Vulnerability and Viability of Small-Scale Fisheries in Sisal, Yucatan, Mexico

by

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Abstract

Small-scale fishing communities are highly vulnerable to changes both climate-related and other socio-economic and institutional changes mostly because of their high dependency on natural resources. Several of the approaches that have been developed and applied to reduce their vulnerability are largely externally driven and involve pre-determined vulnerability assessments. Vulnerability is, however, context-specific, i.e., it may mean different things to different people. Understanding what makes people vulnerable, determining feasible policy interventions for ameliorating such vulnerability, and exploring options for enhancing viability may need to begin with asking people what they think about their own situation. From the governance perspective, it is also imperative to have comprehensive knowledge about the resource system that people depend on, the complexity and dynamics of the social system, and importantly the existing governing system. This thesis brings together two perspectives, a simplified participatory diagnostic approach and interactive governance to investigate the vulnerability and viability of a coastal, small-scale fishing community in Sisal, Yucatan, Mexico. The study involved in-person surveys using semi-structured questionnaires. These surveys were targeting at captains and crewmembers involved in harvesting, and fishing women participating in post-harvesting activities. The survey respondents were asked to populate the list of vulnerability factors, both at individual and community levels, based on their own situation and experience. They were also asked to provide explanation about how these factors make them vulnerable. The respondents were prompted to consider vulnerability related to natural, social, economic, institutional, and technological dimensions. The preliminary results of the in-person surveys were presented to the focus group discussions, organized to enable the survey participants to further discuss vulnerability issues in Sisal, and to explore potential solutions to address them, as well as possible pathways to enhance viability.

Overall, the survey respondents agreed about the natural aspects of vulnerability but diverged in the other four dimensions. The level of agreement was higher between the captains and the crewmembers but lower between the captains and the women participating

in post-harvest activities. The vulnerability factors receiving the highest number of mentions by all respondent groups were related to the social dimension. These include a wide range of issues such as lack of respect for regulations, issues pertaining to migration, lack of support from financiers, and lack of support and recognition for women working in post-harvest related activities. The interactive governance analysis of the fisheries in Sisal reveals that the vulnerability of the fish harvesters and the women are related to the high complexity, dynamics, and scale of the natural and the social systems. In addition, weak capacity of the governing system and the poor quality of interactions exacerbate vulnerability. Nevertheless, rich ecosystem, community solidarity, and strong leadership are key factors fostering viable livelihoods for the people of Sisal. Social relationships, proactive attitudes, high capacity and in-depth knowledge are key strengths of the community. These strengths can be built upon to encourage people to organize and participate in decision-making about their future.

In conclusion, by studying how people involved in the harvest and post-harvest activities perceive threats to their livelihoods and what they see as possible avenues for strengthening their community, this thesis adds to the general discourse regarding vulnerability and viability of resource-dependent coastal communities. The outcomes of this simplified participatory diagnostic approach, coupled with the understanding of the governance system, provide sound advice for the development of fisheries policies that benefit local communities and their surroundings.

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List of Abbreviations and Symbols

DFID:	Department for International Development
PRA:	Participatory Rural Appraisal
RRA:	Rapid Rural Appraisal
SAGARPA:	Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food
CONAPESCA:	National Commission on Aquaculture and Fisheries
INAPESCA:	National Fisheries Institute
NOMs:	Mexican Official Standards
CNP:	National Fisheries Chart
PROPESCA:	Program for the Promotion of Fisheries and Aquaculture
PEMEX:	Mexican Petroleum
IPCC:	Intergovernmental Panel on Climate Change
MSY:	Maximum Sustainable Yield
SEDESOL:	Secretariat of Social Development
SSF Guidelines:	Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries
TAC:	Total Allowable Catch
UMDI-Sisal:	National Autonomous University of Mexico
CINVESTAV:	Center for Research and Advances Studies of the National Polytechnic Institute
UADY:	Autonomous University of Yucatan
SDGs:	Sustainable Development Goals

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CHAPTER 1. Introduction

This chapter introduces the thesis by highlighting the need to better understand what makes coastal small-scale fishing communities vulnerable, how and why. It first describes the research methods commonly used to locate sources of vulnerability and then argues for alternative ways to look at this global concern. The simplified participatory diagnostic approach undertaken in this investigation is presented, along with a brief description of the interactive governance theory used as complementary lens to examine the whole fisheries system. The chapter concludes with the research scope and questions.

1.1 Vulnerability in the context of coastal communities

Communities around the world are vulnerable to environmental and anthropogenic changes. Coastal, small-scale fishing communities are particularly susceptible to the global and local change processes, given their high dependency on natural resources and the strong attachment to coastal areas (Allison et al. 2005; Allison et al. 2006; Islam 2011; Chuenpagdee and Jentoft 2015). External threats, inherent challenges within their own socio-economic conditions, as well as political environments, all contribute to magnifying their vulnerability, affecting their ability to have viable livelihoods (Béné et al. 2009; Allison et al. 2009; Zou and Wei 2010; Bavinck et al. 2018; Salas et al. 2019).

The concept of vulnerability has proliferated through different disciplines such as environmental science, sociology, anthropology, health and nutrition, and economics. It refers to the potential of a system (at individual, household or community levels) to be negatively affected by social, economic, and institutional changes or physical events

(Füssel and Klein 2006; Kelly and Adger 2000). Vulnerability is also considered as an *a priori* condition of the system which refers to its susceptibility to changes from a combination of socioeconomic factors and environmental stresses. Stress, in turn, refers to unexpected changes and disruption to livelihoods (Chambers 1989; Adger 1999; Allen 2003; Thorpe 2004; Füssel and Klein 2006).Some of the sources and causes of vulnerability to coastal communities include limited resource availability, overfishing, overcapacity, poor governance, as well as factors operating at a larger scale such as climate phenomena, competition with industrial fisheries, globalized markets, urban development, and land transformation (Andrew et al. 2007; Chuenpagdee 2011; Schuhbauer and Sumaila 2016; Utete et al. 2018). These challenges constrain small-scale coastal fisheries to deliver the benefits they provide to the wider society. Viability, on the other hand, is defined as "the quality or the state of being viable; capacity of living; the ability to live under certain conditions" (Simpson and Weiner 1989). Schuhbauer and Sumaila (2016) state that while viability of industrial enterprises focuses on profit maximization, viability in small-scale fisheries is achieved when nonnegative net benefits to society from fishing are maintained; these includes livelihoods, employment, fish consumption per capita, degree of economic dependence, and fair distribution of benefits, among others (Pollnac and Poggie 2008; Hospital and Beavers 2012).

When studying vulnerability, two different perspectives are commonly used. The first is drawn from the field of disaster risk management, which considers vulnerability as a function of exposure to a physical impact, the degree of sensitivity to such impact, and the capacity to act and respond to the impact (IPCC 2007; Khattabi and Jobbins 2011).

This first definition and the applications has been largely used in climate-related events (Turner et al. 2003; Hall 2011; Cinner et al. 2012). The second perspective is social vulnerability, which refers to a state that individuals, communities, and sectors deal with a broad array of multi-scalar and multi-temporal, social, political, and economic changes, some of which make them highly vulnerable (Adger 1999; Andrew et al. 2007; Béné 2009; Zou and Wei 2010; Salas et al. 2011; Bennett et al. 2016). The two perspectives are not mutually exclusive; thus analyses that combine both types of stressors and pressures have been conducted in different studies (Cutter et al. 2000; Wu et al. 2002; Khattabi and Jobbins 2011).

The methods employed for addressing vulnerability concerns have been mostly undertaken at a large-scale, through a top-down assessment, and often using a predetermined set of indicators (Allison et al. 2009; Mills et al. 2011; Schwarz et al. 2011; Taylor et al. 2014). Vulnerability is, however, context-specific (Adger 2006; Wisner 2006; Khattabi and Jobbins 2011; Nayak and Berkes 2019), such that different stressors can have different impacts. It is important to recognize that vulnerability can mean different things to different people, depending on their locations and contexts. Other studies have argued, however, that bottom-up participatory approaches may be more appropriate than the classically designed top-down assessment (Barrett 2013; Berkhout et al. 2014; Ayantunde et al. 2015). This perspective is consistent with the field of disaster management, which applies participatory methods to study vulnerability according to local situations (Ayantunde et al. 2015; Wisner 2006). Freire (1973) and Chambers (1983) were the pioneers in promoting these alternative approaches that can result in

empowerment of local people, e.g., helping them to understand the specificity of their problems and enabling them to find opportunities for increasing awareness and defining strategies for self-protection. Although the use of these bottom-up approaches allows comparison among communities, it does not aim to compare or measure people's vulnerability at national or international levels. Rather, it aims to create awareness among the communities of their conditions and enable them to take control over their own situations (Wisner 2006).

Participatory approaches have advantages over the pre-determined methods in capturing sources of vulnerability and mobilizing local communities to create innovative solutions to face challenges and constraints (Park 2001; Pain 2004; Barrett 2013; Burns et al. 2013). However, as any other method, participatory approaches have been subject to criticism for creating a path dependency, relying on people's participation, depending highly on the dynamic of the place, among others (Chambers 1992; Mosse 1994; Martin and Sherington 1997; Kozanayi 2005). In this study, it is argued that having comprehensive knowledge of the resource systems that people depend on (Wisner 2006), the complexity and the dynamics of the social system, as well as the existing governing system (Chuenpagdee and Jentoft 2015), can help address the shortcomings of participatory methods. For instance, having a clear picture of how the fisheries system works can improve the accuracy of locating the sources of vulnerability and can point to alternative pathways toward viable livelihoods that are normally not explored. In this regard, the interactive governance theory (Kooiman et al. 2005) offers a lens to describe the system under study in a holistic and systematic way. The broader knowledge of the

fisheries system can be employed to substantiate the information gathered from the participatory diagnostic approach and provides a strong basis for the design of public policies and programs to reduce vulnerability and enhance viability of the local communities.

It is noted that each segment of the population, e.g., men, women, elderly, children, can be exposed differently to the sources of vulnerability (Wisner 2006; Islam and Chuenpagdee 2013; Ayantunde et al. 2015). Understanding what gives people a sense of vulnerability requires asking all involved parties to accurately capture the different roles they play in fishing activities of the social system, and that they also have different tools to respond to the stressors. In small-scale fisheries, women are mostly engaged in post-harvest activities (Thompson et al. 1983; Harper et al. 2013), sometimes with little or no recognition of their work (Bennett 2005; Frangoudes 2011; Harper et al. 2013). However, they can play a critical role in dealing with factors that negatively affect their livelihoods and can encourage and support community in moving towards required reform and transformation (Frangoudes 2011; Mutimukuru-Maravanyika et al. 2017). Therefore, in finding ways to ameliorate sources of vulnerability and move to more viable livelihoods, it is important to consider how women perceive different types of stressors and how they deal with them.

1.2 Participatory diagnostic approach in the study of vulnerability

Participatory techniques have entered the policy-making domain of large international agencies like the World Bank since the 1980s (Howes 1992; Cornwall 2008). These processes acknowledge the need to tap into the wealth of wisdom and experience of

stakeholders in formulating solutions that correspond to their needs and different issues based on the initial analysis of their own situation (Bradley et al. 2002; Cornwall and Jewkes 1995). Arnstein (1969) refers to a similar concept in the 'ladder of participation' model, which shows different types of engagement and different levels of power-sharing between governments and civil society. Several participatory approaches and methods have been developed, including participatory rural appraisal, which evolved from the rapid rural appraisal that focuses mainly on information gathering by outsiders (Chambers 1996). Participatory rural appraisal aims particularly at enabling people to express, share, and analyze their own realities and conditions, plan their own actions, and monitor the outcomes out of the proposed actions (Chambers 1994; Chambers 1996). Along with the participatory rural appraisal, other techniques have also emerged, such as participatory resource mapping employed to capture and integrate knowledge into environmental and development plans, this approach prevents outside groups misinterpreting local realities (Chambers 1994, 1995, 1997).

The participatory diagnostic approach is one variation of participatory approaches that focuses on listening to what people have to say in order to obtain collective construction of data, based on certain realities (Freitas et al. 2012). This listening method is commonly used in the medical sciences, as well as in farming (Bai et al. 2016; Chatikobo et al. 2013; Kimiti et al. 2007; Sanogo et al. 2017), in urban planning (Joerin et al. 2009; Nembrini et al. 2006) and, to a lesser extent, in fisheries (Delisle et al. 2016; Eriksson et al. 2016). The process generally starts from narrowing down the issues to be addressed through a series of diagnostic questions and methods, whereby the next step depends on the results of the

preceding inquiry (Cornwall and Jewkes 1995; Eriksson et al. 2016). Verdejo (2003), for instance, suggests the following stages in the participatory diagnostic approach. Firstly, it involves people in the gathering, synthesis, and prioritization of local concerns. Second, it promotes collective learning and sharing process that allows participants to either reinforce or modify their opinions and perceptions. Finally, it encourages collective awareness related to local constraints and conditions. Some of the advantages of participatory diagnostic processes thus include the broadening of participation, not just in problem-solving but also in the problem-identification phase (Joerin et al. 2009). In this research, a simplified participatory diagnostic approach was carried out which firstly involved the gathering of individual concerns through a self-diagnostic phase and its later prioritization. A collective learning and identification of potential solutions based on local strengths were encouraged through a group discussion which still prompted people to share knowledge and exchange perceptions of local constraints that impact their fishing livelihoods.

1.3 Interactive governance theory

A description of the entire system in the most comprehensive and systematic way is needed to discuss the underlying causes of vulnerability identified by local people and to subsequently locate opportunities for fishing livelihoods viability. This becomes especially important since governing institutions have a strong role to play in a well-functioning resource system. Interactive governance theory (Kooiman et al. 2005) offers a lens that enables such an investigation, by looking at the basic characteristics of the natural, the social, and the governing systems that exist in a given location. As the

governability concept states (Chuenpagdee et al. 2013; Chuenpagdee and Jentoft 2009), people's vulnerability may be influenced on one hand by the inherent dynamics of the natural system (e.g., variability in resources), and on the other hand by the diversity and complexity of the social system. Thus, the structure of the governing system and its capacity and quality to govern can contribute to making people more or less vulnerable, but can also help explore potential solutions and enact locally-based opportunities to face those conditions (Bavinck et al. 2005; Kooiman et al. 2005; Kooiman and Bavinck 2013).

Although different frameworks and approaches have been developed to analyze problems and challenges in fisheries (Allison and Ellis 2001; Fanning et al. 2007; Fletcher et al. 2005; Garcia et al. 2008; Ostrom 2009), the interactive governance theory differs from others in its emphasis on the understanding of governing interactions and the role of governing actors (e.g., the state, market, and civil society) in improving fisheries governance. In this research, interactive governance is employed to supplement the simplified participatory diagnostic approach in order to describe the multiple facets of the resource system and, based on what local people express regarding their surrounding environment, locate where policy interventions are required, which policies can be improved to ameliorate vulnerability in small-scale fisheries, and what opportunities exist for improving the viability of fishing people's livelihoods.

1.4 Research scope and questions

This research is inspired by an alternative process to examine vulnerability issues and livelihood concerns that matter most to people. For this, a simplified participatory

diagnostic approach is applied on Sisal, a small fishing community on the Yucatan coast of Mexico. This approach allows for an initial instigation of what vulnerability means from the perspective of fishing community members, and what they consider as possible pathways to reduce their vulnerability and to enhance the viability of their livelihoods. In addition, the interactive governance lens is employed to provide a holistic and systematic description of the characteristics of the fisheries resources, the community, and the governing system, including all actors involved formally and informally, directly and indirectly, in the governance. The information gathered from the local fishing people is supplemented with the interactive governance perspective. Findings from this investigation provide a basis for discussion about policy interventions that may help to reduce vulnerability, increase livelihood viability, and enhance governance in fishing communities such as Sisal.

Specifically, the thesis aims to answer the following questions:

1. According to the fishing people of Sisal, what makes them vulnerable and to what extent do these perspectives differ from the theory and other studies?
2. Are there gender differences in how vulnerability is perceived and what potential solutions are provided for making small-scale fisheries more viable?
3. Following the interactive governance theory, what does the governing system look like and how it can be improved to make Sisal more viable?
4. Based on the above, what are some policy interventions that may make people related to fishing in Sisal more viable?

1.5 Thesis outline

This thesis contains six chapters. After this introductory chapter (Chapter **1**), Chapter **2** presents a review of the literature regarding vulnerability and viability, both in general and in the context of fisheries. This is followed by a review of participatory methods and a brief description of the interactive governance theory. The chapter concludes with a rationale behind the proposition of using the simplified participatory diagnostic approach and complementing the identified ways to move from vulnerability to viability with the interactive governance theory.

A description of Sisal fishing community as a whole system is illustrated in Chapter **3**. This chapter draws from the interactive governance perspective to describe the fisheries system by its components; the natural and social system-to-be-governed and the governing system taking place in Sisal.

Chapter **4** describes the mixture of methods employed to collect data about the meaning and sources of vulnerability according to the fishing people. It also provides details about how the simplified participatory diagnostic approach was conducted in this research and its application to Sisal fishing community. The outcomes of the application are the vulnerability factors impacting Sisal, according to captains and crew members involved in capture fisheries.

Using a similar process, Chapter **5** captures gender-based vulnerability. For this, the simplified participatory diagnostic approach was conducted to captains (men-dominated) and processors (women-dominated) engaged in small-scale fisheries of Sisal, Yucatan. The comparison enables an understanding of gender differences in how vulnerability is

perceived as well as suggestions about possible alternatives to reduce it. Both chapters **4** and **5** have a methodological contribution to the theory as well as conceptual contribution on the vulnerability topic in small-scale fisheries.

Chapter **6** explores potential opportunities for fostering viability of fishing livelihoods in Sisal. This illustration is based on the characteristics of the governing system (e.g., governing institutions and permit-holders) and the outcomes from the simplified participatory diagnostic approach. Finally, policy implications are provided as well as an overall conclusion from this investigation.

CHAPTER 2. Literature Review

This chapter presents a literature review about vulnerability and viability, examining how the concepts have been conceived as areas of study, and which methods are commonly employed to examine them, particularly in coastal small-scale fishing communities. The chapter also describes participatory approaches and interactive governance theory, discussing how the frameworks have been used to enhance knowledge about vulnerability and viability. Finally, the chapter provides the rationale for employing the interactive governance theory perspective to complement the simplified participatory diagnostic approach in the study.

2.1 Vulnerability associated with small-scale fisheries — An overview

2.1.1 Small-scale fisheries as a means of livelihoods

Coastal communities around the world have relied on marine resources as a mainstay of their livelihoods for several decades. It is widely recognized that these resources make multiple contributions to societies, cultures, and the economy, especially in terms of employment, food security, income, and revenues (Allison et al. 2001; Allison et al. 2009; Zeller et al. 2006; Béné 2006; Teh et al. 2011; Belhabib et al. 2015) . In terms of conservation, Pauly (2011) states that small-scale fisheries have the potential for being the fisheries of the future. As coastal communities are connected with their natural resources and therefore hold a sense of belonging, it is suggested that they will employ less-destructive fishing practices.

Although benefits from small-scale fisheries far exceed those from large-scale industrialized fisheries (Pauly 2006), they are frequently overlooked and neglected in mainstream policy worldwide (Chuenpagdee 2011; Thorpe 2004; Zeller et al. 2006). Many fishing communities around the world face several challenges in maintaining their livelihoods, including limited access to resource, poor resource availability, overfishing, degradation of the marine environment, poor governance, climate phenomena, competition with industrial fisheries, globalized markets, and marginalization (Allison et al. 2005; Andrew et al. 2007; Chuenpagdee 2011; Schuhbauer and Sumaila 2016; Song et al. 2018; Stoll et al. 2018; Bavinck et al. 2018; Chuenpagdee et al. 2019). These issues directly affect small-scale fishers' ability to sustain their livelihoods and respond to changing conditions. For small-scale fisheries to deliver their full benefits to society, sources of vulnerability must be understood at the individual and community levels (Adger 1999; Andrew et al. 2007; Salas et al. 2019). This can lead to exploring potential pathways to move from vulnerability to viability.

Coastal communities commonly face uncertainties due to resource fluctuation, financial uncertainty, and environmental risk. The poor health of the oceans creates hardship to resource dependent fishers, thus changing behaviours like moving to other fishing grounds or venturing further offshore (Salas et al. 2004; Saldaña et al. 2017; Naranjo-Madrigal and Bystrom 2019). In these circumstances, enduring threats to meet basic needs become difficult for fishing people, making them vulnerable. In some cases, coastal fishing households are able to diversify livelihood activities (IMM et al. 2005; Frangoudes 2011). In other cases, people adopt migration as a livelihood strategy to

reduce their vulnerability, moving either within the country or beyond (Islam 2011; Kheang 2013) as a response to economic opportunities offered in other places, acting as a ‘pull factor' (Islam and Herbeck 2013).

A livelihood is defined by the capabilities, assets, and activities required for means of living (Chambers and Conway 1992; DFID 2001). Livelihoods are known to be diverse and multidimensional, and encompass a series of assets or capitals used by people to cope with threats to their wellbeing (Chambers and Conway 1992; White and Ellison 2007). According to the sustainable livelihood framework, there are five capital assets from which people can draw upon: human, natural, financial, social, and physical (DFID 2001).

Schemes existing in the literature split up differently the key variables that influence livelihood sustainability and highlight the different domains from which people can be negatively impacted (Moser 1998; White and Ellison 2007). For example, an urban research, Moser (1998) developed an asset vulnerability framework to address poverty and vulnerability. The proposed framework identifies five assets that include tangible assets such as labour, human capital, and productive assets (focusing on housing); and intangible assets such as household relations (e.g., composition and structure of households as well as cohesion within the household) and social capital (e.g., cooperation and cohesion within the community).

In the context of small-scale fisheries, assets or resources have been critically associated with social identities and power relations at distinct levels such as within households, the

community, or the state (Allison and Ellis 2001; White and Ellison 2007). Within fishing communities, for example, resource users with high social capital (e.g., kinship networks) can have access to a wide array of assets such as financial capital in terms of loans or to natural capital in terms of fishing grounds (Johnson 2013). In one study, the configuration employed to locate sources of vulnerability aligns with the framework proposed by the Department for International Development (DFID 2001). This framework, as stated above, defines human capital as the skills, knowledge, and health that enable people to pursue their livelihood. Natural capital is related to the natural resources (e.g., land, trees, fish stocks) from which resource flows and services useful for livelihoods are derived. Financial capital refers to the financial resources that people use to meet their livelihood objectives. Social capital represents the networks, relationship of trust, or membership that allows for cooperation. Finally, physical capital denotes the basic producer goods and infrastructure necessary to support livelihoods (DFID 2001; IMM et al. 2005). In this study, capital assets are called domains. This framework considers natural domain which is related to natural fishing resources; social domain encompasses kinship, associations, and networks within the fishing community; economic domain denotes savings, access to credits, loans, profits; institutional domain refers to the role of community based rules and state regulations that influence access to natural or financial resources; and technological domain which alludes to the key assets needed to develop fishing activity (e.g., boats, gears, infrastructure).

2.1.2 Vulnerability and viability studies in coastal small-scale fishing communities

Research into vulnerability and viability have provided visibility to small-scale fisheries for the last two decades. Although vulnerability emerges from the climate science and policy arena, the concept has been discussed broadly in the literature (Adger 1999; Cinner et al. 2012; Belhabib et al. 2016; Senapati and Gupta 2017; Nayak and Berkes 2019). In the management disaster risk field, vulnerability is a function of exposure to a physical impact, the degree of sensitivity to such impact, and the capacity to respond to the impact (Blaikie et al. 1994; Khattabi and Jobbins 2011). O'Brien et al. (2007) state two types of vulnerability interpretations to climate change: outcome vulnerability and contextual vulnerability. Outcome vulnerability is considered when any linear result of the projected impacts that climate change has on a biophysical or social unit is offset by adaptation measures. In contrast, contextual vulnerability is referred as a process and multidimensional perspective of climate-society interactions.

In fisheries, among the first studies on vulnerability sought to highlight it as a result of a combination of natural and technological disasters beyond human control (Dyer and McGoodwin 1999). However, people's livelihoods are also impacted by many other issues in addition to climate-related factors. As a result, particular vulnerability schemes associate this concept as inherent to the community, moving beyond specific physical stressors (Adger 2006; Khattabi and Jobbins 2011; Bennett et al. 2016).

From the social vulnerability perspective, a series of economic, social, institutional, and technological factors can constrain people's ability to have viable livelihoods. In small-scale fishing communities, people might be less able to collectively decide and act toward

problems when they are not organized (e.g., when fishing institutions such as cooperatives are missing) (Khattabi and Jobbins 2011). From a human geography perspective, the vulnerability knowledge domain comprises a long history, principally in the fields of disaster, global environmental change, famine, and poverty (Adger 1999, 2006; Kelly and Adger 2000; Cutter et al. 2013). In poverty-related research, vulnerability is considered as a central element (Chambers 1989; Béné 2009), while recognizing that vulnerability and poverty are not synonyms. Specific to small-scale fisheries, several authors have argued that fishers may not necessarily be the poorest of the poor (in terms of money), yet they are the most vulnerable due to their high exposure to different natural, health-related or economic shocks and disasters (Béné 2003; Allison et al. 2006; Jentoft and Eide 2011). This latter perspective rests on the observation that vulnerability integrates additional dimensions related to multiple insecurities and exposures to risk, shock and, stress (Chambers 1989; McCulloch and Calandrino 2003; Béné 2009; Salas et al. 2011).

As previously mentioned, vulnerability of small-scale fishing communities is linked to their high dependence on natural resources and strong attachment to coastal areas (Allison et al. 2006; Islam 2011; Salas et al. 2011; Chuenpagdee et al. 2019). Fishing people, regardless of their gender or age, are actively engaged in different parts of the fish chain, sometimes playing overlapping roles in pre-harvest, harvest, and post-harvest activities (Edwards et al. 2019). Multiple sources of vulnerability, such as disruption of marketing systems, fish declines, and bad climate conditions, affect both fishers and processors alike, since post-harvest activities depend entirely on harvest activities (Tindall and

Holvoet 2008; Pedroza and Salas 2011). It is also well-known that vulnerability have different effects on men and women. Particularly, women suffer a socioeconomic disadvantage toward natural calamities, sexually transmitted infections, or social exclusion, to name a few (Béné and Merten 2008; Arora-Jonsson 2011; Ayantunde et al. 2015). For instance, fatality and the likelihood of post-disaster death was twice as great for women in the 2004 Indian Ocean Tsunami (Birkmann et al. 2007). Therefore, it is important to understand particularities in terms of how women who are engaged in small-scale fisheries experience vulnerable conditions in their surrounding environment, and the extent to which it differs from men.

In small-scale fisheries, early studies on viability measure the financial or economic viability of a given fishery (Béné et al. 2001). However, in this study, it is argued that small-scale fisheries need to be treated differently from their large-scale counterparts when assessing financial viability or economic performance. This is because, apart from profit, traditional, cultural, and social values are also derived from small-scale fisheries (Berkes et al. 2001; Pollnac and Poggie 2008; Trimble and Johnson 2013).

In Mexico, small-scale fisheries are officially defined as activities carried out by both indigenous and non-indigenous fishers, who sell most of the catch at local markets but often keep a portion of it for household consumption. Fishers use small vessels called ‘pangas,’ which are open-deck fiberglass boats around 23 ft length, usually with 50-115 HP outboard engines (gasoline). The most common fishing gears used are gillnets, hook-and-line, hookah diving method, traps, and a range of small bottom-trawl nets. Large-scale fisheries, on the other hand, include vessels with covered deck, inboard engine

(exclusively diesel), mechanical winches and use otter trawls, purse-seiners, and longlines as fishing gears. Two types of fleet are identified, an offshore fleet targeting tuna and billfishes, and a large coastal fleet targeting shrimp and small pelagic fishes such as sardines (CONAPESCA 2017).

Methods to assess vulnerability are mostly pre-determined, based on existing information and expert knowledge (Adger 2006; Moser 2010). Vulnerability assessments are often quantitative, relying mostly on measurable characteristics or attributes to establish scores or indices to represent the degree of vulnerability of a system (Allison et al. 2009; Senapati and Gupta 2017). Although expert-driven assessment can differentiate communities based on its level of vulnerability and can provide some useful insights for policy intervention (Alwang et al. 2001; Yohe and Tol 2002; Allison et al. 2009), studies show that long-term solutions to addressing vulnerability need to be community specific (Barrett 2013; Sowman and Raemaekers 2018). It is further argued that a country-level analysis of vulnerability may miss capturing the sub-national spatial and social differences as well as local conditions that allow for capacity to adapt (Adger 2006; Cutter et al. 2013). Hence, qualitative assessment should be used to complement such research, providing insights and perceptions of vulnerability, especially from the perspectives of local communities (Adger 2006). Such an approach also helps address one of the weaknesses of the majority of vulnerability assessments, which is the lack of incorporation of the perspectives of vulnerable people about what determines their vulnerability, either in the design of the study or in the actual assessment (Salas et al. 2011; Ayantunde et al. 2015; Sowman and Raemaekers 2018). This can result in a

mismatch or disconnect between what vulnerability means to experts or outsiders conducting the study, and what it means to local people who experience vulnerability. Such a discrepancy can lead to the implementation of large-scale vulnerability reduction programs that miss the targeted vulnerable population by wide margins (Vincent 2007; Barrett 2013).

Viability assessments, on the other hand, have been done mostly from a purely financial perspective, focusing on profit maximization (Schuhbauer and Sumaila 2016). Therefore, in studying viability of fishing operations, economic tools have been widely employed (Adeogun et al. 2009), including socio-economic indicators (Ünal and Franquesa 2010) and economic models of production (Gustavson 2002). Cost-benefit analysis is another tool to determine how economically viable an entity is by incorporating temporal aspects into the assessment of net benefits (Tisdell 1996). The most dominant approach to analyze economic viability though is through the viability theory, a mathematical method based on the viability kernel developed by Aubin (1991) (Schuhbauer and Sumaila 2016).

Concerning small-scale fisheries, viability goes beyond economic benefits, since being viable implies that good socio-economic conditions are always paired with achieving social wellbeing. A series of studies have addressed viability related to social capital as a relevant property that enhances communities' wellbeing (McKenzie 2004; Brooks et al. 2010). For example, capital accumulated in migrant networks (migration) plays an important role in the viability of a given fishery, both in terms of landings and employment (Marquette et al. 2002); or cooperation among fishers and between fishers and institutions which have a positive impact in ecosystems and the livelihoods viability

(Salas et al. 2015). Therefore, there are several benefits in engaging communities in the determination of both vulnerability and solutions for viability given that they can become real actors in working towards better livelihoods, as opposed to being seen only as a problem (Chuenpagdee 2011b).

Under this context, although in the literature predominate pre-determined methods to assess the factors or stressors that make fishing people vulnerable (Béné 2009; Mills et al. 2011; Cinner et al. 2012; Brugère and De Young 2015; Freduah et al. 2017; Islam et al. 2014; Quiros et al. 2018), other methods are designed to be more participatory by involving local people in the identification of the key constraints or challenges in their community. This latter method offers an opportunity for them to engage in the diagnostic process (Eriksson et al. 2016; Karr et al. 2017; Sowman and Raemaekers 2018). According to Brockhaus et al. (2013) and Prokopy et al. (2013), participatory approaches are useful when the study aims to change the behavior of the people regarding their response to sources of stress. One of the strengths of participatory assessments of vulnerability is that they focus on people or communities' experiences that have been affected by climatic stress and other shocks in their specific contexts (Ayantunde et al. 2015; Schwarz et al. 2011). Therefore, participatory methods and tools are suitable approaches to identifying problems and encourage local people to find solutions in their context (Eriksson et al. 2016).

Among other things, the participatory approach recognizes that fishing people have a critical role to play in resource governance (Jentoft and McCay 1995; Béné and Neiland 2006; Jentoft et al. 2011; Salas et al. 2019) and that the positive influence of participation

means that they can perceive and understand the socioeconomic and political conditions under which they live, offering relevant knowledge to solve problems (Chambers 1995; Barrett 2013). In this regard, participatory, bottom-up approaches could also be seen as a way to enhance local people's empowerment, which may be better than creating a dependency on outside experts through traditional assessment methods (Chambers 1995; Sowman and Raemaekers 2018). On a whole, the self-identification of sources of vulnerability is critical for the development of measures that address case-specific, local needs, with an aim to avoid one-size-fit-all measures, which often result from externally driven vulnerability assessments (Ayantunde et al. 2015; Sowman and Raemaekers 2018).

Interests in participatory research have grown as a response to the need for the involvement of stakeholders in processes that lead to quality decisions over complex issues (Chambers 1994a, 1995; Seixas et al. 2019). The techniques employed ensure that researchers and participants learn together, rather than the former simply extracting information from the later. Participatory approaches to research have been applied in pastoralism, agriculture, mining, farming, forestry, tourism development, urban and rural planning, and in environmental education sectors (Esilaba et al. 2001; Robottom and Sauvé 2003; Bationo et al. 2007; Esteves 2008; Coppock et al. 2011; Bele et al. 2013; Ramírez 2015; Bai et al. 2016). These applications have shown to be useful to understand, address, and help achieve management objectives such as planning, soil fertility management, and tourism development among others (Bellon et al. 1999; Nembrini et al. 2006; Ramírez 2015).

2.2 Participatory diagnostic approach to study vulnerability and viability

Participatory diagnosis approach is a recent addition to the participatory research suite. They complement a longer tradition of Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA), which is a family of approaches and methods developed in the 1980s and 1970s, respectively. These methods share a similar aim, which is to enable rural people to share, enhance, and analyze their knowledge of life and determined conditions, ultimately leading them to plan and take actions for addressing those problems (Mascarenhas et al. 1991). Other techniques have also emerged along side PRA and RRA, such as participatory resource mapping to capture and integrate knowledge into environmental and development plans, and prevent outside groups misinterpreting local realities (Chambers 1994a, 1994b, 1997).

The participatory diagnosis approach differs from other participatory methods in its main focus, which is mainly to identify and prioritize factors that hinder or enable expected outcomes in a social system, as well as mobilization of responses to such circumstances (Eriksson et al. 2016). The keyword, “diagnostic” refers to methods that stem from medical sciences in gathering information about a system by identifying threats that drive vulnerabilities based on local circumstances (Eriksson et al. 2016). While some participatory diagnostic studies have been applied to fisheries (Delisle et al. 2016; Eriksson et al. 2016), applications to small-scale fishing communities are very limited. Long et al. (2017), for instance, use a participatory diagnostic method to elicit fisher’s perspectives on principles related to ecosystem-based approaches, while Song and Chuenpagdee (2015) developed a participatory diagnostic method to explore values and

principles associated with small-scale fisheries in South Korea. Further, this approach has been used in community-based management and governance transitions in coastal fisheries from the Republic of Kiribati, Indonesia, Philippines, Solomon Islands, and Tanzania (Delisle et al. 2016; Eriksson et al. 2016). Through using a simplified participatory diagnostic approach, this study explores the meaning and sources of vulnerability in one small-scale fishing community, a novel approach to examine a sector facing increased challenges globally.

2.3 Interactive governance: Theoretical foundation

Governance is a concept traditionally used in political science and public administration (Kooiman 2003). The focus on governance in fisheries and other natural resources has been rising in the past decades. Interactive governance is one of the many governance theories employed in different societal systems such as coastal, small-scale fisheries (Jentoft and Chuenpagdee 2015). Kooiman et al. (2005, p.17) define interactive governance as "the whole of public as well as private interactions taken to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them". However, beyond fisheries, the interactive governance theory has been applied and other societal sectors and fields of research have emerged, such as coastal zone management (Pittman and Armitage 2016), forestry (Derkyi et al. 2014), animal husbandry (Löf 2016; Onyango 2016), and the biofuel industry (Di Lucia 2013).

The application of interactive governance to small-scale fisheries begins with a recognition that this particular sector owns a series of problems that resemble wicked problems (Rittel and Webber 1973; Jentoft and Chuenpagdee 2009; Jentoft 2018), which are inherently complex, sometimes part of a bigger problem, and with not an easy solution. Because small-scale fisheries are highly vulnerable to external threats, conventional management approaches that ignore externalities are not effective. Thus, there is a call for expanding the scope from management to a broader frame of governance (Kooiman et al. 2005). This includes new forms of interactions such as cooperation, partnerships, social learning and knowledge co-production to improve the situation of the system (Berkes 2011).

Frameworks and theoretical approaches designed to analyze and mitigate fisheries problems range from ecological and people-oriented (Allison and Ellis 2001; Fletcher et al. 2005; Garcia et al. 2008) to broader approaches that view fisheries systems through the lens of governability (Fanning et al. 2007; Quentin Grafton et al. 2007; Ostrom 2009). Another key governance approach is the socio-ecological system theory developed by Elinor Ostrom (Ostrom 2007), which, like interactive governance theory, deals with complex systems. One major difference between these two approaches lies in their foundation. While the socio-ecological system approach and its accompanying resilience thinking come from ecological background, the interactive governance approach comes from political and social sciences. Further, the socio-ecological system approach assumes the coupling of the natural and the human systems. Interactive governance theory, on the other hand, provides a model for studying the different interactions between society and

ecosystem, which may include de-coupling the natural and the social system-to-be-governed, and study also the interactions taking place between this last and the governing system. Finally, scholars involved in the socio-ecological system usually provide prescription on problem-solution, meanwhile the interactive governance focuses, in the first instance, on the system description, but also offers an analytical framework based on the 'governability' concept, which refers to the overall quality for governance (Bavinck et al. 2013).

The interactive governance theory encompasses three principal sub-systems, i.e. the natural and the social systems that are being governed; a governing system, and the interactions between the two (Jentoft and Chuenpagdee 2015). The social system-to-be-governed is composed of the people involved in the fish chain, while the governing system includes governments, markets, and civil society organizations. For a governing effort to be successful, both the system-to-be-governed and the governing system must be compatible. If the governing system ignores the nature of the system-to-be-governed, governance is likely to fail (Jentoft and Chuenpagdee 2009).

The interactive governance theory holds a series of assumptions that are relevant to governance design. Firstly, the theory states that both the system-to-be-governed and the governing system have inherent properties, i.e. diversity, complexity, dynamics and scale, and understanding them is critical for governance. Diversity is defined by the heterogeneity and the number of components in the system, while complexity is about how the components relate to each other. Dynamics refers to how the governing system and the system-to-be-governed are connected and interact with each other. These

interactions may be caused by external interventions, consequently, tend to change over time. Interactive governance further argues that spatial and temporal scale associated with both systems and their interactions may be an issue affecting governance (Jentoft and Chuenpagdee 2009; Kooiman and Bavinck 2005).

Interactive governance theory recognizes three types of governing modes: top-down or hierarchical governance, often with governments in the controlling role; co-governance, as the power-sharing between the state and user groups; and self-governance, held to be the prerogative of communities (Kooiman et al. 2005). Many small-scale fisheries around the world are governed through a top-down approach, but there is a strong signal for governance transition and reform towards participatory and co-governance (Jentoft and Chuenpagdee 2015). Interactive governance theory does not consider any single mode of governance to be superior or as assurance for good outcomes. Instead, it states that each context requires its own diagnosis for the selection of the most appropriate mode. Given that fisheries systems present complex problems and possible trade-offs, governance decisions are likely to have high impact on both the ecosystem and the people involved. Therefore, from the interactive governance perspective, affected actors need to participate in the discussion and decision-making based on concerns and principles underlying the governance of the system (Bavinck et al. 2013).

The third aspect is related to the order of governance where different actions take place. The ‘first order’ is where daily problem-solving and routine decision-makings are made. The ‘second order’ refers to the institutional design and arrangements that foster the first-order actions but are informed by the ‘meta order,’ which is related to values, images and

principles underlying governance (Jentoft and Chuenpagdee 2009; Chuenpagdee 2011b). The interlinked meta-concerns identified in this approach, which also emerge in the discussions about fisheries worldwide, are ecosystem health, social justice, livelihoods and employment, and food security. All of them are connected to human wellbeing, for both present and future societies (Bavinck et al. 2013).

2.4 Complementing the simplified participatory diagnostic approach with the interactive governance theory

The variety of factors that negatively impact people's livelihoods are often triggered by the diversity, complexity, dynamics, and scale of the natural and social system-to-be-governed, and by the governing system in each case. Thus, it is imperative to examine local fishing people's perspectives on complex concepts like vulnerability as well as on what they identify as the sources that expose them to vulnerable situations. Asking people and allowing them to identify what makes them vulnerable is an initial step towards the formulation of policies to reduce such vulnerability, with an ultimate aim to enhance viability. It is argued here that a holistic understanding of the resource system, considering also the existing governing system, within which fishing people is embedded, revealed through interactive governance framework, can help improve policy development by pointing to aspects of the system that make it more or less governable. Thus, the results from a simplified participatory diagnostic approach, complementing with the interactive governance lens, can provide a solid platform to discuss possible pathways to enhance livelihoods' viability and to design effective governance interventions.

CHAPTER 3. Sisal Fishing Community: A System Description

This chapter employs the interactive governance perspective to provide a holistic and comprehensive view of Sisal fishing community. By looking at the natural environment, the socio-economic characteristics, and the governing structure, this chapter provides detailed information associated with the fisheries system in the study area.

3.1 System-to-be-governed

3.1.1 Natural system-to-be-governed

Sisal is a fishing community located in the northwest portion of the Yucatan Peninsula, Mexico (Fig. 3.1 and 3.2). The coastal typology includes flatbed, rocky areas, and sandy shores with a gradual decline toward the sea. The climate is clearly marked by three seasons: dry (March-June), rainy (June-October), and windy (October-February). The average annual temperature ranges from 25º-26°C, with a lower range being under 10°C in January and a maximum range extending to over 40°C in May (Figueroa-Espinoza et al. 2014).

Figure 3.1 Photo of Sisal fishing port

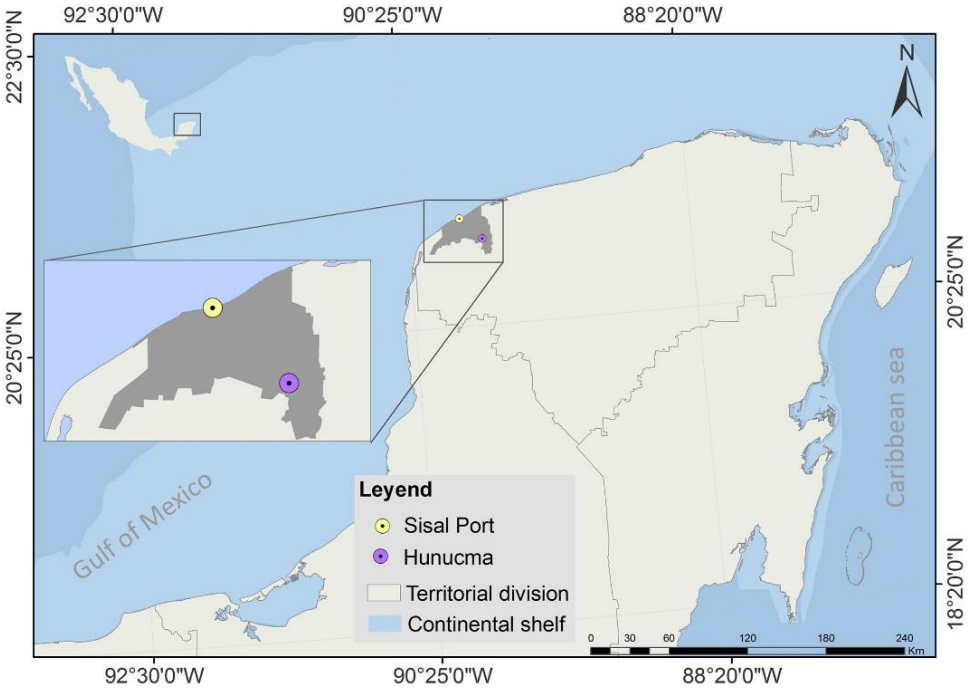


Figure 3.2 Geographical location of Sisal fishing community in the Yucatan state, Mexico. (Map design: Mendoza-Martínez J.)

Sisal is part of the El Palmar State Reserve (50,177 ha), which has been declared an ecological conservation zone in 1990, and later a Natural Protected Area. Since 2003, El Palmar has been considered a wetlands area of international importance by the Ramsar Convention[1] due to the areas' mangrove coverage which is 60 %. This is ecologically important since it provides feeding and breeding habitats for many species, including fish, crustaceous, and birds, serving as a biodiversity hotspot (Batllori et al. 1999; Cowen et al. 2006; Arceo-Carranza and Chiappa-Carrara 2017).

The variety of productive marine habitats found in nearby Sisal make the lucrative fishing grounds important socio-economically. For instance, Sisal has three reef systems close to the coast called Sisal, Madagascar, and Serpiente. Sisal reef is located 23 km from the coast. It has shallow reef structure which is close to shore and covers the largest area of the three reefs mentioned. Madagascar and Serpiente reefs are 40 km and 54 km away from the coast, respectively (Zarco-Perelló et al. 2013). The proximity of these reefs to the Caribbean Sea and the Campeche Bank reefs allows for transportation of diverse taxa (Cowen et al. 2006). These reefs are also affected by different environmental conditions from both natural and anthropogenic sources (Burke and Maidens 2004; SEMAR 2006). As part of the marine flora found in Sisal, Sargassum (*Sargassum bacciferum*/*Sargassum natans*) host various commercial fish species at early stages of development (e.g., Coryphaena, Abudefduf, and Caranx) (Vandendriessche et al. 2007). The region lacks surface water sources such as rivers or lagoons, however, the karstic nature of the terrain

[1] https://www.ramsar.org/news/mexico-designates-ten-new-wetlands-of-international-importance

allows filtration of the rain, creating abundant underground currents (Herrera-Silveira and Morales-Ojeda 2010). These aquifer deposits enable an extensive wetland area (‘Ciénegas’ Spanish) (Herrera-Silveira and Morales-Ojeda 2010) which harbor different fish and crustacea species as well as a variety of birds.

A dynamic natural system such as this can, at times, impose restrictions on fishing operations. Northern winds that can last for more than 24 hours negatively impact the region during winter months (Orellana et al. 2009; Appendini et al. 2012; Figueroa-Espinoza et al. 2014). Local people are also periodically exposed to natural and physical threats such as storms, hurricanes, and algal blooms with yearly occurrences (Meyer-Arendt 1993; Gower et al. 2013; Wang and Hu 2016). These events affect fisheries, tourism, and service sectors (e.g. local stores, restaurants) (Rincón-Díaz 2014; Hernández-Becerril et al. 2007; Ulloa et al. 2017).

Today, fishing is a significant socioeconomic activity in Sisal, contributing to 20% of the total fishing production in the Yucatan State (INEGI 2005). The high diversity of fishery attracts sport and recreational fishing, mostly during weekends, holidays, and summer vacations (July-August) (FIR 2003; The Gulf of Mexico Alliance 2008; Fedler and Hayes 2008; Garza-Pérez 2010). Several fishing tournaments bring visitors to the area (Vidal Hernández et al. 2017), contributing to the economy in the fishing community. Duck hunting is also practiced during winter months in the El Palmar reserve (Curiel-Durán 2015). To a lesser extent, the local people also gain income from wage labor, and agriculture (Batllori-Sampedro et al. 2006; Ruz 2006).

Small-scale fisheries are particularly important in Sisal, with nearly 3,000 tonnes of fish landed in 2017, generating a total of US$7.7 million in revenues (SAGARPA 2018). In the Yucatan state, commercial landings in Sisal come from both small- and large-scale fishing fleets, contributing about 7.6% to the total landings (SAGARPA 2018). Landings in Sisal increased from 1,380 tonnes in 2010 to almost 3,000 tonnes in 2017 (more than 50 %). In terms of revenue, local fisheries in Sisal generated around US$ 7.7 million in income in the last two years (Fig. 3.3). Local catches are highly diverse but octopus (*Octopus maya*) is considered the backbone of the fishery contributing about half of the total catch (8,863 t; US$23.4 million) (SAGARPA 2018a). However, other species such as grouper (*Epinephelus* spp.) and yellowtail snapper (*Osyurus chrysurus*) are also important, with about 14% (2,391 t; US$5.8 million) and 8% of total catch (1,409 t; US$3.2 million) respectively. Information about other important species is provided in Table 3.1 (SAGARPA 2018).

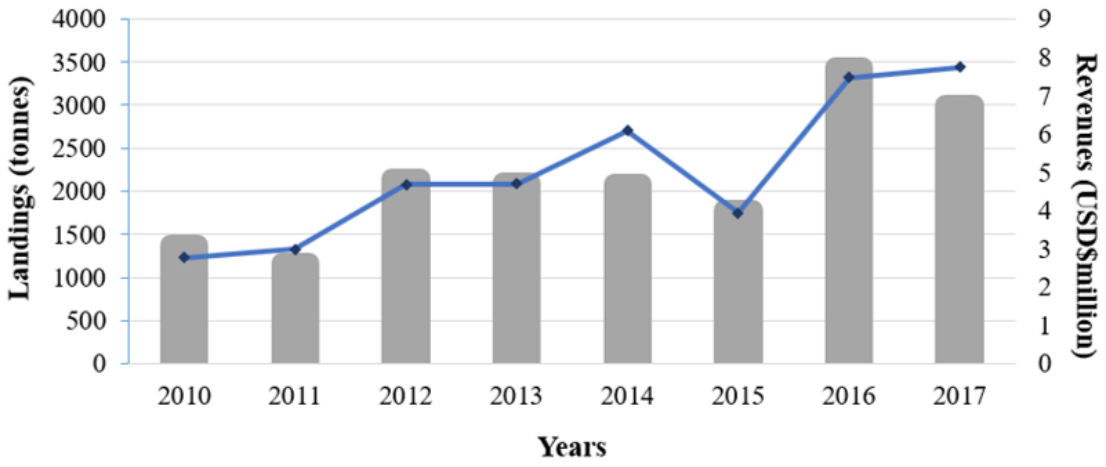


Figure 3.3 Total landings and landing value of the small-scale fisheries in Sisal from 2010-2017

Table 3.1 Total landings and economic revenues of the top ten most important species captured in Sisal from 2010-2017

	2010		2011		2012		2013		2014		2015		2016		2017		Total (2010-2017)	
Common name	t	US$ million	t	US$ million	t	US$ million	t	US$ million	t	US$ million	t	US$ million	t	US$ million	t	US$ million	t	US$ million
Octopus	466.61	1.33	511.41	1.81	842.85	2.01	778.08	1.88	1165.27	3.66	963.73	2.25	2371.19	5.50	1763.63	4.96	8863	23.4
Grouper	167.22	0.31	129.35	0.31	497.60	1.01	530.70	1.08	184.31	0.67	232.24	0.59	301.07	0.83	348.31	1.05	2391	5.8
Yellowtail snapper	127.13	0.27	143.02	0.32	257.01	0.56	196.14	0.44	147.18	0.41	166.17	0.41	164.87	0.35	207.28	0.44	1409	3.2
Sea cucumber	282.31	0.15	162.00	0.19	125.97	0.14	154.60	0.21	129.25	0.14	0.00	0.00	143.07	0.18	161.94	0.29	1159	1.3
Lane snapper	87.56	0.16	65.73	0.12	118.95	0.21	120.43	0.23	121.23	0.25	103.54	0.19	165.22	0.28	162.11	0.27	945	1.7
Hogfish	18.45	0.03	23.06	0.05	56.34	0.10	61.41	0.12	42.57	0.13	55.50	0.13	72.18	0.15	76.35	0.20	406	0.9
King mackerel	94.32	0.16	33.32	0.07	14.54	0.02	19.99	0.04	62.18	0.14	40.06	0.06	22.75	0.04	32.02	0.06	319	0.6
Snapper	17.76	0.03	23.46	0.05	48.45	0.10	42.71	0.10	38.84	0.10	35.66	0.08	38.47	0.08	53.55	0.10	299	0.6
Lobster	16.19	0.20	9.13	0.11	22.45	0.26	26.30	0.33	35.34	0.43	21.41	0.15	17.62	0.05	12.17	0.03	161	1.6
Crevalle jack	10.85	0.05	4.30	0.02	19.19	0.10	15.67	0.09	24.95	0.19	21.67	0.15	13.17	0.10	40.46	0.23	150	0.9

Source: SAGARPA (2018). Revenues were calculated with the annual average US dollars currency provided by the Bank of Mexico (Banco de Mexico 2018).

3.1.2 Social system-to-be-governed

According to the official statistics, in 2014, the Sisal fishing community had a population of 1,837 inhabitants, comprising 6% of the Hunucma municipality's total population (INEGI 2014). There are a total of 1,240 households in Sisal, but only 50% of those are inhabited by the local residents (Canul-Caamal et al. 2017). The rest include owners of summer houses including Mexican and foreigners residents, who are mostly there during July and August (SEDUMA 2007).

Sisal was the main port of Yucatan State operating as the capital in the olden days. The town became important during the boom of 'henequén' industry (*Agave fourcroydes*) in 1807 (García-Frapolli et al. 2008). The henequén plant belongs to the agave family and it is used in the production of cord and twine. Following the decline of the henequén industry in 1871, and as a result of the Integral Program for Rural Development (Herrera-Silveira et al. 2004), Sisal and other coastal communities were recipients of migrants from the inland area. These migrants joined in fishing activities and were supported by government programs, despite having no knowledge about marine resources or coastal fishing practices (Fraga 1993; Salas 2000). Thus, most of the fishers currently active in Sisal are either former henequén workers or descendants of henequén growing workers.

Like the natural system, the social system in this region is highly diverse and complex, with different fishers using a range of fishing gears/methods involved in harvest and post-harvest components. Estimations differ in the number of commercial vessels. In 2016, the Good Practices in Small Vessels Government Program reported a total of 314 vessels. In 2017, a total of 238 fishing vessels were registered (Santoyo-Palacios 2017). Currently, 602 commercial small-scale fishing vessels and 35 recreational vessels were registered in Sisal

(Port Authority 2018). However, not all fishing vessels are active throughout the year. Around 60% of them are inactive during the low fishing season (January-June) (Port Authority 2018).

Estimates for 2016 showed a total of 300 local fishers and 642 non-local fishers from Hunucma and Tetiz municipalities (Santoyo-Palacios 2017). The number of fishers engaged in small-scale fisheries varies throughout the year, with a peak during octopus fishing season (August 01-December 15) (Salas 2000). The rest of the year (January-July) is open to other fish species, except between February 1-March 31 when the grouper fishing season is closed. Most fishers either do not fish during this time or are employed in temporary employment and other economic activities.

Small-scale fishing operations are carried out in 20-32 ft fiberglass vessels with outboard motor (60-85 HP), which allow fishers to move as far as 180 ft depth. All vessels have mobile gross tonnage whose capacity ranges from 250-800 kg. Fishers use ice to preserve the catch. A typical fishing unit includes three fishers, i.e., a captain and two crewmembers, working together in a single day (or night) fishing trip. Around 30% of fishers, however, carry out longer fishing operations that last 2-4 days. Eventually, a fishing vessel would take on board 1-2 small (10 ft length) wooden vessels called ‘alijos’ or ‘chalanes,’ allowing therefore an increase in total fishing effort. Alijos are used both during octopus fishing season, with jimbas as fishing gear, as well as in finfish fisheries using handline. Jimbas are bamboo sticks that usually have crab as bait. While the small-scale vessels can use 8-9 baited lines, the alijos can take 4-5 lines to expand their operations (Salas et al. 2019).

Fishers use different gears according to the fishing season and the target species, although they often combine a number of fishing gears in the same fishing operation (Salas et al.

2019). Common fishing methods and gears used in Sisal are hookah diving (employing hook and harpoon), jimbas, hand line, long line, and a variety of nets. Some fishers use traps for crabs (*Callinectes sapidus*), which are used as food or bait for the octopus fishery (Rocha-Ramírez 1992; Celis-Sánchez et al. 2014). This fishery thus generates jobs and additional income for fishers in the area. Harvesters also have access to different fishing grounds. In addition to fishing in the area from Sisal beach to Alacranes Reef Nacional Park up to 30 ft depth, they also operate from west to east, from Punta Piedra lighthouse to La Bocanera near Chuburna.

Small-scale fisheries in Sisal are not only important sources of employment and income to local people, but also to people from further inland areas or other states. In fact, around 60% of all fishers that land their catch in this community are non-local people, with some of them being involved in post-harvest activities (Santoyo-Palacios 2017). Unlike fishers from other states who have settled down in Sisal, fishers from inland areas travel to Sisal daily to perform their fishing operations.

Most of the fishers work for permit-holders who act as financiers, providing economic loans and fishing equipment. Other fishers are organized in fishing cooperatives, and, to a lesser extent, work independently from the cooperatives or the permit holders. According to the International Cooperative Alliance (ACI), a fishing cooperative is defined as "an autonomous association of common persons united voluntary to meet their common economic, social, and cultural aspirations through a jointly and democratically controlled property" (ACI 2014). In Sisal, fishers' main motivations to organize themselves into fishing cooperatives are for having access to concessions, fishing permits, subsidies, and credits for equipment. Officially, a total of 21 permit-holders and 26 fishing cooperatives

are legally established (Port Authority 2018). Strong leadership is a feature observed in this community since around 40% of the total number of vessels belong to four fishing cooperatives, all of them led by one local permit-holder who also chairs the Nautical Committee and Fisheries Management, a local governing body responsible for enhancing fisher's participation and transparency in decision-making (see below).

The actors involved in the fish chain include fishers, processors, small- and medium scale buyers/traders, as well as restaurants owners, all of whom interact on a daily-basis (Table 3.2). Their range of operation varies. Some of the actors commercialize the fish product at local scale. Actors with means of transportation or whose origin is from towns further inland engage in commercializing their fish product at the municipality scale. Men dominate capture fisheries, with captains and crewmembers actively participating in fishing operations, repairing or fixing fishing gears, and cleaning fishing boats. After landing, the first post-harvest activity is performed by a group formed exclusively by women called '*pachocheras*' who come from other inland towns. These women work in the fishing harbor and carry out primary processing of the fish such as gutting, filleting, and vessel cleaning in exchange for fish as payment. Small-scale buyers/traders are another group of women who also work at the fishing harbor, collecting fish products (mainly fresh fish and fish fillet) and later selling them either to medium-scale buyers/traders or in nearby towns away from the coast. The medium-scale buyers/traders have in-house facilities for short-time preservation of the products and, means of transportation. These players get fish products and commercialize it daily in nearby cities such as the state capital, Merida. On the other side, the large-scale traders use refrigerated trucks to transport the fish product and have big storage rooms, which enable them to face fluctuations between catch and market demands.

They also have facilities and capacity to preserve the catch (e.g., octopus, grouper, yellowtail snapper) and export it to national and international markets such as the European, Japanese, and US markets (Pedroza 2019). Another group of women run small home-based food enterprises where they offer fish and fish products such as fried fish, fish kibis, ceviche, breaded fish, among others to seasonal residents and tourists during weekends, holidays and summer vacations.

Table 3.2 Principal actors engaged in post-harvest activities in Sisal fishing community

Actors	Gender	Scale	Infrastructure
Pachocheras	Female	Municipality level	No
Home-based fish business owners	Female	Local level	Yes/No
Small-scale buyers/traders	Female	Local level	No
Medium-scale buyers/traders	Female/Male	Municipality level	Yes
Large-scale buyers/traders	Male	National and International level	Yes
Restaurant owners	Female/Male	Local level	Yes

Illegal fishing and trading of illegally caught fish have been found along the eastern coast of the Yucatan for at least the past ten years (Pedroza 2013; Kaplan-Hallam et al. 2017). The main resources targeted by illegal fishing are sea cucumber, octopus, lobster, and grouper. Illegal fishing practices have raised conflicts between local fishers and fishers from neighbors fishing communities related principally to the fishing grounds. Given the weak capacity of the governing bodies to adequately enforce rules in the fishing areas, both

local people and people from neighbors' communities, whether small-scale or medium scale, are therefore also motivated to illegally fish and compete in the same fishing grounds (Salas et al. 2011).

3.2 Governing system

The fishery system in Sisal is managed under a centralized, top-down governance mode through laws and regulations stated by the federal government (Espinoza-Tenorio et al. 2011). However, different actors and institutions participate in small-scale fisheries management. The Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) is the central governing entity that manages the use and the sustainable exploitation of aquatic fauna and flora in Mexico (SAGARPA 2018b). The National Commission on Aquaculture and Fisheries (CONAPESCA) deals with fisheries and aquaculture, along with the National Fisheries Institute (INAPESCA) which develops fisheries and aquaculture scientific research (Fig. 3.4). Fisheries management follows the Mexican Federal Fisheries Law, enacted in 1972, which provides the guidelines for regulations, while the Mexican Official Standards (NOMs) settle the conditions for the rational use of the fishing resources. The National Fisheries Chart (CNP) is a policy instrument used to control the fishing effort by regulating gear usage (Espinoza-Tenorio et al. 2011). The majority of the measures to manage small-scale fisheries fall in the ‘first order’ measures such as limitations in fishing effort, total catch quota, minimal length regulations for main species, including mesh size, restrictions on fishing gears and area/seasonal restrictions.

In order to support the small-scale fishing activities, the governing system implements subsidy programs as part of the development plans enacted at the early stages of every

presidential cycle (Dominguez-Sánchez and López-Sagástegui 2018). In Mexico, CONAPESCA implements subsidy programs to improve different aspects of the fishing fleet and the fishing people's livelihoods (CONAPESCA 2018) (Table 3.3). The programs that get more funds are for fishing fuel and technological capacity enhancement (Cisneros-Montemayor and Cisneros-Mata 2018). For instance, subsidies allocated to technological improvement and fishing fuel are common policy interventions that attempt to address vulnerability in relation to resource decline (Chuenpagdee and Jentoft 2011). According to Schuhbauer et al. (2017) subsidies are categorized as beneficial, harmful, and ambiguous. Although those that are allocated to small-scale fisheries are not necessarily harmful, it is necessary to consider possible outcomes from their application. In other words, the subsidy programs must also target increasing benefits for fishers under disadvantageous circumstances without generating a dependence (Dominguez-Sánchez and López-Sagástegui 2018).

PROPESCA is a form of financial support given to fishers involved in harvesting activities. PROPESCA compensates low incomes due to fisheries regulations applied in the fisheries sector or natural restrictions for fishing operations. Other subsidy programs are provided by the state government such as the life insurance program, which is given to fishers' families, and the 'Peso a peso' program. The 'Peso a peso' program aims to provide half of the cost of the tools and working equipment to agricultural producers, livestock, fishing and aquaculture procedures (see Table 3.3). According to the fishers, the 'Peso a peso' program has been widely accepted and beneficial.

Table 3.3 Subsidies provided by the Federal government and the Yucatan State government for the small-scale fisheries sector

Subsidy	Provider	Objective	Amount
Fishing fuel	Federal government	Fuel acquisition for fisheries activities.	The subsidy consists of up to US$ 0.11 per liter of fishing fuel. Up to 10,000 liters per fishing vessel.
Modernization of small-scale fishing vessels	Federal government	Replacement of on- or outboard engine up to 115 HP; replacement of fishing vessel up to 10.5 m length; storage equipment for product conservation; and acquisition of satellite equipment and radio communication.	Up to 50% of the total cost of the good. Engine: up to US$ 4,790; Boat: up to US$ 2,660; storage equipment: up to US$ 154; satellite and radio communication: up to US$ 133
PROPESCA Financial support to fishers to compensate low incomes due to fisheries regulations applied in the fisheries sector or natural restrictions	Federal government	Workshops for good post-harvest management practices, sanitary maintenance, and occupational safety; administration, commercialization or added value; fishing regulations; and sanitary and good post-harvest management practices.	The total amount of support is US$ 373/producer/fiscal year.
Grouper closed fishing season support	Yucatan State	To support fishers in the Yucatan coast with economic incentives and governmental food allocation, as well as with the temporal employment program.	The total amount is US$ 75 per month, considering two months of grouper closed fishing season since 2017; governmental food allocation.

Life insurance for fishers	Yucatan State	Grant support to the family of fishers who die or suffer injuries during their labor at sea; fishers who belong to a small-scale fishing fleet in the Yucatan state, and those fishers who live or not in the state at the time of the event.	The fisher's family as beneficiaries receive US$ 186 during six months from the date on which death is certified; US$ 266 for funeral expenses; and government food allocation per six months from the date on which the death is certified.
'Peso a peso' program	Yucatan State	To grant support elements to agricultural producers, livestock, fishing and aquaculture procedures, equivalent to 50 percent of the total input cost, tools or working equipment.	The State government grants support of US$ 266/producer, and the producer, in turn, contributes with the same quantity to reach US$ 532 for inputs, tools and equipment acquisition.

Source: (CONAPESCA 2018; Gobierno del Estado de Yucatán 2018; Dominguez-Sánchez and López-Sagástegui 2018).

Following with the Figure 3.4, the Port Authority, which belongs to the Ministry of the Navy (DOF 2017), ensures the compliance of legal documents (e.g., vessel's name, registration number) and security equipment onboard while the Ministry of the Navy patrols for illegal fishing. At the local level, the Nautical Committee and Fisheries Management, which emerged in 2015, has an important role to play. They facilitate access to subsidies, offer advice and training programs for fishers, and provide access to the commercialization of fishing products.

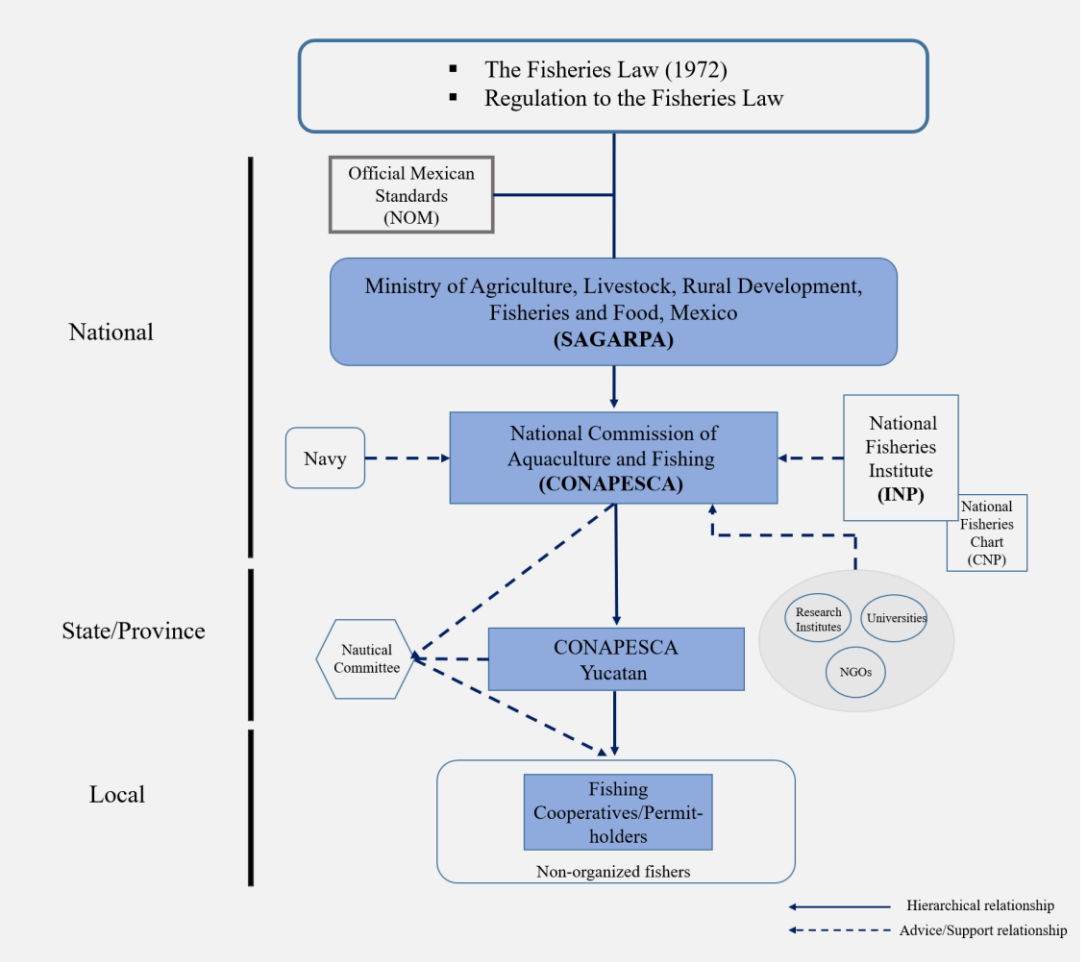


Figure 3.4 Graphical representation and relationships of the multilevel governing system in Sisal, Yucatan, Mexico (Diagram designed by the author)

Permit-holders are local governing actors, who influence physical and social networks such as economic capital, vessels, infrastructure in terms of storage, transportation means, and relationships with other governing actors as the market (Pedroza 2013). Permit-holders were able to get fishing permits when CONAPESCA authorized them for a given fishery that showed a potential for exploitation. Another means for getting fishing permits has been through private sales to individuals (Pers. Comm. with permit-holder). These governing actors do not fish but hire local or foreign fishers (e.g., from Veracruz, Tabasco, Campeche states) to work on their boats and exploit resources under fishing permits they own. Permit-holders, fishing cooperatives, and independent fishers harvest fishing resources under an annual total allowable catch (TAC). In Mexico, SAGARPA sets the TACs for the most economically important species to conserve the stocks and prevent overfishing by restricting fishing effort to its Maximum Sustainable Yield (MSY) level (DOF 2006).

In general, as the mode of governance of the small-scale fishery system in Sisal is hierarchical, governance efforts are highly centralized, and mechanisms and programs for dealing with issues within the system are driven mainly by power relationships. Even though small-scale fisheries are supported by a variety of fisheries agencies and local organizations, governability problems are still evident in the resource system. The diverse and dynamic natural and social system-to-be-governed found in Sisal poses significant governance hurdles to overcome, including issues such as high rates of immigration and illegal fishing practices that exacerbate the vulnerability of fishing people's livelihoods. These challenges, coupled with limited governing resources at the local, state, and federal

levels (e.g., inefficient enforcement), result in a governance challenge. Nevertheless, the resource system has characteristics that have allowed fishing people to make a livelihood from fisheries (e.g., high productivity, ecosystem diversity, strong leadership), properties that are more broadly explored in the next chapters.

CHAPTER 4. Vulnerability in the Fishing Harvest Sector: A Participatory Diagnostic Approach

This chapter presents the methods used for the field data collection and reports the results from the questionnaire applied to the captains and the crewmembers involved in the harvesting sector in Sisal. Vulnerability factors are presented both at an individual level (based on the questionnaire survey) and at a group level from the focus group discussion. The similarities and differences in the factors identified by individual participants and during the focus group are highlighted. In the final section, the outcomes derived from the simplified participatory diagnostic process are discussed, and the conclusions drawn, reflecting particularly on the advantages and challenges in the application of this alternative research method.

4.1 Simplified participatory diagnostic approach: Data collection and analysis

This research relies on a mixture of methods, including individual on-site surveys using questionnaires, a focus group discussion, participant observation, and informal interviews with key informants. Sisal was selected as a case study based on prior knowledge about the area and existing contacts, which is a key element for the participatory diagnosis process (Joerin et al. 2009). Given that Sisal shares several characteristics with many small-scale fisheries in the Yucatan peninsula and other tropical places, it is expected that the lessons learned from this study can be useful for similar areas elsewhere. A scoping visit to the community was made at the early stage in the research to gather preliminary information about the place prior to formal data collection, which helped to determine

when to conduct the study and the best way to connect and build rapport with potential participants.

The simplified participatory diagnosis process employed in this study involved two steps: (1) the self-diagnosis and compilation of vulnerability factors; and (2) a focus group exercise to prioritize the vulnerability factors and to discuss possible solutions. The aim of this self-diagnosis step was to elicit what vulnerability means to the local people as well as to gather their perception of those factors that expose them to such conditions. A questionnaire containing closed and open-ended questions was used to collect the following data: 1) demographic characteristics, 2) fishing practices, 3) attachment to fishing livelihoods, 4) individual vulnerability of small-scale fishers, and 5) vulnerability at the community level. The additional focus on vulnerability within the community is tailored from the assumption that this information can reveal the diversity and complexity of the socioeconomic and cultural contexts of the area under the study. This ultimately can help explain some of the vulnerability issues that the fishing people are exposed to. To capture a broad array of vulnerability factors, the respondents were prompted to consider five dimensions around their livelihoods, i.e., natural, social, economic, institutional, and technological (Allison and Ellis 2001; DFID 2001) (Appendix A4.1).

The first step of the field research took place from April to July 2018. The survey targeted key actors within the harvesting sector, i.e., fishing captains and crewmembers. The selection of the survey participants followed snowball and purposive sampling based on the availability and accessibility of the potential respondents. The survey was conducted until a saturation point was reached. The surveys took place in locations agreed upon with

the participants and the researcher, including at fishing harbor, fisher's homes, and the landing site. The survey was conducted in Spanish, which is the native language of both the participants and the researcher. On average, the survey lasted about 29 minutes, but occasionally they went on longer (between 19 and 72 min to complete). The questionnaire was approved by the Interdisciplinary Committee on Ethics in Human Research (ICEHR) of Memorial University (20181979-AR) (Appendices A4.2-A4.4).

The second step of the study included a focus group discussion conducted in Sisal in May of 2018 with the captains and the crewmembers who participated in the survey. The exercise was opened to all survey participants who were able to make the time and join as it was on a voluntary basis. The aim of the focus group was to prioritize the vulnerability factors gathered during the first step of the process to capture participants' perceptions of the severity these threats have on fishing related livelihoods (Appendix A4.5). The scores for the level of severity were calculated and summarized for the focus group participants to work with in small groups. Working in small groups allowed them to explore possible pathways to reduce the vulnerability of fishing related livelihoods in the community.

4.1.1 Prioritization of the vulnerability factors

The list of the vulnerability factors populated by each group of respondents (captains and crewmembers) during the survey was compiled, and duplications were eliminated. Each factor was allocated a frequency score based on the number of times it was mentioned by each group. The list of factors presented to the focus group discussion included the top five factors mentioned by all respondent groups for each of the five domains considered

in the questionnaire surveys. The final list of vulnerability factors is displayed in Appendix A4.6.

The focus group aimed at capturing participants' individual judgments about how severe the identified vulnerability factors are for the small-scale fisheries in Sisal. Participants were asked to rate each of the selected vulnerability factors, from a range of ‘highly severe’, ‘moderately severe’, and ‘less severe’. After prioritization, general discussions were facilitated among participants to expose different perspectives regarding those vulnerability factors allocated with different levels of threat and reasons for the selection were discussed.

4.1.2 Data analyses

As part of the questionnaire surveys data treatment, the responses gathered were numerically coded and recorded using an MS-Excel spreadsheet. A percentage of overlap in the vulnerability factors listed by each respondent group for each of the five domains was calculated. In addition, to measure the degree of correspondence of the vulnerability factors between groups, a Pearson correlation analysis was conducted. For this analysis, the frequency of mentions was normalized (from 0 to 1) based on the total number of respondents in each group. The normalized scores were then ranked (ordinal ranking) for each respondent group and tested for significant difference using the correlation analysis. Scores of the vulnerability factors gathered from the participants during the focus group discussions were also normalized based on the level of severity of each vulnerability factor.

4.2 Vulnerability of the fishing people involved in harvesting activities

4.2.1 Self-diagnosis and the population of the vulnerability factors

A total of 90 harvesters completed the questionnaires, 46 of which were captains and 44 were crewmembers. These numbers represented about 18% of the captains who were active in the fisheries at that time and about 6% of the total crewmembers in Sisal. The captains and the crewmembers in Sisal are mostly men who have different backgrounds. About 57% of the captains and 61% of the crewmembers are non-locals. These numbers align well with the estimates of the total fishing population in Sisal, i.e., roughly 40% of the harvester's population are locals with a fishing background, while the remaining 60% come from either further inland towns (e.g., Hunucma, Tetiz, Merida, Caucel) or from other states in Mexico (Santoyo-Palacios 2017; Port Authority 2018). About 61% of the captains were 46 years or older and have been fishing for an average of 30 years, and most of the respondents hold elementary and secondary education (Table 4.1).

Table 4.1 Demographic characteristics of the questionnaire survey respondents

Variables	**Captains**	**Crewmembers**	***Variables***	**Captains**	**Crewmembers**
Origin			*Education*		
Locals (Sisal)	20	17	Elementary	21	11
Hunucma	14	7	Secondary	12	16
Tetiz	2	4	High school	9	9
Merida	2	3	Certificate	0	2
Caucel	0	1	Bachelor	2	4
Motul	1	0	No studies	2	2
Yaxche	0	0	**Total**	**46**	**44**
Other states	7	12			
Total	**46**	**44**			

Age			*Gender*		
15-25	3	14	Female	0	2
26-35	4	12	Male	46	42
36-45	15	11	**Total**	**46**	**44**
46-55	13	4			
>55	11	3			
Total	**46**	**44**			

Overall, a similar number of factors were identified by the captains and the crewmembers. Both groups also identified a higher number of vulnerability factors in the institutional and the social domains, compared with the economic, the natural and the technological domains (Table 4.2). Further, there was a high degree of overlap in the vulnerability factors identified by captains and crewmembers, with the exact match (100% overlap) in the natural domain but with only 50% match in the economic-related factors.

Table 4.2 Total number of vulnerability factors mentioned by the respondents and the percentage of overlap between the captains and the crewmembers

Domain	Captains	Crewmembers	Percentage Overlap
Natural	7	7	100
Social	15	17	88
Economic	9	9	50
Institutional	20	19	86
Technological	7	8	88

Table 4.3 shows the top ten vulnerability factors listed by the captains and the crewmembers. The result of the correlation (Pearson analysis) shows a highly significant

correlation of the two lists of vulnerability factors provided by the captains and the crewmembers (r=0.97).Vulnerability factors such as unfavorable climate conditions (natural), low income (economic), lack of respect for fishing regulations (social), subsidies-related issues (economic), and lack of security equipment at sea (technological) were among the top five that received the highest number of mentions. With respect to the institutional dimension, factors causing vulnerability were related to government subsidies programs and lack of government projects. Respondents mentioned that the lack of these government resources make them more dependent on fisheries.

Table 4.3 Top ten vulnerability factors considering the normalized frequency of mentions pointed out by the captains and the crewmembers in Sisal fishing community (See details in Appendix A4.6)

Domain	Vulnerability factor	Captains	Domain	Vulnerability factor	Crewmembers
Natural	Bad climate conditions	0.478	Economic	Lack/No income	0.523
Institutional	Lack of subsidies	0.304	Natural	Bad climate conditions	0.477
Economic	Lack/No income	0.283	Social	Lack of respect for regulations	0.295
Social	Lack of respect for regulations	0.261	Institutional	Useless grouper subsidies	0.273
Economic	Lack of direct markets	0.239	Social	High depredation	0.250
Technological	Lack of security equipment	0.239	Natural	Resource decrease	0.227
Institutional	Lack of government projects	0.196	Natural	Red tides	0.227
Institutional	Poor subsidies allocated to fishers	0.174	Economic	Increase in fuel price	0.227

Institutional	High level of corruption	0.174	Social	Lack of financial support from permit-holders	0.205
Institutional	Lack of temporal employment	0.174	Economic	High inputs costs	0.205

Zooming in to the top five vulnerability factors populated by the respondents within each domain, as shown in the percentage overlap (Table 4.2), the captains and the crewmembers mentioned the same sources of vulnerability in the natural domain and mostly the same in the technological domain. Table 4.4 explains what these factors are for each domain. While they agreed with the top two vulnerability factors in the social, economic, and institutional domains, the captains and the crewmembers differed in other cases. For instance, the captains considered that their fishing livelihoods are threatened by the high number of incoming migrants into Sisal, the lack of health insurance, and the lack of support from permit-holders (e.g., equipment provision). The crewmembers, on the other hand, were more concerned with the lack of financial support from permit-holders, the increase in the number of people involved in harvesting, and the social pressures such as alcohol/drugs abuse. In the economic domain, apart from income issues and market demand of fish products out of the legal fishing seasons, the captains focused on factors related to their long-terms expenses such as the lack of direct markets, fishing equipment maintenance and repair, and the poor quality of the fuel that contributes to engine breakdowns. Unlike the captains, the crewmembers centered their attention on vulnerability factors that impact their short-term profits such as the cost of inputs and the cheating from buyers at the time the catch is weighted when landed at the deck. Finally,

on the institutional domain, both groups referred mostly to subsidies-related constraints, but the captains identified corruption and the lack of temporal employment as main sources of vulnerability.

Table 4.4 Top five vulnerability factors by domain mentioned by the captains and the crewmembers during the self-diagnosis process

Domain	Captains	Crewmembers
Natural	Bad climate conditions Resource decline Red tides Natural resource migration Strong ocean currents	Bad climate conditions Resource decline Red tides Natural resource migration Strong ocean currents
Social	Lack of respect for regulations High predation High people migration Lack of health insurance Lack of general support from permit-holders	Lack of respect for regulations High predation Lack of financial support from financiers Alcohol and drugs abuse Increase in number of fishers
Economic	Lack/No income Market demand out of season Lack of direct markets Bad quality of the fuel Lack of money for maintenance and repair of equipment	Lack/No income Market demand out of season Increase in fuel price High inputs costs Cheating in weight at landings
Institutional	Lack of government projects Poor subsidies allocation to fishers Lack of subsidies High level of corruption Lack of temporal employment	Lack of government projects Poor subsidies allocation to fishers Poor grouper subsidies Lack of dissemination of news related to subsidies Lack of employment diversification
Technological	Lack of security equipment onboard Old fishing equipment	Lack of security of the equipment Old fishing equipment

	Equipment breakdowns Ecological impacts by technological improvement	Equipment breakdowns Impacts by technological improvement
	Increase in number of boats	Competition with small-scale fleets from other ports

The captains and the crewmembers interviewed mentioned that fishing is the primary occupation from where they get most of their income. However, they make additional income from other occupations. 72% of the captains are engaged in at least one secondary occupation and 34% of them are involved in up to two secondary occupations. Secondary occupations include skill-demanded activities such as construction, carpentry, ironwork, fiberglass reparation, as well as tourism-related duck hunting and sport-recreational fishing, as well as inland activities (e.g., agriculture and land cleaning). The remaining percentage of captains receive additional income from temporal wage labors. Some captains also indicated that they have diversified investments into other fields outside of fisheries. The crewmembers, on the other hand, are engaged in up to four secondary activities. The most frequently mentioned were skill-demanded occupations, inland jobs, and tourism-related activities.

4.2.2 Focus group discussion

A total of 10 fishers including four captains and six crewmembers attended a 4-hour long focus group discussion. The exercise offered some insights about the perceived level of severity that some vulnerability factors have on their livelihoods. Based on the severity

score aggregated across all participants in the focus group discussion, the economic-related vulnerability factors were ranked higher than others (Table 4.5). Participants emphasized that the lack of income affected them most, specifically during times of crisis when they rely heavily on savings, loans, or on alternative sources of income. The increase of fuel costs was also an important factor, referred to as a constraint impacting their livelihoods, particularly when undertaking longer fishing trips. They indicated that the rise of fuel costs increased their debts, which enhanced their vulnerability, especially when it came to deal with income uncertainty. This situation would become worse when they had to deal with engine repair.

As was shown in the survey, captains and the crewmembers participating in the focus group discussion pointed out that one major problem was related to the lack of respect of fishing regulations. They claimed that small- and large-scale fishing fleets from neighboring ports, and some of their own fellows, participated in illegal practices, causing a significant impact on their short- and long-term profits. The participants considered that resource decline due to fish migration was moderately severe. According to the participants, fishing regulations that take place in the region are neither appropriate nor necessary, given the biological pattern in fish behaviour since the fishing resources “ban” themselves, restricting their own availability. Unfavorable climate conditions were strongly emphasized as an important factor affecting navigation, fishing activities, and limiting the access to their fishing grounds. The participants did not seem overly concerned with red tides, an environmental phenomenon occurring occasionally in the area. This is possibly because when the algal bloom starts, it brings resources toward the

nearby fishing grounds, making them accessible to fish harvesters who can then obtain higher profits and spend less fuel in the fishing operation at that time. On the other hand, red tides do leave damages after their presence since they can last in the port for weeks.

Vulnerability factors related to harvester's social environment, such as the lack of support from their peers or from the permit-holders, were categorized with a moderate level of severity. Participants stressed that not all fishers depend on private enterprises and those who work individually or belong to fishing cooperatives manage to perform their fishing operations without incurring debts with financiers. The lack of interactions between fishers and the government was considered to have a lower level of severity and the participants stated that although small-scale fisheries in Sisal are perceived to be more marginalized than other fishing communities along the Yucatan coast, harvesters are able to maintain their livelihoods from this activity. However, both groups recognized that an improvement in the relationship with government institutions could be beneficial.

Table 4.5 Individual prioritization and weighted average severity score of the 15 vulnerability factors gathered in the first phase (N=10)

Domain	Vulnerability factors	Highly severe	Moderately severe	Less severe	Weighted average score
Economic	Low/no income	10			3.0
Economic	Increase in fuel price	10			3.0
Economic	Lack of money for fishing equipment reparations	10			3.0
Social	Lack of respect of fishing regulations	10			3.0

Natural	Bad climate conditions	9	1		2.9
Technological	Old fishing equipment	9	1		2.9
Social	Newcomers who do not respect social norms	8	2		2.8
Technological	Lack of security equipment on board	8	2		2.8
Economic	Control of fish price	7	3		2.7
Natural	Red tides	5	4	1	2.4
Social	Lack of support from permit-holders	5	5		2.5
Economic	Lack of direct markets	4	6		2.4
Natural	Resource decrease (natural behavior)	4	6		2.4
Social	Lack of support from peers	3	7		2.3
Institutional	Lack of closeness between fishers and the government	3	4	2	2.1

4.3 Vulnerability at the community level

Although fishing activities are important in the community, other non-fishery related issues can exacerbate fishing people's vulnerability and eventually influence their sense of wellbeing. In Sisal, 33% of the captains and the crewmembers perceive weak social ties among the community members. Reasons that were mentioned the most were political differences, high levels of jealousy, selfishness, and weak support for people who attempt to stand out. Another issue the surveyed respondents brought up in the conversation was a lack of willingness to take active roles in organizations or associations. From the total number of the surveyed captains and the crewmembers, only 27% of them are engaged in organizations outside of fisheries (e.g., *Ejido*-related, religious, mutual aid fellowships, neighborhood-related, or informal gatherings). Informal

gatherings are led by local people who pursue grants for the fishing community, such as the allocation of land for housing. *Ejido* is a legal form of common lands established by Mexico's Land Reform during the 20th Century (1915-1992), which granted its legal status in Article 27 of the 1917 Mexican Constitution. In this system, members are given usufruct rights to plots of agricultural land and communal rights to non-agricultural land (pasture and forest) (Assies 2008).

During the field data collection, it was common to hear complains about the presence of garbage both in work areas (fishing harbor) and in the community. Other problems mentioned were poor power infrastructure and supply, water services shortage, and the lack of maintenance of infrastructure such as roads in the fishing community. According to the captains and the crewmembers interviewed, the lack of a proper local institution was the main reason for the problems already cited since at the time of the study, Sisal did not have a Mayor to solve local problems in the fishing community.

When asking about government institutions that have positive impacts on their community, nearly 30% of the respondents from both groups mentioned they received support from the federal government, mainly in the form of subsidies during the grouper fishing closure, good onboard practices training, and technological capacity enhancement that some programs offer. Nonetheless, almost the same proportion of the respondents (24%) perceived that no government institutions had a positive impact on Sisal fishing port. This sense of marginalization could be an outcome of the poor interactions fishing people have with fisheries government institutions, possibly leading to exacerbating the perceived vulnerability when pursuing their livelihoods.

4.4 Discussion

The simplified participatory diagnosis approach carried out in Sisal fishing community captured important insights about what matters most to the fishing people and what represents threats for them considering their surrounding natural, socioeconomic, institutional, and technological environments. Although the surveyed captains and the crewmembers mentioned experiencing general enjoyment about their fishing life and having the ability to improve their livelihoods, they perceived threats toward their viability coming mainly from the social and the institutional domains. This vulnerable situation was then enhanced by natural constraints such as red tides, northern winds, and strong ocean currents.

4.4.1 Pressing vulnerability factors

While the natural domain was less populated by both groups of respondents compared to other domains, the complete overlap in the factors identified by both groups indicates consistency in the perceived threats and the negative impacts they have over their fishing activities, particularly while at sea. Of all the vulnerability factors identified under this domain, bad climate conditions were the most frequently mentioned. The captains and the crewmembers indicated that these climate-related conditions are beyond their control and they do not only restrict fishing operations but can also increase the probability of death or injury at the sea. Both group of respondents made connections between some of the vulnerability factors that exacerbate one another. For example, both groups related resource declines either with natural fish migration (e.g., when they migrate during

spawning season) or with resource depletion caused by the lack of respect for regulations, use of destructive and/or intensive fishing practices, and high predation. These factors, either on their own or together, were referred by several authors as sources of impact in fishing activities, ultimately affecting harvesters' income (Jiménez-Badillo 2008; Salas et al. 2011; Marín 2019; Tolentino-Arévalo et al. 2019).

Interlinked vulnerability factors were also identified by both groups of harvesters in the social and institutional dimensions. In the social domain, the increase of immigration had a cascade effect in both the fishery system and in the whole community, because the new comers in the fisheries add pressure on the resources and create resource use conflicts. In addition, the survey respondents stressed the increase in alcohol and drug abuse, as well as robbery of fishing equipment and fuel in the past few years, which they associated with the migrant fishers. These behaviors have been described in other fishing communities (Bavinck 2011; Islam 2011; Salas et al. 2011), suggesting different social pressures (e.g., piracy and increase in drug consumption among youth and women) can enhance vulnerability in the fishing communities. As for the institutional domain, both groups of respondents alleged that the lack of government subsidies together with their uneven distribution were issues that worried them. The financial support (cash compensation) provided by the government during the grouper closed season (SEPASY 2019) was frequently mentioned by both groups as insufficient and not suitable. According to the issues heard in the field data collection, this subsidy program is an example of poor government recognition of the needs of the small-scale fishing sector. Although the program attempts to bring socioeconomic benefits to fishing families by investing

roughly US$5 million per year, its impact has not necessarily been positive given that fishing dependent people still engage in illegal fishing practices. This amount of money is also limited considering the large population of fish harvesters, a group that continues to grow. Nowadays, the Mexican government recognizes that a higher proportion of subsidies are given to sardine and tuna large-scale fishing fleets, mainly in form of fishing fuel and capacity-enhancing (Schuhbauer et al. 2017; Sumaila 2017; CONAPESCA 2019). To correct the existing inequality, the new federal government seeks to provide special attention to small-scale fisheries by providing increased subsidies to this sector. These subsidies, according to the fisheries authorities, will be allocated directly to the fishers instead of to organizations in order to avoid corruption (BienPesca; CONAPESCA 2019).

4.4.2 Differences in what make fishing people vulnerable

The captains and the crewmembers differed when it came to what vulnerability factors mattered most. This suggests that they have different priorities and that their livelihoods are threatened by different stressors and that they have different assets they use to face such threats. These differences lie mostly in their position on the fisheries. For example, the captains emphasized that the most pressing concerns to them lie outside of the fisheries sphere, such as the increase of immigration, which, according to the interactive governance theory, speaks to the issue of scale (Kooiman et al. 2005; Jentoft and Chuenpagdee 2015). Small-scale fisheries do not exist in isolation and thus a broadened perspective is required for effective governance, a position that applies to Sisal and

other fishing communities on the Yucatan coast (Jiménez-Badillo 2008; Salas et al. 2011). Fishing people in Sisal see themselves at the ‘outfall,' receiving the end of a string of causes and effects that originate in other places. It is common though, to see how socioeconomic conflicts can push people from their place of origin in order to seek out better livelihoods (Adger 1999; DFID 2004; Islam and Herbeck 2013).

An example of this is the social conflicts in the southeast coast of Mexico where the lack of employment and displacement have been some reasons behind people’s mobility. Displacements have resulted from the conflicts between the fishing industry and the oil and gas industry which is owned by *Petroleos Mexicanos* (PEMEX). The main conflict in this instance arouse from the implementation of security measures enacted on the coastal shelf by the federal government in 2001, which encompasses the establishment of an exclusion zone forbidding marine transit (Bozada-Robles 2006). These regulations resulted in a reduction of fishing areas for local fishers and a subsequent fishers’ revolts against such regulations (Tolentino-Arévalo et al. 2019).

The crewmembers, on the other hand, perceived themselves more vulnerable by the lack of access to financial support from permit-holders. Permit-holders do not interact directly with the crewmembers but with the captains with whom they make arrangements and provide loans for fishing operations in exchange of the catch. Therefore, crewmembers who have a lower power position onboard and see themselves at a disadvantage due to the lack of direct access to financial support. Another issue identified by the crewmembers that exacerbate their sense of vulnerability is the lack of bargaining power with respect to the landing prices, which are controlled by the permit-holders who monopolize the

market. The control of the local market by the permit-holders creates unfair competition, preventing crewmembers from the possibility of buying their own fishing equipment. This problem has been reported in other fishing communities in the region as documented by (Salas et al. 2011).

The captains and the crewmembers consider that subsidies-related issues have an impact on their fishing livelihoods. For instance, the captains identified corruption practices taking place in local (e.g., within cooperatives) as well as state institutions as a major concern. They expressed that when attempting to pursue some credits, they encountered limitations caused by the fishing cooperatives/permit-holders they work for. There is a union-based committee (Nautical Committee and Fisheries Management) that integrates members of the community and they are supposed to be interlocutors of the community with official institutions, such as Fisheries Management agencies, for the fishers to have access to subsidies, advice, training, and commercialization of fishing products. This body, however, comprises several permit-holders who look only to benefit their own enterprises. Permit-holders use first-hand information from government programs, which negatively impact the captains by constraining them to get government subsidies.

In Sisal, there is a well-known season between February to April, locally called ‘the crisis time’ when natural restrictions (i.e., natural resource decline, unfavorable environmental conditions) and institutional regulations constrain fishing operations. Fishers’ livelihoods are particularly vulnerable during this period, with captains stressing the poor support from the government they get in such as the lack of temporal employment diversification needed to cope with these difficult periods like this. For example, at the end of 1990s a

shrimp farm in Sisal represented an additional source of employment and income for local people. However, poor farm management decreased the production and the health issues caused the farm closure in 2005 (Garza-Pérez 2017; Santoyo-Palacios 2017).

In economic literature, income diversification is commonly viewed as an alternative to overcome the social trap, which results from resources degradation and livelihood impoverishment (Adger 1999; Cinner 2011; Islam 2011; Carrà et al. 2014). However, resource users can also fall into the social trap when they become solely dependent on the government for alternative sources of income (Salas and Torres 1996). Fishers who are more proactive can get employment in sport tourism and recreational activities, during the summer or in the duck hunting, during winter (northern winds season). Respondents that have a proactive perspective in Sisal are aware of the rich diversity of ecosystems to the extent that the number of tourism cooperatives has increased over the last five years (García de Fuentes et al. 2011; Santoyo-Palacios 2017). Through conversations with the respondents who actively participate in providing ecotourism services, this alternative in Sisal has the potential to reduce dependence on fish stocks.

During the focus group discussion, participants perceived a higher level of severity in the vulnerability factors categorized under the economic domain. The captains were most concerned about long-term issues such as the lack of direct markets and reparations of fishing equipment caused by normal wear and tear or bad fuel quality. The crewmembers, on the other hand, perceived themselves threaten mostly by short-time issues that have direct impacts on their profits after undertaking their fishing operation (e.g., input costs, cheating in weight at landing). Therefore, the crewmembers have a day-to-day response

and, according to the situations derived from their position onboard, they cannot make long-term plans.

The demographic characteristics of both groups can also explain the different priorities. Most of the crewmembers are young and highly mobile. The latter implies that they choose freely who to work for and for what companies within the fishing harbour. They also move from one fishing community to another. Therefore, fishing investors like permit-holders usually do not trust that they will get the money back if they were to invest in these more mobile workers. Conversely, captains normally stay with one permit-holder and have physical resources (e.g., vessel, engine) that make them accountable for all the investment associated with the equipment and the fishing operations. Thus, these different conditions expose the respondents to the different vulnerable situations.

4.4.3 Vulnerability as perceived within the community

In capturing the meaning and the sources of vulnerability of the fishing dependent coastal communities, it is critical to look beyond the individual or the household levels and pay attention to the community where other sources of vulnerability may be found. In Sisal, the social structure of the fisheries system (e.g., people with different ethnic background) leads to weak ties among community members. Social conflicts tend to increase because those fishers who have a longer fishing tradition have a sense of ownership over the resources. According to Bavinck (2011), new people often enter a fishery for two main reasons - high expectations of benefits and low entry thresholds. The first case results from a combination of the fishery system's attributes such as availability of resources,

economic-related benefits, and available technology, while low entry thresholds result from a lack of entry control by fisheries institutions, allowing new-comers to get in the fisheries without major limitations (Bavinck 2011). Among the concerns that the captains and the crewmembers expressed were not just conflicts over the resources, but other issues that affect the whole fishing community, such as increase in alcohol and drugs consumption and theft. This process generates conditions for two potentially dangerous outcomes: 1) an increase in community fragmentation (Paton and Johnston 2001); and 2) constraints that limit people from investing in activities like resources stewardship. Under this context, the creation of grassroots local organizations such as a cooperative might not be that easy or may not succeed in the long-term.

Lack of mutual support and trust among community members was evident in Sisal, principally when vested interests were prominent. In this community, several fishing cooperatives have been created by members with and without family ties. Nevertheless, these organizations have failed in the short-term, due to mismanagement in the organization and lack of trust among their members. Currently, only two fishers' organizations work as 'real cooperatives' (one run by a family and other by people from Hunucma), although both cooperatives have problems related to poor management (e.g., administration, profits-related conflicts). Failures of fishing cooperatives are well-known in the literature, where several authors have indicated that the lack of trust and poor organization contribute to failures in sustaining strong local institutions (Bailey and Jentoft 1990; Kosamu 2015). Despite this situation, respondents recognized solidarity as a commonly seen attribute in this fishing community. Usually fishers (mostly locals) come

together to support their peers especially in times of need (e.g., sickness of poor families). In addition, when it comes to security and safety, captains and crewmembers show mutual support to each other, mainly at sea. For example, during the time that the research took place, it was observed that under unfavorable climate conditions or when engines are likely to break down, two or three vessels agreed to accompany each other in the fishing operation even though they do not share the catches. This cooperative attitude has emerged as a result of accidents happening where crewmembers have gotten lost at sea. Cooperation is found in other fishing communities in the Yucatan coast like Dzilam de Bravo fishing community (Salas 2000; Salas et al. 2019) where fishers work in teams comprised by two fishing vessels and share their catches regardless of who brings more fish to the landing site. This strategy is employed to ensure positive revenues by both vessels.

As stated by several authors, social capital has a positive impact on governance and sustainability of small-scale fisheries (Kosamu 2015; Triyanti et al. 2017). When there are common interests, the increase of social capital drives local people to manage and solve threats to their livelihoods (Triyanti et al. 2017). For instance, a participatory research study carried out in Uruguay explored steps toward co-management. In this study, Trimble and Berkes (2013) described how high social capital of local fishers together with the involvement of the government, nongovernmental organizations, and university scientists were key stimulators to addressing the main problems in the local small-scale fisheries. During that research, workshops, meetings and fishing-related festivals were organized to discuss a main problem to local fishers (i.e., sea lions impacts on longline

fishery). The authors argue that these dialogs during gatherings enhanced fishers' sense of value and acceptation by the community and fisheries institutions, which contributed to increased and better governance. According to the respondents, the organization of festivals increase social cohesion among Sisal community members, bring people together and get them organized. Therefore, governing actors at municipal and state levels should understand the relationships among the people they aim to govern, invest in communities, and make use of the social capital to improve the governance of small-scale fisheries (Jentoft et al. 2011; Triyanti et al. 2017).

Constraints faced by the fishing people in maintaining their livelihoods and the deficient public services provided by the municipal government in Sisal (e.g., garbage service, lack of drinking water, deficient electric power service, poor health services) influence their sense of vulnerability and the feeling of neglect. These results suggest that while it is important to understand people's vulnerability toward potential climate impacts in a reduction in the resource abundance, it is equally important to consider how people perceive institutional and social changes that could influence their fishing-related livelihoods (Mills et al. 2011; Barnett and Eakin 2015; Sowman and Raemaekers 2018). Along the Yucatan coast, interlinked issues that come from both the institutional and the social domains include surveillance and enforcement of fishing. This has been observed mostly when the surveillance is removed from the area. When this occurs, large-scale fishing fleets and neighboring small-scale vessels arrive in the area to fish illegally. This situation either increases the frustration on fishers from Sisal or encourages them to violate regulations and engage in illegal practices as well, generating a social trap effect

(Cinner 2011). This situation sets an example of how geographical scales of the system-to-be-governed should be matched by the governing system's capacities in order to cover people's needs (social system-to-be-governed) adequately.

In understanding vulnerability issues in coastal communities, the analysis of the governance dimensions and how this affects vulnerability is critical (Kolding et al. 2014; Sowman and Raemaekers 2018). In Sisal, where the mode of governance is hierarchical, issues associated with the governing system such as the lack of town mayor, insufficient enforcement (at land and at sea), and people´s sense of marginalization by municipal government institutions enhance people's vulnerability. This neglected condition is attributed mainly to political differences since the Municipal President represents one political party and the community members of Sisal (social system-to-be-governed) support the opposing party. This situation has resulted in a lack of attention paid by the municipal institutions to Sisal, despite the fact that the entire municipality is economically activated when the octopus fishing season takes place with those taxes, as well as economic benefits provided by tourism, are absorbed by the municipal institutions. Additionally, the municipal government does not attend to fishing people's demands, especially when asking for subsidies, surveillance, and proper enforcement. Therefore, broken relationships are perceived between resource users and fisheries institutions at both local and federal scales, a situation that has been observed in other regions (Jiménez-Badillo 2008; Jentoft et al. 2011).

4.4.4 Participatory diagnostic approach versus pre-determined methods

There is an extensive literature on methodologies available for vulnerability assessment which vary according to the contexts, through the issues addressed and the scale of analysis. Many of these are consistent with the models proposed by the Intergovernmental Panel on Climate Change (IPCC 2001) and have focused on assessing vulnerability towards environmental hazards related mainly to climate change (Brooks et al. 2005; Adger 2006; Allison et al. 2009; Cinner et al. 2012; Sowman and Raemaekers 2018). Yet other frameworks address this global concern through a combination of environmental threats and socio-economic burdens (Wu et al. 2002; Füssel 2007; Freduah et al. 2017). Different assessment frameworks have been developed to analyze vulnerability at the local (Wu et al. 2002; Bennett et al. 2014; Freduah et al. 2017; Senapati and Gupta 2017), regional (Allison et al. 2009; Béné 2009; Mills et al. 2011; Sowman and Raemaekers 2018), and international levels (Yohe and Tol 2002; Adger and Vincent 2005; Brooks et al. 2005; Cinner et al. 2012). However, despite the undeniable utility of these approaches, they have been criticized for the selection of the vulnerability indicators. It is argued that this selection may be guided by other frameworks found in the literature or it is generally defined by researchers who may assume a relationship among the features, factors, and processes that lead to vulnerable conditions (Brooks et al. 2005; Vincent 2007). Moreover, these methods have been questioned for being top-down, highly quantitative, and unable to adjust to local demands and needs (Barrett 2013).

Having said that, the simplified participatory diagnostic approach used in this study revealed similar vulnerability factors compared to other studies using the pre-determined

approaches (Christophe Béné 2009). For instance, both approaches reveal the importance of catch level and income, as critical for livelihoods maintenance and are directly related to other concerns such as food security, education, technology maintenance, health, among others (Freduah et al. 2017). Some pre-determined frameworks have taken into account ecosystem concerns, particularly those that are measurable, such as coral bleaching, sea level rise, increase in sea surface temperatures (Wu et al. 2002; Cinner et al. 2012; Islam et al. 2014). These studies have gained considerable attention due to the importance of healthy fisheries ecosystems for local people's livelihoods (Cinner et al. 2012).

Social aspects covered by existing frameworks are frequently encapsulated as social capital, or as vulnerability factors embedded in the community (Adger 1999; Marshall et al. 2013; Quiros et al. 2018). The variables commonly used to measure social aspects are: level of education, access to basic human rights (e.g., health services), and security (Füssel 2007), which encompass non-economic factors related to wellbeing. Scholars have related social vulnerability as being directly impacted by the natural vulnerability (Klein and Nicholls 1999), but other pre-determined frameworks conducted at the household level have considered specific social pressures (e.g., health, employment, food security, addictions) as indicators of social vulnerability (Mills et al. 2011; Freduah et al. 2017).

Several pre-determined methodologies used by vulnerability studies also consider governance and institutional issues (Mills et al. 2011). Although some authors stress that governance processes are difficult to quantify or the associated measures lose detail in

arrangements taking place in the area of study (Vincent 2007), certain frameworks have proposed factors to capture these attributes (Keskitalo 2009; Mills et al. 2011; Sowman and Raemaekers 2018). Among those are the level of negotiations on rules and regulations, communication between users and governors, and the number of organizations involved.

Despite the utility of indicators for comparing how vulnerability differs from place to place and between local and national levels (Allison et al. 2009; Cinner et al. 2012; Freduah et al. 2017), its use is controversial. According to Vincent (2007), one of the disagreements is that indicators can mask a complex reality of a system. For instance, researchers can make assumptions around the factors and processes that situate people in vulnerable conditions, informed, generally, by an intuitive understanding of human-environment interactions. Therefore, there is a risk to either oversimplifying or representing complex processes in a limited way (Vincent 2007).

Several scholars have employed semi-structured interviews or questionnaires to gather fishing people's perspectives about socio-economic, institutional, and climate-related issues that threat their fishing livelihoods (Jiménez-Badillo 2008; Islam 2011; Salas et al. 2011; Bennett et al. 2014; Utete et al. 2018). In these pre-determined methods, local people are asked to weigh the severity of a list of vulnerability factors offered by the researcher, whereas in the participatory diagnostic approach, the factors are identified and populated by the people as part of the process. The participatory diagnostic approach also allows for those identified factors to be ameliorated (Cornwall and Jewkes 1995).

Therefore, the methods taken with this approach can allow people to identify the domains with the most shortcomings.

It is recognized that viability enhancement of local people goes beyond improving the income or providing financial support to the vulnerable. Viability enhancement can include assisting local people in realizing what is missing to overcome vulnerability, encouraging people to take ownership over the issues encountered, and to help them lead actions that allow for the improvement of their conditions (Chambers 1992; Park 2001; Pain 2004). For this, complementary actions at multiple levels are required. In this sense, the participatory diagnostic approach, coupled with mechanisms to share and exchange ideas, like the focus group discussion employed in the study, allow cross-fertilization and can facilitate empowerment of the local people (Park 2001; Pain 2004).

Finally, while the aim of vulnerability assessment is to provide information for policy-makers, and to guide investments as well as initiatives against hazards (Allison et al. 2009; Hughes et al. 2012; Salas et al. 2011), having multiple ways to identify the most pressing vulnerability factors taking place on fishing communities can help to align policy interventions and programs that help people to reduce sources of vulnerability.

4.4.5 Challenges of the participatory diagnostic approach

The simplified participatory diagnostic approach conducted in Sisal revealed the problems in the actual context of the Sisal community and directly captured people's perceptions about the factors that generated a sense of vulnerability and concern that worried them the most, without the need of additional interpretations or assumptions

made by the researcher (Cornwall and Jewkes 1995; Park 2001). Despite these positive features, this approach also has some inherent challenges. For instance, due to the voluntary and interactive nature of the participatory approach, some people may find it difficult to express themselves, while others may not be willing to participate (Chambers 1992; Park 2001). The entire process highly depends on the dynamics of the place and the people (Martin and Sherington 1997). Hence, unexpected changes in the system under study can have an impact on both the process and the outcomes (Cornwall and Jewkes 1995). In addition, the success of focus group discussions can be highly influenced by power relationship among the participants within the fishery system (Pain 2004). In this regard, some people can limit themselves to express their opinions or their participation can be restricted by the presence of certain people (Woelk 1992; Pain 2004). The process needs to be flexible, which might surpass the instrumental capacity of the organizations or institutions conducting this alternative methodological approach. In terms of scale, the process may be more suitable to study a local level problem but may be too complex to apply in a larger context.

The results from this study provide important insights about capturing the perceived vulnerability in fishing dependent communities and what aspects of their surrounding environment need more attention. The approach used in this case can be replicated in other coastal small-scale fishing communities and to any natural resources dependent community. The methodology employed in this investigation adds to the broad array of methods and approaches applied to visualize community issues from different angles, especially when addressing vulnerability. The use of different lenses can contribute to

develop and implement more feasible and effective public policies in response to what local people express. Likewise, alternative approaches allow researchers to broaden their perspectives beyond focusing on clasic environmental contexts.

CHAPTER 5. Gender Perspectives on Vulnerability and Viability

The aim of the chapter is to explore the gender perspectives on vulnerability and viability issues within the contest of small-scale fisheries in Sisal. Using a participatory diagnostic approach, a survey was conducted with captains involved in harvesting, which is largely male-dominated, and fishing women involved in post-harvesting activities in the small-scale fisheries chain in Sisal, Yucatan. The chapter presents similarities and differences between these two groups regarding what makes them vulnerable and what constraint them in pursuing their fishing-related livelihoods. The chapter begins with the description of the fish chain and concludes with discussion about potential solutions to move toward viable livelihoods that the participants identified.

5.1 Small-scale fisheries chain

Similarly to small-scale fisheries elsewhere, many actors participate in the fish chain in Sisal, which runs from harvesting, processing, marketing, and distribution, with consumer at the end of the chain. The catch that lands in Sisal is either sold as fresh fish or distributed as fresh and frozen fillets through various channels. Figure 5.1 depicts the post-harvest component of small-scale fisheries in Sisal as well as the main actors engaged in the post-harvesting part of the chain.

With respect to fresh fish, a group of non-local women locally called *pachocheras*, jump into the boat at its arrival at the landing site and start basic processing of the catch. These women do primary processing of the catch, which involves gutting and cleaning of the fish, predominantly of economically important species such as grouper, yellowtail

snapper, and octopus. The primary processing is the only type of processing the fish product gets. Instead of getting cash payment for their work, the *pachocheras* receive around 1-2 fish product per person as a gift, which they can take home to the family or sell to other buyers, including the main storages owned by permit-holders/fishing cooperatives. Most of the catch, however, is sold fresh to the main storages where the catch is sorted by weight/size and kept in refrigeration until it is time to sell to bigger plants for further distribution to national and international markets (e.g., Japan, Europe, USA). A sizable amount of catch also goes to small- and medium buyers/traders for further distribution. These buyers/traders are mainly women and can be differentiated by their technological facilities. Medium-scale buyers/traders have storage and means of transportation that allow them to do primary processing at their location, and distribute and sell products in Merida, the state capital. Another characteristic found in medium-scale buyers/traders is the bartering power they have with the owners of the main storages. Since medium-scale traders are better positioned to sell cheap fish to Merida, internal trading between medium-scale traders and the main storages are made exchanging the most expensive species for the cheapest species. Small-scale buyers/traders, on the other hand, lack the means of transportation and usually store the fish product in a top-freezer refrigerator at home to be distributed to towns further inland.

Women who run home-based fried fish business buy fresh fish from the main storages or get it from family (e.g., fisher husband). Since they do not have freezer facility, they prepare fried fish at home and sell it from their house as ‘take out’. Local restaurants, on the other hand, buy fish mainly from the main storages and keep the fish in freezers.

Apart from fresh fish, fish fillets are also commercialized in Sisal. Indeed, all actors in the fish chain, except the main room storages, handle fish fillets. Filleting is done by the *pachocheras* at the landing site and fillets are made from either cheap fish species or small-size fish (e.g., yellowtail snapper, grouper, white grunt, and mojarra). Filleting is carried out at a small-scale level, either by the *pachocheras* at the landing site or at the small- and medium buyers/traders' home. The processing of the fish fillet involves de-boning, cleaning, packaging, and freezing. As fish fillets are easily distributed, the whole process from processing to commercialization with local consumers/restaurants or selling the fillets in Merida, the capital of the Yucatan state, results in a shorter value chain.

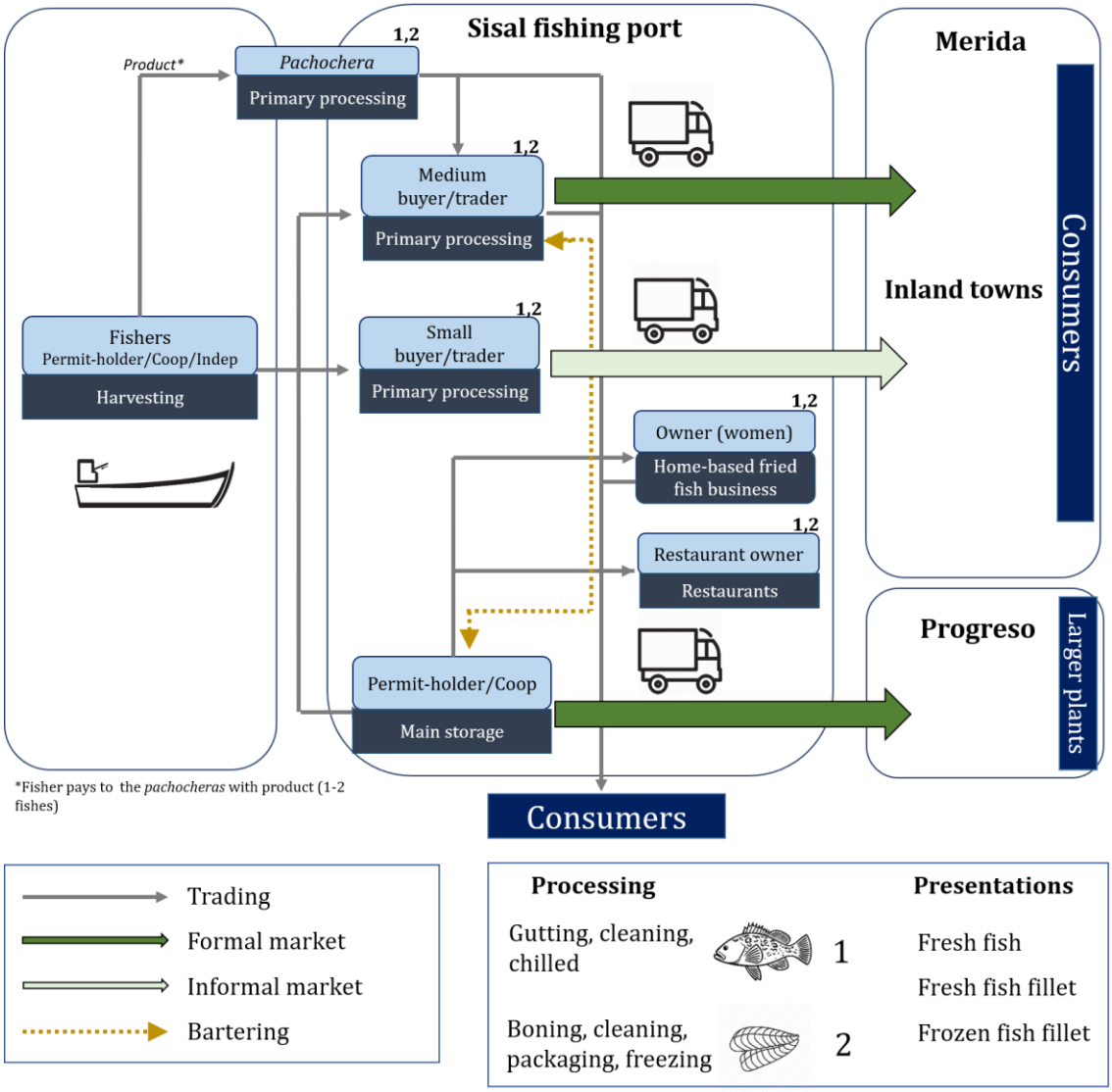


Figure 5.1 Descriptive value chain of the most economically important fish species captured in Sisal (Diagram designed by the author)

5.2 Study methods

A mixture of methods was employed in the study, including in-person surveys using questionnaires, focus group discussion, participant observation, and informal interviews with key informants from the community to examine gender perspectives on what makes people vulnerable and how to become more viable. The questionnaire was designed to

capture perceived vulnerability at an individual level, as well as at the community level (see Appendix A5.1). The respondents were also asked to identify factors that enhance their fisheries-related livelihoods. The study took place from February to July 2018 and involved two main steps.

First, in-person surveys were conducted with 46 male captains, operating 18% of active fishing vessels, and 35 people involved in the post-harvest, mostly women (e.g. *pachocheras*, small- and medium traders, home-based fried fish business owners, and restaurant owners), out of about 45 active women during the time of fieldwork. These two groups have certain autonomy in decision-making about their operation, including investment decisions.

The selection of the survey respondents followed a purposive sampling based on availability and accessibility of potential participants. The surveys took place mostly in the fishing harbor, but many of the women respondents were also reached at their homes. The surveys administered to the captains took between 19 to 64 minutes to complete, with an average of 32 minutes, while those carried out with the women took longer at about 36 minutes on average (between 24 to 63 minutes).

The second step involved two focus group discussions, firstly with four captains (May 2018) and later with ten women involved in the post-harvest (July 2018). The focus group discussions aimed at prioritizing the vulnerability factors in terms of their severity, exploring possible solutions to deal with threats and to become more viable. The analysis of the survey responses and the focus group discussions was done to identify similarities and differences in gender perspectives on the issues of vulnerability and viability.

Data gathered from the surveys were numerically coded and recorded using an MS-Excel spreadsheet. Common responses gathered by the fishing people involved in harvesting and post-harvesting activities were categorized through content analysis. A percentage of overlapping was calculated within each of the five vulnerability domains to compare the responses between the captains and the women. The number of times each factor was mentioned by each group was normalized to the score of 100 in order to compare the top vulnerability factors.

5.3 Respondent demographics

Around 40% of the respondents who are engaged in harvest and post-harvest activities are from Sisal, and the rest are from inland towns who travel on a daily basis to the fishing harbor (Table 5.1). The majority of the respondents hold elementary education, with women having lower education than men. Another difference that was mentioned was in regard to the terms of their working team. Although respondents from both groups work in a team, with exception of some *pachocheras*, the captains do not always have kinship relations with their crewmembers. Conversely, women have high support from their family (e.g., husband and children) who cooperate in processing activities, administration, transportation, and commercialization of their products. Most of the captains and the post-harvest women are involved in their activities throughout the year. About 33% of the captains indicated that they participate in capture fisheries only during octopus fishing season.

Table 5.1 Demographic information of respondents involved in harvest and postharvest fishing activities

	Harvest	Post-harvest		Harvest	Post-harvest
Origin			*Education*		
Locals (Sisal)	20	14	Elementary	21	21
Hunucma	14	11	Secondary	12	8
Tetiz	2	3	High school	9	2
Dzilam González	0	1	Bachelor	2	2
Merida	2	1	No studies	2	2
Buctzotz	0	1	**Total**	**46**	**35**
Motul	1	0			
Yaxche	0	1	*Fishing background*		
Peto	0	1	Yes	31	18
Ucú	0	1	No	15	17
Other states	7	1	**Total**	**46**	**35**
Total	**46**	**35**			
Genre			*Involved in activities throughout the year*		
Men	46	5	Yes	31	30
Women	0	30	No	15	5
Total	**46**	**35**	**Total**	**46**	**35**
Age			*Work team*		
15-25	3	3	Yes	45	26
26-35	4	6	No	1	9
36-45	15	10	**Total**	**46**	**35**
46-55	13	9			
>55	11	7	*Kinship relationships*		
Total	**46**	**35**		Not in all cases	Yes

5.4 Vulnerability factors identified and explained

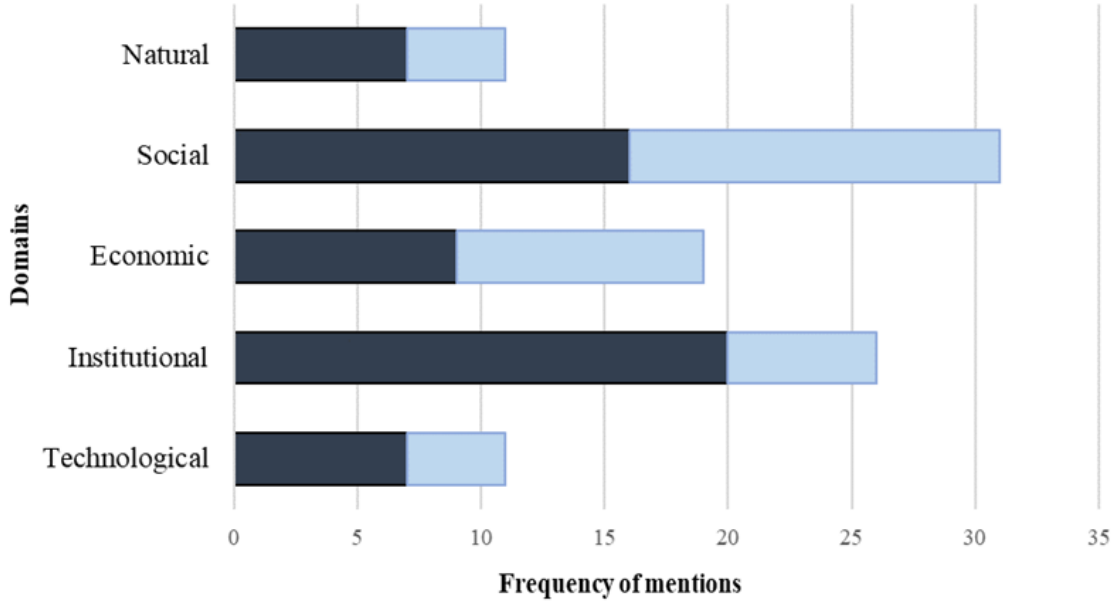
5.4.1 Comparison of vulnerability factors

The list of vulnerability factors populated by the captains and the women were compared, and considerable differences were found. For example, the captains populated a higher number of vulnerability factors than the women in four out of five domains considered in this study, with the largest difference occurring in factors related to institutions. As shown in Figure 5.2, the top two dimensions for the captains in terms of threats to livelihoods came mainly from institutional and social elements. The women were also able to identify numerous social factors that make them vulnerable, but they also considered economic factors to be highly important.

When looking within each domain, the factors populated by the captains and the women are different, as suggested by the percentage of overlaps. In general, there were more similarities between the environmental factors (37% overlap) but the percentages are very low for the technological and social dimensions (9% and 15%, respectively). On the similarities, the captains and the women concur that the lack of fishing resources due to bad weather conditions and algal blooms are important sources of vulnerability, which in turn affect their income. Other common factors are the lack of social support from peers and the government and the lack of technological equipment, which were considered to have negative impacts on their fishing livelihoods (Table 5.2).

When it comes to divergence in responses, the captains and the women identified vulnerability factors that are closely related to the activities they are involved in such as harvesting or post-harvesting, respectively. For instance, the captains emphasize the lack

of respect for fishing regulations, consistent immigration, and a high level of predation as factors that make them vulnerable. The latter involves excessive fishing pressure on both undersized fish species and uncommonly target reef species used mainly for filleting.



	Natural	Social	Economic	Institutional	Technological
Captains	7	16	9	20	7
Women	4	15	10	6	4
% Overlap	37	15	21	24	9

Figure 5.2 Total number of vulnerability factors identified by the men captains and women involved in fish processing in Sisal fishing community, along with percentage of overlaps

The captains also indicated that the high price of fuel directly affects their profits from each fishing operation, especially if they take longer fishing trips of 4-5 days as opposed to a daytrip. Longer fishing trips are carried out in 32 ft long vessels with two outboard engines which allow fishers to operate far from the coast (up to 55m depth). Other constraints that the captains face, apart from limited access to markets, was the lack of

bargaining power over prices, which are usually controlled by the permit-holders. In the institutional domain, subsidies-related issues such as uneven allocation of capacity-enhancement, fuel, and training program subsidies, corruption within fisheries institutions and inappropriate alternative livelihood projects sponsored by the government were referred to as the most pressing vulnerability factors. Regarding technology, the captains indicated that not having safety equipment on board and navigating with old engines increase their vulnerability at sea (Table 5.2). They mentioned how dangerous the fishing operation would be if their engine broke down, particularly during strong winds. They also noted the poor quality of life-vests whose material does not allow them to stay afloat for several hours. See A5.2 for a full list of vulnerability factors that the captains generated.

As previously stated, the women put high emphasis on economic and social issues. On the economic front, they highly depend on the harvesting sector and often struggle to get fresh fish for their processing. Women who own and run small business usually get fish from family-operated vessels. However, when fish is scarce women must deal with the main storage owners (permit-holders) who often refuse to sell them fish or when they do sell, it is at extremely high prices. They were also concerned about the lack of government support in providing loans to run a new business or to keep the existing ones going. Finally, the women were worried about daily expenses regarding transportation and energy costs (e.g., electricity, propane gas, and coal).

Among the women group, the *pachocheras*'s situation is slightly more complex. Many *pachocheras* work in the fishing harbour on the regular basis, however, they must

compete with seasonal *pachocheras* who work at the fishing harbor only during high fish seasons. The latter category get employment in other wage labor in their hometowns when fish is scarce. The permanent *pachocheras* argued that they help harvesters throughout the year, and thus deserve better recognition and more secured profits compared to the seasonal workers. In addition, they mentioned the lack of access to capacity development programs implemented by the government such as the post-harvest good practices training. They were also interested in other training such as on value-addition to fish products and diversification of livelihoods beyond fisheries (e.g., shell-handicraft, entrepreneurship skills). See Appendix A5.3 for the full list of vulnerability factors generated by the women in post-harvest.

Table 5.2 Top ten most mentioned vulnerability factors identified by the captains and the women involved in post-harvest in Sisal fishing community, normalized to 100

Captains			**Women**		
Domain	*Vulnerability factor*	*Normalized Freq (%)*	*Domain*	*Vulnerability factor*	*Normalized Freq (%)*
Natural	Bad climate conditions	48	Natural	No fishing due to bad weather	74
Institutional	Lack of subsidies	30	Economic	Low income in certain seasons	63
Economic	Lack/No income	28	Economic	Higher prices in main storage	51
Social	Lack of respect for regulations	26	Natural	Fish scarcity (natural behavior)	37
Economic	Lack of direct markets	24	Social	No benefits to constant *pachocheras*	34
Technological	Lack of security equipment	24	Technological	Lack of refrigerators/ freezers	29
Institutional	Lack of government projects	20	Social	Lack of selling from the main storage	26
Institutional	Poor subsidies allocation to fishers	17	Economic	Public transportation expenses	23

Institutional	High level of corruption	17	Economic	Less service when fishing is low	23
Institutional	Lack of temporal employment	17	Institutional	Lack of support for business	23

With respect to vulnerability within their household, a different perspective was mentioned by the captains and the women involved in post-harvest. While the captains mentioned being worried about potential problems related to their fishing livelihood (capture fisheries) such as the lack of income, probability of death at sea, and probability to get sick, the women worry more about sickness of family member (elderly), household income, and education of their children. This different perspective also influenced their responses when asked about how they manage potential barriers and constraints. The captains said being cautious and saving money are the main strategies they use to face potential threats. Women, on the other hand referred to working hard and having family support as the main strategies to deal with negative situations within their household.

5.4.2 Vulnerability concerns within the fishing community

When asked about concerns within the community, a factor mentioned by about 35% of the captains and nearly half of the women was the poor economy during the low fishing season (February-April). Social issues were also emphasized by both groups, with the captains stressing the increase of alcohol and drugs abuse as a problem not being properly addressed. The women on the other hand were more worried about self-image toward the community and the lack of municipal authority. Being a *pachochera* is not an acceptable occupation for the community members, which was why fishers' wives do not get

involved as *pachocheras*. The *pachocheras* are either single, divorced, or widows, mostly from other inland towns. Most of the local fishing people negatively perceive this activity, seeing that personal relationships between the *pachocheras* and the fishers can emerge.

Regarding the lack of municipal authority, the women perceive that it affects the general dynamics in the fishing community because basic services (e.g., health, drinking water, electricity) have declined, but revolts and insecurity within the community increase. Finally, the respondents from both groups mentioned poor garbage collection service in Sisal as another concern in the community.

5.5 Factors that enhance viability in fishing related livelihoods

5.5.1 Viability factors

The captains and the women involved in post-harvest coincided in identifying a variety of factors that are important for their livelihoods' viability. Some of them are the flip side of vulnerability such as having good catches of high-demand species, having good weather conditions, and owning technical equipment for undertaking their activities. Other factors point to the importance of social relationship, such as having support from fellow fishers and developing relational strategies. For example, mutually beneficial relations take place between the *pachocheras* and the fishers. Apart from profits, women find satisfaction and relaxation in providing emotional and moral support to fishers, in turn, fishers find listeners after a long and tiring fishing operation. Also, good surrounding such as peacefulness, high natural diversity, and people kindness make fishing people feel

pleasant and enjoyable. Specifically, the women expressed natural diversity (e.g., wetland, beach, diverse flora and fauna), and cultural services (e.g., recreation and aesthetic experience) as key characteristics that Sisal offers to the locals and visitors.

Ecosystem diversity also allows fishing people to diversify their sources of income, thus enhancing their viability. For instance, the captains mentioned their involvement in tourism-related business such as hunting and sports fishing guide, as well as wage labor (e.g., construction work, carpentry and general labour). The women are normally engaged in activities that they can perform at home, mostly during weekends, like cooking and selling grilled chicken, offering dinner service, or selling ice cream. With tourism becoming an important economy in Sisal, many women get employment working in summer and vacation homes (e.g., house cleaning, flowers selling) or by running small home-based restaurants.

Most of the survey respondents indicated subjective benefits coming from their occupations that make them satisfied. Feeling of enthusiasm and enjoyment, release of stress, and being able to see different ecosystems in the case of fishing divers (fishers who target lobster) were the most cited factors. The captains referred also to material wellbeing including the ability to build their house, providing education, and buying clothes and shoes for their children. Many of them mentioned the ability to work from home while at the same time taking care of their family as another important factor contributing to their viability. The women were generally satisfied with their activity because they felt empowered to see how their standard of living as well as their participation in decision-making within the household have increased. The feeling of

satisfaction is also reflected in their reluctance to leave their fishing activity given that most of the respondents from both groups expressed their willingness to remain in Sisal as long as their physical strength and health allow them to perform the demanded activities.

One area in which the two respondent groups differed most is regarding how they managed in time of crisis. About 25% of the captains expected the government to take actions in solving crisis in Sisal, while the women expressed more self-reliance when faced with crisis including getting alternative employment or drawing on pawns.

Social networks and social cohesion are mentioned as key factors for community viability. Religious activities such as ‘La Fiesta del Cristo Negro' and ‘La Virgen de Tetiz' are important festivals where people of all ages participate. These festivals do not just foster cultural identity among inhabitants but also generate economic benefits in the community since these traditional celebrations attract a high influx of tourists. Families also attend sports activities such as baseball, softball, and football, which help strengthen social bonds. Interestingly, 76% of the captains reported being involved in community events while a much lower number of women said so (20%). This difference could be because of the women’s focuse on household’s activities. The women mentioned that they prefer to spend time with their family, playing with their children, doing chores, or watching TV. On top of that, women perceive that in comparison to the past, the number of gatherings that seek to increase women’s participation have decreased. The captains, on the other hand, commonly hang out with friends, playing sports, card games, domino, pool, or hunting.

Regarding to the organizations that respondents belong to, 35% of the captains belong to organizations such as fishing-related (permit-holder/cooperative), *Ejido*, Alcoholic Anonymous, religious organizations, and neighborhood-related entities. From these organizations, the captains receive different kind of support such as loans when they are sick or face poor climate conditions, access to credits for fishing equipment, or emotional/moral support from fellowships. Conversely, the majority of the women (80%) do not belong to any professional organization, and thus do not receive any type of support for their business in times of need. The rest of the women (20%) belong to organizations, mainly religious organizations, the health center committee, and the social organization committee. However, unlike men, women provide support to these organizations by leading them and managing activities.

Slightly similar responses were gathered regarding the future of Sisal. For example, 57% of the captains were positive about the future, given the expected increase in tourism and commerce which can bring more job opportunities. The other 43% were not as enthusiastic, with concerns centered around high immigration to the community, increases in fishing effort, lack of respect for regulations, and high depredation of fishing resources. Half of the women perceived a positive future, attributed to the increase in tourism and employment, while the other half was concerned about decrease in fishing year after year and the lack of attention paid to the community by the municipal government.

5.5.2 Potential solutions toward viable fishing livelihoods

During the focus group discussions different perspectives and pathways to address vulnerability problems facing the fishing community of Sisal were raised. In the captains' focus group discussion, the violation of temporal fishing closures was stressed as a common practice in the area coming from both local fishers and from fishers based in nearby communities. According to the focus group participants, the problem needs to be addressed along the fish chain,

> "*It is unfair that fishers are the only one to blame, for catching fish during closed seasons. It should also be recognized that as long as there are those who buys, there will be those who catch*".

To deal with this complex problem, alternative employment should be available to them. Opportunities to work in collaboration with government institutions are generally welcomed in Sisal to generate awareness, as well as setting regulations for fishers, traders, and restaurants. Nevertheless, the captains said that one of the biggest challenges is corruption. Institutions responsible for monitoring and surveillance do not do their job as they should, allowing fishing, and selling and buying of fish throughout the year.

In dealing with the high level of newcomers in the community, the captains mentioned the support of permit holders, cooperatives, and the government to limit the entry of more people to the fishery given that the impact is not just from an economic perspective, but also from a social perspective. In addition to increasing fishing effort over the years, newcomers bring their own values and habits to the place.

"A lot of people have settled down in Sisal and competition for the same fishing resources has increased. They [newcomers] arrived due to the lack of employment in their towns, therefore, representing a threat for us who have made our livelihoods out of fishing for generations. The worse is that the level of alcoholism and drugs, and robbery also increases, thus, local people no longer feel as safe as they're used to years ago".

The discussion with the women involved in post-harvest took a different turn, mainly showing their proactive stance. Firstly, the women suggested that the violation of the fishing closures in Sisal was due to three main reasons: a limited support from the government in terms of monitoring and surveillance; lack of temporal employment during fishing closure; and limited financial and nutritional support.

"*One of the problems fishing people face in Sisal is the poor performance of federal authorities. CONAPESCA and the Navy do not meet their duties. It is common to hear fishers from Sisal complaining about the intrusion of fishers from other ports in their fishing grounds. This pushes fishers from Sisal to not comply with the regulations*".

Another woman participant stated:

"*We recognize that small-scale fisheries in Sisal provide us high economic benefits, but this is just a certain period because there are months in which fishers do not fish because of the weather and, in addition, the grouper closed season. Although fishers are hired under temporary employment programmes which have been provided by the State Government, the financial support provided by the State government is not enough for them and we are not considered in those programs*".

The women at the focus group discussion were more concerned about environmental issues. While the captains did not talk about damaging practices in the rocky habitats, women said the damage that some fishers from the neighboring fishing communities do in the fishing grounds created a bigger problem beyond overexploitation. As for the increase of newcomers, they mentioned that social problems cannot be ascribed only to the newcomers but also to local people,

> "*Local people have also contributed to the social pressure due to the lack of educational and limited recreational activities for children and the youth. There is a lack of interest in children's education in general. Sisal needs activities that keep children and youth off alcohol and drugs, such as sports games and cultural activities*".

To deal with this problem, the women proposed a formation of a well-established surveillance group that includes members of the neighbouring community. This group would also work in coordination with the local police. The duties proposed for this committee is to monitor newcomers to guarantee higher security in Sisal.

The lack of government recognition of women's roles in fisheries was also discussed in the focus group. Courses like the post-harvest training program (PROPESCA), seek to build capacity for good post-harvest management practices, hygienic-sanitary maintenance, and occupational safety, all while excluding women - an example of how the government marginalizes women involved in post-harvest. Even though women (*pachocheras*) handle the catch during gutting and filleting, this program targets only captains and crewmembers. To address these shortcomings, the women proposed the integration of a formal organization to get professional advice, training, and financial

resources to implement development projects. Finally, the participants called for the government to recognize the economic and social role of the post-harvest fisheries sector when formulating policies for the use of resources and the sustainable development of fisheries and the community.

5.6 Discussion

5.6.1 Gender differences in perceived vulnerability

The participatory diagnostic approach carried out in Sisal reveals important differences between the captains and the women with respect to perceived vulnerability. Broadly speaking, captains considered themselves more affected by issues coming from the institutional and social environments. During the fieldwork, it was common to hear complaints about the fisheries governing entities (e.g., Port Authority, Ministry of the Navy, CONAPESCA), as well as about the state and federal governments. Given that the people of Sisal have aligned themselves with political parties, the captains tend to relate political favoritism with the enjoyment of perks like subsidies (e.g., capacity-enhancing, fuel, and PROPESCA training). Social pressures identified by the captains regarding newcomers, competition with neighbors fishing fleets, and lack of respect for regulations would not only result in an increase of fishing effort but also in rent dissipation (Salas et al. 2011). The increased number of newcomers can also influence cooperation attitudes within the fishing community. For example, in Dzilam de Bravo, Salas et al. (2019) report how the constant entry of newcomers has modified local arrangements since cooperative strategies commonly adopted in the past among fishers have decreased. In the focus group

discussion, captains strongly expressed their sense of ownership over local resources, which newcomers lack and thus tend to use more damaging fishing gears. The problem of rule violation by new entrants to the fisheries has been recognized in other studies (e.g., Chuenpagdee and Juntarashote 2011 in the case of Thailand and Islam and Herbeck 2013 in Bangladesh), and addressing it would require changes in the governance structure and function, as suggested by the study participants.

Power relationships can be associated with constraints and barriers that each group of respondents discussed. One of the most mentioned issues by the captains was the importance of having support from permit-holders or cooperatives when performing their fishing operations. Since most of the captains depend on financiers for loans, ice, fuel, and fishing gears, their relationship can be either mutually beneficial or disadvantageous. As Pedroza (2013, 2019) identified, after a captain gets a debt (e.g., loans) with a permit-holder, the former is obliged to sell the total catch to the latter. Nevertheless, it is well-known both in Yucatan and other states of Mexico that permit-holders who own the main storages have local market monopoly, thus controlling the price of the catch (Salas and Torres 1996; Cinti et al. 2010; Pedroza 2019; Tolentino-Arévalo et al. 2019). Sometimes harvesters can violate this contract by selling part of the catch to medium-scale processors/traders who offer a higher price for the fish product, affecting the relationship harvesters have with their financiers. Hence, insufficient bargaining power and the high dependence on private financial support make captains vulnerable.

According to the literature, women are generally more vulnerable in a number of situations when compared to men (Arora-Jonsson 2011; Gezon 2012; Islam and

Chuenpagdee 2013; Ayantunde et al. 2015). In Sisal, women expressed being highly dependent on capture activities and, in addition, having less access to financial, human, social, and technological resources for performing their activities. Those women processors/traders who own fish shops depend on expensive freezers to preserve the product and, although women in Sisal wish to expand their business, they face constraints due to the high level of investment needed. It is broadly documented how financial investments represent a barrier to women, especially if they lack external economic support. Tindall and Holvoet (2008), for instance, show that women engaged in trading in Mali are particularly constrained by a lack of access to credits. Despite that women are also members of the traders' association, wholesalers prefer giving credits to men. This situation leaves women in weaker positions. One solution used by women is to keep independent sources of credit in order to reduce reliance on wholesalers.

In terms of income, the literature suggests that men earn more than women (Islam 2011; Weeratunge et al. 2014; Santos 2015; de la Torre-Castro et al. 2017), and in Sisal traditional ideas related to the housewife role of women are commonly heard. Women engaged in post-harvest in Sisal acknowledge their high contribution to household maintenance, specifically when fishing becomes less economically viable such as during times of fishing crisis. Within their households, women spend their earned income to support their families, pay for children's education, and provide what their children need. Similar focus has been identified in other places. In Brazil, after earning money from processing, the *marisqueiras* (Portuguese name) who peel shellfish (crustaceans and bivalve mollusks) save their money and invest in expenses related to the household, such

as spending it on their children's education. It has also been shown that when possible, women use their saving to buy small rowboats (Santos 2015). Bangladeshi women who are involved in fisheries as processors, packagers, and vendors frequently become the financial mainstay of their household once they are active in income generation (Islam 2011). Despite being active participants in their household's economy, most women still are not likely to see themselves as head of the household (Gammage 2004).

Socio-cultural pressures also limit women involved in post-harvest to make better livelihoods. In the Bengali coastal fishery, barriers emerged from the patriarchal socio-cultural construct and the prejudice of religion traditions undermined women their capacity to raise their voice and pursue their aspirations (Deb et al. 2015). In Sisal, although working at the fishing harbor provide good income, especially during octopus fishing season, fisher's wives from Sisal do not get involved in filleting and cleaning activities at the landing site. Those who own home-based fried fish small businesses follow societal standards and leave their husbands to get fish product from the harbor while they organize what the business demands from home. General involvement at the community level are also gendered. The few surveyed women are mostly involved in religious gatherings while men take a more active participation with other community members in a broad array of activities outside of the household, such as sport activities.

In pursuing viability for their livelihoods, women develop certain skills such as social strategies and networks which facilitate obtaining outcomes. (Weeratunge et al. 2014) cite three documents from the gender literature in fisheries which refer to how the involvement of women has an impact on wellbeing (Nadel-Klein and Davis 1988;

Lambeth et al. 2002; Bennett et al. 2004). In these documents, two major roles are articulated as being adopted by women. Tangible roles are derived from their economic contribution (e.g., income provision to the household, ability to build a house, to contribute to their household expenses, or to acquire personal items) but women also adopt intangible roles which include emotional contributions (e.g., moral support, friendship, family care). In Sisal, unlike fishers' wives, the *pachocheras* do not hold blood relation with harvesters, instead, they provide emotional and moral support to fishers after a long and tiring fishing operation, attitudes that are welcomed by the fishers. Women's relational capacity is also seen when negotiations take place. In the border between Cambodia and Thailand, women play an important role in negotiations with soldiers, due to the common belief that women naturally avoid conflicts (Kusakabe et al. 2006). This skill is also seen in Sisal where women processors/traders have stronger bargaining power and exchange fish based on quality and species, according to their business' needs.

5.6.2 Potential actions in dealing with vulnerability

When discussing potential actions to deal with threats and challenges associated to their fishing livelihoods, captains showed dependency on external support (e.g., the government) while women reacted by showing willingness to take active participation through the creation of social organizations. This could be explained by the daily roles adopted by each group when performing their activities. While the captains focus on capturing alone in a boat, women involved in post-harvest create social networks with fishers and customers. Beyond having improved access to a range of material resources

(e.g. built/improve the house, freezer, electronics), an advantage for women involved in post-harvest is the capacity to build strong networks, enforce human capacity (e.g. leadership, entrepreneurship, administration) and their proven social abilities (network with suppliers or clients) (Kleiber et al. 2017). The skills and capabilities developed by women have helped them to oscillate with economic, market, natural changes to safeguard their livelihoods (Lwenya and Yongo 2012). In Tanzania, innovative projects implemented in this village have resulted in increased empowerment among women and decreased poverty. Participants in this place mentioned handcrafting as an alternative livelihood, in addition to seaweed farming, which has improved their self-confidence as well as their decision-making authority in their household (Lwenya and Yongo 2012; Fröcklin et al. 2018).

Although the government has an important role to play when it comes to improving fishing people's lives, policies and government programs offered in coastal communities are gendered (Hanson 2016). In other parts of the world, discriminatory policies related to ownership rights, access to finance, and insurance services limit women's capacity to boost their skills and knowledge (Heritage 2018; Monfort 2015). This explains why the women in Sisal perceive themselves as politically and economically ignored. In Mexico, legislation, plans, and programs are focused on the male-dominated capture fisheries. In fact, some programs oriented to economically empower women have resulted in undesired outcomes. One of the most important programs in Mexico, PROSPERA, has been found to make women even more vulnerable given that men (especially those residing in the US) use the program an excuse for avoiding sending money to their family

(Haenn 2018). Another program, SEDESOL, also launches women-targeted programs that support entrepreneurship by providing economic loans for different sectors. Survey participants in Sisal mentioned that beneficiaries from this program usually spend the money or sell the acquired technological equipment even before starting the project. Regarding small-scale fisheries related activities performed by women, there is a general lack of support from government in form of management plans and programs.

5.6.3 Problems and opportunities found within the community

The respondents from both groups in Sisal mentioned the diverse activities they are engaged in to obtain alternative income and to cope with economics at times of crisis in the fishery. However, captains' identities are strongly associated with fisheries as part of their masculinity or they engage in tourism services. Several captains mentioned their reliance on tourism services, especially in high peak seasons such as duck hunting in winter and boat tours in summer. Currently, when tourism in the community has increased, the captains expressed that it means a potential alternative income. Fishers' wives take the role of being productive and diversify their activities to secure sufficient family earnings, mainly when the fisher's household income is under threat (Frangoudes 2011). Studies show that poverty levels influence women's participation in fishing. In small-scale fisheries in Chile, Villanueva García Benítez and Flores-Nava (2019) found that the lower the cash income was for fishing-dependent families, the higher the participation of women was. Similar results are offered by Islam (2011) who identified that women from poor households in Bangladesh are forced to engage in income-

generating activities to foster their livelihoods. Likewise, in Tanzania, women are involved in seaweed farming to provide additional cash to their households. Because the farms are placed on accessible and geographically close seagrass meadows, this livelihood source allows women to perform both their productive economic activities and reproductive activities at home (de la Torre-Castro et al. 2017). In this sense, the higher number of alternative employments expressed by women involved in post-harvesting can be explained given that the occupation can be considered part-time (Mills et al. 2011) and allows them to combine productive and reproductive work (de la Torre-Castro et al. 2017).

Different examples demonstrate how the participation of women has improved the sustainable use of natural resources. In a forestry community in India, the engagement of women has led to better protection of forests than when men were involved (Singh 2012). With respect to mangrove conservation in Philippines, Bagsit and Jimenez (2013) outline how the management positions within a mangrove's organization turned from men's to women's leadership given that the later got actively engaged on the broad array of activities the mangrove project demanded, from nursery development, maintenance, planting, protection, until management of the mangrove area. With respect to small-scale fisheries, women have demonstrated commitment by investing time, effort, and resources to develop a sustainable fisheries management plan, compared to men (Frangoudes et al. 2013; Revollo-Fernández et al. 2015). In Loreto, Baja California Sur a women cooperative became an example of stewardship by designing a management plan to marine aquarium species even before starting to fish (Revollo-Fernández et al. 2015).

Although Sisal lacks women organizations related to fisheries, other forms of initiatives, supported by larger companies, have succeeded for years. Such is the case of Coox Mole, a cooperative led by women, which focuses on collecting polyethylene terephthalate bottles and aluminium (Pacheco 2010; Urrea-Mariño 2012; Fundación BEPENSA 2018). This can show how strong initiatives have potential to bring economic opportunities for women in Sisal to achieve both contribution to household's expenses and improving the general wellbeing of the community.

In other fishing communities of Yucatan, the development of women-run fisheries organizations has proved how women can identify and embrace opportunities to improve their livelihoods. In San Felipe, a women-run cooperative that focuses on a non-traditional fishing resource (*maxquil*, spider crab) used as bait for octopus fishery, is seen as an example of success given that members were able to find creative solutions to both social and ecological constraints and to change relations with men (Gavaldón and Fraga 2011; Perea-Blázquez and Flores-Palacios 2016). The examples cited above, and several found in other places show how different segments of the society take advantage of social and natural characteristics to improve their living conditions. As Chuenpagdee and Jentoft (2011) state, building local capacity in social organization, financing and business development serves to incentivize collective action, help fishing people to develop their own strategies in reducing their dependence on private financiers. In this context, it is important to support the creation of women cooperatives in Sisal and other coastal communities. These organizations can encourage local people to take new roles in governance of the resource system and the market. For instance, the creation of

cooperatives for implementing new marketing strategies (e.g., added-value to fish products) could help to mitigate the effect of fish price fluctuations. Therefore, the expansion of domestic market can give fishers more power to bargain prices of their catch.

A women-run cooperative can also be used as a platform to request investments in minor projects related to coastal activities, for example, mangrove restoration, community garbage collection campaigns, or tree planting, recognizing at the same time their pro-environmental behavior. These projects can help to mobilize resources to support skill and knowledge acquisition, which in turn can justify environmental-related policy interventions that target women. In implementing this type of projects in Sisal, desirable outcomes can be obtained given the characteristics highlighted by women involved in the participatory diagnostic process which can enhance the likelihood of accomplishment.

The results from this research show the importance of gathering gender perspectives when identifying sources of vulnerability in small-scale fisheries. More revealing, the results highlight differences in how fishing people perceive their natural, social, economic, institutional, and technological environment and what potential pathways can be designed to address difficulties and barriers. While it is argued that problems of small-scale fisheries are context-specific, solutions can also be found within the same fisheries chain (Kooiman et al. 2005; Jentoft and Chuenpagdee 2015). Listening to what women have to say is imperative and their involvement can foster positive outcomes, especially when informing strategies and plans to reduce vulnerability at the household and community level (Beck et al. 2012; Gezon 2012; Calhoun et al. 2016).

In terms of policy, it is important to consider gender perspectives on vulnerability issues and potential actions offered by local fishing people for fostering viability of their fishing livelihoods. Considering the challenges encountered by all stakeholders involved in the harvest and post-harvest components can provide valuable information for the development and implementation of programs that have an equitable impact along the fish chain (Tindall and Holvoet 2008).

The approach undertaken in this study contributes to the international agenda, especially to the implementation of the fourth guiding principle of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (SSF Guidelines; FAO 2015). This bottom-up approach allows for the examination of context-specific barriers identified by both sectors. Therefore, these results pave the way to operationalize successful governance interventions that target gender equity and equality. For example, one of these potential ways is by drawing on women's skills and their strengths as well as building on them. Considering this encouraging pathway, desirable outcomes from interventions can be achieved and governance of small-scale fisheries can be enhanced.

CHAPTER 6. Policy Implications and Conclusions

In this chapter, the locally-based strengths of small-scale fishing people in Sisal are highlighted. Considering the characteristics of the fisheries related governing system (e.g., governing institutions and results from conversation with eleven permit-holders) and the outcomes gathered from the simplified participatory approach, potential opportunities for fostering viability in these fisheries are discussed within the three-order governance lens. Finally, implications for policy are provided as well as an overall conclusion from this research.

6.1 Opportunities located at the level of three orders of governance

6.1.1 First order of governance

The first order of governance deals with day-to-day affairs situated wherever people and organizations interact (Kooiman et al. 2005). One of the main barriers identified by the fishing people (captains and crewmembers) was the lack of access to fishing resources due to natural and institutional constraints, ultimately affecting their income. Sisal fishing communities and their surroundings offer high potential for local people to have viable livelihoods. The diversity of ecosystems allows local and nearby people to benefit from natural resources. The fishing grounds are influenced by a variety of reefs, making this a highly productive area from which Sisal and other small-scale fishing communities that live in the vicinity can benefit (Martínez-Portilla 2008; Urrea-Mariño 2012; Zarco-Perelló et al. 2013). Wetland extensions are also productive places for fishing, tourism, and hunting activities. One of the policy actions to reduce vulnerability of fishing dependent

people is through livelihoods diversification. Economic transitions to ecotourism have taken place successfully in nearby fishing communities in the Yucatan. For instance, Salas et al. (2015) illustrate how people from the San Felipe fishing community have developed a strong interest in this alternative activity, leading them to securing an agreement of the Actam Chuleb Marine Reserve to be part of the state ecotourism network. This reserve started from an informal initiative among local people, turning into community-based action supported by government agencies. According to the people of Sisal, ecotourism has become a promising source of livelihoods, with currently six eco-tourism cooperatives being integrated to meet the demands of tourism (Santoyo-Palacios 2017). Among the services offered by these organizations are small boat trips to the wetland, biking, diving, snorkeling, fishing, bird watching, and lodging. Such a variety of services can have a positive impact on commerce and home-based restaurants run by local women, such as what is observed in other places (Frangoudes 2011).

Livelihoods in Sisal can also be diversified by focusing on inland activities. According to the local fishers, the *Ejido* Commissary, composed of 159 members, own common lands near Hunucma Municipality. Currently, few people in Sisal practice agriculture, growing guayaba, guanabana, coconut, mango, sapote, and tamarindo. These crops are mainly grown for personal consumption. The government can support *Ejido* members with capacity development and financial means for the implementation of medium- or large-scale agricultural projects. Developing new means of livelihoods may benefit communities, and indirect changes could lead to the decrease of fishing pressure on common fishing resources (Salas et al. 2019).

6.1.2 Second order of governance

The second order of governance focuses on institutions and agencies that frame resource governance (Kooiman et al. 2005; Jentoft and Chuenpagdee 2015). Improving conditions of local people will require targeting new designs and rearrangements of existing institutions so that they correspond to the characteristics of the sector in both social and environmental conditions. During the simplified participatory diagnostic process, women surveyed (post-harvest) discussed alternatives they wanted implemented, considering their strengths. Jentoft and Chuenpagdee (2015) state that to improve the governability of small-scale fisheries it is necessary for people to be empowered, which in some cases can be achieved through better organization. For example, in coping with the volatility in prices, government can promote the creation of women-dominated cooperatives to have more control over fishing products. This can be done with marketing cooperatives that allow increasing prices for their fish products (Chuenpagdee 2011; Pedroza 2019). These organizations can enable women's empowerment and stimulate them to participate in decision-making regarding the future of their community (Tindall and Holvoet 2008; Santos 2015). In bringing these initiatives to the discussion, women involved in post-harvest identified physical and relational facilities that play a vital role. While physical infrastructure (e.g., storage and transportation) were identified as being important for viability, their high capacity and knowledge about the dynamic of the post-harvest activities were highly recognizable attributes. Specifically, their ability to create and maintain social relationships with fishers, middlemen, and customers can nurture long-term initiatives, ultimately reducing the risk and uncertainty of their livelihoods (Mutimukuru-Maravanyika et al. 2017).

According to harvesters, their relationships with permit-holders can be advantageous due to the fact that fishers can get credits for buying fuel, gears, or by acquiring fishing equipment. Similar to other places, like Thailand (Chuenpagdee and Juntarashote 2011), permit-holders can act as financiers which facilitate the performance of fishing operations (Pedroza 2013; Pedroza 2019). Although permit-holders are usually driven by vested interests, they have played an important role in fisheries governance in Sisal. Specifically, their leadership, attitudes, and power relationships with other governing players have been helpful in enabling fishing people's participation in both fishing-related movements and other social activities.

Focusing on illegal fishing issues in Sisal, permit-holders have encouraged fishing people to respect fishing closures and refrain from using prohibited fishing gears and methods. One permit-holder stated that:

"Fishers are aware of what species and fish sizes are not allowed to be captured. For instance, I [permit-holder] do not buy lobster tails that are too small, but fishers use to sell them to the restaurants or to keep them for their own consumption. Many times, fishers violate fishing closures or minimum sizes for earning more money, or because they think if they do not capture those small lobsters, their peers will capture them anyways".

In June 2018, when the fieldwork was being undertaken, the permit-holders organized a meeting in Sisal with resource users to discuss market issues, piracy, and competition with other fishing ports. Later, during conversations with one of the most influential permit-holder in Sisal, he said that:

"We [permit-holders] have had several meetings with fishers where they have shown to be willing to cooperate, respecting the agreements. However, fishers claim that even when they stop capturing octopus during closed fishing season, other fishers from Celestún and Chuburná continue capturing this species which is not fair! That is why fishers get angry with us [permit-holders]".

Permit-holders in Sisal also get involved in social gatherings by supporting and encouraging the community events through contributions both economically and in terms of logistics. For instance, permit-holders aid when celebrations and local gatherings take place (e.g., religious, Navy day, sports). Local permit-holders are also concerned about environmental issues, especially during the grouper closed fishing season when they hire fishers to clean the fishing harbor and the wetland from garbage. The most influential permit-holder in Sisal stated that:

"*Mostly in February, I hired fishers to pick up garbage in the fishing harbor and the nearby wetland. I think that tourism also generates benefits in Sisal and it is not possible that those tourists who come to see the flamingos leave with a bad impression of Sisal*".

Therefore, permit-holders can be the means for strengthening the unity among fishing people and enhancing the governability in Sisal.

Looking to the governing system, existing institutions must correspond to the diversity, complexity, and dynamics of the small-scale fishery in question. In Sisal, it is necessary a rearrangement of fisheries institutions in in order to have a higher flexibility and capacity to respond to the demands of fishing people. In this regard, CONAPESCA and the Ministry of the Navy should deal not just with the highly dynamic social system but also

with the changing environmental conditions of the region that have been shown to affect resource users. In Sisal, the creation of the Nautical Committee as a local body represents an institution that can be bolstered or built upon. It could be considered as a first step toward addressing sources of vulnerability, especially at the social and institutional dimensions. Addressing governability problems will not start from scratch (Jentoft and Chuenpagdee 2015), necessitating the examination of already present institutions and regional capacity. Fishing people in Sisal are willing to be involved in a restructuring of this local body, ideally avoiding the already existing power imbalances.

Potential future collaborations could include stakeholders working with other institutions such as nearby research centers and universities. Examples of these institutions are National Autonomous University of Mexico (UMDI-Sisal), the Center for Research and Advances Studies of the National Polytechnic Institute (CINVESTAV), and the Autonomous University of Yucatan (UADY). Non-governmental organizations can also contribute in redirecting efforts toward more desired scenarios of small-scale fisheries in Sisal. Building partnerships with academia, civil society organization, government institutions, and local stakeholders can broaden the knowledge base of the resource system, leading to increased trust.

6.1.3 Third order of governance

This order sets forth the guiding principles, norms, and values that support the institutional framing in place (Kooiman et al. 2005). The exploration of vulnerability and viability in Sisal can provide means to realize that the core problems found are related to

the values and images of the fishing people and the principles by which the fisheries institutions are driven. In Mexico, the Constitution has a moral and legal framework designed for the proper exploitation of natural resources. Specifically, Article 27 states that land and water natural resources belong to the National jurisdiction and it is the Nation's duty to allocate property rights for the rational use of the fishing resources to either individuals or entities/organizations (Ponce-Díaz et al. 2009). However, this allocation has been focused toward the most economically important species. Although fisheries law has restrictions on entering various fisheries, in practice these restrictions are difficult to enforce given the complexity, diversity, and dynamics of the resource system.

Efforts to enhance governability often can be hampered when governing institutions don't fully understand the characteristics of the system-to-be-governed. Contextualizing the diversity of a system matters and therefore the solutions provided should match the problems at hand. One example captured in this study surrounds the grouper closed fishing season subsidies. Although this program can be a positive interaction between fishing people and the government, its outcomes are still far from desirable. A more ideal scenario is providing socioeconomic benefits to fishing depended families (SEPASY 2019). Yet, fishing people continue to partake in illegal fishing. The most important reason for this action by local people is that the financial compensation is limited considering the increasing number of harvesters. In this sense, although the government spends millions of dollars on this program, it does not guarantee success, potentially because governing institutions do not engage and fully understand the system-to-be-

governed. Specifically, this program would benefit from working together with harvesters to enhance decision making and subsequently the finding of new solutions.

To align institutional principles to local needs, a focus on social characteristics is necessary. Attributes found among local people in Sisal such as solidarity during crisis time, unity, cohesion, and trust can provide insights about potential levels of success if training and capacity building are implemented with a goal to improve viability along the fish chain. These features could play an important role in whether or not people agree to coordinate their actions against threats and challenges. From the governability perspective, common objectives need to be agreed upon. Then relationships among different players, together with strong ties and solidarity, can become the vehicle for increasing collective action and facilitating social benefits from small-scale fisheries (Andrew et al. 2007).

6.2 Policy Implications

Small-scale fisheries in Sisal are of great importance not just for local people but for men and women further inland. Lessons illustrated in this study provide alternatives that are worth considering. Most prominently, the creation of governance interventions is needed for improving livelihoods' viability in Sisal. Shortcomings raised indicate action priorities that policy-makers can turn into congruent and responsive mechanisms to local fishing people's situations. Employing the outcomes from this research, implications for policy are provided as follows:

- In attempting to ameliorate sources of vulnerability at the social and institutional levels, mechanisms must start by reducing the gap between fishing people and governing fisheries institutions. This will require broader investments in the local governance institutions such as local level committees that serve as nodes between the governors and the governed people. In doing so, the governing system can be more aware of urgent needs that need to be addressed based on what local people are experiencing.

- In responding to the growing demand of tourism services, governing institutions must support the creation of cooperatives to reduce vulnerability of local people, especially in times of institutional and environmental constraints. For the success of this initiative, it is important to invest in training opportunities among community members and provide the infrastructure necessary to provide such services.

- Three main issues are highlighted in relation to subsidy programmes. First, increased subsidy programmes (e.g., capacity-enhancing, fuel, training, financial) should be directed to address the challenges and barriers of small-scale fisheries. Second, given that the granting of subsidies facilitates corruption enacted by higher actors, support from these programmes should be given directly to the fishers rather than allocating them to organizations. Finally, government programmes should target all people involved in the fish value chain, including both fishing people involved in harvesting as well as women involved in post-harvesting activities.

- Based on the identified strengths and positive attributes among local fishing people (e.g., strong leadership, community solidarity, high capacity, and knowledge), the government

must invest in capacity development programs that help to build on these strengths to accomplish long-term viability of fishing-related livelihoods.

- Government programs must be designed to target the post-harvest component. Programmes, such as those focused on post-harvest management training, technology-enhancing, value-added capabilities, and handcrafting provided to women-organizations can empower them not just to improve their livelihoods but to be more active participants in decision-making and governance. Through support for strong initiatives, such as the creation of women-organizations that encourage expanding of their locally-based business and enter to larger markets can pave the way to provide women with equal access to opportunities. This will allow women the ability to increase their capacity, ultimately allowing them to face situations that enhance viability more equitably.

Similar to vulnerability assessments, alternative approaches, such as the one employed in this research, can be used to advise in the design of appropriate policies for people engaged at a different component of the fish chain. Proposed programs will require monitoring and evaluation plans that provide evidence of the improving fishing-related livelihoods.

6.3 Conclusions

An initial instigation into what vulnerability means to local fishing people and what issues matter most to them is an important process to be done in understanding this global concern. For example, this process can lead governing institutions to be one step closer to effectively ameliorating sources of vulnerability and subsequently to improve

governance. In doing so, local scale analysis that examines situations leading to vulnerability in small-scale fisheries is needed. Vulnerability, when attached to the local context, can be interpreted as a lived experience by people who struggle to cope with the constraints and challenges faced in daily life. Therefore, to understand the meaning of vulnerability and what interventions can make a difference to people, it is necessary to fully examine, with their involvement, an approach that top-down assessments do not facilitate. It is important to recognize that large-scale top-down assessments are not minimized in this study, instead, the leading argument of this research is that the exploration of this global concern might start by asking people how people perceive vulnerability at their local scale. Empirical information is required at the individual harvest and postharvest components at the community level to have an analytical perspective such as the one interactive governance offers. Based on the results obtained from this research it can be concluded that:

People from the Sisal fishing community are particularly vulnerable to impacts coming from different environments, some of them are largely beyond their control. Fishing people involved in harvest and post-harvest components face significant socio-economic and institutional threats, and environmental issues exacerbate their already vulnerable conditions. The participatory diagnostic process involving local communities in all steps, from the individual identification of threats to the provision of potential pathways to move toward viability are gaining importance in fisheries and other fields.

There are gender differences in how vulnerability is perceived within Sisal fishing community. While men involved in harvesting struggle most with issues coming from

their institutional and social environments, women involved in post-harvest are more concerned about their social and economic environments. Important differences were also gathered with respect to potential solutions for making their livelihoods more viable. For example, harvesters show themselves more reliant on government initiatives, but women are more proactive in the creation of cooperatives to improve their livelihoods. Strengths highlighted among the participants such as leadership, social relationships, capability, process knowledge are characteristics that the governing institutions should take into account given that those strengths could play a critical role in people's organizational capacity, enabling them to become agents of positive change in their fishing community.

The set of prevailing fisheries institutions in Sisal at all levels (e.g., local, state, federal) lack capacity and quality to face the dynamic and diverse natural and social system-to-be-governed. Issues related to the scale at the social system also increase the challenge to govern the resource system adequately. For example, the high level of migration and diverse fishing fleets, both small- and large-scale, compete for the same resource, with illegal practices adding to the problem resulting in a sector that is difficult to govern. To improve the viability of fishing dependent livelihoods in Sisal, the set of prevailing institutions must steer it in a required direction. In other words, all stakeholders involved must take part, participate, and engage with local people to make the system work. The diverse academic institutions, fisheries-related local bodies, and fishing organizations (permit-holders and fishing cooperatives) that already exist in Sisal can create synergies to improve the conditions of fishing people. In addition, governing institutions could help women in gaining status, encouraging their participation in decision making and local

resource governance. For this, strong initiatives proposed by women should be supported and embraced, specifically by providing opportunities such as training that make their voice heard, leading to a real difference in fisheries resource governance.

The operationalization of the simplified participatory diagnostic approach carried out in Sisal provided important outcomes about what sources of vulnerability create the most burden. While the approach considers local people's perspectives on vulnerability and provides potential pathways to enhance their livelihoods, it is also recognized that participatory approaches can elicit isolated issues that result from unexpected changes in the system under study, therefore influencing the outcomes. The group discussions can be tailored and influenced by power relationships among the participants, limiting the exposure of social shortcomings within the fishery system. However, this process offers many advantages.

One of the most important characteristics of this alternative approach is not just about revealing differences among coastal fishing communities but also engaging people throughout the process. Starting from the self-identification of sources of vulnerability, the process allows local people to take ownership of their situations and provide potential solutions based on the opportunities and strengths they find in their own context. This approach also reveals problems from the local context, capturing people's perceptions about their exposure to vulnerable situations without the need of additional interpretations or assumptions made by the researcher.

Outcomes from this research have broader implications at the international agenda. For example, addressing vulnerability issues in coastal communities and suggesting ways to

ensure their long-term viability contribute to the Sustainable Development Goals (SDGs; United Nations 2015), specifically with Goal 14 "Life Below Water" that promotes ocean and fisheries sustainability (UN-OCEANS 2016). Although the Target 14b — “provide access for small-scale artisanal fishers to marine resources and markets” explicitly refers to small-scale fisheries, identifying the threats that impact the ability of these communities to pursue their livelihoods are also addressed by other goals such as SDGs 1, 5, and 16, related to poverty, gender equality, and justice and strong institutions respectively. Furthermore, improving the viability of fishing livelihoods is also one of the primary objectives of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries, developed in the context of food security and poverty eradication (SSF Guidelines; FAO 2015). This instrument highlights basic principles such as human rights and dignity, non-discrimination, gender equality and equity, transparency and accountability, consultation and participation, the rule of law, and the integration of holistic approaches (Jentoft and Chuenpagdee 2015; Chuenpagdee et al. 2019) that are relevant to mitigate vulnerability and enhance viability of small-scale fisheries. Therefore, the application of the method employed in this study can help to enable sound implementation of the SSF Guidelines on the ground (Jentoft 2014).

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Appendix A4.1. Questionnaire Harvest

In responding to this questionnaire, consider that you can skip any questions that you do not wish to answer, including demographic questions. You are free to withdraw from the study at any time. Just inform the researcher of your desire to stop. There will be no consequences associated with withdrawal from this study.

Viability and vulnerability in small-scale fisheries

A questionnaire

No.___ Fishing port _____

Date_____ Gender _____

Duration_____ Target group _____

A) Demographic characteristics

1. Where are you from?

   □ Sisal □ Hunucma □ Merida □ Tetiz □ Other location _____

2. How long have you been living here? _____ years

3. What is your age?

   □ 19-25 □ 26-35 □ 36-45 □ 46-55 □ 56- 65 □ >65

4. Which is your highest level of formal education?

   □ Never studied □ Bachelor (_____)

   □ Primary school (____) □ Certificate (_____)

□ Secondary school (___)

□ Trade school (____)

□ High school (____)

□ Masters (_____)

□ PhD (_____)

5. How many people depend on you for their livelihoods? _____ people
6. What are your primary and secondary occupations that provide you more income? (Mark P= primary, S= secondary)

□ Fishing

□ Construction

□ Carpentry

□ Duck hunting guiding

□ Tourism guiding

□ Small trading

□ Permit-holding

□ Cooperative administration

□ Sports fishing guiding

□ Taxi driving

□ Trading

□ Other local jobs _____

B) Fishing practices

7. What kind of fishing do you practice?

□ On-boat fishing □ Line fishing □ Other

8. What is your position on-board?

□ Captain □ Motor manager □ Crew member □ Other_____

9. If captain, do you belong to a fishing organization?

□ Cooperative member □ Works for permit-holder □ Free fisher

□ Other_____

10. If crew member, does your captain belong to a fishing organization?

□ Cooperative member □ Works for permit-holder □ Free fisher

□ Other_____

11. Do you fish with a crew?

□ Yes □ No (alone) If yes, how big the crew is? _____ people

12. Do you own a boat?

□ Yes □ No If yes, how many? _____boat(s)

13. What are the characteristics of your boat(s)?

Material_____ Engine ____ hp Length _____ft

14. Do you own fishing gear?

□ Yes □ No

15. If yes, what fishing gear do you own?

□ Jimbas □ Gillnets

□ Harpoon/compressor □ Traps

□ Long-line □ Other_____

□ Hook-and-line

C) Connection to fishing livelihoods

16. At what age did you start fishing? _____years old

17. How many years have you been fishing? _____ years

18. Do you come from a fishing family?

□ Yes □ No

19. Are you a full-time fisher?

□ Yes, fishing throughout the year □ No, fishing seasonally □ Other _____

20. What was the reason for you to start fishing?

□ Fishing provides a better livelihood □ Enjoy fishing

□ Lack of alternative activities □ Other _____

□ Lack of other skills

D) Viability and vulnerability for small-scale fishers

21. Why are you still fishing?

_____
_____
_____

22. Have you ever thought about leaving the fisheries?

□ Yes □ No

23. For how many more years do you think you will stay in fisheries? _____years
Why?

_____
_____

24. Are you happy/satisfied in your fishing activity?

□ Yes □ No Why?

_____
_____
_____

25. What are the main concerns in your family?

_____
_____
_____

26. How do you handle these concerns, in general?

_____
_____
_____

27. According to the following domains, which factors positively impact your fishing activity?

Natural	**Social**	**Economic**	**Institutional**	**Technological**
(e.g. high catch)	**(e.g. good organization)**	**(e.g. profits)**	**(e.g. consultation)**	**(e.g. storage facilities)**
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

28. Considering the following domains, which factors negatively impact your fishing activity?

Natural	**Social**	**Economic**	**Institutional**	**Technological**
(e.g. decrease in catch)	**(e.g. lack of organization)**	**(e.g. decrease in profits)**	**(e.g. lack of training courses)**	**(e.g. old motors)**
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

E) Viability and vulnerability at a community level

29. Do you feel that you belong to this community?

□ Yes □ No Why?

_____

30. Do you feel strong ties in your community?

□ Yes □ No If not, why?

_____

_____

31. What do you like about this community?

_____

_____

32. What do you not like about this community?

_____

_____

33. Do you get involved in social and cultural activities in your community?

□ Yes □ No

34. What do you do outside of your normal job?

1. _____
2. _____

3. _____
4. _____
5. _____

35. Which of those activities are about engaging with your community?

_____
_____
_____

36. What are the main concerns in your community?

_____
_____
_____

37. How has your community handled moments of crisis?

_____
_____
_____

38. Do you belong to an organization?

□ Yes □ No

39. If yes, what organization do you belong? _____

40. Is this organization related to fisheries?

□ Yes □ No

41. What kind of support do you receive from your organization?

□ Higher catch price □ Support against a sickness □ Support during adverse climate seasons □ Credits for equipment □ No support □ Other _____

42. Which organization has a positive influence in your community? (Check all that apply)

□ Municipality □ Federal government □ Cooperative □ Permit holder

□ NGOs □ None

What do you think your community will look like 10 years from now?

_____

_____

_____

Appendix A4.2. Questionnaire Recruitment Letter

My name is Alicia Saldaña Millán, and I am a graduate student in the Department of Geography at the Memorial University of Newfoundland in Canada. I am conducting a research project called *Viability and Vulnerability of Small-Scale Fisheries: A Participatory Diagnostic Approach* for my master's degree under the supervision of Dr. Ratana Chuenpagdee. The purpose of the study is to understand what viability and vulnerability means for small-scale fisheries and what affects it.

The present study is not connected with any local committees, fishing cooperative, the government/department of fisheries or any other organization; and your participation will not be reported to any members or authorities in any group or organization.

I am contacting you to invite you to participate in an interview using a structured questionnaire, in which you will be asked to provide information about what viability and vulnerability means to you and, according to your opinion, what factors either enhance or ameliorate viability and vulnerability in your fishing activity. The interview will take around 30 min to one hour, and will be conducted at a convenient place of your choice. Note that you can skip any questions that you do not wish to answer, and you can stop the interview at any time without needing to explain why, and without any consequence.

All the information you provide will be anonymous and confidential and only my supervisor and I are authorized to have access to your information. This study will not reveal your identity as any name or description of your physical appearance will be reveal, instead, I will use a code for managing the data analysis. The total information from participants will be aggregated. I might take photographs of your equipment, only if you give me consent, yet, I do not intend to publish information of a private or personal nature in any of the products of this study.

If you are interested in participating in the study, please contact me to arrange a meeting time.

If you have any questions about me or my project, please contact me by email at asaldanamill@mun.ca or by phone at (695) 108 7800.

Thank-you in advance for considering my request,

Alicia Saldaña Millán

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as your rights as a participant, you may contact the Chairperson of the ICEHR at icehr.chair@mun.ca or by telephone at 709-864-2861.

Appendix A4.3. Questionnaire Consent Form

Title: Viability and Vulnerability of Small-Scale Fisheries: A Participatory Diagnostic Approach

Researcher: Alicia Saldaña Millán
Department of Geography
Memorial University
asaldanamill@mun.ca

Supervisor: Dr. Ratana Chuenpagdee
Department of Geography
Memorial University
ratanac@mun.ca

You are invited to take part in a research project entitled 'Viability and Vulnerability of Small-Scale Fisheries: A Participatory Diagnostic Approach'.

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is part of the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact the researcher, Alicia Saldaña Millán, if you have any questions about the study or more information not included here before you consent.

The present study is not connected with any local committees, fishing cooperative, the government/department of fisheries or any other organization; and that participation will not be reported to any members or authorities in any group or organization.

It is entirely up to you to decide whether to take part in this research. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction

I am a graduate student from Memorial University of Newfoundland in St. John's Canada. As part of my Masters' thesis, I am conducting research under the supervision of Dr. Ratana

Chuenpagdee. The research is part of a project named Too Big To Ignore, which is a global partnership for small-scale fisheries research and intends to address the meaning of viability and vulnerability for small-scale fishers and their relationship as an integrated concept, using a participatory diagnostic approach. This research is based on the belief that efforts to address the concerns of small-scale fisheries often come from outside of the community, based on lessons and experiences in other locations. However, these pre-determined methods could make implicit assumptions about the nature of impacts and threats being experienced by local people, which may not reflect well what and how the communities feel. Considering that local communities need to be part of any effort to promote sustainability, we propose that the meaning and sources of vulnerability as well as the opportunities for enhancing viability be understood from their perspective.

Purpose of the study:
You are invited to participate in this study by answering a set of questions related to your fishing activity that take place in the region. The objective of this questionnaire is to obtain your perspective regarding viability and vulnerability issues in fisheries, what these issues means to you and what factors are important to consider when addressing viability and vulnerability in small-scale fisheries. This questionnaire also intends to gather demographic characteristics of the local fisheries, your fishing practices and your connection to fisheries livelihoods.

Length of time:
The completion of the questionnaire is expected to take around 30 min to one hour.

Withdrawal from the study:
Participation is completely voluntary, and respondents can exercise their right to withdraw from the study if they whish to, as well as any information they have provided, at any point while data is being collected. To stop and/or end involvement in the data collection, the participant can communicate to the researcher the willingness to stop and/or end the involvement in study. Data collected up to the point of a participant's withdrawal will be destroyed. Participants also can skip any questions that they do not wish to answer. There are no consequences associated to the participants' withdrawal from the study.

Possible benefits:
This research intends to provide practical potential benefits to Sisal fishing community of Yucatan, Mexico. Participants will have the opportunity to share knowledge about what viability and vulnerability means to them and the factors they perceive causes vulnerability and allow viability in their fishing activity. As for the scientific community, this research intends to fill a knowledge gap that exists concerning the relationship that may exist

between viability and vulnerability concepts (conceptual contribution), as well as the implementation of methods that allow capturing the meaning of viability and vulnerability to fishing people and the factors that impact on their livelihoods (methodological contribution). With this study, I hope to provide insights for governance interventions that align with the actual needs of the small-scale fishery under study.

Possible risks:
There are no potential risks of being involved in the study.

Confidentiality:
Confidentiality is ensuring that identities of participants are accessible only to those authorized to have access. Privacy of participants will be maintained and identity kept confidential, and this will be achieved as it follows:

- No personal information will be collected that may directly reveal the identities of participants (e.g. name of the person or description of physical appearance);
- The returned questionnaires will be coded using identification numbers;
- Sorting and ordering data will be numerically transformed and recorded in a spreadsheet for further analysis;
- Information about the participants will be aggregated;
- Overall, data released will not contain names, initials or other directly identifying information, as it will be about the community as whole, not about individual opinions.
- If the participant gives permission, I intend to take photographs of participant's fishing equipment which may be included in academic product as part of the fishery system description. Nonetheless, I do not intend to publish information of a private or personal nature during this study.

Anonymity:
Anonymity refers to not disclosing participant's identifying characteristics, such as name or description of physical appearance. The interview will be conducted without writing any names on the questionnaire. Instead, there will be a document that link personal/contact information of the participant and their respective code. Thus, for questionnaire application, transcript, analyses, and consequent stages in the research will be manage under a specific

code. This information will be keep secured in encrypted computers and will be only available to the principal researcher and the supervisor. All primary data collected during this questionnaire will be retained for a minimum of five years, as per Memorial University's policy on Integrity in Scholarly Research. Every reasonable effort will be made to ensure the participant's anonymity, and they will not be identified in any reports and publications. If it is the case, participants will also be sent copies of any draft research material containing their comments and will have an opportunity to verify, vet, or withdraw comments prior to publication. Because the participants for this research project will be selected from a small community and there will be a workshop deliberation, residents have the knowledge to identify participants in this study. However, no sensitive information will be asked either during questionnaires nor in the workshop and I will take special care not to publish any material that can be used directly or indirectly to link sensitive information with individuals.

Recording of data:
Apart from the written records, I intend to record audio while the interview is conducting, as long as you give permission to audio record your responses. Additionally, if appropriate, through this consent form I am also requesting permission for photographing boats and fishing gears. Note that any boat's visual information will keep confidential, thus, it will not be display publicly. However, all the information provided will be used only for the principal investigator and the project supervisor.

Storage of data:
Recorded questionnaires will be downloaded immediately to MUN laptop computers containing the required encryption software. The recording transcriptions will be kept on secure laptops (encrypted). Transcripts and coded data will be kept secure location at all times. No names or identifiers will be used in transcriptions or tapes –a numerical code will be assigned to individuals who accept to be part of the study and will be kept in a locked data storage facility in the research supervisor's office (International Coastal Network housed in the Bruneau Centre). As per Memorial University's policy on Integrity in Scholarly Research, all primary data resulting from this research will be retained for a minimum of 5 years, before being destroyed. This material will only be accessible to the principal researcher and the project supervisor.

Sharing results with participants:
By the end of the first phase of the data collection, findings such as the built list of factors (gathered at the individual level together with the principal researcher's list and literature review list of factors) will be presented in an open workshop. I encourage you to voluntary participate in this open workshop which will be held in a known location of your fishing

community. The purpose of this workshop will be information dissemination (shared in an aggregated form) and discussion. Open invitation to this workshop will be also by oral means and by posting remainders in your landing site, thus, you will be aware of this event. All materials produced by this research, including publications and visual material, will be made publicly available on the Too Big To Ignore project website [http://toobigtoignore.net/] and will be available to anyone interested. As study findings will be published in my master's thesis which will be publicly available via the QEII library http://collections.mun.ca/cdm/search
/collection/theses].

Questions:

You are welcome to ask questions at any time during your participation in this research. If you would like more information about this study, please contact:
Researcher: Alicia Saldaña Millán
Email: asaldanamill@mun.ca. Phone number: +52 695 108 7800
Supervisor: Dr. Ratana Chuenpagdee
Email: ratanac@mun.ca

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Consent:

Your signature on this form means that:

- You have read the information about the research.
- You have been able to ask questions about this study.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw participation in the study without having to give a reason, and that doing so will not affect you now or in the future.
- You understand that if you choose to end participation during data collection, any data collected from you up to that point will be retained by the researcher, unless you indicate otherwise.
- You understand that your data is being collected anonymously and therefore cannot be removed once data collection has ended.

I agree to be photographed ☐ Yes ☐ No

I allow data collected from me to be archived in International Coastal Network housed in the Bruneau Centre ☐ Yes ☐ No

By signing this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Your Signature Confirms:

☐ I have read what this study is about and understood the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.

☐ I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.

☐ A copy of this Informed Consent Form has been given to me for my records.

_____ _____

Signature of Participant Date

Researcher's Signature:

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

_____ _____

Signature of Principal Investigator Date

Appendix A4.4. Workshop Informed Consent Form

Title: Viability and Vulnerability of Small-Scale Fisheries: A Participatory Diagnostic Approach

Researcher(s): Alicia Saldaña Millán
Department of Geography
Memorial University
asaldanamill@mun.ca

Supervisor(s): Dr. Ratana Chuenpagdee
Department of Geography
Memorial University
ratanac@mun.ca

You are invited to take part in a research project entitled *"*Viability and Vulnerability of Small-Scale Fisheries: A Participatory Diagnostic Approach ".

This form is part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. It also describes your right to withdraw from the study. In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. This is the informed consent process. Take time to read this carefully and to understand the information given to you. Please contact the researcher, Alicia Saldaña Millán, if you have any questions about the study or would like more information before you consent.

The present study is not connected with any local committees, fishing cooperative, the government/department of fisheries or any other organization; and that participation will not be reported to any members or authorities in any group or organization.

It is entirely up to you to decide whether to take part in this research. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction:

I am a graduate student from Memorial University of Newfoundland in St. John's Canada. As part of my Masters' thesis, I am conducting research under the supervision of Dr. Ratana Chuenpagdee. The research is part of a project named Too Big To Ignore, which is a global partnership for small-scale fisheries research and intends to address the meaning of viability and vulnerability for small-scale fishers and their relationship as an integrated concept, using a participatory diagnostic approach. This research is based on the belief that efforts to address the concerns of small-scale fisheries often come from outside of the community, based on lessons and experiences in other locations. However, these pre-determined methods could make implicit assumptions about the nature of impacts and threats being experienced by local people, which may not reflect well what and how the communities feel. Considering that local communities need to be part of any effort to promote sustainability, we propose that the meaning and sources of vulnerability as well as the opportunities for enhancing viability be understood from their perspective.

Purpose of Study:

You are invited to participate in a public workshop which intend to dissemitate and discusse information gathered at an early stage of this research. The workshop aims at identifying and ranking issues and opportunities, as well as sharing possible solutions to the problems found in your fishing community. This form has the purpose of stating some of the ethical issues derived from your participation in this workshop.

What You Will Do in this Study:

Your participation in this workshop will be based on applying and assessing a list of factors that create vulnerability and viability in your fishing activity. This list will be an aggregated form of three principal list obtained in the field before (e.g. the list built from literature review, from an in-person questionnaire survey, and from field observation). The workshop will be held as a group discussion, which will include the following three exercises:

1) Populating the list. The allocation of the factors from the list in the different domains using in this study (natural, economic, social, institutional and technological).

2) Applying/ assessing the list. In exercise will be carried out in small groups in order to make a self-assessment, prioritizing those factors through ranking scores. The

aim of this exercise is to define which of those factors are more important as well as the discussions of why some factors worth a higher value than others.

3) Problem identification/solving. Once participants identify their sources of vulnerability and viability, are expected to launch the possible solutions their conditions.

Length of Time:

The completion of the questionnaire is expected to take around four hours.

Withdrawal from the Study:

Participation is completely free and voluntary, and respondents can exercise their right to withdraw from the study if they whish to, as well as any information they have provided, at any point while data is being collected. To stop and/or end involvement in the data collection, the participant can communicate to the researcher the willingness to stop and/or end the involvement in study. Data collected up to the point of a participant's withdrawal will be destroyed. Participants also can skip any questions that they do not wish to answer. There are no consequences associated to the participants' withdrawal from the study.

Possible Benefits:

This research aims to provide practical potential benefits to Sisal fishing community of Yucatan, Mexico. People related to fisheries that wish to participate in this workshop will have the opportunity to share knowledge about the meaning of viability and vulnerability to them as well as the factors they perceive causes vulnerability and allow viability in their fishing activity. One of the most important benefits that people can obtain from this workshop will be te empowerment for solving problems that they have identified in their activity.

As for the scientific community, this research intends to fill a knowledge gap that exists concerning the relationship that may exist between viability and vulnerability concepts (conceptual contribution), as well as the verification of the methodology applied to capture the meaning of viability and vulnerability to fishing people and the factors that impact on their livelihoods (methodological contribution). After finalizing this study, I expect to obtain insights for governance interventions that align with the actual needs of the small-scale fishery under study.

Possible Risks:

Potential social risks have been identified of being involved in the study, which are exposed as follows:

- This workshop will be based on discussion and interaction with other peers of your fishing community. Given the nature of the exercises, it will be hard to achieve anonymity and confidentiality of your participation. However, no sensitive information will be asked to discuss in the workshop and, I will take special care with all the shared information.

- Although participants could be easily recognized by their peers during the workshop, all efforts for not publishing any material that can be used directly or indirectly linked with participants will be made.

- No names or identifiers will be used in information derived from discussions. Information provided during registration and discussion will be kept secured according to the protection policies in order to ensure privacy at all times. Such information will only be accessible to the principal researcher and the project supervisor, and it will be stored in a secure location for five years, as per Memorial University's policy on Integrity in Scholarly Research.

Confidentiality:

Confidentiality is ensuring that identities of participants are accessible only to those authorized to have access (researcher and supervisor). Altough there are limits to maintiain the participants' confidentiality during the workshop, the confidentiality of their participation after the workshop can indeed be achieved by safeguarding participants' identities, personal information, and data from unauthorized access, use, or disclosure. Privacy of participants will be maintained and identity kept confidential, and this will be achieved as it follows:

- No personal information will be recorded that may directly reveal the identities of participants (e.g. name of the person or description of physical appearance);

- Information about people's participation will be presented in an aggregated form;

- Overall, data released will not contain names, initials or other directly identifying information, as it will be about the community as whole, not about individual opinions.

- If the participant grants permission, I intend to take photographs during the workshop in order to document of the event. Nonetheless, I do not intend to publish information of a private or personal nature during this study. If the participants do not wish to be target of photographs they are in their right of withdrawing by requesting to the principal investigator.

Anonymity:

Anonymity refers to protecting participants' identifying characteristics, such as name or description of physical appearance. Because the participants for the workshop are from a small group of people, all of whom are known to each other, it is possible that you may be identifiable to other people on the basis of what you have said, thus, participants' anonymity cannot be guaranteed. However, every reasonable effort will be made to ensure your anonymity in reports after this workshop, as information provided by members of this fishing communitys will be reported in an aggregated form and without identifiers.

Recording of Data:

Apart from the written records, and of your permission is granted, I intend to photographing the workshop session in order to document the event. All the information provided will be used only for the principal investigator and the project supervisor.

Use, Access, Ownership, and Storage of Data:

All data gathered from the workshop will be downloaded immediately to MUN laptop computers containing the required encryption software. Information will be kept secure location at all times. No names or identifiers will be used in records and will be kept in a locked data storage facility in the research supervisor's office (International Coastal Network housed in the Bruneau Centre). Data will be kept for a minimum of five years, as required by Memorial University's policy on Integrity in Scholarly Research, before being destroyed. This material will only be accessible to the principal researcher and the project supervisor.

Reporting of Results:

All materials produced by this research, including publications and visual material, will be published in my master's thesis which will be publicly available via the QEII library

http://collections.mun.ca/cdm/search/collection/theses]. Additionally, results will be made publicly available on the Too Big To Ignore project website [http://toobigtoignore.net/] and will be available to anyone interested.

Sharing of Results with Participants:

One phase of the results (findings such as the built list of factors gathered at the individual level), will be shared sharing with participants though this open workshop. This open workshop will be held with the purpose of information dissemination and discussion. By the end of this study, a report will be shared. This report will contain the results of the entire research in a clear manner in order to achieve the results dissemination to fishers of Sisal community.

Questions:

You are welcome to ask questions at any time during your participation in this research. If you would like more information about this study, please contact:
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E-mail: asaldanamill@mun.ca. Phone number: +52 695 108 7800
Supervisor: Dr. Ratana Chuenpagdee
E-mail: ratanac@mun.ca

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Consent:

Your signature on this form means that:

- You have read the information about the research.
- You have been able to ask questions about this study.
- You are satisfied with the answers to all your questions.
- You understand what the study is about and what you will be doing.

- You understand that you are free to withdraw participation in the study without having to give a reason, and that doing so will not affect you now or in the future.
- You understand that if you choose to end participation during data collection, any data collected from you up to that point will be retained by the researcher, unless you indicate otherwise.
- You understand that your data is being collected anonymously and therefore cannot be removed once data collection has ended.

I agree to be photographed	☐ Yes	☐ No
I allow data collected from me to be archived in International Coastal Network housed in the Bruneau Centre	☐ Yes	☐ No

By signing this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Your Signature Confirms:

☐ I have read what this study is about and understood the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.

☐ I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation.

☐ A copy of this Informed Consent Form has been given to me for my records.

_____ _____

Signature of Participant Date

Researcher's Signature:

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

_____ _____

Signature of Principal Investigator Date

Appendix A4.5. Scores of Responses

No.	Question	Very severe	Moderately severe	Less severe
1	How damaging is having low/no profits for small-scale fisheries in Sisal?			
2	How damaging is the limited access [opportunity] to direct markets for small-scale fisheries in Sisal?			
3	How damaging is the increase in fuel price for small-scale fisheries in Sisal?			
4	How damaging are the natural restrictions of resource availability (migration, spawning) for small-scale fisheries in Sisal?			
5	How damaging are red tides for small-scale fisheries in Sisal?			
6	How damaging is the lack of social support from peers for small-scale fisheries in Sisal?			
7	How damaging is bad weather for small-scale fisheries in Sisal?			
8	How damaging is the lack of interaction between fishers and government for small-scale fisheries in Sisal?			
9	How damaging is the fluctuation in the price of catches for small-scale fisheries in Sisal?			
10	How damaging is having old engines for small-scale fisheries in Sisal?			
11	How damaging is the high dependency on private sources of funding for fishing operations for small-scale fisheries in Sisal?			
12	How damaging is having new-comers who do not follow local norms for small-scale fisheries in Sisal?			
13	How damaging is not having money to replace/repair engines for small-scale fisheries in Sisal?			

14	How risky is the lack of security equipment on board (VHF radios, lifejacket) for small-scale fisheries in Sisal?			
15	How damaging is the violation of fishing closures for small-scale fisheries?			

Appendix A4.6. Vulnerability factors per domain mentioned by the crewmembers and the captains during the self-diagnostic part in Sisal fishing community.

Natural	Cp	Cr	Tot	Social	Cp	Cr	Tot	Economic	Cp	Cr	Tot	Institutional	Cp	Cr	Tot	Technological	Cp	Cr	Tot
Bad climate conditions	22	21	**43**	Lack of respect for regulations	12	13	**25**	Lack/No income	13	23	**36**	Lack of subsidies	14	7	**21**	Lack of security equipment	11	8	**19**
Resource decrease	6	10	**16**	High predation	5	11	**16**	Increase in fuel price	3	10	**13**	Uselessness of grouper subsidies	6	12	**18**	Old fishing equipment	6	6	**12**
Red tides	4	10	**14**	Alcohol and drugs abuse	4	7	**11**	Market demand out of season	4	8	**12**	Lack of government projects	9	8	**17**	Equipment breakdowns	2	5	**7**
Natural resource migration	1	8	**9**	High people migration	6	4	**10**	Lack of direct markets	11	0	**11**	Poor subsidies allocation to fishers	8	8	**16**	Impacts by technological improvements	3	4	**7**
Strong ocean currents	4	5	**9**	Lack of financial support from financiers	0	9	**9**	High inputs cost	0	9	**9**	Lack of dissemination of subsidies-related information	5	9	**14**	Increase in the number of boats	3	3	**6**
Uncertainty	1	3	**4**	Lack of health insurance	5	4	**9**	Bad fuel quality	4	4	**8**	High level of corruption	8	6	**14**	Competition with small-scale fleets from other ports	1	4	**5**
Loss ecosystem of shrimp	1	1	**2**	Lack of general support from permit-holder	5	4	**9**	Economic impacts due to diving	4	4	**8**	Lack of communication between fishers and the government	6	7	**13**	Competition with large-scale fleet	1	3	**4**
				Increase in number of fishers	3	5	**8**	Scale/weight robbery at landings	0	7	**7**	Lack of temporal employment	8	5	**13**	Lack of own equipment	0	3	**3**
				Lack of fishers' organization	2	5	**7**	Control of fish price	3	2	**5**	Long closed fishing seasons	6	6	**12**				
				Waste of money	3	4	**7**	Lack of money for fishing equipment repair	4	0	**4**	Lack of dredging of the fishing harbor	8	4	**12**				
				Lack of support from peers	5	2	**7**	Lack of profits at year end	0	3	**3**	Lack of employment diversification	3	8	**11**				

Equipment and fuel robbery	4	2	**6**	Fish price variation	2	0	**2**	Lack of support from the Nautical Committee	5	5	**10**
Risk of death	1	3	**4**					Lack of government commitments	5	4	**9**
Lack of social acceptance	1	3	**4**					Lack of access to subsidies by independent fishers	5	3	**8**
Presence of negative people	2	1	**3**					Vested interest of cooperative administrators	5	3	**8**
Favoritism between financiers and fishers	0	2	**2**					Vested interest of the Nautical Committee	4	3	**7**
Monopolization	1	1	**2**					Selling of fishing equipment by cooperative members	4	3	**7**
Dependency of private companies	1	1	**2**					Lack of compliance	1	3	**4**
								Temporary ban for Hookah method	4	0	**4**
								Bad government	3	0	**3**
								Lack of conservation-related courses	0	1	**1**

Cr= crewmembers; Cp= Captains; Tot= Total

Appendix A5.1. Questionnaire Post-harvest

In responding to this questionnaire, consider that you can skip any questions that you do not wish to answer, including demographic questions. You are free to withdraw from the study at any time. Just inform the researcher of your desire to stop. There will be no consequences associated with withdrawal from this study.

Viability and vulnerability in small-scale fisheries

A questionnaire for gender component

No.___ Fishing port _____

Date_____ Genre _____

Duration_____ Target group _____

A) Demographic characteristics

1. Where are you from?

   □ Sisal □ Hunucmá □ Mérida □ Tetiz □ Other location _____

2. How long have you been living here? _____ years

3. What is your age?

   □ 19-25 □ 26-35 □ 36-45 □ 46-55 □ 56- 65 □ >65

4. Which is your highest level of formal education?

   □ Never studied □ Bachelor (_____)

   □ Primary school (____) □ Certificate (_____)

□ Secondary school (___)

□ Trade school (____)

□ High school (____)

□ Masters (_____)

□ PhD (_____)

5. How many people depend on you for their livelihoods? _____ people
6. Is there another income provider in your family?

   □ Yes □ No If yes, who else provides income in your family? _____

7. What are your primary and secondary occupations that provide you more income?

   (Mark P= primary, S= secondary)

   □ *Pachochear* (vessel cleaning, fish evisceration)

   □ Fish collection centre

   □ Small fish-trading

   □ Household fried fish selling

   □ Restaurant services

   □ Housewives

   □ Other local jobs _____

B) Fishing related practices –pre- and post-harvest

8. Do you perform your activity in company with other members?

   □ Yes, has her/his team (informal) □ No, does the job by her/himself

   □ Other_____

9. If yes, how big is the team? _____ people
10. Is your team part of your family?

    □ Yes □ No If yes, which members of your family? _____

11. From whom do you receive fishing product?

    □ From different fishers □ From one specific fisher □ Other _____

C) Connection to fishing livelihoods

12. Do you come from a fishing family?

□ Yes □ No

13. Currently, are there fishers in your family?

□ Yes □ No If yes, what is the relationship you have with these fishers?

_____

14. How many years have you been involved in this fishing related activity? _____ years

15. What was the reason for you to start doing this activity? (Check all that apply)

□ Economic need

□ Enjoyment of the activity

□ Lack of economic alternatives

□ Other _____

16. Do you practice this activity the entire year?

□ Yes, does the activity throughout the year □ No, does the activity seasonally

□ Other _____

D) Viability and vulnerability at individual level

17. Why are you still doing this fishing related activity?

_____

_____

_____

18. Have you ever thought about leaving your activity?

□ Yes □ No Why?

_____

_____

19. For how long do you think you will stay doing this activity? _____years
Why? _____

_____

20. Are you happy/satisfied in your activity?

□ Yes □ No Why? _____

_____

_____

21. What could be a better scenario for you to obtain better benefits out of your activity?

_____

_____

22. What are the main concerns in your family, in general?

_____

_____

_____

23. How do you handle these concerns?

_____

_____

_____

24. According to the following domains, which factors positively impact your activity?

Natural	**Social**	**Economic**	**Institutional**	**Technological**
(e.g. high catch)	**(e.g. good organization)**	**(e.g. profits)**	**(e.g. have receive economic support for business)**	**(e.g. storage facilities)**

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

25. Considering the following domains, which factors negatively impact your activity?

Natural	**Social**	**Economic**	**Institutional**	**Technological**
(e.g. decrease in catch)	**(e.g. lack of organization)**	**(e.g. decrease in profits)**	**(e.g. Lack of economic support)**	**(e.g. not storage facilities)**
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

E) Viability and vulnerability at a community level

26. Do you feel that you belong to this community?

□ Yes □ No Why? _____

27. Do you feel strong ties in your community?

□ Yes □ No If not, why?

_____

_____

28. What do you like about this community?

_____
_____

29. What do you not like about this community?

_____
_____

30. Do you get involved in social and cultural activities in your community?

□ Yes □ No

31. What do you do outside of your normal job?

6. _____
7. _____
8. _____
9. _____
10. _____

32. Which of those activities are about engaging with your community?

_____
_____
_____

33. What are the main concerns in your community?

_____
_____
_____

34. How has your community handled moments of crisis?

_____
_____
_____

35. Do you belong to an organization?

□ Yes □ No

36. If yes, to what organization do you belong? _____

37. Is this organization related to fisheries?

□ Yes □ No

38. What kind of support do you receive from your organization?

□ Lower catch price □ Support against a sickness □ Support during adverse climate seasons □ Credits for business □ No support □ Other _____

39. Which organization has a positive influence in your community? (Check all that apply)

□ Municipality □ Federal government □ Cooperative □ Permit holder

□ NGOs □ None

40. What do you think your community will look like 10 years from now?

_____

_____

_____

Appendix A5.2. List of vulnerability factors populated across the five domains by the captains engaged in harvest activities in small-scale fisheries in Sisal.

Captains									
Natural	*Freq*	*Social*	*Freq*	*Economic*	*Freq*	*Institutional*	*Freq*	*Technological*	*Freq*
Bad climate conditions	22	Lack of respect for regulations	12	Lack/No income	13	Lack of subsidies	14	Lack of security equipment	11
Resource decrease	6	High people migration	6	Lack of direct markets	11	Lack of government projects	9	Old fishing equipment	6
Red tides	4	High predation	5	Market demand out of season	4	Poor subsidies allocation to fishers	8	Impacts by technological improvements	3
Strong ocean currents	4	Lack of health insurance	5	Bad fuel quality	4	High level of corruption	8	Increase in the number of boats	3
Natural resource migration	1	Lack of general support from permit-holder	5	Economic impacts due to diving	4	Lack of temporal employment	8	Equipment breakdowns	2
Uncertainty	1	Lack of support from peers	5	Lack of money for fishing equipment repair	4	Lack of dredging of the fishing harbor	8	Competition with small-scale fleets from other ports	1
Loss ecosystem of shrimp	1	Alcohol and drugs consumption	4	Increase in fuel price	3	Uselessness of grouper subsidies	6	Competition with large-scale fleet	1
		Equipment and fuel robbery	4	Control of fish price	3	Lack of communication between fishers and the government	6		
		Increase in number of fishers	3	Fish price variation	2	Long closed fishing seasons	6		
		Waste of money	3			Lack of subsidies-related news dissemination	5		

	Lack of fishers' organization	2	Lack of support from the Nautical Committee	5
	Presence of negative people	2	Lack of comply of government commitments	5
	Risk of death	1	Lack of access to subsidies by independent fishers	5
	Lack of social acceptance	1	Vested interest of cooperative administrators	5
	Monopolization	1	Vested interest of the Nautical Committee	4
	Dependency of private companies	1	Selling of fishing equipment by cooperative members	4
			Temporary ban for Hookah method	4
			Lack of employment diversification	3
			Bad government	3
			Lack of compliance	1

Table A5.3. List of vulnerability factors populated across the five domains by the women engaged in postharvest activities in small-scale fisheries in Sisal.

Women involved in post-harvest									
Natural	*Freq*	*Social*	*Freq*	*Economic*	*Freq*	*Institutional*	*Freq*	*Technological*	*Freq*
No fishing due to bad weather	26	No benefits to constant pachocheras	12	Low income in certain seasons	22	Lack of support for business	8	Lack of refrigerators/freezers	10
Fish scarcity (natural behavior)	13	Lack of selling from the main storage	9	Higher prices in main storage	18	Lack of support in the fishing harbor	6	Lack of transportation means (mototaxi/tricycle)	7
Red tides	4	Cheating to fishers	7	Public transportation expenses	8	Closed fishing seasons	5	Lack of infrastructure in working area	3
Cold weather	3	Problems with other *pachocheras*	7	Less service when fishing is low	8	Uneven subsidies allocation	2	Power outage	3
		Rude fishers	7	High electricity costs	7	Lack of subsidies-related news dissemination	2		
		Bad reputation as *pachochera*	6	Main storage does not buy any kind of fish	5	Lack of permit for commercialization	1		
		Lack of ice during no fishing times	5	Need to buy coal	5				
		Prostitution	5	High propane gas consumption	4				
		Lack of public health insurance	5	High expenses in refrigerator reparations	3				

Lack product consumption during red tides	3	Lack of economic capital	2
Lack of family support	3		
Problems with financiers	2		
Lack of trust from fishers (fish weighting)	2		
Lack compromise of fishers as suppliers	2		
Need to get fish products from other fishing	1		