elinor Ostrom, Roy Gardner and James Walker, 246-266. Michigan: The University of Michigan Press.
- Schlager, E., W. Blomquist, and S. Y. Tang. 1994. "Mobile Flows, Storage, and Self-Organized Institutions for Governing Common-Pool Resources." *Land Economics* 70 (3):294-317.
- Schlüter, M., J. Hinkel, P. W. G. Bots, and R. Arlinghaus. 2014. "Application of the SES Framework for Model-based Analysis of the Dynamics of Social-Ecological Systems." *Ecology and Society* 19 (1). doi: 10.5751/ES-05782-190136.
- Silva, P. 2006. Exploring the linkages between poverty, marine protected area management, and the use of destructive fishing gear in Tanzania. . In *World Bank Policy Research Working Paper 3831* World Bank, Washington, DC, USA.
- SISBEN. 2007. Base Certificada Nacional del Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales (SISBEN). Colombia: Departamento Nacional de Planeación
- SISBEN. 2012. Base Certificada Nacional del Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales (SISBEN). Colombia: Departamento Nacional de Planeación
- Sumaila, Ussif R., and Carl Walters. 2005. "Intergenerational discounting: a new intuitive approach." *Ecological Economics* 52 (2):135-142. doi: <http://dx.doi.org/10.1016/j.ecolecon.2003.11.012>.
- Sumaila, Ussif Rashid. 2004. "Intergenerational cost–benefit analysis and marine ecosystem restoration." *Fish and Fisheries* 5 (4):329-343. doi: 10.1111/j.1467-2679.2004.00166.x.
- Teh, Louise S. L., Lydia C. L. Teh, and U. Rashid Sumaila. 2011. "Low Discounting Behavior among Small-Scale Fishers in Fiji and Sabah, Malaysia." *Sustainability* 3 (6):897-913.
- Torres, L. E., A. Schlüter, and M. C. Lopez. In preparation. "Understanding artisanal fishermen's behavior: the case of Ciénaga Grande de Santa Marta, Colombia ".

- Torres, L. E., A. Schlüter, and M. C. Lopez. in revision. "Collective action in a tropical estuarine lagoon: Adapting Ostrom's SES framework to Ciénaga Grande de Santa Marta, Colombia."
- UNEP. 2006. Marine and coastal ecosystems and human well being: A synthesis report based on the findings of the Millennium Ecosystem Assessment. UNEP
- UNESCO-MAB. 2000. "Biosphere Reserve Ciénaga Grande de Santa Marta, Colombia.". UNESCO - The MAB Programme Accessed 01-05-2015. <http://www.unesco.org/mabdb/br/brdir/directory/biores.asp?mode=gen&code=COL+04>.
- Vedeld, T. 2000. "Village Politics: Heterogeneity, Leadership and Collective Action." *Journal of Development Studies* 36 (5):105.
- Velez, Maria Alejandra, and Maria Claudia Lopez. 2013. "Rules Compliance and Age: Experimental Evidence with Fishers from the Amazon River." *Ecology and Society* 18 (3). doi: 10.5751/ES-05721-180310.
- Velez, Maria Alejandra, John K. Stranlund, and James J. Murphy. 2009. "What motivates common pool resource users? Experimental evidence from the field." *Journal of Economic Behavior & Organization* 70 (3):485-497. doi: <http://dx.doi.org/10.1016/j.jebo.2008.02.008>.
- Velez, Maria Alejandra, John K. Stranlund, and James J. Murphy. 2012. "Preferences for government enforcement of a common pool harvest quota: Theory and experimental evidence from fishing communities in Colombia." *Ecological Economics* 77:185-192. doi: <http://dx.doi.org/10.1016/j.ecolecon.2012.02.030>.
- Vilardy, S. P., and J. A. González. 2011. *Repensando la Ciénaga: nuevas miradas y estrategias para la sostenibilidad en la Ciénaga Grande de Santa Marta*. Santa Marta, Colombia: Universidad de Magdalena / Universidad Autónoma de Madrid. Editorial Gente Nueva.
- Wade, R. 1988. *Village republics: economic conditions for collective action in South India*. Vol. 40, *Cambridge South Asian Studies*. Cambridge: Cambridge Univ. Press.
- Wade, R. 1994. *Village republics: economic conditions for collective action in South India*. San Francisco, CA: ICS Press.
- Wilén, James E., Martin D. Smith, Dale Lockwood, and Louis W. Botsford. 2002. "Avoiding Surprises: Incorporating Fisherman Behavior into Management Models." *Bulletin of Marine Science* 70 (2):553-575.

- Wilson, James, Liying Yan, and Carl Wilson. 2007. "The precursors of governance in the Maine lobster fishery." *Proceedings of the National Academy of Sciences* 104 (39):15212-15217. doi: 10.1073/pnas.0702241104.
- Yaffe, L. 2011. "Conflicto armado en Colombia: análisis de las causas económicas, sociales e institucionales de la oposición violenta." *Revista CS* 8:187-208.