Chapter 10
Addressing Vulnerability: Coping Strategies of Fishing Communities in Yucatan, Mexico

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Abstract In this chapter, we present a case study from Yucatan, Mexico. The main hazards that fisher groups are confronted with in coastal areas are explored, as well as the coping strategies fishers have developed to face them. We also investigate the sense of well-being according to fishers' perceptions, and contrast with the level of marginalization reported in official records. Our findings suggest that fishers do not consider themselves poor, as long as they have access to fishing. Fishing gives them food security, but declining catches and other factors beyond their control, such as increase in the frequency of hurricanes and red tides, also expose them to risk and vulnerability. Several social and political issues generate concern among fishers as well. They employ proactive and reactive strategies at the individual and community levels to face those challenges. However, our research discovered that there are differences between communities and groups of fishers regarding those strategies. We contend that socio-economic conditions and levels of organization influence the ways fishers develop coping strategies. We discuss our findings in light of strategies that can be promoted to improve adaptive capacity of fishers in coastal communities, averting them from vulnerable conditions.

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10.1 Introduction

In Mexico, 90% of the national fishing fleet is comprised of small-scale boats between 8 and 12 m long, and close to 300,000 people depend on small-scale fisheries (Fernández et al. in press). In Yucatan, this sector generates about 15,000 direct jobs. The relevance of the fishing activity lies on its contribution as a source of jobs, food and foreign currency. However, as in other regions, fishing also carries its own risks, given the uncertainty of resource availability, hostile environmental conditions and increase in market demands. The latter has been an incentive to remain in fishing (and sometimes violate regulations) as long as there is a buyer. This condition also brings newcomers into the activity, increasing competition in the coastal areas (Sethi et al. 2005; Seijo et al. 2009).

In the last decade, declining catches in Mexico, and in Yucatan in particular, have brought concerns to those who depend on fishing. This situation has been associated with different factors, as suggested by several authors (Fernández et al. in press; Fraga et al. 2008; Mexicano-Cíntora et al. 2009). Such factors include increasing fishing pressure, habitat deterioration and ineffective management practices. In addition, fishers argue that a surge in frequency and intensity of phenomena like hurricanes and red tides in recent years has contributed to augment the stress of fishers. For instance, hurricanes can have an impact on their assets, their activities and their personal life. As in the case of red tides, fishing operations are reduced as fish die or move away during such a phenomenon, reducing caches. The demand for sea food also decreases when this phenomenon occurs. The situation of stress has also been exacerbated by the entry of newcomers who, on a temporary or permanent basis, increase the pressure on the already limited resources. The results are rent dissipation and local conflicts, which affect the livelihoods of fishers (Salas et al. 2007).

All these conditions can increase the sense of vulnerability, and threaten people with poverty conditions (OECD 2001; Béné 2009). Fishers are highly dependent on fishing resources and the health of the marine environment. Consequently, any change in these conditions may affect their livelihoods in ways that are detrimental to them. How people cope and recover from stress and shocks varies, and is partly context dependent (Cinner and Pollnac 2004). Thus, coping strategies are framed by people's circumstances and the options available to them within the communities they live in. One factor to be reckoned with is how fishing communities are organized and the extent to which fishers cooperate, especially under conditions of stress.

In Yucatan, there are three forms of organizational strategies which are available for fishers to utilize, and which may influence their reactions to conditions of crises. First, fishers can operate independently and individually; that is, they do not have any organizational affiliation and are therefore basically on their own when a crisis hits. Second, in some communities fishers belong to producer cooperatives, which may provide support in times of crisis. Third, some fishers run their own business enterprises; that is, they have people employed either in processing and/or as fishers, and have therefore some kind of responsibility for the welfare of others during a crisis.

In light of this, we were interested to investigate how these different strategies affect how fishers cope with the above noted challenges. In order to do this, we studied two neighboring communities: San Felipe and Dzilam de Bravo. These are relevant case studies, since fishers have opted for quite different organizational strategies in each case. In San Felipe, the majority of fishers are mainly cooperative fishers, while independent fishers dominate the organizational landscape in Dzilam de Bravo. We explored these issues by asking the following questions: (1) How do people perceive poverty conditions and which conditions generate for them a sense of vulnerability? (2) How do the different groups of targeted fishers perceive the impact of hazards that can affect their livelihoods? (3) How does each group deal with vulnerability?

In this chapter, we first introduce the theoretical framework used for our analysis associated with poverty, vulnerability and coping strategies. Next, we describe the research methods and the characteristics of the two communities and fisher groups targeted. We report our results and discuss our findings in light of what kind of strategies can be promoted to improve the adaptive capacity of fishers – to improve the livelihood conditions for people from coastal communities, averting them from vulnerable conditions and hence from poverty.

10.2 Theoretical Framework

Poverty is a complex matter as underlined by a large body of literature, and particularly in the context of small-scale fisheries several authors have addressed issues on this matter (OECD 2001; Macfadyen and Corcoran 2002; Béné 2003, 2009; Fafchamps 2003; Béné et al. 2007; Fisher and Christopher 2007; Thorpe et al. 2007; Olmos et al. 2008; Seijo et al. 2009). One of the main issues when dealing with poverty alleviation has been to define indicators that can account for poverty reduction policies; however, "changing the numbers" of some of those indicators could give a false idea of improving conditions. In many cases, the indicators related mainly to income, and gross enrolments are somewhat the basis to define short-term policy changes. However, as stated by Thorpe et al. (2007), fishers can be very vulnerable given their lifestyle (which could involve several activities in addition to fishing) and the pressure that exogenous shocks (storms, hurricanes, tsunamis) can impose on them. Hence, economic evaluation of fishers' households alone cannot properly portray actual conditions regarding poverty.

According to the human development index (PNUD 2009), Mexico ranks 53rd, way below other Latin American and Asian countries. At a national level, the coastal and rural areas are considered to have limited livelihood standards; Yucatan ranks 19th out of the 32 Mexican states. In Yucatan, 51% of the population is suffering from income poverty, 26% of them have limited skills to get out of poverty, and 44% do not have access to health services (Pérez 2009). Only 3 out of 106 municipalities scored high on the human development index by 2005 (Pérez 2009). These indicators give an idea of the poverty situation in the region. However, this index does not necessarily

apply equally to all sectors. Even within its own sector, fishers are a heterogeneous group, and some are poorer or more vulnerable than others. This circumstance brings up questions about how different groups of fishers perceive poverty, and which factors make them more vulnerable and at risk of becoming poor. It is also relevant to understand what kind of coping strategies people develop in order to face hazards that engender vulnerability. Those strategies are complex and diverse, and they can vary by social group, household, gender and the way they are organized (Bærenholdt and Aarsæther 1998; Béné 2009). In this context, the concepts of vulnerability, coping strategies and resiliency become relevant to understand how people from coastal areas have been facing different types of disturbances that may expose them to poverty.

Chambers (1989) defines vulnerability as the condition under which people feel helpless, insecure and exposed to risk, shocks and stress. Several authors (cited by Béné 2009) define this concept as a factor that is comprised of three components: exposure to risk, susceptibility and adaptive capacity. Under circumstances where people feel vulnerable, they develop strategies that make them master, tolerate or minimize stress (Chambers 1989; Jóhannesson et al. 2003; Clay and Olson 2008; Jiménez-Badillo 2008). According to several authors, poverty and vulnerability may constrain a fisher's ability to engage with state policies oriented to promote resource conservation (i.e. Adams et al. 2004; Allison et al. 2006; Fisher and Christopher 2007; Olmos et al. 2008).

In this context, it is important to stress that, even if poverty and vulnerability are linked, they are not necessarily the same. As stated by Béné (2009), not always the poorer are the most vulnerable. Furthermore, a program that aims at reducing poverty would not necessarily reduce vulnerability, but the contrary may apply (Macfadyen and Corcoran 2002; Béné and Friend 2011). Hence, in order to ensure sustainable fisheries, it is important to find under which circumstances people can best solve these matters in a way that promotes sustainability for their socio-ecological system. How such a socio-ecological system responds to different sources of stress, i.e. social, political or environmental change, and how such stress may affect fishers' situations are key issues. In addition, it is important to ask to what extent and in what form the two issues may be linked.

When a system can respond without suffering long-term damage or modification, it can be defined as resilient (Adger 2000; Gunderson 2000, 2002; Janssen et al. 2007; Gibbs 2009). Resilience has to do with the system's adaptive capacity, which is the ability to deal with change and disturbance (internal and exogenous) through learning, knowledge sharing and responding to feedbacks (Gunderson 2000; Fabricius et al. 2007). The higher the system's adaptive capacity, the more resilient it will be (Smith and Wandel 2006). When facing hazards, people tend to modify their behavior by generating strategies to cope not only with immediate problems; sometimes this can also generate a more robust socio-ecological system (Adger 2000, 2006; Folke 2006; Gallopín 2006; Janssen et al. 2007). However, one risk with adaptations is the possibility of accepting things "the way they are" as normal.

In this chapter, we will lean on Fafchamps (2003) classification of coping strategies as ex ante (proactive) and ex post (reactive) strategies, depending on how the system responds to the stressors. The former is in place before a shock has occurred,

while the latter takes place afterward. According to Macfadyen and Corcoran (2002), proactive strategies include a set of preventative actions in order to reduce vulnerability. Reactive strategies include changes in livelihood activities that can solve the problem in the short term; however, they often increase vulnerability in the medium and long term. Reactive strategies are generally the first response when facing hazards, and through a learning process the adaptation can lead to proactive actions. The process is dynamic and both strategies are not exclusive. Under those conditions, people can also be creative and innovative in their choice of strategies (Bærenholdt and Aarsæther 1998). This innovation can be based on building social networks and cultural identity, which in turn can build adaptive capacity.

Networking can be developed over time, but can also be strengthened by cooperative processes. In this context, the generation of fishing cooperatives throughout the world has had different outcomes with mixed success (Jentoft and Davis 1993; Jentoft and Sandersen 1996; Råkjær Nielsen et al. 2004). However, there are also examples of how they can improve the development of social capital, in addition to facilitating members' access to material goods (Bjørkan 2005; Halpern 2005). Here, we understand social capital as an abstract property of relationship which facilitates cooperative action (Bourdieu and Wacquant 1992; Halpern 2005). Accordingly, social capital plays an important role in people's coping strategies, especially with regard to networking and cooperation (Bærenholdt and Aarsæther 1998).

10.3 Methodological Approach

From previous work in Yucatan, we are aware of the heterogeneity that characterizes the fishing communities in the region. Despite the fact that people have fishing as the main activity, target the same fishing resources and operate under the same fishing regulations, they still display significant differences in the way they deal with environmental challenges and undertake their fishing activities. We chose two neighboring communities – Dzilam de Bravo (DB) and San Felipe (SF) (Fig. 10.1) – which share many features, including the same fishing grounds. Still, they differ in the level of social and community organization (Salas and Pitcher 1999; Fraga et al. 2005), which makes an interesting contrast for this study.

A key difference between the two communities is the organizational landscape. In SF, the dominant organizational alternative for fishers is the cooperative. This is a political force with strong ties to the local government. Two fishing cooperatives operate in the SF community. In DB, the permit holders are the strongest political group, and the majority of fishers that work in the area are independent fishers who work on their own or get hired by permit holders. Only a small fishing cooperative exists in this area. Many of the independent fishers are migrants from other regions who mainly participate in the octopus fishery. This is a very crew-demanding fishery, and involves low travel and investment costs. This fishery is more accessible for migrants than others, as it does not require many skills. During the octopus season, firm owners depend on a high number of fishers; many come from rural inland areas or even from other states.

Fig. 10.1 Locations of the fishing communities San Felipe (SF) and Dzilam de Bravo (DB) in Yucatan, Mexico

Table 10.1 Characteristics of fisher groups interviewed in San Felipe and Dzilam de Bravo

Cooperative fishers	Independent fishers	Firm owners
Belong to an organization that holds the fishing permits and owns the boats	Work independently	They own boats and most fish-processing plants
They commit to comply with cooperative rules and get the benefits of being a member of the organization	Some of them can hold a fishing permit and own their own boats to work on their own; others get hired to work on other people's boats, which are mainly owned by firm owners	This allows them to participate in the extraction and commercialization process of the products at different levels
The organization sells their products directly or through the firm owners	Those who own a permit and a boat can sell their product to fishing cooperatives or to firm owners	

The three types of fishing participants organized under three different schemes in Yucatan are described in Table 10.1. While the fishers are understood as a homogenous group at the national level, fishing groups can differ in how they are organized, and also in the approach they follow to cope with stressors. Hence, we took as a basic premise the idea presented by Thorpe et al. (2007) – that fishers' households/communities are unequally vulnerable to stressors. We defined three groups (as presented in Table 10.1) as our target in this study.

According to the National Institute of Statistics, Geography and Informatics (INEGI 2005), the populations in DB and SF are 2,248 and 1,838 respectively, with a high percentage of people dedicated to fishing (75% in SF, and 65% in DB). In both communities, fishing is combined with other activities like tourism, ranching and agriculture, but the level of diversification among fishers is not homogeneous (Fraga et al. 2005).

We estimated a marginality index to obtain socio-economic indicators using the Stratification Technique that is generally used by INEGI (Dalenius and Hodges 1959).

Hence, this index was obtained by groups in contrast to a global value from the whole community as official records report.

To gather information in the field, we interviewed fishers in their homes, landing sites and processing plants, using semi-structured interviews and participatory observations (Bråten 2002; Ingles and Sepez 2007). A total of 101 fishers were interviewed in SF, and 159 in DB, having close to 10% of fishers from each community represented in the sample. We applied questionnaires to the three target groups defined in Table 10.1: cooperative fishers, independent fishers and firm owners.

We divided the survey questions into three main components related to: (a) fisher's perception on poverty and sense of well-being; (b) factors that generate a sense of vulnerability; and (c) coping strategies developed by fishers to face different shocks or hazards. For the first issue, we asked fishers if they considered poverty as a problem for them and their community; evaluated official indicators on marginalization; and explored perception of fishers regarding factors that provide a sense of well-being.

For the second issue, we evaluated vulnerability in terms of exposure to shocks that can affect fishers' livelihoods; what means they have to make a living; and what resources they depend on.

As to the third issue, we evaluated at an individual and a community level the strategies fishers have developed to face vulnerability. We applied content analysis to integrate information from the interviews for further evaluations. To compare information between communities, and among groups of fishers within the same communities, we employed a one-way randomization test of significance of pseudo F values through the statistical software R.

We also used information from scientific literature, technical reports and official statistics to determine the current status of resources and assess official marginalization indicators. In addition, a member of our research team spent about 6 weeks in each community making participatory observations.

10.4 Results

10.4.1 Poverty Conditions: The Official Picture and the Heterogeneous Reality

The indicators of marginalization reported by the Council of National Population (Consejo Nacional de Población, CONAPO) are frequently used by Mexican government agencies as a reference to evaluate the level of poverty in local communities, and to define poverty reduction interventions. We used the same technique as used by CONAPO to obtain the marginality indicators for the target groups we had selected. The purpose of doing this was to evaluate if the indicators applied to the whole community could be equivalent for all groups within the community.

As it can be observed in Table 10.2, according to official indicators, people in DB have a lower level of marginalization than those from SF. However, when we

Table 10.2 Socio-economic indicators, marginality index (MI) and marginality level (ML) for fishers in Dzilam de Bravo (DB) and San Felipe (SF) by target group: IF = independent fishers; COOP = fishers from cooperatives; FO = firm owners

			Interviewed fishers		IF[b]		COOP[c]		FO[d]	
	DB[a]	SF[a]	DB	SF	DB	SF	DB	SF	DB	SF
Population	2,248	1,838	159	101	119	41	24	55	16	5
Illiterate population above 15 years	6.9	6.7	9.7	6.4	12.9	4.8	0	7.3	0	0
Population above 15 years w/o elementary completed	33.0	38.9	41.0	38.2	53.6	46.5	46.6	32.7	8.16	0
People w/o sewage or sanitation in their houses	5.1	1.9	16.0	2.1	20.5	2.5	7.1	0	0	0
People w/o power in their houses	1.3	3.5	2.3	2.1	3.1	2.5	0	0	0	0
People in houses w/o drinking water	2.0	2.6	3.2	2.08	3.2	2.5	5.9	0	0	0
People in houses w/dirt floor	1.3	1.9	8.9	0	11.1	0	5.3	0	0	0
MI	−0.7	−0.6	−0.3	−0.7	−0.2	−0.4	−0.5	−0.8	−1.4	−1.5
ML	L	M	M	M	H	M	M	L	VL	VL

[a]Defined by CONAPO, other values estimated by the authors

[b]The total number of independent fishers is unknown but there are more independent fishers in DB than in SF

[c]In SF, there are two cooperatives; in DB there is one fishing cooperative

[d]16/22 firm owners in DB, 5/5 firm owners in SF. Range value for indicators: VL = very low (−2.366: −1.221); L = low (−1.220: −0.649); M = medium (−0.648: −0.077); H = high (−0.077:1.066) (INEGI 2005)

analyze the information by target group, we observe differences among them; a higher level of marginalization in DB for independent fishers is evident. For this group, the higher values of most socio-economic indicators show more disadvantageous conditions than in the case of other groups within the same community. This is even more prominent with regard to their level of education and living conditions – this group has a higher level of analphabetism (13%) than the general level in the community (6.9%).

In contrast, housing and education for the group of firm owners in both communities show a lower level of marginalization than the other groups; actually their index performs better than the population in general. Importantly, this shows that the fishers are a heterogeneous group – both within a community and between neighboring communities. The results in the "big picture," reported in official records, may be influenced by the weight of firm owners and ranchers in the community.

Despite official marginalization and socio-economic indicators demonstrating a certain level of poverty in the communities studied, close to 70% of the fishers that we interviewed do not define themselves as poor. However, many consider poverty as a problem in their communities. There were more people recognizing problems of this nature in DB (8 out of 10) than in SF (3 out of 10).

When fishers talk about poverty, they usually compare themselves with the inland communities nearby (people from rural areas, defined locally as "pueblos"): "*At least we can go out and fish for food, while in the pueblos, there is not money even to get food*!" Such remarks were typical in both communities. Official reports also confirm that in general terms, coastal communities have a better standard of living than rural inland communities in Yucatan (POETCY 2007).

These results make one wonder what it means to be poor for fishers in SF and DB. In both communities, poverty is perceived as an extreme situation, mainly defined by a lack of, or limited access to, food. Hence, working as a fisher is in itself a coping strategy to avoid poverty, since by fishing they have at least something to feed their families with. However, they recognize that their standard of living could be better if they could improve on other indicators such as income, health, education and access to other occupational opportunities.

Associated with income, the decline of fishing resources was an expressed concern by members from both communities. They see this situation aggravated by the immigration of people from rural and urban areas, looking for a source of income at the coast. Competition for limited resources has therefore increased lately. Lack of livelihood alternatives was reported as the most crucial issue. Having access to health services and education was defined by most respondents as the second concern in both communities. Interestingly, when fishers were asked if they considered participation in decision-making relating to resource management and community organization as relevant issues, most local fishers did not appear to value those issues highly. However, independent fishers (migrants) from DB expressed feelings of being rejected by local members of the community, and therefore felt unable to participate in local decisions, which for them generated a sense of vulnerability.

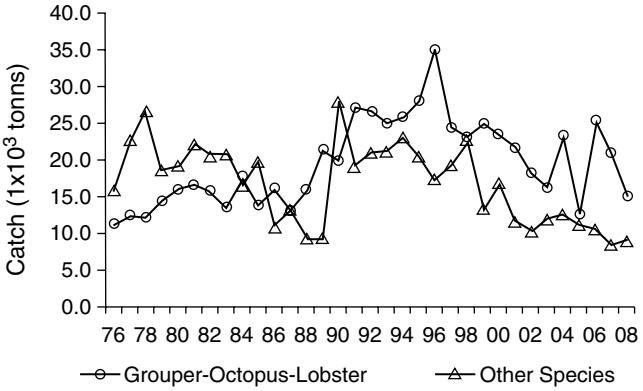

Fig. 10.2 Catch trends of main fishing resources (grouper, lobster and octopus) and other species caught in Yucatan from 1976 to 2008 (Source: 1976–1989 SAGARPA. Cuentas Mensuales de Oficina Regional. Subdelegación de Pesca. Delegación Federal en Yucatán. 1990–2007. Anuarios Estadísticos de Pesca)

10.4.2 Vulnerability

One of our aims here was to understand fishers' own perceptions about what factors increase their sense of vulnerability. Based on questionnaires and interviews, we were able to determine three areas of main concern: (a) resource availability given high variability in catches of main fishing resources, e.g. octopus, grouper and lobster, associated with governance issues (illegal fishing due to lack of compliance related to limited enforcement); (b) environmental factors (increased frequency and intensity of hurricanes, prevalence of red tides and strong winds); and (c) socio-economic issues (low fish price, increase in social problems).

The fishing resources in Yucatan include close to 60 species, but the economy of fishers depends largely on only a few of them (octopus, lobster, grouper and demersal fishes related to grouper). If fishers generally consider good and bad years and fluctuating catches as an intrinsic characteristic of the fishing activity, in the last decade they have noticed a decline in catch of the most important resources (Fig. 10.2). These conditions have also been reported by government institutions. Stock biomass reductions of grouper, lobster and other demersal resources have been reported by several scientists (Burgos and Defeo 2004; Salas et al. 2006; Solana et al. 2006; Ríos–Lara and Salas 2009). The critical condition of fishing resources was pointed out by all respondents in both communities as one of the most important sources of vulnerability they perceived.

The main reference fishers have in order to determine the status of their fishing resources is the volume of catches and number of species caught over time. However, the reasons people gave differ regarding why catches have decreased in the two communities. While in DB 56% of our informants associated lower catches with an increase in fishing pressure (due to an increase in newcomers), in SF only 36% of them agreed on this as a cause.

It is important to point out that a higher proportion of migrant people have arrived into DB than in SF. For instance, one of the interviewed fishers in DB stated: "*There are too many fishing boats chasing every day more limited resources.*" Although fishers in SF acknowledge that there has been an increase in coastal population and hence fishing pressure, they argue that environmental factors have also deteriorated the habitat of fishing resources, and that this could have an increased negative effect on fishing. In SF, more people (54%) placed a higher weight on environmental factors impacting their catches; they also complained about how those factors can limit the number of fishing days.

Beside the impact on fishing resources in both communities, hurricanes are perceived as a major threat to fishers' assets (boats, houses, community infrastructure and health).[1] The north winds and red tides were defined as the next most important environmental factors that affect fishers in both communities.[2] Red tide has an impact on the economy of fishers, not only because of the limitation on the fishing days, but also due to the customers' tendency to buy less seafood after such an incident.

At least one-third of our informants in both communities did not relate to social factors as a potential source of shock that could generate personal vulnerability. However, when we asked fishers about the impact on the community, their perception changed. For instance, alcoholism was pointed out as a common problem in both communities. Garbage disposal was mentioned by a third of the fishers interviewed in DB as one of the main problems (generating diseases), while in SF the equivalent proportion of people (30%) referred to drug consumption as a big community problem.

An increase in drug consumption, especially among the young, is becoming a major concern in SF. Few fishers from the SF cooperative mentioned their limited options for negotiating prices with the middlepersons as a factor that could generate vulnerability.[3]

Political conflicts were mentioned as a source of division between groups of fishers (between 6% and 7% in DB and SF communities, respectively); they inferred that in some cases different preferences for one political party could create conflicts even among family members. In Mexico, three political parties, PAN, PRI and PRD, have dominated.[4] It is not an everyday matter which party you vote on: according to

[1]Catch reduction was mentioned as one of the main concerns associated with those phenomena. This can happen while limiting them to operate during those days (cost of not fishing) and also because demersal fishing resources move away, as the sea bottom gets damaged by those impacts. Fishers also associate an increase in human diseases during the passage of hurricanes.

[2]The increase in frequency of hurricanes in the last decade in the region has been reported by several authors (Salas et al. 2007; Fraga et al. 2008; Mexicano-Cíntora et al. 2009), as well as an increase in frequency of red tides (Herrera-Silveira et al. 2004). This also coincides with the perception of fishers. In SF, fishers (57%) state that hurricanes have increased in intensity and frequency.

[3]This is remarkable because the social relationship between fishers and middlepersons is not based on supply and demand, but rather on debts fishers have with the buyer, so they have limited capacity to bargain. In short, fishers have a complex relationship with the middlepersons, where trust is an important dimension, while the middlepersons still gain more in terms of income.

[4]These are acronyms for Partido Accion Nacional (PAN); Partido Revolucionario Institucional (PRI); Partido de la Revolucion Democratica (PRD).

the informants, after the elections, the party in power tends to favour their followers with financial support through governmental programs. The conflicts generated by these conditions have become an increasing concern especially in SF.

In DB, on the other hand, rejection toward migrant people who arrive into the community is now considered to be a social problem. Migrants hardly get the chance to be integrated, mainly due to their different cultural backgrounds and because they are held responsible for most illegal activities that affect fishing resources.

To summarize, in both communities the main sense of vulnerability expressed was related to declining catches due to both natural hazards and fishing pressure. How severe the impact is from different sources is not totally clear, and it differs among fishing communities and groups of fishers. With regard to the social context, alcohol and drugs consumption was reported as a common problem generating worries at the community level. Such addictions are perceived to reduce peoples' capacity to save money and increase conflicts. Other sources of conflict had to do with political preferences, which can affect the construction of social capital in the communities. All these elements generate some propensity to reduce adaptive capacity and promote vulnerability.

10.4.3 Coping Strategies: How to Maintain Secure Livelihoods

According to official statistics (CONAPO 2005), people in Yucatan's coastal communities face a number of poverty problems such as inferior health services, fewer employment alternatives and limited access to education. Our study shows that vulnerability generated by factors like overfishing, natural hazards and social problems can be a concern of its own in addition to the indicators defined by CONAPO. As reported above, such stressors force people to develop strategies to keep vulnerability, and therefore poverty, at bay.

At an individual level, fishers from both communities use a range of strategies to secure their everyday lives. These strategies can be adapted through time when circumstances change. This adaptive capacity is what defines their vulnerability to shocks (Folke 2006; Smith and Wandel 2006). Taking as a base the concept of strategies (ex ante or proactive, and ex post or reactive strategies) defined by Fafchamps (2003), we observe this type of behavior in the studied target groups in both communities. As referred earlier, the ex ante strategies include a set of preventative actions in order to reduce vulnerability before a shock has occurred, whereas the ex post strategies include activities after a shock has occurred (Macfadyen and Corcoran 2002).

The data show that in comparison to other groups, firm owners have developed more ex ante strategies. All firm owners in SF, and close to 60% in DB, apply these types of strategies. These can include lending money to cooperative or independent fishers, which provides them with future bargaining power; in addition, they make their own savings (Table 10.3). It can also be said that cooperative fishers have an advantage over independent fishers, as belonging to an organization means that they will obtain some support from this organization in case of need. Thus, being a member of a cooperative is an ex ante strategy in itself.

Table 10.3 Individual coping strategies of fisher groups from San Felipe and Dzilam de Bravo

Strategies	Dzilam de Bravo (% fishers)			San Felipe (% fishers)		
Ex ante	IF	COOP	FO	IF	COOP	FO
Saving	11.3	9.5	15.8	5.6	19.3	80
Alternative activity [a]	0.0	0.0	15.8	0.0	3.5	0
Complementary activity [a]	15.4	9.5	21.1	5.6	26.3	0
Lending money to workers	0	0	5.3	0	0	20
Subtotal	26.8	19	57.9	11.1	49.1	100
Ex post						
Alternative activity [b]	28.9	28.6	21.1	38.9	15.8	0
Complementary activity [b]	11.3	14.3	0	16.7	8.8	0
Migration	2.1	4.8	0	5.6	5.3	0
Expenses reduction	7.2	23.8	5.1	16.5	10.5	0
Government support (food, temporal work programs)	7.3	00	0.0	8.3	1.8	0
Borrowing money (family, cooperative, middlepersons)	16.5	9.5	15.8	2.8	8.8	0
Subtotal	73.2	81	42.1	88.9	50.9	0

[a] Without external support

[b] With external support (government programs or borrowing money from middlepersons)

Despite the fact that they get less money for their catch, the cooperative provides members with important benefits which include medical and life insurance, a bonus at the end of the year, and funerary expenses in case of death. The end of the year bonus represents a form of saving for fishers. This helps them to obtain assets for their activity, to improve living conditions or to face times of crises, such as hurricanes or low catch season. Saving is also an important strategy developed by fishers in both communities for sending kids to school, as they do not want them to get into fishing given current conditions. In SF, 19% of fishers used this strategy. Interestingly, independent fishers from DB reported using saving as a strategy (11.3%) more than cooperative fishers (9.5%) in DB. This is because many of the independent fishers come from other regions, and either they want to save money to be able to get their own boats, get integrated into other activities or send money to relatives in other places.

Saving was a declared ex ante strategy reported in SF among cooperative fishers and independent fishers (Table 10.3). They indicated that they save money in order to be able to invest in complementary or alternative activities to maintain their livelihoods during periods of low catches. Some fishers also report saving as a strategy to send their kids to school out of town. Occupational plurality is an important ex ante strategy, as it allows for diversification of livelihood.

Another interesting issue came up in the interviews: Given that people are evacuated if there is a hurricane alert in their community, fishers with saved up money can afford to rent a house. This is an alternative to mass shelters, and their families can be more comfortable during the evacuation and recovery period.

Ex post strategies dominated among independent fishers in both communities (73.2% and 88.9% in DB and SF, respectively). Fishers who use these strategies generally have less means to support themselves and to respond to shocks.

They acknowledge high dependency on government or firm owners. Under those conditions, they are also unable to save money given the debt commitments they have with firm owners, which also limit their ability to negotiate fish prices. Pomeroy et al. (2006), Cinner et al. (2009), and Béné and Friend (2011) report examples of similar social traps in which people find limitations to mobilize the necessary resources to overcome either shocks or low-income situations, and consequently remain in conditions that weaken their status even more, including the possibility to fall into, or remain in, poverty.

As stated by Thorpe et al. (2007), fishing is just one component of the portfolio of activities to support fishers' livelihoods. Within this scheme, undertaking complementary or alternative activities (ranching, tourism, aquaculture or setting up a grocery store) was observed as a common strategy among fishers who develop ex ante and ex post coping strategies. The difference is in who provides the financial support to undertake such activities. For instance, 26.3% of fishers from cooperatives in San Felipe developed complementary activities without external support (government, relatives, firm owners), while 28.6% of fishers from cooperatives from DB undertook alternative activities encouraged and supported by government programs. Even if people in both cases see the advantages of having another source of income different from fishing, those from SF save money to invest in alternatives, while those from DB only do so if there is external support offered to them.

Interestingly, between 2% and 5% of fishers from cooperatives and independent fishers indicated that the best option to get out of crises is to migrate to another place and look for a different livelihood. Several fishers underlined that they do not want their children to become fishers, as they do not see a good future in this activity. This is becoming a common statement of fishers in several regions of the country (Fraga et al. 2008; Jiménez-Badillo 2008).

10.4.4 Networking and Cooperation

When looking into collective strategies, we used the dimensions defined by Bærenholdt and Aarsæther (1998) – namely networking, identity formation and innovation. The identity dimension in our case study can be understood in the sense of belonging, and this is related to the access to resources and dealing with newcomers. This is important according to our informants, since they relate the decline in fisheries, and hence in their income, to the increasing number of immigrants. Networking and cooperation appears to be an important strategy as well in the communities, especially in SF.

In both communities, fishers agree that belonging (identity) is important with regard to who should have access to fisheries, despite the official access regulations. Local fishers, especially in DB, argue that migrants do not have a sense of belonging, and therefore do not commit to protect the resources. The migrants are blamed for most of the illegal fishing activities. Firm owners in the same community, who

dominate the fishing activity, do not totally agree with those statements. This could be explained by the fact that many of the immigrants have been brought to DB from other regions by the firm owners themselves. In San Felipe, there are two cooperatives and only two firm owners. Here, the cooperatives have more political power in the community than the firm owners.

As mentioned earlier, *a sense of belonging* can define a willingness to cooperate, especially under stressful conditions. Cooperation processes are understood here as part of the networking developed by people under such conditions, or when they work toward common goals. This strategy seems to be important for both communities. Several of our informants in SF indicated that those who belong to the category *from here* seem to help each other out in times of crises. Cooperative actions in DB have also been reported by Salas and Pitcher (1999), where fishers form teams to go fishing during the windy season.

The teams are comprised of two or three fishers, who go fishing using their own boats, but when they get back to port they share their catches regardless of who brought in more. In this way, all members of the team can be sure to maintain an average catch that can provide viable income when strong windy conditions limit fishers' operations. The authors reported this strategy in the 1990s, and when we asked fishers in DB if the strategy remains, they confirmed that it is still in place. The cooperative agreements between members of the team involve mainly relatives or close friends.

Other examples of cooperation are the relationships built up among both coastal communities and some inland communities. These are trust-based agreements for providing mutual support: fishers can seek shelter within the inland communities during the hurricane season, while the people from those communities can go fishing seasonally to the fishers' fishing grounds, especially during the octopus fishing season.

The cooperative actions among fishers do not seem to be random, but rather part of a complex system of coping strategies, where belonging, networking and innovation are important ingredients in order to be less vulnerable. This, of course, is making people with less networks and "different identity" – such as independent fishers – more vulnerable and with fewer options.

10.4.5 Generating New Options and Innovative Coping Strategies

According to Pomeroy et al. (2006), fishers mix a number of strategies to cope, and these vary according to season, skills, access to capital, education and risk preference. As noted above, the reduction of income due to low catches and low prices of fish has forced fishers in both communities to search for alternative or complementary activities; search for new fishing grounds by going further; spend more time at sea; or even undertake illegal fishing activities.

In the search for new alternative activities that generate an income for fishers, tourism is becoming one of the most popular strategies. With tourism, fishers can

Fig. 10.3 San Felipe fishers with their catch. Waiting for the octopus fishery to open, they are targeting other species such as sharks

take advantage of the natural beauty of the region. In both communities, cooperative fishers and often elderly fishers have started to guide tourists to mangrove areas, beaches, sink holes, as well as birdwatching areas. There is also one tourist cooperative in each community that is established by cooperative fishers and by other members of the community. Women from the fishing cooperative that targets crab in SF as bait for octopus also provide these services. In SF, the cooperatives work together to provide the tourists with the necessary services. In DB, on the other hand, cooperative actions are more common among relatives.

Competition can also take place under conditions of uncertainty. During times of catch reduction, people have to find ways to get more for their invested time (Fig. 10.3). Since many fishing grounds close to shore have been less productive, fishers have started to search for new fishing grounds by going farther and fishing in deeper areas. These actions can be risky for all fishers, but especially for divers who fish lobster. Diving for longer periods in deeper waters and without careful regulations can have an impact in the short term, with potential increase in health problems in the long term.

Officially, from 2004 to 2009, 250 decompression accidents and five deaths have been reported in Yucatan associated with lobster diving (Fig. 10.4). These records may be underestimated, as many fishers do not go to the hyperbaric chamber unless they feel really bad; some mild bends do not receive medical attention. More cases

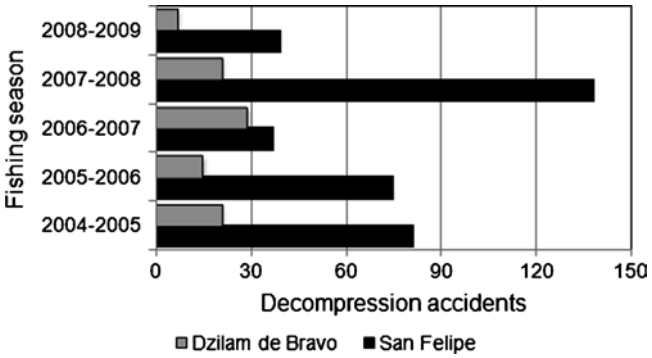

Fig. 10.4 Decompression accidents reported in San Felipe and Dzilam de Bravo between 2004 and 2009. Lobster fishery season (Source: IMSS: Unidad de Medicina Hiperbárica, Tizimín, Yucatan. Nov. 2009)

have been reported in SF than in DB, which can be related to a stronger diving tradition in this fishing community (Salas and Pitcher 1999).

The coping strategies employed by fishers also include illegal actions that can contribute to stock deterioration in the long term. In 2008, by the time we undertook the survey, the octopus (*Octopus maya*) fishing season was not generating good yield and fishers were claiming that their income was reduced at that time. Under such conditions, some fishers took the risk of fishing octopus by diving and employing a hook, which is a forbidden gear by regulations. Others employed chlorine to push the animals to leave their refuges. These actions have a tremendous impact on the habitat of fishing areas, especially on females during the incubation period. Females do not feed during this time, so they are generally not caught by the legal, traditional fishing method. The use of chlorine and hook facilitate the capture, which negatively impacts the female and the eggs she is guarding.

Another strategy with illegal implications is fishing for horseshoe crab (*Limulus polyphemus)* – considered a living fossil and protected by Mexican law. While the Longnose Spider Crab (*Libinia dubia*) is the preferred bait for octopus, some fishers turn to the horseshoe crab as an alternative when the former gets scarce. Interestingly, they use mobile phones and text messages as innovative techniques to contact potential buyers. This is risky, since fishing this crab is considered a federal crime and is penalized with high fines and jail. However, those who catch it are willing to take the risk to increase their incomes, or sometimes just to maintain it.

10.4.6 Governance Issues

The majority of fishers in both communities recognize that the sustainability of their fishing resources is threatened. However, they do not seem to perceive how they can contribute to a solution. Rather, it is expected that the Government will intervene

in order to solve their problems. Some local management initiatives have been taken by cooperative fishers from SF in an attempt to reduce such vulnerability. For example, one initiative is linked to the self-control to avoid fishing small lobsters during the recruitment process, so they do not fish during February, despite losing 1 month of the fishing season (August to February). Introduction of artificial habitats to improve lobster habitat was another action implemented by those fishers to generate habitat for lobsters, with the expectation of increasing production over the long term (Salas et al. 2008).

In SF, a strong tradition for community participation linked to resource management has been reported by several authors (Chuenpagdee et al. 2002; Fraga et al. 2005; Bjørkan 2006). This has also been linked to a high level of social capital, which facilitates problem-solving actions and improves the capacity to face challenges in the community. In DB, low social capital appears to be a condition that limits cooperative actions between community members. Several of our informants in DB explained that they do not participate in issues that concern the whole community, because there is little cohesion among its members. This condition was also reported by Arceo (2005). Under such conditions, fishers in this community have to search for options at an individual level if they want to diversify their activities or contribute to resource protection.

10.5 Discussion

Cinner et al. (2009) state that there are two main explanations for the generation of poverty conditions in small-scale fishing communities: the lack of alternatives outside the fishery sector; and resource overexploitation. Both of these factors may apply under the context of the communities we studied. Competition for limited resources can be exacerbated over time if newcomers continue to enter the fisheries, with the consequential impact on local people. These people, therefore, need to develop different strategies under changing conditions. Poor understanding of how they deal with variability and which factors generate a sense of vulnerability can limit public policies that attempt to mitigate the impact of different kinds of stressors and reduce poverty.

Béné (2009) points out the relevance of considering exposure to risk as a condition that increases vulnerability, and contributes to reinforce poverty. A combination of factors can trigger vulnerability. Macfadyen and Corcoran (2002) present some of them which, in most cases, apply to the communities we studied. Table 10.4 summarizes an adapted list of such factors.

Uncertainty has been an increasing issue in the fisheries in Yucatan due to different factors which include reduction in resource availability, limited capacity to negotiate fish prices and hence to save money and lack of cohesion in the communities or groups which limits the cooperation processes. All these factors can be aggravated by triggers such as increase in coastal population; increase in sea food demand; and increase in social problems such as alcohol, drugs and political conflicts which can reduce the capacity of people to cope with vulnerability.

Table 10.4 Factors linked to vulnerability in fishing communities and factors that contribute to increasing vulnerability

Factors linked to vulnerability	Vulnerability triggers
• Fishers are prone to suffer accidents, and generally have insufficient health services • High fluctuations in natural resources and increase in risky and uncertain conditions for the activity • High fluctuations in fish price, and fishers have limited capacity to bargain • Increase in cost of fishing operations, reduction of fishing days, income reduction • Conflicts, lack of cooperation • Limited capacity to save money, increase in conflicts in communities	• Reduction in catches provides incentives to fish farther and deeper • Increase in fishing pressure as the number of fishers is increased • Changes in the relationship between middleperson and fishers • Entrance of newcomers • Extreme weather conditions affects fishing resources and the fishing activity • Increase in social problems given income reduction, changes in political context, immigration • Alcohol and drug consumption, women adopting some addictions

The perception of what triggers vulnerability is similar among people in both communities. However, differences were evident in the way each group of fishers faced disturbances. We argue that the groups showed different adaptive capacity – ability for renewal and reorganization of the system followed by disturbance (Folke 2006, p. 259) as a result of different levels of flexibility and self-organization, which are necessary to build such capacity in a continuous development while facing change (Gunderson 2002; Folke 2006).

The marginalization indicators and the strategies developed by fishers suggest that both the cooperative and the independent fishers in DB are more vulnerable groups than firm owners and cooperative fishers in SF. While the cooperative fishers have a higher level of organization, the firm owners have better means to face challenges. Hence, these groups tend to develop more proactive strategies to face different types of hazards, and they perform better in light of the marginalization indicators which allocate them as less vulnerable groups.

According to Folke (2006, p. 261), social capital (including trust and networking) and social memory (including experience for dealing with changes) are essential for socio-ecological systems to adapt to and shape change. Livelihood assets and capabilities of the population to adapt are also linked to resilience (Allison and Ellis 2001; Plummer and Armitage 2007; Cinner et al. 2009). Therefore, the low level of organization and the lack of social cohesion in DB, which are especially evident in the relations between locals and migrants, could contribute to increase vulnerability, and hence to reduce resilience within this community.

Most fishers in DB recognize that population growth in coastal areas has imposed more pressure on natural resources. These conditions make people's livelihoods more vulnerable; however, this is outside community control. In the same way, the illegal strategies reported earlier, which can provide an income during periods of low catches, are deteriorating the ecosystem in the long term. These issues can aggravate fishers' vulnerability in the long term. Still, they do not seem to find a way

out of this vicious cycle, which reduces their capacity to face new challenges (Béné 2003; Venkatesh 2006; Béné et al. 2007; Cinner et al. 2009).

Identifying and characterizing the poor or vulnerable, their attitudes toward the conditions that generate such vulnerability, and how they face those challenges are crucial for designing and implementing actions to improve their situation, and to contribute to sustainability of natural resources (Adams et al. 2004; Fisher and Christopher 2007; Thorpe et al. 2007). While we found heterogeneity dominates small-scale fishers, government agencies that aim to reduce poverty tend to assume that poor, small-scale fishers are a homogeneous group (Pérez 2009). This means that they are ignoring the complexity of the heterogeneous group that the fisheries system comprises. Hence, it is essential to identify meaningful groups for policy and program actions (Thorpe et al. 2007; Olmos et al. 2008; Béné 2009; Béné and Friend 2011).

It is necessary to address sustainability of fisheries and deal with socio-economic problems to maintain sustainable communities. In this sense, temporary palliative solutions generated by government programs that encourage ex post strategies – predominantly developed by independent fishers in DB – cannot solve problems in the short term, but do not contribute to build resilient systems in the long term. In Yucatan, temporary jobs are one example of how to create incentives to generate ex post strategies. These jobs are central to fishers in times of crisis, as they can generate an income in the short term. Such times of crisis occur when hurricanes hit the coast, or during the closed season for grouper. However, this also creates a dependency, as now fishers do not cooperate unless there are economic incentives. These conditions reduce the possibility that fishing communities will build human and social capital, and furthermore increase resilience.

In order to break the cycles that generate dependence of fishers and instead promote adaptive capacity in the communities, it is necessary to acknowledge the link between social resilience and ecological resilience (Allison and Ellis 2001; Fafchamps 2003; Folke 2006; Janssen et al. 2007). We underline that the ability of ex ante strategies developed by several of the groups studied here had to do with a strong adaptive capacity. This capacity facilitates the development of strategies that allow them to increase, or at least to maintain, the quality of life while facing disturbances. They also appear to be searching for ways to deal with resource sustainability. It is natural that while facing conditions of stress, people respond reactively to solve immediate problems. However, there could be a risk getting trapped in a vicious cycle in which while trying to maintain an income, they respond mainly to immediate problems and hence they cannot build capacity to face new challenges, including resource deterioration, as suggested by Folke (2006) and Smith and Wandel (2006).

To guide efforts toward governance of the complex socio-ecological systems in which fisheries are embedded, we need to increase our understanding of the conditions that define fishers' strategies. This also applies to the interactions between the components of the socio-ecological system (Janssen et al. 2007). Based on the results of our study, we attempt to explain the interactions among different components of a conceptual model (Fig. 10.5). In this model, a combination of collective strategies (innovation, networking and identity formation) and individual strategies (ex ante and ex post) are understood as ways to deal with stress.

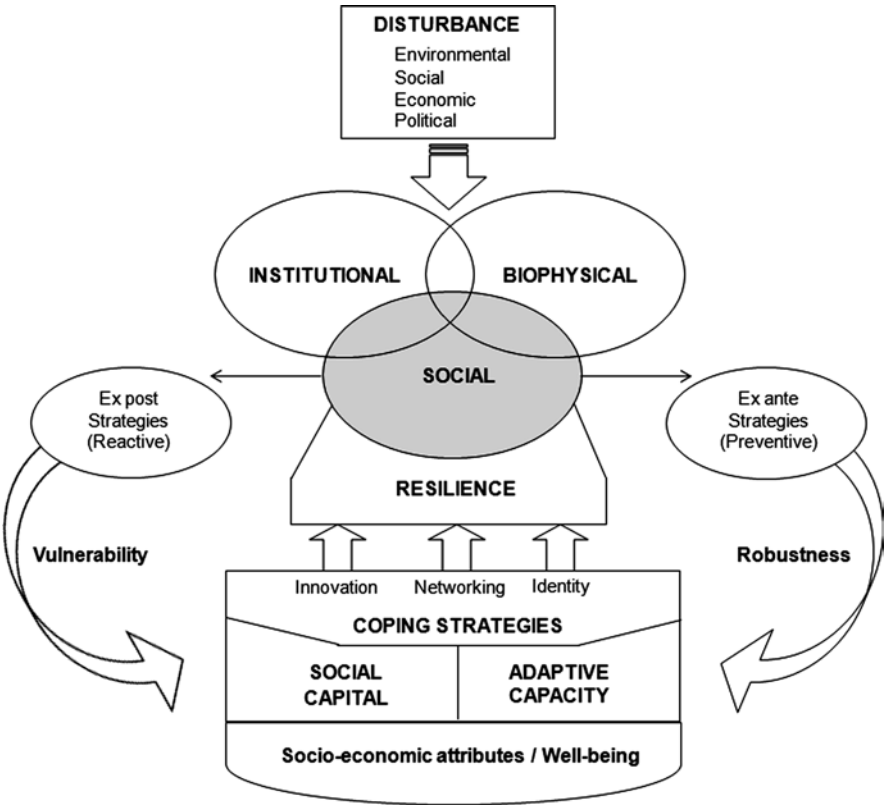

Fig. 10.5 Conceptual model of a social-ecological system that links social vulnerability and resilience to the coping strategies chosen by members of fishing communities

These strategies can be developed at the same time, or in alternative ways, as a dynamic process is in place.

The combination of strategies developed will define the level of adaptive capacity of the system. Socio-economic conditions within fishing communities, the level of organization of fisher groups, and the flexibility to adapt to changes can generate robust systems that can deal with the disturbances. We point out that ex ante strategies can contribute to building robust systems, while ex post strategies can expose the system to higher vulnerability in the long term. Social networks also represent an asset, as they can reduce transaction costs and increase trust among community members, thus building social capital (Schmid 2000).

We acknowledge that it is difficult to integrate a model that captures all potential interactions of a social ecological system. Here, we concentrate on the social system, not by dismissing the biophysical system, but because our study did not explore those issues directly. Despite this limitation, we consider that this can shed some light on the interactions within and between systems, and draw attention to how to promote a robust system that can favour higher resilience in coastal communities.

The model illustrates a path to increase adaptive capacity of communities (or groups). In this sense, resilience does not involve improving capacity only in the vulnerable groups; it also demands flexibility of the governance system.

Recognizing what kind of strategies people develop, and encouraging those that improve adaptive capacity of the groups and communities could lead to better forms of governance. In this sense, increasing social capital can improve people's abilities for self-organizing and for creating capacity; contribute to building resilience; and to develop more efficient ways to prevent people from falling into poverty conditions (Olmos et al. 2008; Béné and Friend 2011). It is important to define indicators that allow for understanding of the multiple socio-ecological interactions as well as the multiple sources of risk. These indicators could guide public policies and allow monitoring changes in the socio-ecological systems using an interdisciplinary approach considering social, political, economic and environmental issues (Ohl et al. 2007; Clay and Olson 2008).

10.6 Conclusions

Since fishers from SF and DB have access to food through their fishing activities, they do not consider themselves poor, despite acknowledging poverty issues in their community. They consider themselves in better condition than people from the rural sector. However, they acknowledge that they are vulnerable, due to different hazards and shocks they have been facing though time. Those hazards have recently increased both in frequency and intensity, negatively impacting their livelihoods. They report exogenous factors (i.e. hurricanes, red tides, entrance of newcomers, increasing competition) and endogenous factors (i.e. illegal fishing, limited opportunities to get an income outside fishing, different types of addictions), all of which represent potential sources of uncertainty, which can increase vulnerability.

At least 80% of fishers in DB and 30% of fishers in SF recognized poverty as a problem in their community, and acknowledged that better health services and education could help build up their sense of well-being at a community level.

Even though fishers from both communities, and different groups within the communities, share some problems, heterogeneity in terms of social and economic capacity affects significantly how these groups face the increasingly uncertain conditions related to their activities and lifestyle. In both communities, a combination of ex ante and ex post coping strategies has been developed among fishers to overcome exposure to vulnerable conditions. However, independent fishers (mainly migrant people) appear to be particularly vulnerable. This vulnerability can be worsened when community members in DB reject them. A key issue here is how to implement management programs to overcome vulnerability, and at the same time recognize the differences between groups to apply the programs accordingly. In light of the degradation of the resources fishers depend on and the heterogeneity of the groups, this becomes even more relevant.

In this context, the Mexican management framework needs to address these issues in order to move toward poverty reduction in coastal communities. While dealing

with poverty, Mexican policies have been oriented toward changing some numbers of marginality indicators. However, they do not address crucial issues related to vulnerability, which can also expose people to poverty. It is necessary to recognize that minimal steps to reduce marginalization cannot necessarily improve population welfare. Rather, it is essential to increase fishers' adaptive capacity to deal with the increasingly risky conditions that the fishery sector is facing, especially within the small-scale fisheries sector. In this context, it is fundamental to encourage ex ante strategies from fishers if an improvement in local conditions of coastal resources is the goal. Public policies need to be oriented to strengthen the capacity of coastal communities and elsewhere, using a long-term perspective.

Temporary palliative solutions cannot build resilient systems. The solution, at least in part, is to generate opportunities – improve skills and assets of communities and those of the institutions in charge of fisheries management. Intervention programs should acknowledge risk and uncertainty conditions within the fishing sector and fishing communities. This includes diversification of livelihoods, and development of contingency programs to overcome the increasing challenges coming from outside (meteorological factors, market demands, urban development, migration, among others). Those conditions can lead to building resilient socio-ecological systems. A wide range of social, economic, environmental and institutional factors define the complexity of these dynamic socio-ecological systems. Given that uncertainty cannot be eliminated, knowledge improvement in several fields is necessary (Seijo et al. 2009). A careful analysis that accounts for the diversity of groups that integrate these systems, and the factors both inside and outside the sector that promote vulnerable conditions which can drive people into the poverty trap are required.

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