Adaptation of Artisanal Fishers in the Context of Climate Change: The case of Costa Rica

Inspelen op klimaatverandering in de kleinschalige visserij: het geval van Costa Rica

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A mi amada madre, María Isabel: Fuerza transformadora.

Siempre fuerte y cálida como las olas caribeñas.

Gracias por ser un ejemplo de amor, libertad y coherencia.

A la memoria de mi querido abuelito: Papá Lingo.

Llevo en mi corazón sus ojos de mar tropical.

Virgen de Los Ángeles: Infinita gratitud por guiarme en el océano de la vida.

To my dear mother, María Isabel: a transformative force.

Always strong and warm like the waves of the Caribbean.

Thank you for being an example of love, freedom, and coherence.

To the memory of my beloved grandfather, *Papá Lingo*.

I keep in my heart the memory of your tropical sea-blue eyes.

Virgen de Los Ángeles: My infinite gratitude for guiding me through the ocean of life.

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Abstract

Climate change represents a major threat to artisanal fisheries worldwide (FAO, 2018a; Clemente Beyer, et al., 2019). The threat is heightened in Costa Rica, a country located in Central America, one of the most vulnerable regions in terms of climate (OAS, 2001; ECLAC, 2018). Historically, artisanal fishing is developed on both coasts of Costa Rica, in the provinces of Guanacaste, Puntarenas, and Limón. While fisheries hold a minor participation in the national economic structure as compared, for example, to agriculture or tourism, it is an essential source of income for coastal areas and contributes indirectly to tourism (Chévez & Campos, 2014). Costa Rica's artisanal fishing sector has been consistently neglected throughout history, motivated by government policies that tend to focus on the populous Central Valley and a national socioeconomic development model that promotes industrial fishing, tourism, and services (and, more recently, increasing pressure from the aquaculture sector) (FAO, 2016; UCR, 2018). Moreover, similar to other places in Latin America and even around the globe, artisanal fisheries in the country struggle with high levels of informality. In this context, this thesis aims to study the effects of climate change on Costa Rican artisanal fishers with a view to understanding how and to what extent they are able to adapt by examining their vulnerabilities, resilience, and adaptation.

The main objective of this research is to analyze climate change adaptation among Costa Rican artisanal fishers to understand how they perceive and implement the concept in their daily lives while already subject to the effects of climate change. Therefore, the main research question is: What does adaptation to climate change mean for Costa Rican artisanal fishers and their communities? To answer the main research question and to better understand the climate change adaptation experiences of artisanal fishers, this dissertation uses an analytical framework based on the concepts of vulnerability, resilience, and adaptation, as well as a qualitative methodology. Given that Costa Rica has two coasts with numerous fishing communities, a heterogeneous geography, and differing weather conditions, biodiversity, and socioeconomic development, the research focused on four communities (two on each coast) for methodological reasons regarding time and resources. Along the Caribbean coast, the communities of Cahuita and Barra del Colorado were selected as case studies; while on the Pacific coast, the study focused on Dominicalito and Cabuya.

At the outset of my study, I expected to find that climate change was a primary concern for artisanal fishers and that they were able to adapt to it or, at the very least, aimed or strived to do so. This expectation was partly based on the mainstream climate adaptation literature (Galappaththi et al., 2022), which suggests that fishers implement different adaptation strategies in the short, medium, and long terms. The strategies are meant to be implemented individually or collectively. This literature usually portrays climate change as an external, natural, and inevitable phenomenon (Mullenite, 2017) primarily based on present and future situations, which limits the understanding of the main causes of human vulnerability, capabilities, and adaptation. In these mainstream approaches, adaptation is mainly considered a standardized and monolithic

idea (Lövbrand et al., 2015; Goldman, et al., 2018), in which each group's context (historical, social, political, cultural, environmental, etc.) is excluded. As I progressed in my research, I discovered that climate change and adaptation are not top priorities for artisanal fishers, but rather they have other immediate concerns to resolve on a daily basis (Coulthard, 2012). I also found that depending on the context, climate change can be either a direct challenge or a multiplier of structural issues such as poverty, social inequality, and political marginalization that have historically affected the sector.

From a broader perspective, this research aims to analyze the social and political dimensions of climate change and its power dynamics. Climate change is a global driver that holds an important place on the international political, geopolitical, and scientific agenda, but it cannot be studied as an isolated and technical issue disconnected from the realities of local communities. Further studies must analyze how climate change interacts with political, economic, and even cultural aspects, with the understanding that despite mainstream political discourses that maintain climate change is an urgent topic, it is not always about climate change, and it is not always the main priority for every community.

Inspelen op klimaatverandering in de kleinschalige visserij: het geval van Costa Rica

Samenvatting

Klimaatverandering vormt wereldwijd een grote bedreiging voor de kleinschalige visserij (FAO, 2018a; Clemente Beyer et al., 2019). Het gevaar is extra groot in Costa Rica. Dit land ligt in Midden-Amerika, dat een van de kwetsbaarste gebieden is als het gaat om klimaatverandering (OAS, 2001; ECLAC, 2018). De kleinschalige visserij is in de loop van de geschiedenis ontstaan aan beide kusten van Costa Rica, in de provincies Guanacaste, Puntarenas en Limón. Hoewel visserij slechts een klein onderdeel is van de binnenlandse economie vergeleken met bijvoorbeeld landbouw en toerisme, vormt deze sector wel een belangrijke bron van inkomsten in de kustgebieden. Ook levert de visserij indirect een bijdrage aan het toerisme (Chévez & Campos, 2014). In de geschiedenis van Costa Rica is er nooit veel aandacht besteed aan de kleinschalige visserij. Het overheidsbeleid was meer gericht op de dichtbevolkte Centrale Vallei, en in het nationale sociaaleconomische ontwikkelingsmodel werden industriële visserij, toerisme en diensten gestimuleerd (recentelijk is ook de druk vanuit de aquacultuur toegenomen) (FAO, 2016; UCR, 2018). Bovendien heeft de Costa Ricaanse kleinschalige visserij te kampen met een hoge mate van informaliteit. Hetzelfde geldt voor andere landen in Latijns-Amerika en zelfs daarbuiten. Tegen deze achtergrond is onderzocht wat klimaatverandering betekent voor de Costa Ricaanse kleinschalige visserij. Om inzicht te krijgen in de wijze waarop en in welke mate vissers zich kunnen aanpassen, is hun kwetsbaarheid, veerkracht en aanpassingsvermogen onderzocht.

Het hoofddoel van dit onderzoek is om aanpassing aan klimaatverandering in de Costa Ricaanse kleinschalige visserij te onderzoeken om te begrijpen hoe vissers aankijken tegen dit verschijnsel en hiermee omgaan in het dagelijks leven, waarin de invloed van klimaatverandering al voelbaar is. De centrale onderzoeksvraag van dit proefschrift is daarom: *wat betekent aanpassing aan klimaatverandering voor Costa Ricaanse kleinschalige vissers en hun gemeenschappen?* Om de centrale onderzoeksvraag te beantwoorden en beter te begrijpen wat de aanpassing aan klimaatverandering in de praktijk betekent voor kleinschalige vissers, is een analytisch kader gebruikt op basis van de begrippen kwetsbaarheid, veerkracht en aanpassingsvermogen, en ook een kwalitatieve methodologie. Costa Rica heeft twee kusten met diverse vissersgemeenschappen. Aangezien de kusten verschillen in geografie, weersomstandigheden, biodiversiteit en sociaaleconomische ontwikkeling, zijn gemeenschappen aan beide kusten onderzocht. Vanwege de beschikbare tijd en middelen zijn in totaal vier gemeenschappen (aan elke kust twee) onderzocht. Aan de Caribische kust zijn de Cahuita en Barra del Colorado als casestudy onderzocht, en aan de kust van de Grote Oceaan zijn de Dominicalito en Cabuya onderzocht.

Aanvankelijk verwachtte ik dat kleinschalige vissers zeer bezorgd waren over klimaatverandering en dat ze zich eraan konden aanpassen, of dit in ieder geval probeerden en beoogden. Deze verwachting was deels gebaseerd op de literatuur op het gebied van klimaatadaptatie (Galappaththi et al., 2022). Daarin wordt beschreven dat vissers verschillende aanpassingsstrategieën hanteren op de korte, middellange en lange termijn. Dit kunnen

individuele of collectieve strategieën zijn. In de literatuur wordt klimaatverandering beschreven als een extern, natuurlijk en onvermijdelijk verschijnsel (Mullenite, 2017). Daarbij wordt uitgegaan van de huidige en toekomstige situatie, waardoor de hoofdoorzaken van menselijke kwetsbaarheid, capaciteiten en aanpassing onderbelicht blijven. In deze gevestigde benaderingen wordt aanpassing hoofdzakelijk opgevat als een gestandaardiseerd en monolithisch idee (Lövbrand et al., 2015; Goldman, et al., 2018), waarin de context van elke groep (op historisch, sociaal, politiek, cultureel, omgevingsgebied, etc.) buiten beschouwing wordt gelaten. In de loop van mijn onderzoek ontdekte ik dat klimaatverandering en aanpassing geen absolute prioriteit zijn voor kleinschalige vissers, maar dat zij dagelijks andere dringende kwesties moeten oplossen (Coulthard, 2012). Daarnaast bleek dat klimaatverandering, afhankelijk van de omstandigheden, ofwel een directe uitdaging kan vormen, of een verergering kan betekenen van structurele problemen zoals armoede, sociale ongelijkheid en politieke marginalisatie, waarmee de sector van oudsher te maken heeft.

In bredere zin is het doel van dit onderzoek om de sociale en politieke dimensie van klimaatverandering en de eraan verbonden machtsdynamiek te onderzoeken. Klimaatverandering is een wereldwijd fenomeen dat hoog op de internationale politieke, geopolitieke en wetenschappelijke agenda staat, maar kan niet worden bestudeerd als een op zichzelf staande en technische kwestie die losstaat van de realiteit van lokale gemeenschappen. De politieke, economische en zelfs culturele aspecten van klimaatverandering moeten onderwerp zijn van toekomstig onderzoek. Daarbij moet worden bedacht dat klimaatverandering volgens het heersende politieke discours weliswaar een urgent probleem is, maar niet altijd voor elke gemeenschap de belangrijkste zorg is.

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List of Acronyms

ASADA	Asociación Administradora del Sistema de Acueductos y Alcantarillados Comunal (Communal Aqueduct and Sewer System Administration Association)
COLAC	Consejo Local Marino Costero (Local Marine Council)
COOPESOLIDAR	Cooperativa Autogestionaria para la Solidaridad (Self-managed Co-op for Solidarity)
ECLAC	Economic Commission for Latin America and the Caribbean
EEZ	Exclusive Economic Zone
ENSO	*El Niño*-Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
FECOP	Federación Costarricense de Pesca (Costa Rican Fishing Federation)
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
INCOPESCA	Instituto Nacional de Pesca y Acuicultura (National Institute for Fisheries and Aquaculture)
IPCC	Intergovernmental Panel on Climate Change
IUU	Illegal, unreported, and unregulated fishing
JAPDEVA	Junta de Administración Portuaria y de Desarrollo Económico de la Vertiente Atlántica de Costa Rica (Board of Port Administration and Economic Development of the Costa Rican Atlantic)
MAG	Ministerio de Agricultura y Ganadería (Ministry of Environment and Livestock)
MIDEPLAN	Ministerio de Planificación Nacional y Política Económica (Ministry of National Planning and Economic Policy)
MINAE	Ministerio de Ambiente y Energía (Ministry of Environment and Energy)
MTSS	Ministerio de Trabajo y Seguridad Social (Ministry of Labor and Social Security)
OCDE	Organisation for Economic Co-operation and Development
OSPESCA	Organización del Sector Pesquero y Acuícola del Istmo (Organization of the Fisheries and Aquaculture Sector of the Central American Isthmus)

PNUD	Programa de las Naciones Unidas para el Desarrollo (United Nations Development Program)
SINAC	Sistema Nacional de Áreas de Conservación (National System of Conservation Areas)
SLR	Sea level rise
SSF	Small-scale fisheries
UCR	Universidad de Costa Rica (University of Costa Rica)
UNA	Universidad Nacional (National University)
USAID	United States Agency for International Development

1. Introduction

Climate change represents a major threat to artisanal fisheries worldwide (FAO, 2018; Clemente Beyer, et al., 2019). The threat is heightened in Costa Rica, a country located in Central America, one of the most vulnerable regions in terms of climate (OAS, 2001; ECLAC, 2018). In this context, this thesis aims to study the effects of climate change on Costa Rican artisanal fishers with a view to understanding how and to what extent they are able to adapt by examining their vulnerabilities, resilience, and adaptation.

At the outset of my study, I expected to find that climate change was a primary concern for artisanal fishers and that they were able to adapt to it or, at the very least, aimed or strived to do so. This expectation was partly based on the mainstream climate adaptation literature (see Galappaththi et al., 2022), which suggests that fishers implement different adaptation strategies in the short, medium, and long terms. These strategies are meant to be implemented individually or collectively, such as diversification of fishing sites, gear or targets, productive diversification, temporary or permanent migration, exiting fisheries, use of technology, and training, among others. This literature usually portrays climate change as an external, natural, and inevitable phenomenon (Mullenite, 2017) primarily based on present and future situations, which limits the understanding of the main causes of human vulnerability, capabilities, and adaptation. In these mainstream approaches, adaptation is mainly considered a standardized and monolithic idea (Lövbrand et al., 2015; Goldman, et al., 2018) in which each group's context (historical, social, political, cultural, environmental, etc.) is excluded.

From a mainstream perspective, adaptation to climate change is normative and divides people into two categories: those who can adapt and those who cannot, failing to recognize the uneven nature of climate change effects across the globe. This categorization often relies on physical and material capabilities without addressing the reasons for success, failure, or even choosing not to adapt (Taylor, 2014), such as structural elements that also influence resilience and vulnerability and ultimately the way people perceive or respond to climate change effects and changes in general (Goldman, et al., 2018).

The mainstream approach could be contrasted with a critical approach to the agency of fishers. Coulthard (2012), for example, points out that fishers have their own priorities, which could differ from those of researchers or national and international policymakers. Consequently, whether climate change and adaptation to it is or is not a priority is a function of specific circumstances. In other words, individuals and groups are exposed to unique experiences and attempt to decipher changes based on their context to define responses that make sense to them. Importantly, this includes the possibility of not responding or of responding at different speeds or timings.

As I progressed in my research, I discovered that climate change and adaptation are not top priorities for artisanal fishers, but rather they have other immediate concerns to resolve on a daily basis. I also found that depending on the context, climate change can sometimes be either a direct challenge or a multiplier of structural issues such as poverty, social inequality, and political marginalization that have historically affected the sector. This realization did not change the main objective of this research, which is to analyze climate change adaptation by Costa Rican

artisanal fishers to understand how they perceive and implement the concept in their daily lives while already subject to the effects of climate change. However, I did phrase my main research question in such a way as to avoid some of the shortcomings of the mainstream adaptation literature: What does adaptation to climate change mean for Costa Rican artisanal fishers and their communities?

To answer the main research question and to better understand climate change adaptation experiences by artisanal fishers, this study will analyze three main elements: 1. Vulnerabilities; 2. Resilience; and 3. Adaptation. Three sub-questions guide the analysis of each element: 1. What are the principal vulnerabilities of the artisanal fishers and to what extent do these vulnerabilities affect their daily lives? 2. What are the components of resilience for the artisanal fishers? and 3. How do artisanal fishers adapt to climate change?

Vulnerability, resilience, and adaptation

This dissertation employs an analytical framework based on the concepts of vulnerability, resilience, and adaptation along with a qualitative methodology to understand the adaptation experiences of artisanal fishers in the context of climate change. For the research, vulnerability refers to the "potential for disruption or harm" (Wisner, 2004: 183). It involves several factors that determine the extent to which livelihoods, property, and other assets of a person or group are put at risk (i.e., prone to disruption or harm) by social or natural events or situations derived from the main event. In other words, vulnerability describes those things that make it difficult for an artisanal fisher to engage in this practice. For instance, a vulnerability arises when fish move further off the coast due to warmer waters as a result of climate change.

Meanwhile, resilience is understood as the ability or capacity of a system to absorb disturbances before it changes to a completely different state (Adger, 2006; Goldman, et al., 2018). It refers to "the capacity for adaptation to emerging circumstances" (Adger, 2006: 268-269). Resilience makes adaptation possible and implies either tangible (e.g., having financial capital to buy a bigger boat) or intangible resources (e.g., an adventurous personality allowing a fisher to look for possibilities to diversify income). Building on the previous example, resilience within the context of the relocation of fishing sites (due to warmer waters) could play out as having access to savings or secondary income that could enable a fisher to develop effective responses.

Finally, adaptation entails "adjustments in a system's behavior and characteristics that enhance its ability to cope with external stresses" (Brooks, 2003: 8) or changes. It is considered a contested and progressive act in which several actors can perceive and implement different strategies. Adaptation is not a static concept (Pelling, 2011); it refers to a process that aims to reduce vulnerability (Naess, 2013) and increase resilience (Lei et al., 2014). For the purposes of this study, the goal of adaptation is the reproduction of artisanal fishing as a practice despite the diversity of obstacles or disturbances faced by fishers. A concrete example of this would be purchasing a larger boat to follow the fish into their (more distant) locations.

While signs of artisanal fishing in a community (e.g., boats and infrastructure like landing sites) and even self-identification as an artisanal fisher can be seen as (successful) adaptation, for this research, successful adaptation is defined when the primary source of income of a particular

community is from artisanal fisheries. This choice highlights that in order to be a fisher, the majority of income must come from fishing activities, and that a successful fishing community will continue to receive its main source of income from fishing activities. In this research, the fishing community is the unit of analysis and is understood as the community of fishers within the study site. They are conceptualized dynamically to recognize that a community constantly reproduces itself.

Artisanal fishing in Costa Rica and case studies

Historically, artisanal fishing is developed on both coasts of Costa Rica, although the Pacific (especially the Gulf of Nicoya) is home to the majority of fishing activity due to its diverse geography (e.g., bays, gulfs, etc.) and long coastline compared to the Caribbean, which has a shorter, straighter coastline and choppy waters. Fishing takes place in the three coastal provinces of Guanacaste, Puntarenas, and Limón. Guanacaste and the Gulf of Nicoya (a gulf shared by Guanacaste and Puntarenas) contribute the most in terms of artisanal fishing catches (Moreno-Díaz & Alfaro, 2018); whereas the Province of Puntarenas boasts the highest number of people working in fishing (62% of the total population) (FAO, 2016). Limón hosts only a few small, scattered fishing communities.

While fisheries hold only a minor participation in the national economic structure as compared, for example, to agriculture or tourism, it is an essential source of income for coastal areas and contributes indirectly to tourism (Chévez & Campos, 2014). For instance, although the precise number of people involved in fishing is unknown by the government, according to the most recent data by the Organization of the Fisheries and Aquaculture Sector of Central America (OSPESCA in Spanish), in 2011, 14,800 people worked directly in the artisanal fishing sector (13,860 men and 940 women) and there were 6,100 artisanal fishing boats registered (OSPESCA, 2011). Meanwhile, Solís et al. (2022) consider that 30,000 people are either directly or indirectly involved in small-scale artisanal fishing (including fishing at sea, lakes, rivers, and mollusk extraction). Currently, 1,745 fishing licenses for small-scale fisheries are officially registered (INCOPESCA, 2024a).

Costa Rica's artisanal fishing sector has been consistently neglected throughout history as a result of the central government's policies and a national socioeconomic development model that promotes industrial fishing, tourism, services, and environmental conservation (and, more recently, increasing pressure from the aquaculture sector) (FAO, 2016; Ramírez Cover, 2017; UCR, 2018). Moreover, similar to other places in Latin America and around the globe, artisanal fisheries in the country struggle with high informality levels.

Because Costa Rica has two coasts with numerous fishing communities, a heterogeneous geography, and differing weather conditions, biodiversity, and socioeconomic development, the research focused on four communities (two on each coast) for methodological reasons regarding time and resources. Along the Caribbean coast, the communities of Cahuita and Barra del Colorado were selected as case studies; while on the Pacific coast, the study focused on Dominicalito and Cabuya. I selected these four communities for a number of reasons, including their geographical position (i.e., they represent the diversity of each coast) and remoteness (i.e., two communities are located in remote areas and the other two are not); the relevance of artisanal fishing for their local economy; their level of poverty; and because their proximity to marine or

land conservation area can affect fishing. I also consulted with experts and documentation to define the case study areas for this research.

Regarding each study site, Barra del Colorado is a small community located inside the protected area known as Barra del Colorado Wildlife Refuge (*Refugio Natural de Vida Silvestre Barra del Colorado* in Spanish) in the northern Caribbean, a geographically isolated region with scarce productive alternatives and threatened by organized crime (drug trafficking). The community of Cahuita, on the other hand, is a small village in the southern Caribbean and home to the popular Cahuita National Park. Here, tourism is growing as a productive alternative, but there is still a small group of artisanal fishers, particularly of Afro-Costa Rican descent.

Meanwhile, Cabuya is located on the northern Pacific Coast. This community faces pressure from being in a tourist hotspot and in close proximity to a highly protected natural reserve (Cabo Blanco), which directly and indirectly affects the artisanal fishers' livelihoods. The fourth and final community is Dominicalito, located in the southern Pacific. It is situated in a popular area for tourism, parties, and surfing and it is close to Marino Ballena National Park, which increases pressure on artisanal fishers due to tourism, conservation, and real estate interests.

Structure

This dissertation is divided into seven chapters. Chapter One introduces the broad context of the study and its analytical approach. This section details the research questions and objectives. Chapter Two delves into the analytical framework based on the concepts of vulnerability, resilience, and adaptation using a political ecology approach. This section explains the research's applied methodology, including the selected case studies, ethical considerations, positionality, limitations, risks, and barriers faced by the researcher during the development of this study.

Chapter Three reflects on the main historical, environmental, socioeconomic, and political elements shaping the realities of the four study sites. The objective is to provide a background of Costa Rican artisanal fisheries in the context of climate change and specifics about each place. This contextualization aims to understand the elements that potentially affect the fishers' vulnerabilities, resilience, and adaptation.

Although the concepts of vulnerability, resilience, and adaptation overlap, they were separated and analyzed into empirical chapters for this dissertation. Thus, Chapter Four discusses the principal vulnerabilities faced by Costa Rican artisanal fishers in the context of climate change. This chapter documents the diversity of socioeconomic, political, and environmental elements affecting the lives of fishers and influencing their interaction with the effects of climate change. I analyze the vulnerabilities of the artisanal fishers through biophysical, social, economic, technological, and governance factors. The reflection focuses on each community's particularities and the vulnerabilities it shares with the other villages.

While current literature (see Mahmudul Islam & Chuenpagdee, 2022) focuses mostly on biophysical factors, which are usually the main sources of vulnerabilities, for the fishers in the study sites, social, economic, and governance elements emerged as their main sources of concern, not always directly related to climate change. Aspects such as excessive regulations for

artisanal fishing, pressures from the government and environmental organizations, lack of institutional support, and low prices have critical effects on their present and future livelihoods, increasing uncertainty and the ability to maintain their livelihoods. This also demonstrates the complexity and situational nature of the vulnerabilities.

Chapter Five explores the resilience of the fishers, contributing to my reflection on specific aspects of this concept and how they influenced my understanding of it. In terms of resilience, I analyzed the elements that comprise, enhance, or hinder the fishers' resilience in each community. This resilience is unequal and shaped by the socioeconomic, political, and environmental context, which affect their capacities to cope with (or not) undesired changes. This reflection is guided by tangible (i.e., natural systems, people and livelihoods, institutions and governance, and external drivers) and intangible elements (i.e., change in individual behaviors, self-organization, and social learning, identities, and self-perception) aimed at understanding the nature and complexity of this concept.

In each community, I identified sources of resilience, such as savings, access to financial capital, the possibility of contracting insurance, as well as income, knowledge (e.g., experience and training), and the willingness to diversify their fishing practices and income. Here, the cultural element, particularly identity, also influences their resilience. Despite the possibility of adverse material conditions for the fishers (including extreme weather and ecological changes in marine systems), motivations, ideas, beliefs, and emotions about fishing also contribute to keeping artisanal fishing alive.

Next, Chapter Six analyzes the adaptation of the artisanal fishers in each community. The objective is to analyze what fishers are doing in response to their changing circumstances. This includes understanding why some measures are more or less common than others and how this diverges from the literature regarding climate change adaptation in artisanal fishing communities. I studied the adaptation of artisanal fishers based on the type of response: coping mechanisms, adaptative strategies, and management responses. I discuss everyday adaptation identified on each coast and in each village to understand what elements are shared and distinct in each case and how the contexts shape adaptation in each community. Most adaptation strategies, such as the use of technological devices and diversification of species or livelihoods, are considered reactive (organic based on pressures stemming from the context). Similar to vulnerabilities, these adaptations are not necessarily a direct response to the effects of climate change but rather to the immediate political, economic, and social context pushing and threatening the ability of the fishers to continue this practice.

Despite the fishers acknowledging climate change and being concerned about its effects, their priorities in terms of adaptation are defined by more urgent "day-to-day" matters, such as lower prices and unfair market competition. This further diverges from mainstream literature on adaptation to climate change (see Taylor, 2014), which promotes the imminent need to adapt in all coastal communities, without considering cases where climate change effects are sometimes slower or less severe and are not yet the primary existential threat for the fishers.

Lastly, Chapter Seven summarizes the main findings of the research and discusses the study's contribution to the field of artisanal fisheries, adaptation, and development studies by reflecting on the priorities and actions of the fishers to sustain their livelihoods and lifestyles when climate change is not necessarily the top priority.

In summary, this thesis aimed to study to what extent and how artisanal fishing communities reproduced in response to vulnerabilities emerging from climate change. The findings, however, evidenced that their vulnerabilities are more complex (with climate change being just one concern among many) than what the mainstream climate adaptation literature would suggest. The research discusses if and how the fishers are reproducing (adapting) artisanal fishing livelihoods in response to issues that include but are not limited to climate change. This dissertation ultimately argues that climate change is not the only or main concern for the artisanal fishers when other structural issues such as poverty, inequality, and exclusion immediately affect their lives and well-being. Ultimately, communities prioritize issues or threats based on their context. Here, climate change and adaptation to it may be either a primary concern, one concern among many, or not a concern in the fishers' immediate reality.

2. Analytical framework

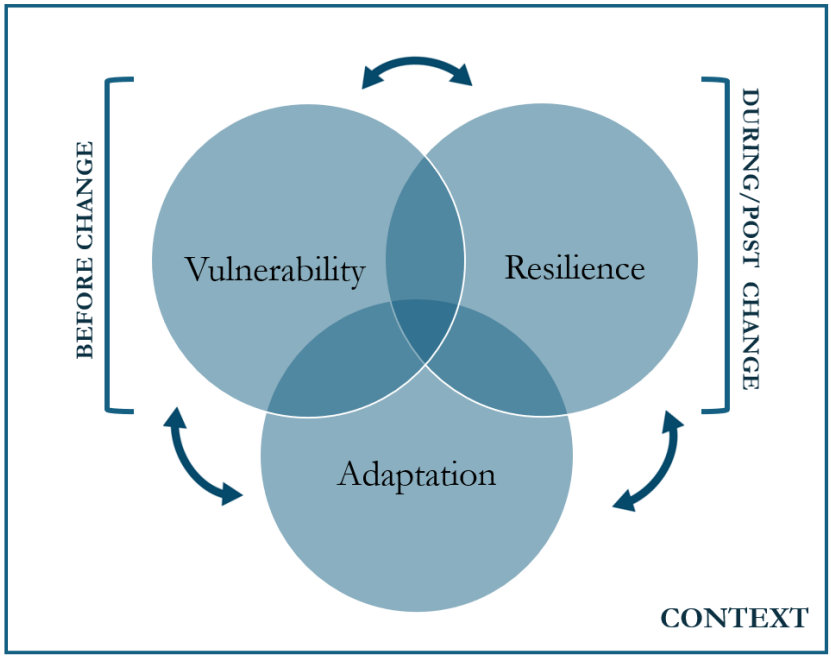
The concepts of vulnerability, resilience, and adaptation guide this research by offering crucial insights into the main concerns and realities of artisanal fishers in the context of climate change. Each concept is situated and contested in nature (Pelling, 2011; Lei et al., 2014), which helps to dive deeper into the structural and historical aspects influencing the socioeconomic, political, and environmental realities of the artisanal fishers in the researched communities. This research is significant as it sheds light on these often misunderstood and misapplied concepts, providing a deeper understanding of their implications in the context of climate change.

2.1. Vulnerability, resilience, and adaptation in the context of climate change from a critical perspective

Vulnerability, resilience, and adaptation are three concepts often referenced in the literature on the human dimensions of climate change (Goldman et al., 2018). These three concepts are malleable, interrelated, overlapping, and contested (Pelling, 2011; Lei et al., 2014; Simonet & Fatorić, 2016), where power relations and the unequal distribution of resources define their scope. They are often criticized for being applied statically in traditional approaches to standardize knowledge on climate change (Vogel et al., 2007; Taylor, 2014) without recognizing the diversity of contexts, their relational nature and intangible factors, and the historical structures that define them (Coulthard, 2008; Badjeck et al., 2010). In this research, however, these concepts are discussed from a critical political ecology perspective to better understand the power dynamics behind the three concepts and how they influence the perceptions, ideas, and experiences of adaptation of artisanal fishers, as well as the way they put these ideas into practice in the context of climate change.

Vulnerability refers to the "potential for disruption or harm" (Wisner, 2004: 183), while resilience is understood as the ability or capacity of a system to absorb disturbances before it changes to a completely different state (Adger, 2006; Goldman et al., 2018), and adaptation entails "adjustments in a system's behavior and characteristics that enhance its ability to cope with external stresses" (Brooks, 2003: 8). According to Lei et al. (2014), these three concepts describe "inter-overlapped rather than mutual [sic] contained" (p. 615) interactions. It is, however, possible to identify moments in which each concept materializes when a system is facing a disaster (or change) (see figure 2.1). Vulnerability, for example, arises before a disaster, while resilience (affected by vulnerabilities) occurs during and post-disaster (or changes), contributing to alternatives for resisting, recovering, and influencing the potential for adaptation. Adaptation, on the other hand, is tied to both of these concepts through proactive actions aimed at reducing vulnerabilities (Brooks, 2003; Naess, 2013) and fostering resilience (Lei et al., 2014).

Figure 2.1: Relationship between vulnerabilities, resilience, and adaptation



Source: Prepared by the author.

Thus, if a group, community, or system is highly vulnerable to external stresses or shocks, its resilience is reduced and its capacity for adaptation is constrained. However, if the capacity of adaptation of a given group, community, or system increases, then it is expected to be less vulnerable when facing new changes or disruptions, thereby fostering resilience (Brooks, 2003; Lei, 2014; Naess, 2013). This interrelation is complex and dynamic; each concept affects the others. Studying these concepts from a political ecology perspective brings visibility to aspects such as power relations, beliefs, values, and perceptions, as these issues also shape the responses to change and contribute to the understanding of how vulnerability, resilience, and adaptation manifest in real life. It is essential to highlight that, for practical purposes, these three concepts are analyzed separately in this section and in their respective empirical chapters. However, the order in which the concepts are discussed implies no linear relationship.

2.1.2. Vulnerability

Vulnerability, as a concept affecting and affected by resilience and adaptation, is perceived as "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard" (Wisner et al. 2004: 11). Vulnerability involves several factors that determine the extent to which livelihoods, property, and other assets of a person or group are put at risk (i.e., prone to disruption or harm) by social or natural events or situations derived from the main event. Such factors include class, gender, and ethnicity (Cannon, 1994). Wisner et al. (2004: 183) contend that vulnerability remains a common notion of "potential for disruption or harm."

From a critical perspective, Hillhorst et al. (2004) state that vulnerability offers the advantage of understanding how groups or individuals categorized as similar (e.g., based on class, gender,

identity, and profession) are affected in different ways by harm, revealing the complex, dynamic nature of vulnerability. The vulnerability may change over time and by cause of context (e.g., the conditions of a person or group at a given point), giving rise to the need for comprehensive analyses to understand the reasons for it. Vulnerability as a concept has been mostly studied from a relational perspective because it is produced by social relations (Turner, 2016). As Turner (2016: 31) argues, vulnerability "is situational, dependent on the interplay among a diverse set of social relations at particular historical moments".

Vulnerability is a political-ecological concept that considers the relationship of people with the environment and the political-economic forces in society shaping this relationship (Oliver-Smith, 2017). According to Wisner et al. (2004: 7): "Vulnerability is determined by social systems and power, not by natural forces" and it "needs to be understood in the context of political and economic systems that operate on national and even international scales." Consequently, people can be prone to potential harm in several ways and with different intensities at different times.

The situational nature of vulnerability becomes evident when we consider that it is shaped not only by the present or future potential for harm but also by past experiences, as Hillhorst et al. (2004: 4) point out in stating that "history reveals that vulnerability may be centuries in the making." Here, we can affirm that vulnerability is the outcome of socioeconomic processes (Hillhorst et al., 2004). Although shaped by historical forces where a number of factors define vulnerabilities for a group or individual (e.g., location, gender, sexual orientation, origin, class), these vulnerabilities are transformed as a result of variations in environmental, economic, and social conditions, where human activities limit human and natural resilience and adaptation (Holling, 1994).

Vulnerability is a multidimensional concept (Luers, 2005; O'Brien et al., 2007), where access to wealth, resources (e.g., food, water, productive resources, knowledge), and the shared obligations and reciprocity between individuals or societies all matter. Hence, vulnerability is contextual—given in specific places and times (Adger, 2006)—and can be perceived differently by different individuals and societies. When studying vulnerability from a critical perspective, we must ask *'Who is vulnerable?'* and *'To what?'* (see O'Brien et al., 2007), especially since vulnerability is likely not often discussed in daily life (as is also the case with resilience). Instead, people show vulnerability by describing, for instance, how their situation is difficult or worsening, the stress they feel about their situation, and the ways they are dealing with it.

An important factor often neglected by traditional approaches is the relational nature of this concept. Vulnerability is not the result of natural forces affecting people but rather social systems and power dynamics defining who, how, and when they will be affected by an external concern (Wisner et al., 2004). These social systems and power dynamics must be analyzed historically (Hillhorst et al., 2004) to better understand the long process and structures giving shape to people's lives and vulnerability. This approach is usually overlooked in mainstream perspectives, which are primarily based on present and future situations (Taylor, 2014) and, therefore, are limited in scope to understand the main causes of vulnerability and the capacities and potential for adaptation.

In the context of globalization, the interplay of local and global processes leads to many possible harms or disruptions to communities or individuals (Hillhorst et al., 2004). Cannon (1994) argues that cultural and social processes that increase vulnerability are embedded in broader processes of "expressions of international or national political and economic considerations" (as cited in Hillhorst et al., 2004: 2). Meanwhile, Wisner et al. (2004) contend that global challenges and vulnerabilities and their causal chain approach are linked to how political and economic ideologies affect the allocation of resources in society; therefore, broader and more complex events (e.g., markets, environmental conditions, and climate change) that allow for differentiated access to resources affect resilience and, in turn, levels of vulnerability.

Vulnerability in the context of artisanal fisheries

Specifically in the context of the artisanal fisheries that are the subject of this research, vulnerability represents the potential for harm or disruption due to historical factors related to climate change and the influence of these factors on the potential for adaptation. For instance, artisanal fishers face disruption due to increased competition resulting from changes in the biodiversity composition of their fishing zones.

According to Montejo-Damián et al. (2022: 57-58), living in rural coastal areas under marginalized circumstances could make "artisanal fishers extremely vulnerable to exceptionally risky conditions given that they are culturally connected to a transitional area between land and sea that is rich in natural resources yet subject to numerous threats that jeopardize their livelihoods."

The vulnerabilities of artisanal fishers are not necessarily defined by natural threats, like storms or rising sea levels, but rather by the socioeconomic and political conditions that have historically neglected and disempowered these groups (see Montejo-Damián et al., 2022). These conditions influence both global and national discourses about *why* artisanal fishers are vulnerable according to certain individuals (e.g., researchers, policymakers, politicians), and *how* these fishers should be resilient and adapt in the context of climate change, yet failing to acknowledge the ideas and experiences of the fishers themselves regarding their context, vulnerabilities, capacities for adapting (or not) to climate change, and how they choose to cope with change in general.

Artisanal fishers are accustomed to facing environmental and social stresses due to the nature of their activity, shaped by changing fish stocks and historical contexts of sociopolitical marginalization (Too Big to Ignore, 2020; Cánovas-Molina & García-Frapolli, 2022; Montejo-Damián et al., 2022). They are exposed to multiscalar social, political, economic, and environmental events (stressors) that heighten their vulnerabilities. It is important to mention that COVID-19 was yet another significant stressor that further influenced factors that historically have negatively affected the artisanal fishing sector worldwide. These impacts stemmed from market and mobility restrictions, which, in turn, affected fish prices, sales, purchasing power, and food security for fishers and others involved in the sector (Too Big to Ignore, 2020).

Moreover, there is a high level of uncertainty linked to the activity that requires a multidimensional understanding and approach, where context must be studied in detail to fully analyze the main factors affecting the community's vulnerability. Sometimes, not all factors are

related to income or poverty, as Bené (2009: 925) states: "Exposures to health risks (…) or climate change are as disabling, or perhaps, even more disabling factors for individual or community wellbeing and human development than economic vulnerability."

According to Mahmudul Islam and Chuenpagdee (2022), vulnerability in the small-scale fisheries sector is linked to five main factors: biophysical, social, economic, technological, and governance. The authors consider biophysical factors to be the most dominant source of vulnerability and include weather/climate (e.g., climate change, changing temperatures, cyclones, rainfall irregularities, stronger winds), hydrological aspects (e.g., floods, saline water intrusion, sedimentation), geophysical issues (e.g., coastal erosion, earthquake, landslides), habitat/ecosystem (e.g., habitat degradation, invasive species), fish/fisheries (e.g., a decline in fish stocks and seasonality), biological hazards (e.g., red tide, disease, parasites), and the built environment (infrastructures, such as dams or sand mining).

Social factors include:

> Low social capital (e.g., low education and skills, lack of awareness", aging workforce, low or moderate levels of trust, community conflicts), user conflict/resource competition (e.g., conflict between recreational/industrial fisheries, redistribution and privatization of common property), poor occupational health and safety facilities (e.g., physical accidents during fishing, theft of fishing gear and boats, fatal encounters with wildlife), inadequate facilities and infrastructure (e.g., absence of basic infrastructure, food insecurity and drinking water problems), overfishing, unsustainable fishing practices and a high dependency on fisheries (e.g., illegal fishing, high fishing pressure, strong attachment to occupation/place, physical isolation), gender issues, and bias (e.g., social exclusion, low participation of women, social norms regarding women, gender violence) (Islam & Chuenpagdee, 2022:5).

Meanwhile, economic factors encompass:

> Unsustainable development (e.g., tourism development, conversion from fishing to services and tourism, expansion of human habitats), price-taker risk/unfavorable market conditions (e.g., unfair distribution of benefits, lack of access to affordable credit, market access restrictions, increase in operating costs, high transport costs to market), lack of assets (e.g., lack of boat ownership, poverty, lack of financial capacity and land resources, poor housing), little or no livelihood options (e.g., higher unemployment, declining opportunities in other land-based sources), and high fishing costs (e.g., debt and high interests rates, increasing fuel cost and scarcity, lack of investment capacity, high costs of efficient fishing gear). (Islam & Chuenpagdee, 2022:5)

On the other hand, the technological factors involved include:

> Fish-catching power (e.g., industrialization of fisheries, gear damage, changes in fishing practices, intensification of fishing efforts), consequences of specific gear (e.g., introduction of new technology, decline of traditional harvesting practices, low-technology craft and gear), lack of capacity at landing sites (e.g., limited storage/refrigeration facilities, old, neglected infrastructure), pre-sale processing constraints (lack of adequate cold storage facilities), inadequacy of safety devices (e.g., lack or outdated safety gear, lack of protective wear), and vessel incapacity (e.g., inability to fish deeper at sea). (Islam & Chuenpagdee, 2022:6)

Lastly, the governance aspect includes:

> weak governance/low capacity (e.g., very little government support to strengthen fishers' livelihoods, political decision-making with no consultation of fishers, weak rules and regulations, unfavorable fiscal environment, lack of adequate management personnel, failure of government fishery projects), weak monitoring, control, and surveillance (e.g., limited presence of government institutions at fishing sites, inadequate personnel and funding for enforcement), inadequate stakeholder participation and interaction (e.g., low participation in local and regional decision-making processes, ineffective communication from government, little to no political attention given to small-scale fisheries (hereinafter, SSF), refused a voice or role in government), unfair rules/regulations (e.g., disproportionate sharing of benefits, unequal access rights and ownership, new regulations to limit resources use/fishing areas, government bias against SSF and in favor of industrial fisheries, no legal recognition of the small-scale sector, political negligence in the development of coastal areas, high fishing licensing fees, fishing ban), inappropriate institutions (e.g., lack of an effective conservation program, inappropriate centralization, fishery conservation actions with no consideration of SSF, harsh implementation of fishery laws and policies, privatization for aquaculture, colonial legacy of oppression, and lack of local autonomy), and poor organization (e.g., lack of institutional support, lack of community-based organization, poor management of cooperatives, dormant fishery associations, and low participation in community organization). (Islam & Chuenpagdee, 2022:6)

Mahmudul Islam and Chuenpagdee (2022) argue that natural and physical vulnerability factors have been researched more so than economic and social factors. This also supports the need for multidisciplinary and transdisciplinary research and policy formulation to understand and foster transformative approaches in adaptation processes. Thus, a holistic approach is required in vulnerability assessments to enable comprehensive inputs to promote resilience and adaptation (Montejo-Damián et al., 2022). Meanwhile, in a systematic review of vulnerabilities in SSF worldwide, Cánovas-Molina & García-Frapolli (2022) identify a total of 21 drivers linked to natural, socioeconomic, and political aspects. The most common include: declining catches (e.g., reduction of fish stocks, spatial restrictions), marginalization (e.g., productive displacement by tourism, industrial fishing, or aquaculture; geographical isolation), high dependence on fisheries (e.g., lack of savings or assets, lack of productive diversification, access to informal credit at high interest rates), and environmental issues (e.g., temperature anomalies, variations in wet/dry seasons, changes in stock distribution).

The aforementioned authors also highlight that, in the context of vulnerability, it is important to consider the marginalization and invisibility of women in the sector. Despite representing 46% of the total SSF workforce worldwide, the contribution of women to this sector continues "to be undervalued and invisible in fishing statistics" (Cánovas-Molina & García-Frapolli, 2022: 496). The participation of women is scattered along the production chain as free fishers, administrators of people, finances, and payments, and leaders of local or regional associations; all in addition to domestic activities such as childcare and education (Montejo-Damián et al., 2022).

Montejo-Damián et al. (2022) also reflect on the importance of understanding the meaning of artisanal fishing for fishers when analyzing the high dependence on fisheries as a vulnerability and proposing productive diversification as "the alternative" to foster resilience. However, a passion for fishing and the identity derived from it explain why some fishers choose to continue

in the activity despite high exposure and sensitivity. Here, self-identity and social well-being linked to job satisfaction and price are considered "non-material benefits" of artisanal fisheries that are usually minimized or neglected in research and policy formulation (Cánovas-Molina & García-Frapolli, 2022: 497) with negative consequences for policy implementation.

2.1.3. Resilience

From the Latin word *resiliere*, which means "leap back" (Brown, 2013), resilience is "the magnitude of disturbance that can be absorbed before a system changes to a radically different state, as well as the capacity to self-organize and the capacity for adaptation to emerging circumstances" (Adger, 2006: 268-269). Resilience is a popular concept in policy-oriented discourses about climate change (Goldman et al., 2018), implying change and continuity at the same time. The purpose of resilience is to protect activities considered beneficial for human well-being or ecological sustainability, including activities threatened by present or future environmental change phenomena such as climate change.

Resilience is also a situated concept. As Fisher (2016: 33) argues, it is "found, made or situated within people, communities (human and non-human), cities, and economies." It is a complex concept that must recognize the diversity of individuals and communities; for this reason, Carpenter et al. (2001: 766) argue that resilience is characterized by three properties: 1. the degree to which a system can undergo and endure a disruption (e.g., a hazard or environmental change); 2) the degree to which a system regards self-organization; and 3) the degree to which a system creates the capacity to learn and adapt.

Self-organization and social learning are essential elements in facilitating change in resilient groups or systems. To elaborate, social learning refers to "the capacity and processes through which new values, ideas, and practices are disseminated, popularized and become dominant in society or a sub-set such as an organization or local community" (Pelling, 2011: 87). Social learning is analyzed through the shared values, beliefs, and behavioral norms adopted by the institutional architecture of social life.

Self-organization concerns "the propensity for social collectives to form without direction from the state or other higher-level actors" (Pelling, 2011: 89). Self-organization is dynamic. It can evolve at different speeds (e.g., slowly due to demographic transformations or changes in local ideologies, or quickly as a response to disaster events challenging the dominant organization's forms). It can occur in two ways: formal organization, such as community groups or trade associations, and informal (shadow) organization, such as networks of people and groups of neighbors working independently from formal organizations. Regarding the latter, Pelling (2011) emphasizes their relevance as they allow for experimentation, innovation, and quick changes as compared to formal organizations, and because they are malleable. If these informal systems work, they have the potential to become formal systems. Social learning and self-organization are deeply interconnected; in fact, "a social system exhibiting rich capacity for social learning is also likely to have considerable scope for self-organization" (Pelling, 2011: 91).

In terms of resilience, contrary to what is considered the norm in Western science-based approaches, we must consider not only tangible or measurable factors (i.e., infrastructure or economic resources) (Goldman et al., 2018) but also "inner worlds of emotion and affect"

(Pelling, 2011: 85). This means including values, identity, desire, fear, and beliefs in our analyses. From a critical perspective, in which different contexts are also valid (Fisher, 2016; Shah et al., 2017), these intangible elements are crucial to understanding the practices of individuals, communities, and groups as regards resilience.

To operationalize this concept, when analyzing resilience, some questions that must be raised include *'resilience of whom or what?'* and '*resilience to what?'* (Brown, 2013; Dwiartama, 2016). In the study of vulnerabilities, these same questions can be asked by considering how the capacity for resilience of a group or individual might affect their potential for adaptation and what vulnerabilities they might face.

Understanding and managing resilience requires looking for alternatives instead of adopting a one-size-fits-all solution to the situations faced by fishers and communities. A series of negotiated alternatives is needed to reach the desired conditions after a crisis. Here, the stakeholders involved agree to the desired conditions and attempt to keep the system within them (CPWF, 2013). This is also proof of the situated nature of resilience in general and in artisanal fisheries in particular.

Resilience in the context of artisanal fisheries

In analyzing the resilience of artisanal fishers, one must consider both material and immaterial aspects in order to understand how this group responds to change. While it is true that the lack of material resources, infrastructure, and technical knowledge affects resilience, increases vulnerability, and diminishes their potential for adapting (Coulthard, 2008), solely basing the resilience of fishers on material factors neglects the intangible aspects (e.g., values, ideas, cosmovision) and structures (e.g., inequality, discrimination, poverty) behind individual responses to change (Coulthard, 2012).

The immaterial side of resilience is evidenced in changes in the fishers' individual behaviors, which can either enhance or hinder their resilience, for instance, by restricting household expenses or diversifying target species (Villasante et al., 2022). Shared values, beliefs, and meanings, consolidated trust among fishers, and a sense of involvement in governance structures are other immaterial elements in the building process of collective and individual resilience. For example, the meaning of fishing for fishers and their communities influences their desire to either keep the practice "alive" no matter what or to opt for strategies like exiting the fishery (Satumanatpan & Pollnac, 2020).

On the intangible side of resilience, perceptions are crucial to understanding how the fishers deal with change (they cope or transform). In a study about the self-perception of fishers in the Gulf of Thailand, Satumanatpan & Pollnac (2020) analyzed the elements influencing the self-perception of resilience of the artisanal fishers. The authors reflect on a series of elements (material and non-material) that affect this self-perception and the capacities and responses of fishers to change. This self-perception is built on elements such as personal background (e.g., age, gender, years in fishing, financial status), but is also shaped by subject factors like ideas, values, and beliefs. They also discuss the complex interactions between resilience and well-being when a high degree of resilience does not necessarily imply improved well-being. When a resilience measure considers only a few dimensions of the context, and neglects elements like

satisfaction and pride in working in fisheries, an individual's or group's well-being could be compromised as could their willingness to commit to programs promoting these measures.

Mason et al. (2022) reflects on processes that erode resilience and concludes that both the absence of attributes and the excess of them can negatively affect the resilience of a fishery; for instance, complex governance and excessive regulation can obstruct flexibility and increase costs. In other cases, a vital attribute of resilience can hinder the development of other attributes; for example, in ecological systems that are highly resilient due to stable population size, the process of building resilience in social and governance structures can be negatively affected "because community members are accustomed to the system absorbing any pressure and shocks that have occurred" (Mason et al., 2022: 538).

The CGIAR Challenge Program on Water and Food (CPWF, 2013:3) identifies four domains to consider when analyzing resilience: natural systems, people and livelihoods, institutions and governance, and external drivers. Each domain contains several indicators that contribute to the comprehensive study of resilience. For instance, natural systems include "biodiversity, stocks status and trends, fishing practices, and aquatic ecosystem conditions". People and livelihoods reflect on "human capability, assets and income poverty, diversification/income dependence, living conditions, and competition". Institutions and governance analyze "fisheries and development policies, organizational and institutional capacities, access to markets and financial services, collective action abilities, governance performance and rights, and legal framework". While external drivers are focused on international markets, "macroeconomic instability, climate change, and environmental uncertainty" (CPWF, 2013:3).

Moreover, in studying not only resilience, but also vulnerabilities and adaptation to climate change, Coulthard (2012) stresses a critical aspect: the agency of people—in this case, the fishers. She argues that this agency manifests when: 1) people not only respond to a threat but influence its nature; 2) people have their own priorities which could differ from those of researchers and national and international policymakers; and 3) the context in which people live or act affect their choices and, in turn, their vulnerabilities and resilience. Coulthard (2012: 4) writes:

> For example, an alternative livelihood to fishing is often advocated as an important adaptation strategy to cope with declining fishing income and as a means to reduce fishing pressure and improve the resilience of the fishery system (Salayo et al. 2008, Cinner et al. 2009). However, if that alternative livelihood is not a valued way of life for the fisher, and if exiting the fishery would mean 'letting down' his crew members and other dependents in the fish chain, e.g., those who buy his fish, or involve a loss of prestige or social position, he may be unlikely to choose to adapt in this way.

Another interesting element in the critical analysis of resilience is the "naturalness" of resilience (i.e., everybody must be resilient). In the paper, *Can We Be Both Resilient and Well, and What Choices Do People Have? Incorporating Agency into the Resilience Debate from a Fisheries Perspective*, Coulthard (2012) raises this issue from a critical perspective by arguing that sometimes resilience and well-being can be in conflict and policies aiming to increase the resilience of fishers can undermine their well-being, fostering vulnerabilities and undermining adaptation choices. Quentin Grafton (2010) presents an example of this in his criticism of inflexible fishery governance tools such as TACs (i.e., total allowable catch) as a strategy to promote resilience among fishers and coastal

communities. The author argues that this tool generally leads to overcapacity of the fishery and to fishing becoming a marginal activity, thereby reducing "the resilience of the socioeconomic systems around fishing and their [fishing] communities as even small shocks may generate large negative effects" (Quentin Grafton, 2010: 614).

Like vulnerability, resilience is defined by context and capacities, the scale of the fishery, and associated stressors. Mason et al. (2021: 539) argue that understanding context helps to analyze the resilience "*of what, to what, and for whom*", the boundaries of the studied system (the fishery), and the timing and scale of responses.

It is also important to mention that the COVID-19 pandemic was another external stressor that affected the resilience of fisheries worldwide. Financial assets (e.g., wealth and savings), diverse markets (e.g., online alternatives, local markets), and social relations (e.g., social support networks) were vital for fishers to generate income and remain in the sector.

2.1.4. Adaptation

According to Brooks (2003: 8), adaptation refers to "adjustments in a system's behavior and characteristics that enhance its ability to cope with external stresses." The author argues that "the direct effect of adaptation is to reduce social vulnerability"[1] (ibid.: 9). Pelling (2011) affirms that adaptation is a political and social action that can shape power relations in society.

Adaptation is considered a contested act in which multiple stakeholders can perceive and implement divergent strategies. As such, viewing it as a technical, non-political issue limits the understanding of the stakeholder's support of or resistance to adaptation measures. Adaptation is not a static concept (Pelling, 2011); it is a process that aims to reduce vulnerability (Naess, 2013) and increase resilience (Lei et al., 2014). Heijmans (2004) also confirms this idea by arguing that even though communities and individuals around the world face similar conditions and global challenges, such as climate change, natural hazards, or market fluctuations, their adaptation strategies may differ due to their unique contexts and perception of vulnerabilities. This also acknowledges the situated nature of adaptation. In short, according to Heijmans (2004: 120), "there is not one universal response."

This research also highlights other factors limiting the traditional approaches: climate change as an apolitical issue, the naturalness of adaptation, environmental determinism and victimization of locals, and the presentism of adaptation (Klepp & Chavez-Rodriguez, 2018; Taylor, 2014; Mullenite, 2017; Lövbrand et al., 2015).

Since climate change is considered a scientific (or objective) concept, its negotiated nature as a set of coordinated discourses and institutional practices goes unquestioned, leading to the perpetuation of its apolitical nature. The same occurs with adaptation and other interrelated concepts, including resilience and vulnerability (Klepp & Chavez-Rodriguez, 2018; Taylor, 2014). Climate change adaptation is considered a universal idea promoted by science, in which culture and socioeconomic issues are less addressed. From a traditional perspective, adaptation to climate change is normative and divides people into two categories: those who can adapt and

[1] Vulnerability in human systems because of poverty, inequality, marginalization, housing quality, among others (Brooks, 2003: 4).

those who cannot. This categorization of successful or unsuccessful adaptation fails to recognize the unequal nature of climate change effects across the globe; it relies solely on physical and material capacities without addressing the reasons for success, failure, or even choosing not to adapt (Taylor, 2014), such as structural elements also influencing resilience and vulnerability and ultimately affecting the way people perceive or respond (adapt?) to changes (Goldman et al., 2018).

Adaptation, however, is considered natural, the only alternative to climate change, and so individual contexts are often disregarded. It follows a neoliberal logic in which the responsibility for resilience and adaptation depends exclusively on those affected by these changes in a context where climate change cannot be stopped; therefore, adaptation is a must (Klepp & Chavez-Rodriguez, 2018). This critique does not deny the fact that throughout history human beings have adapted to change, but instead addresses the argument that the economic (productive) model affecting climate change is not questioned in traditional approaches. Attention is instead centered on climate change adaptation rather than on changing the main causes of this phenomenon (Oliver-Smith, 2017). Moreover, international and local elites address the idea of adapting to survive in the context of environmental determinism, in which some people are entirely disempowered. Everybody must adapt, and it must be done according to the global narratives and agreements on how to successfully or rightfully adapt, where the local experiences of the people facing the changes are neglected, leading to a mismatch between global and national conceptual frameworks on the adaptation needed and implemented by communities and individuals (Morchain, 2018).

The inevitability of adaptation leads to an environmental determinism in which natural threats are inescapable but somehow governable. Mullenite (2017) argues against this naturalness and highlights that adaptation must consider threats as 'produced' and 'uncertain', rather than 'natural' and 'inevitable'. In terms of victimization, since some people can adapt and others cannot because of external/foreign standards and institutions, those who cannot adapt are considered or portrayed as victims by global or local powers. Again, this critique does not deny the effects of climate change on local communities, but rather argues that local perceptions, experiences, knowledge, and responses to these effects are being marginalized and that it is critical to understand the structures influencing not only the responses but also the vulnerabilities and resilience.

Another element influencing climate change adaptation is presentism, called by Taylor (2014: 3) "adaptation now". This concept is based on incremental technocratic measures for adapting to the immediate effects of climate change, in which the historical structures affecting social and environmental transformations are ignored (Oliver-Smith, 2017). From a radical perspective, as exposed by Taylor (2014), all these constraints hinder the transformative purposes of adaptation (i.e., changing current structures), and adaptation becomes a form of mitigation strategy (i.e., solving problems to keep the status quo).

For analytical purposes, Pelling (2011) highlights some questions that must be raised when studying adaptation. For instance, to understand adaptation responses, the question might be *'How does an individual/group adapt?'* To understand the causes of adaptation, the question can be *'Why do individuals have to adapt?'* Regarding the manifestation of changes, particularly climate

change in a specific place and time, one might ask: *'What needs to be adapted to?'* Similarly, with human or non-human actors and their particularities, the question could be *'Who or what adapts?'* Lastly, for the success or failure of adaptation strategies, research can ask: *'What are the limits to adaptation?'* In addition, within a critical analysis, it is necessary to go even further and question the concept of adaptation itself by asking: *'What does adaptation represent for them?'* and *'Are they really adapting (and according to whom)?'* These last questions critically reflect on individual/group adaptation experiences and perceptions to understand the gap between global discourses on adaptation and its local manifestations.

From a situated knowledge perspective, climate change adaptation must be recognized as a partial, incomplete concept in which the complexity of climate change is simplified to make sense of the problem itself (Goldman et al., 2018). Studying adaptation as a situated concept means recognizing that the "objectivity" of Western science is limited as it tries to generalize and understand nature under a binary (simplistic) logic (Haraway, 1991). Therefore, diversity and power-differentiated communities must be acknowledged in the world-making process of climate change adaptation.

Regarding how communities and individuals adapt to climate change, Heijmans (2004) explains that people have always responded to hazards by implementing adaptation strategies learned through the years, from one generation to the next. In other words, individuals and communities respond to the effects of global events by designing strategies based on their own experiences. Meanwhile generic strategies based on traditional science-based approaches seem no longer effective because of the speed of socioeconomic, political, and environmental changes and the partiality of external proposals primarily focused on technical issues.

In the adaptation process, the effects of external phenomena are assessed through a multidimensional approach that considers personal circumstances and factors, such as resource availability (e.g., food, money, personal assets), personal characteristics (e.g., age, gender, class, religion, education, knowledge), timing, location, past experiences, and previously implemented strategies. These circumstances and factors are pondered when designing short- and long-term strategies. Consequently, after analyzing their unique context, the person or community will choose the strategy they feel will result in less harm (including the possibility of not adapting), and may continuously adjust their livelihood strategies to minimize potential risks and avoid "irreversible responses" that could severely compromise their livelihoods and overall well-being.

Adaptation in the context of artisanal fisheries

In a complex, uncertain field like that of artisanal fisheries, contextualization is crucial in understanding climate change adaptation. The artisanal fishery sector is not only heavily affected by environmental changes, but it has also been historically marginalized and victimized by generic national and international socioeconomic policies that exclude artisanal fishers' vast experiences with change and overlook the structural elements that hinder their well-being.

For analytical purposes, adaptation is categorized according to the nature of the response. An analysis could also compare adaptation responses, as some could be similar while others could differ based on the context (Azril et al., 2017). Schipper (2020) argues that adaptation can be planned (e.g., planning for coastal development) or organic/autonomous (e.g., driven by people,

for example, artisanal fishers changing fishing locations) (see Samudra Monograph, 2016: 22). Adaptation can also be distinguished by time (e.g., short term or long term) and by being proactive (e.g., before a change happens), reactive (e.g., in response to a change), localized (e.g., specific place, group, or sector) or widespread (e.g., national initiatives for adaptation).

One of the most common adaptation strategies in literature is productive diversification (Stoll et al., 2017; Salgueiro-Otero, 2022; Kadfak, 2020), influenced by flexibility in income diversification and diversity of target resources (Salgueiro-Otero et al., 2022). According to Salgueiro-Otero et al. (2022:1), "socio-ecological system knowledge, communication with different fishing groups, trust in institutional actors, and gender (female) were positively related to livelihood diversification" in the context of climate change. Conversely, "the fishing experience, communication within the fishing group, and trust in other fishing groups" (as opposed to institutional actors) negatively impact diversification, which illustrates the relevance of social networks and capital in individual and group adaptation strategies.

An important distinction to make here is that artisanal fisheries are unique in that it is considered more than an occupation. In fact, fishers are usually less interested in the possibility of alternative employment, a factor historically misunderstood by policies promoting diversification in fisheries with no understanding of its true meaning to those involved in this sector (Salgueiro-Otero et al., 2022). Miranda & Stotz (2021), after researching artisanal fisheries in Chile, found that the motivation to keep working in artisanal fisheries is linked to the way of life and freedom offered (e.g., no work schedules, no superiors, love of adventure) and where family is usually is a strong component. Thus, policy interventions are ineffective when they fail to consider this factor and instead attempt to impose a market logic relying solely on economic maximization.

This market logic views the fisher as "predatory individual" interested primarily in maximizing profits, rather than an individual also motivated by subsistence and well-being in the context of a moral economy (Miranda & Stotz, 2021). Understanding motivations implies reflecting on economic and non-economic satisfaction, which helps to examine why some fishers refuse to leave the sector despite declining incomes and precarious conditions (Pollnac & Poggie, 2008).

Another factor to consider in adaptation strategies and policy formulation is the heterogeneity of fisheries at the individual level with a view to understanding the connection of fishers with their environment, the unequal impacts of change in general and climate change in particular, the potential responses from fishers based on their fishing portfolios, and their motivations (Stoll et al., 2017). These motivations are shaped by sociocultural values, norms regarding fishing, external context, distribution of power, governance structures, and economic dynamics (Miranda & Stotz, 2021)

Despite the popularity of diversification within fisheries, there is a recent governance trend concerned not only with the state of stocks, but more importantly with creating a set of regulations against overfishing and maintaining healthy fish inventories. These norms regulate the gear used and limit who and the number of people that can work in fisheries (Stoll et al., 2017), affecting the potential for diversification within the sector and pressuring fishers to exit fisheries.

From a theoretical perspective, there is an interesting debate about the nature of the diversification process. Diversification is considered by some as a transformative response (Salgueiro-Otero, 2022; Kadfak, 2020), while others criticize it as promoting the status quo since the conditions and structures provoking an exit from the activity have not changed; rather, the change is in the productive activity within the same power structure (Schipper, 2022). This argument can be extrapolated into an analysis of adaptation and the scope of its transformative nature when the underlying drivers of vulnerability (root causes) are not effectively addressed (e.g., gender inequality, ethnic marginalization, power asymmetries, among others). Adaptation, therefore, becomes ineffective or, alternatively, maladaptation occurs (i.e., the root causes are not addressed, only the effects of climate change to a certain degree). According to Schipper (2020), maladaptation occurs because of the failure to identify the right actors involved, misunderstanding the development context, or merely investing in infrastructure instead.

Schipper (2022: 617) understands maladaptation as the process whereby people become "more, rather than less, vulnerable to climate change" derived from an initial adaptation strategy (rebounding vulnerability). For instance, moving a community inland away from the coast in order to avoid flooding; however, if the community is home to fishers, then their access to the sea is restricted by distance. Alternatively, say the inhabitants are granted money to build a house in a different location, yet they choose to spend the money on something else they consider to be more important or urgent (Schipper, 2020).

Maladaptation can be derived from strategies for adaptation of infrastructure, institutions, and behavior. In planned adaptation strategies, maladaptation can occur due to little knowledge of the social and ecological contexts where projects are implemented; meanwhile, in autonomous strategies, it is the result of "limited information leading to poor choices, lack of support networks to fall back on, and insufficient capacity to undertake new employment or follow through with the strategies" (Schipper, 2020: 412).

This phenomenon can also affect groups not initially impacted by the adaptation strategy in the process of vulnerability distribution, or what is called "shifting vulnerability" (Schipper, 2020: 411) (i.e., promoting productive diversification in artisanal fisheries without considering ancillary activities in a community). However, it can also lead to negative externalities by creating new problems not necessarily linked to vulnerability to climate change (i.e., environmental and socioeconomic pressures from new productive activities replacing artisanal fishing).

In the adaptation process of artisanal fishers to changes in the context of climate change, local knowledge and experiences are crucial for effective measures. Integrating local knowledge acknowledges the experiences and familiarity of fishers with local conditions. Here, it is essential to recognize the advanced knowledge of fishers on issues related to weather and natural resources (Martin et al., 2022), which also helps to understand their decision processes based on diverse sources: scientific reports, forecasts, knowledge, and local networks (i.e., other fishers and trusted individuals).

In the context of fisheries, adaptation has been analyzed through the responses of fishers and their communities to ongoing changes. Despite how diverse the responses can be, it is possible to identify general categories of adaptation strategies designed by fishers and their communities:

institutional, social, technical, and productive (i.e., livelihood) transformations, among others (Coulthard, 2012). In the article *Climate Change Adaptation in Fisheries*, Galappaththi et al. (2022) do a systematic literature review of scientific publications intersecting climate change, fisheries, and adaptation from 1990 to 2019 and identify three primary adaptation response categories: coping mechanisms, adaptive strategies, and management responses. These categories affect different levels or scales (individual, household, community, national, regional, and international). Moreover, each response assumes specific forms (e.g., financial, technical, institutional, migration, behavioral, agency, cultural, social, markets, infrastructure, knowledge, information, migration, etc.).

Coping responses are understood as "short-term responses, including autonomous responses to climate change and associated impacts" (Galappaththi et al., 2022: 9). These measures are informal and temporary, such as changes in fishing behaviors (e.g., reducing the number of days at sea, changing locations, diversifying the catch, using different gear, switching gender roles, sharing fishing-related information, etc.). Meanwhile, adaptive strategies "(…) are long-term responses or shifts in livelihood strategies in response to multiple stressors, including climate change" (Galappaththi et al., 2022: 12), for instance, "modifications of fishing operations, adaptive capacity building, income diversification, ecosystem-based approaches, change in rules and regulations, community involvement, migration, and application of modern and traditional knowledge systems" (Galappaththi et al., 2022: 12). On the other hand, management responses represent "long-term collective responses that involve planning, coordinating, organizing, and monitoring at various scales to support climate adaptation" (Galappaththi et al., 2022: 12). Examples of these responses are co-governance measures (e.g., monitoring systems, inclusion of SSF guidelines in legislation), fostering communication between policymakers and the community, community-based adaptation for local fishery management, community-based initiatives to manage fish habitats, inclusion of local and indigenous knowledge in management strategies, promoting co-production of knowledge to support better decision making, improving market logistics (transportation), government support in finding new markets and strengthening presence in existing markets, and adaptative coastal infrastructure.

Table 2.1: Adaptation response categories

Adaptation response category	Examples
Coping mechanisms	Changing fishing sites Broadening fishing targets Using weather information Diversifying fishing gear Taking out small loans Temporary migration Using family members as labor
Adaptative strategies	Increasing fishing efforts to improve yield Capacity building (e.g., workshops, education, research) Diversifying livelihoods Contracting insurance Keeping cultural identities Changing fishing practices (e.g., catch and release)

	Using new technology for collaboration: location sharing Diversifying markets Using different knowledge systems Exiting fisheries Permanent migration Strengthening local institutions or creating new ones
Management responses	Fostering communication between policymakers and the community Community-based adaptation for local fishery management Community-based initiatives to manage fish habitats Including local and indigenous knowledge in management strategies Promoting knowledge co-production to support better decision-making Improving market logistics (transportation)

Source: Prepared by the author based on Galappaththi et al. (2022).

Artisanal fishers and their communities may implement these strategies at different moments and with different levels of success, determined by both the context in which they are developed and their perceptions and ideas concerning the responses. This, in turn, also defines the resilience and vulnerability of the fishers and their communities. For instance, a standard adaptation measure is productive diversification whereby communities introduce another form of agriculture or aquaculture, or even tourism, to complement their diet and income. This measure can be successful if the new productive activity resonates with the fishers' and communities' culture and environment and if the knowledge about the new activity can be easily implemented by the fishers and their communities (Coulthard, 2008). As a result, these communities and fishers will be more prepared when faced with low fishing seasons. The new productive activity reduces vulnerabilities based on dependence on one source of food and income, increases resilience to changes in fishery stocks, and leads to adaptation when changes in fish inventories become a permanent issue.

There are no set strategies for adaptation and measures can be defined by a combination of factors, including experience, formal and informal knowledge of fisheries and related matters, gender, land ownership, gear type, and institutional support (Kamba & Katengeza, 2020).

In their research, Kamba & Katengeza (2020) noted that despite being aware of climate change, the fishers did not act at all if their fishing practices were not negatively affected. Meanwhile, Alam et al. (2021) found that a high income does not guarantee that fishers will adapt to the effects of climate change. Those who adapt struggle with access to markets, restrictive regulations, a history of previous adaptation strategies (e.g., diversification), or low incomes. Acknowledging the complex influence of income in adaptation is vital for policy formulation; however, Coulthard (2008) emphasizes that resources do not always define adaptation choices. The author cites the example of the Pattinaver fishers in India who chose to continue using the same gear to catch bigger prawns (despite this being a highly regulated fishery), instead of diversifying techniques with the smaller, unregulated gear usually employed by lower castes to

increase catches. This decision to not change (adapt?) was based on beliefs instead of technical criteria or available material resources.

Analyzing climate change adaptation from a critical political ecology perspective implies going beyond the biophysical nature of climate change to view it as a socio-political phenomenon (Klepp & Chavez-Rodriguez, 2018). This shift in approach aims to understand that climate change adaptation is an ambiguous concept (Simonet & Fatorić, 2016) in which "adaptation means different things to different actors" (De Wit, 2018: 50). Individuals and groups have different experiences and decipher changes based on their specific context in order to define a response that makes sense for them (including not responding).

A critical analysis of adaptation, resilience, and vulnerability requires acknowledging the contexts, power relations, and structures to delve deeper into human realities and perceptions of external phenomena and how these external situations occur and affect their lives. Mainstream approaches offer generic solutions focused on technical issues that oversimplify climate change. These technical solutions can be useful only when they are tailored to local realities and when the structures of injustice and exclusion are recognized as elements affecting the ability to face and adapt to climate change (Mullenite, 2017).

Thus, a critical approach to climate change adaptation implies transformative actions such as questioning the concepts themselves and the global context in which they are enacted—an economic system that promotes growth based on energy-intensive consumption, for instance (Klepp & Chavez-Rodriguez, 2018; Simonet & Fatorić, 2016; Oliver-Smith, 2017). A critical approach requires new ways of understanding human-nature interactions.

Taylor (2014) calls for deconstructing adaptation as a self-evident, static concept reinforced by mainstream climate change discourses and argues that a critical approach moves away from the notation of climate change as an external, deterministic threat, thinking instead of different ways to acknowledge the historical structures affecting the lives, perceptions, and choices of the people, contributing to a broader understanding of their interaction with nature (Mullenite, 2017). Thus, an inclusive and critical approach to climate change adaptation, considers social justice and equity and how concepts, ideas, norms, perceptions, and policies are framed and enacted by individuals with different capabilities and access to power (Morchain, 2018). In short, critical, transformative adaptation in the context of climate change must ask whose nature is being represented, by whom, and why (Lövbrand et al., 2015).

A critical analysis of resilience and adaptation does not reject science or encourage the relativization of climate change and its effects. Instead, it understands that climate change exists in the material world with multiple political, social, and ecological implications. Here, climate science and related technologies build the "reality" of climate change as a representation of nature (Forsyth, 2003) and adaptation as the alternative to govern it.

Lastly, for the purpose of clarification, this research is focused on adaptation instead of coping or mitigation (Oliver-Smith, 2017). The main reason for this is the level of transformation as regards the effects of climate change. While coping refers to "the ability of a unit to respond to an occurrence of harm and to avoid its potential impacts," mitigation addresses the causes of climate change (Zhao et al., 2018). Adaptation refers to "the ability of a unit to gradually

transform its structure, functioning or organization to survive under hazards threatening its existence" (Kelly & Adger, 2000, as cited in Pelling, 2011: 55-56) and addresses the effects of climate change. Because this research is focused on transformative changes and effects in the context of climate change, I selected to study the concept of adaptation.

3. Methodology

3.1. Type of methodology and research questions

This research is primarily qualitative. The main objective is to conduct an in-depth analysis of the experiences, ideas, meanings, and perceptions of resilience and adaptation of Costa Rican artisanal fishers in the context of climate change. The aim is to understand how the fishers perceive and implement resilience and adaptation measures in their daily lives when confronting the effects of climate change. Ultimately, the overarching goal is to understand how Costa Rican artisanal fishers perceive climate change effects and respond (or choose not to respond) to them. Since perceptions and experiences are fundamental to this research, it required a methodology based on in-depth methods and content analysis techniques to analyze how the artisanal fishers and their communities experience vulnerabilities, resilience, and adaptation in the context of climate change. Specifically, this research seeks to understand how the artisanal fishers perceive and embody these concepts on a daily basis with a view to examining how they align with mainstream ideas on climate change adaptation, the underlying reasons for any similarities or dissimilarities, and their respective impact. Thus, the main research question guiding this study is: What does adaptation to climate change mean for Costa Rican artisanal fishers and their communities? To answer this research question, I studied the aspects of vulnerability, resilience, and adaptation by means of three sub-questions: 1. What are the principal vulnerabilities of the artisanal fishers and to what extent do these vulnerabilities affect their daily lives? 2. What are the components of resilience for the artisanal fishers? and 3. How do artisanal fishers adapt to climate change?

While this research centers on artisanal fishers, it also analyzes the artisanal fisher community within the study area, which is understood as a group of individuals who identify themselves as artisanal fishers within the village. As Barrow et al. (2002: 37) state, "(…) a community is a social entity, bound by a common cultural identity, living within defined spatial boundaries and having a common economic interest in the resources of an area." Bixler et al. (2015: 171) argue that this definition allows for the study of "small social aggregations where the household and village level are the basis of the organization of much of a rural area." This conceptualization considers intangible aspects related to culture and identity, which is essential for understanding the ideas and actions of fishers in the context of climate change and climate change adaptation.

Given that Costa Rica has two coasts with numerous fishing communities, a heterogeneous geography, and differing weather conditions, biodiversity, and socioeconomic development, the research focused on four communities (two along each coast) for methodological reasons regarding time and resources. Along the Caribbean coast, the communities of Cahuita and Barra del Colorado were selected as case studies; while on the Pacific coast, the study focused on Dominicalito and Cabuya.

3.2. Data collection

3.2.1. Survey, in-depth interviews, and observation

Considering the interrelationship between vulnerabilities, resilience, and adaptation as outlined in the analytical framework, along with practical constraints related to timing and access to the informants, this study employs a survey and in-depth semi-structured interviews with key stakeholders among the fishers and their communities. Both instruments were deployed simultaneously to understand the communities' socioeconomic context, the possible socioeconomic effects of climate change on artisanal fisheries, resilience, and adaptation in each area. A total of 37 fishers were surveyed, of which 35 were also interviewed (see Table 3.1. for details). The instruments were designed and employed in Spanish (their translation was not necessary since all the fishers were Spanish speakers). Both the survey and in-depth interview asked questions regarding vulnerabilities, resilience, and adaptation from a general perspective and in the context of climate change. This aimed to assure consistency across the topics of interest of this research.

Table 3.1. Information about the fishers interviewed

	Women	Men
Number of fishers surveyed	7	30
Number of fishers interviewed	8	27
Active fishers	4	25
Retired fishers	3	5
Age range	28-65	20-74

Source: Prepared by the author.

The survey was organized into six sections, which included sociodemographic information, fishing activity (e.g., years in fisheries, fishing gear, etc.), knowledge of climate change (e.g., definition and effects), questions about vulnerability (e.g., material or institutional support, risks, and concerns, etc.), questions about resilience (e.g., support mechanisms, training, values), and transformation of the fishing activity (i.e., changes in techniques, gear, etc.). On the other hand, the in-depth interviews were divided into four topics in accordance with the main concepts covered by the research questions:

- Topic 1: Socioeconomic effects of climate change: the relationship between climate change and fishing and the perceived effects of climate change on artisanal fishing
- Topic 2: Vulnerability: the current situation facing artisanal fishers
- Topic 3: Resilience: the meaning of being an artisanal fisher and reasons for fishing
- Topic 4: Adaptation: experiences dealing with daily problems in fishing, particularly in the context of weather phenomena or disasters

The survey and interviews were conducted of the same individuals to better understand their experiences and perceptions. Depending on the informant's responses, this took anywhere from 40 minutes to 2 hours 30 minutes. It is important to note that the discrepancy between the number of people surveyed and those interviewed is due to two individuals declining an

interview, citing time constraints (scheduling an additional meeting was not feasible). Of the 37 fishers surveyed, 29 were active, and eight were retired from fishing (although still fished recreationally) (see Table 3.1). Additionally, I interviewed five key informants (community leaders, small business owners, national park representatives, etc.) to provide information on context.

The purpose behind pairing the survey with an interview was to triangulate the inputs to dive deeper into the analysis with more details (Antonova, 2021). The survey was given to the fishers first at a group meeting to collect inputs about their socioeconomic profile, fishing activity, and possible effects of climate change. The interview was conducted right after the survey and the inputs from the survey were used to guide the in-depth interviews.

The survey and in-depth interview were applied to a convenience[2] sample (Creswell & Plano, 2014), which I defined based on the availability of individuals living in the community and/or working in the artisanal fisheries.

To begin, I contacted the leader of the fisher association in each community and sought their advice on which fishers to survey and interview. In many cases, the association leader provided the contacts of both experienced fishers and fishers relatively new to the activity. I also used the snowball technique by asking the interviewees for recommendations of other potential informants (Gustavsson, 2021). The association leader's support in providing contacts was vital given the high levels of distrust in the sector, making it challenging to access the fishers (FAO, 2017; Gustavsson, 2021).

When a fisher being interviewed had ample experience and had lived in the community for a long time, I also asked life story-type questions (e.g.., how did you become an artisanal fisher? Which weather events do you remember the most and why? How did these events affect you and your family? What happened after the event? What are the most dangerous things you have experienced while at sea?). These questions are intentionally broad and retrospective for the purpose of diving deeper into the fisher's personal history. In this case, I asked eight fishers from the sample (two in each community) about their life stories. These fishers had an average age of 62 years and average experience of 35 years in the fishing sector.

The purpose of interviewing and surveying nearly the same sample was to maximize engagement with the informants while minimizing the risk of being perceived as too persistent and demanding of their time. I observed that many fishers found it difficult (or were unwilling) to dedicate an extended period of time or multiple sessions for the survey and interview. Additionally, my time in the communities was limited due to work constraints and, during the initial fieldwork phase, COVID-19-related challenges.

As stated previously, I incorporated several questions in the in-depth interview to gather the life stories of a few key stakeholders to better understand the community's socioeconomic history, the relationship of the interviewee with the activity (Gustavsson et al., 2021), and to track the

[2] According to Creswell and Plano (2014), a convenience sample is used when the individuals are available and can be studied. Regarding this research, due to time constraints and physical access to some communities in the context of a global pandemic, I asked the local leaders, NGOs, and universities already working in these communities for informant contacts.

effects of climate change on the fishing sector and community from an intimate and historical perspective (Moezzi et al., 2017). Meanwhile, these life stories provided insights into the vulnerabilities and resilience of the fishers over time, extending beyond the effects of climate change.

Informal conversations (Ross, 2015) with the fishers and other community members at supermarkets, restaurants, hotels, and national parks were also crucial in understanding the history of fishing and the community in general. In addition, I conducted participant observation (passive observer) during the site visits (Johnson, 2017). For this, I took long walks on the beach, visited the harbors and national parks, and strolled around the community to better understand its history and socioeconomic context. This observation helped to identify potential visible effects of climate change (e.g., rising sea level, coastal erosion, red tide, infrastructure built by the locals, community, or local governments, climate change and environmental protection campaigns, etc.), while also providing insight into daily life in these locations.

Thus, the data collected from the in-depth interviews and life-story questions were intended to delve deeper into the fishers' perceptions and experiences of vulnerability. This also contributed to understanding their resilience, values, ideas, and motivations for handling and adapting to change, as well as to a reflection on their relationship with the local and national government and other stakeholders such as NGOs and academia.

On the other hand, I also gave in-depth semi-structured interviews to "experts" from NGOs, universities, and policymakers (government officials) to understand their perceptions and positions regarding artisanal fishing, climate change adaptation in Costa Rica, and adaptation to climate change by the artisanal fishers in the country. I interviewed 23 individuals with diverse backgrounds, including marine biologists, ecologists, oceanographers, attorneys, and political scientists, among others. Some occupied high-ranking positions at the time in the Ministry of Environment and the National Institute of Fisheries; while others work as advisors or academics at public universities or as NGO consultants.

These interviews were conducted via Zoom, primarily due to the restrictions related to COVID-19 and scheduling. The average duration of each interview was approximately one hour. The in-depth interview was organized into three sections: the first, entitled "about you," asked about the informant's personal story and how he or she became familiar with their field of knowledge. The second section touched on the main concerns regarding adaptation to climate change from their perspective as well as their personal thoughts about adaptation to climate change in Costa Rica (whether or not the country is adapting and the reasons for it). The last section incorporated questions about climate change and artisanal fisheries and their perceptions of the current socioeconomic conditions, vulnerabilities, resilience, and adaptation by the fishers.

These informants were also chosen by convenience, where their expertise in the field and availability were the main criteria. Recommendations from other interviewees were essential in gaining access to a few key contacts, especially informants in official positions or those working in international organizations. All were contacted by email and the interviews were recorded (only one informant requested to respond in writing). Two in-depth interviews were in person

at the informant's request. The interviews were conducted in Spanish (no translation was required) and the majority of the informants, with the except for one person, were Costa Rican.

3.2.2. Literature review

In addition to the above, I compiled academic and gray literature on artisanal fisheries in the country and region and relevant climate events, as well as available statistical data as critical inputs to identify the potential effects of climate change, the socioeconomic context of the different communities, and potential vulnerabilities. Additionally, available socioeconomic data including landing records, fishery transformations (e.g., gear, species caught), licenses, employment rate, employment rate by gender and age, and social indicators (e.g., social inequality, poverty, access to essential services, education) contributed to the analysis of vulnerabilities and historical marginalization of the fishers and their communities. The data was collected for the period 2000 to present with the aim to identify patterns or trends. One important challenge I faced was collecting historical data on the artisanal fishing sector in Costa Rica due to a lack of records or information scattered across multiple institutions and gaining access to it. This literature was complemented by news articles related to the topic from the leading Costa Rican news outlets as well as foreign media.

Since my research focused on perceptions and experiences in terms of the fishers' vulnerabilities, resilience, and adaptation in the context of climate change, it was sometimes challenging to determine whether vulnerabilities, resilience, and adaptation responses were directly linked to climate change effects or influenced by other factors. Thus, I incorporated several significant climate events as reference points during data collection to examine the role of perceived vulnerabilities, resilience, and adaptation experiences among the fishers in the context of climate change.

3.2.3. Data analysis

The qualitative data (in-depth semi-structured interviews, oral stories, and related literature) were analyzed using content and thematic analysis to identify patterns in the factors that are the subject of this research, such as processes, relations, ideas, discourses on adaptation, and their implementation, among others (see Ross, 2015). The software Atlas.ti was used for the content and thematic analysis of the in-depth semi-structured interviews. This qualitative software aided in systematizing the interviews and identifying themes, differences, and similarities in the data through quotes to support the arguments made throughout the following chapters. Meanwhile, the basic quantitative data (demographic information and data about fishing activity) were analyzed using simple descriptive statistics in Excel. This quantitative data helped to build and understand the socioeconomic context of each community and the material concerns of the artisanal fishers, also contributing to the discussion on their vulnerabilities, resilience, and adaptation experiences in the context of climate change.

Following the situated nature of this research, where contexts are critical to understanding the fishers' ideas, perceptions, and actions in the context of climate change, vignettes are utilized as a writing resource at the beginning of each empirical chapter to better illustrate key aspects, sharing anecdotal moments from my fieldwork (Humphreys & Watson, 2009).

The data collected from the in-depth semi-structured interviews, life stories, participant observation, and surveys were triangulated with the available academic literature on climate change adaptation in the artisanal fishing sector, academic and official documents, and statistical data regarding the artisanal fisheries in Costa Rica and the studied communities. As Antonova (2021) highlights, triangulation is crucial because it "allows for a fuller assessment and a deeper description of the dynamics in case studies."

3.3. Positionality statement and ethical considerations

3.3.1. Access

As a young professional woman living in the Central Valley of Costa Rica, gaining access to the artisanal fishers and their communities presented a challenge, due in the most part to their location and distrust of outsiders. Artisanal fishing communities worldwide have been historically marginalized (Doyon, 2002; Mosepele & Kolawole, 2017), and Costa Rica is no exception (Fernández Carvajal, 2013; Salazar Araya, 2012). Generally, these communities face high levels of poverty and unemployment and lack access to essential services like public security, electricity, roads, water, and sanitation. I observed a general discontent with the Costa Rican State and its governments over time as well as with the approach of research institutions (i.e., public universities, NGOs, and international organizations), which engage with them in a transactional and utilitarian manner to extract information or implement projects for budget execution.

As a lecturer at one of the largest public universities in Costa Rica, I considered the potential benefits of leveraging my institutional affiliation when reaching out to the fishers and other community members, which, in the end, I believe gave legitimacy to my work and contributed to building trust. However, I also acknowledged that it might represent a disadvantage as regards the past experiences of the fishers and community with the university I represent. In fact, in several of the interviews with the artisanal fishers and association leaders, I observed a feeling of discontent in the form of questions about what the community would gain from my research or if they would be compensated in exchange for providing data (see Gustavsson et al., 2021).

The informants shared several stories about how NGOs, scientists, FAO officials, and the Costa Rican government had come to the community asking questions for research projects and talking about proposals or fishing practices without care or consideration for their knowledge and experiences. This distrust and frustration were evident across all four study sites. This was challenging to hear and prompted me to consider what I would give back to the community by developing a research project of this kind, and more generally, how research effectively contributes to the communities in which it is conducted. This is not a new discussion in development studies, but it has been an opportunity to think critically about the research scope and practice in the context of justice.

I explained to the local leaders, informants, and community members that, despite working for a public university, the project was personal. I clarified that I was not permitted to pay for information and that one of my main interests was to document artisanal fishing experiences in the country, about which literature and research are still limited. For this, I would explicitly incorporate the fishers' voices and ideas as quotes in the written document. I was adamant about

the potential for a project of this kind to help create written academic evidence that could support future projects within their communities and even as potential evidence for the communities themselves when proposing new projects (all four communities are politically active).

Given these challenges in gaining access to the community, establishing initial contact with the fisher association leaders proved crucial for introducing myself in a less intrusive and more approachable manner (Gustavsson, 2021). Contact was challenging by cellphone due to signal issues and timings, but it was more fluid when I visited the communities.

In addition to issues of distrust, gender and race also influenced by ability to access research participants. As a female researching a male-dominated sector like artisanal fishing (Gustavsson, 2021), I faced challenges regarding access, safety, and the candidness of the fishers. Additionally, violence against women has risen in recent years along the coasts of Costa Rica, especially in the tourist areas. Gender-based violence poses an additional threat to some fishing communities and was a safety concern I remained mindful of during my fieldwork.

The race factor is also noteworthy, particularly given that one of the communities is Afro-Costa Rican. In a few of the interviews, my skin color was explicitly acknowledged by the fishers and local leaders in phrases like '*Usted, blanquita…'* ('You, white person…'). They would usually follow this with an example of how my skin color influenced access to services and social mobilization within Costa Rican society. It took me by surprise as this was the first time in my life that I had been identified as a white person; usually, in Costa Rica I have been addressed as *chola* (a derogatory expression for an indigenous person), *morena* (brown-skinned) or *negrita* (black-skinned). While these adjectives can be used offensively, they are more often part of the country's slang and used in a friendly manner. However, this does shed light on the notions of race implicit in Costa Rican society, where debates about ethnicity, race, and racism are still considered tabu (Hutchinson, 2019).

These situations, in which my skin color was perceived differently across contexts, caused me some discomfort but also prompted deep reflection on my intersectionality and the "complex fluidity of the 'meaning' of skin color" (Shakthi, 2020: 1). I had never considered my skin color in relation to privilege (Ounanian., 2021). As a brown-skinned woman from a low-income family and community, I never imagined I would be categorized as 'white' based on my skin color. These experiences deepened my understanding of the relational nature of privilege in my position as a brown-skinned professional woman living in the Central Valley.

As a result, I began to feel a sense of distance in how the fishers perceived me, particularly in this Afro-Costa Rican community. I became increasingly aware that this might create additional obstacles to building rapport, fostering close connections, and engaging in more natural conversations. However, it also helped me to critically analyze the dialogues and data collected in relation to identities as well as historical and sociopolitical contexts.

On the other hand, as a woman doing fieldwork and research in the artisanal fisheries, there were also limitations to my access to some spaces and experiences, mostly due to safety concerns (see Gustavsson, 2021). For instance, I made sure to do all interviews during the daytime and, depending on the location, I would take a person of trust (a male) with me. I also made sure to

arrange for the dialogues in public spaces, avoiding bars or isolated areas. My opportunities for joining the fishers out at sea were minimal given that I was alone most of the time and I did not think it wise to go out to sea without company. I received a few suggestive comments regarding my marital status or invitations to drinks or dinner; I politely declined them all, explaining that I was in a serious relationship, which affected the way the fishers spoke with me (they became more cautious).

During some conversations, the informants (primarily men but a few women as well) at times reinforced gender stereotypes, particularly regarding traditional roles and societal changes. Despite my positionality as a feminist woman, I deliberately chose to downplay this aspect of my identity and refrained from explicitly challenging the prevailing masculinity within the community. This approach allowed me to maintain a "sympathetic engagement with the context and culture" (Pini, 2004: 174). Nevertheless, I believe that this choice of behavior did not compromise my position as a female researcher; rather, it served as a pragmatic approach to navigating this complex issue. Despite this, I never felt threatened during fieldwork, and the conversations remained polite and friendly, even when addressing sensitive topics like alcoholism or violence.

While being female could represent a limitation to research in a male-dominated field like artisanal fishing, it also contributed to gaining access to information from the women working in the fisheries (whether directly or indirectly) as well as women in the studied communities (Gustavsson, 2021). During my conversations, most of the woman I interviewed or surveyed emphasized their role in fishing and their concerns that it is usually disregarded by their partners or families, the community, and even by research. These conversations allowed me to better understand the gender dynamics within the communities; for instance, how challenging it is for some women to work as fishers and the division of labor—from their roles onboard to taking care of their husbands and children at home, selling the product in the community, and their active participation in local organizations.

My position as a woman in this context and from a feminist perspective also prompted me reflect on masculinity (see Gustavsson & Riley, 2020), particularly in terms of what it means to be a fisher, the qualities men are expected to embody, and how they derive pride and meaning from their work, which is often considered more than just a job. I believe these reflections are relevant to the research as provide a deeper understand of the community's socioeconomic context and their perceptions about change and adaptation in general.

3.3.2. Ethics

All data collection methods and tools required each participant's approval via informed consent. Before implementing the survey and in-depth interviews, I explained the informed consent in detail, including the purpose of the employed instruments, and answered any questions about the research project and how the information would be handled. Privacy is guaranteed; only myself, the researcher, and my supervisors have access to the collected data. Since the research used qualitative techniques, such as oral stories, in-depth interviews, and informal conversations, I requested approval from each participant before using their real names and specific quotes.

This standard also applied to any images, videos, or audio taken during the fieldwork. Nevertheless, to protect individual identifies, I opted to use pseudonyms in this research.

3.3.3. Positionality: Situated knowledges

In her paper *Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective*, Haraway (1988: 581) refers to situated knowledges as "feminist objectivity," which she understands as looking at partial perspectives—limiting the location and avoiding the transcendence and division of subjects and objects. This concept challenges the basis of Western science in terms of generalization and a binary understanding of nature in the context of a "science" developed in "late-industrial, militarized, racist, and male-dominant societies" (Haraway, 1988: 581).

Despite how Haraway critically approaches knowledge production and understanding, she clarifies that partial perspectives are not synonymous with relativism. Partial perspectives are about locatable knowledges, acknowledging the web of connections and shared conversations in epistemology. The author criticizes relativism and totalization by arguing that "both deny the stakes in location, embodiment, and partial perspective; both make it impossible to see well. Relativism and totalization are both 'god tricks' promising vision from everywhere and nowhere" (Haraway, 1988: 584).

Situated knowledges recognize heterogeneous multiplicities that cannot be reduced to general structures or cumulative lists; instead, they emphasize the interpretation and translation of knowledge. This concept refers to positioning science within a range of contexts (Nightingale, 2003). A key argument in Haraway's paper concerns the nature of natural knowledge, which is not rooted in disengagement but rather in critical interpretation among networks of interpreters and decoders. It emphasizes the importance of recognizing the power dynamics inherent in knowledge production. Going even further, Harcourt (2023: 299) argues for the "political strategy of knowledge production" that facilitates "find[ing] strategic partnerships" aimed at challenging mainstream constructions (e.g. climate change adaptation) and "bring[ing] about much needed ecologically, cultural and economic transformations."

Analyzing the vulnerabilities, resilience, and adaptation of the fishers in the context of climate change from a situated perspective entails going beyond the biophysical nature of climate change and recognizing its social-political dimensions. This broadened approach aims to understand what climate change means for specific people and to decipher, from a resilience and adaptation perspective, what they are responding to. Using only the biophysical entry point and a technical perspective in researching climate change adaptation is valid, but limits the potential for discovering different ontological and epistemological positions from socio-political contexts in which the climate change and climate change adaptation processes are enacted (Nightingale, 2016).

Regarding the artisanal fishers and their communities, situated knowledges may contribute to understanding how they perceive, experience, are perceived, and respond to changes in the context of climate change based on their socio-political, environmental, cultural, and economic conditions. This facilitated an analysis of how these communities adapt based on their vulnerability and resilience, both concepts that are situated and contested in nature.

3.3.4. Limitations, risks, and barriers

Limitations

Extended stays in the areas of study were a challenge due to the COVID-19 pandemic, work-related limitations, and physical access to some communities. However, I established contact with the leaders of the respective fisher associations and key informants in each community and aimed to spend as much time as possible with them, discussing the research topics and engaging in informal conversations about their daily life in the community and as fishers. It is important to note that in most cases, the fishers limited the conversation to one hour. For this reason, I sought to maximize the topics of conversation while respecting the defined boundaries.

Another important challenge was my inability to join the fishers at sea. This limited my in-depth understanding of their perceptions, ideas, and actions about the weather and the reasons behind their fishing practices. I did have access to these aspects through the survey, interviews, and passive observation, but not as a direct experience. Moreover, having limited our meetings and conversations to the daytime and to busy public spaces may have negatively impacted my ability to access more personal experiences in terms of their life stories, nighttime fishing behaviors or practices, or viewpoints regarding the local and national context, such as local politics or problems like drug trafficking and insecurity, due to the timing, formality, and proximity of these spaces.

While these limitations are worth noting, I perceived my interactions with the fishers (both male and female) as open and candid, allowing them to share their concerns, experiences, and personal stories. This allowed me to triangulate the data collected with the literature and the interviews with experts who had previously worked within the communities.

Risks

Costa Rica is considered one of the safest countries in Latin America (Global Peace Index, 2023). Armed conflicts do not exist, and traveling solo within the country is typical. That said, drug trafficking and organized crime are increasing concerns in the country, with a particular interest in the coastal areas where criminal violence is relatively high as compared to the Central Valley (Murillo, 2022). There has also been a rise in violent crimes against women (Pomareda García, 2024). The researched communities face problems related to drug trafficking, but criminal violence is not a primary concern according to the survey and interviews. Community organization is evident, with members looking out for one other by taking notice of suspicious individuals and keeping track of minor incidents, like petty theft, dangerous locations, or individuals selling small quantities of drugs, etc.. During my visits, I avoided meeting with informants late at night or in locations considered to be unsafe. Before visiting the areas, I asked the key informants about primary safety considerations.

The majority of my fieldwork took place during the COVID-19 pandemic and falling ill posed a significant risk. As a precaution, I was vaccinated before commencing my site visits. Additionally, I took into consideration all health recommendations when interacting with people, including wearing a facemask, keeping my distance, using hand sanitizer, etc.). However, once the COVID-19 measures were relaxed and I was able to travel without restrictions, I visited the

communities several times to walk around and hold informal conversations with members of the community.

Barriers

Existing data about artisanal fishers in the country are scattered and limited. While research on the biological and ecological aspects of fisheries in Costa Rica is more abundant and up-to-date, data on the social dimensions of fisheries in general, and artisanal fisheries in particular, are limited. Statistics and official reports regarding the socioeconomic conditions of individuals working in fisheries in the country are outdated. Moreover, academic research about climate change and artisanal fishers is scarce and limited to a few descriptive studies. Therefore, I collected data from diverse sources to build a comprehensive narrative.

Additionally, as previously discussed, another important barrier is related to gender. As a female doing research on artisanal fisheries for the last nine years (both my master's and Ph.D. theses are on the topic), I acknowledge that some spaces and information are likely not shared by men due to the need for trust and familiarity to speak candidly (Gustavsson, 2021) or due to limitations in terms of the safety of physical spaces for interacting.

4. Artisanal fisheries in Costa Rica: Context and study sites

Sadly, we, the fishers, do all the heavy work; we carry a heavy weight.
We are responsible for going to sea and looking for fish.
Nights without sleep, hunger, sun exposure, and, sadly,
we earn less money because we are punished by super low prices (…)
And we, the fishers, are the ones suffering at sea; we spend many nights
without any sleep and facing harsh conditions at sea.
It is difficult, and we barely catch what is necessary to survive.[3]
Jonathan, fisher from Cabuya with 24 years of experience

This chapter aims to examine the key historical, environmental, socioeconomic, and political factors shaping the realities of the study sites. The objective is to provide background information about Costa Rican artisanal fisheries in the context of climate change as well as specifics about each site. The first section will discuss the broader context of artisanal fishing in Costa Rica and the effects of climate change on coastal zones. The second section will outline the main aspects shaping the current socioeconomic, environmental, and political situation of each study site.

4.1. Artisanal fisheries in the context of climate change

4.1.1. Context and current situation

According to Salazar Araya (2012), as a traditional activity in Latin America, the history of fishing dates back to prehispanic times, representing an economic activity with strong cultural and social dimensions for native people in the continent, and Costa Rica is no exception. Fishing for commercial purposes began in the country circa 1955, when the first shrimp catches were recorded (Chavarría, 1988).

Today, fishing activities are developed on both coasts of the country, although the Pacific (especially the Gulf of Nicoya) is home to the majority of the activity due to its diverse geography (e.g., bays, gulfs, etc.) and long coastline compared to the Caribbean, which has a shorter, straighter coastline. Moreover, historically, access to the Pacific has been easier in terms of infrastructure, which is evidenced in the number of fishers on each coast. For example, in 1973, there were 1,290 fishers registered: 1,200 in the Pacific and only 90 in the Caribbean (Chavarría, 1988).

More specifically, fishing activity is developed in the coastal provinces of Guanacaste, Puntarenas, and Limón. Guanacaste and the Gulf of Nicoya (a gulf shared by Guanacaste and Puntarenas) contribute the most in terms to artisanal fishing (Moreno-Díaz & Alfaro, 2018);

[3] Original quote: *Porque, desdichadamente, nosotros los pescadores, somos los que llevamos el trabajo pesado, somos los que de verdad llevamos el yugo, la carga de ir a buscar los peces, llevar noches de desvelo, hambre, sol; y desdichadamente somos los que menos dinero ganamos porque nos castigan los precios, nos los pagan super bajos (…) Y nosotros los pescadores somos los que sufrimos en el mar, pasamos muchas noches de desvelo, en el mar super bravo, duro y de todo y terminamos sacando apenas como para lograr sobrevivir.*

whereas, the province of Puntarenas boasts the highest number of people working in the fishing industry (62% of the total population) (FAO, 2016). Limón hosts only a few small fishing communities.

Over the years, fisheries have held a minor participation in the national economic structure as compared, for instance, to agriculture or tourism. However, it is an essential source of income for coastal areas and contributes indirectly to tourism. In 1982, for example, artisanal fishing represented approximately 0.42% of the GDP (Chavarría, 1988), while in 2017, the Costa Rican fishing and aquaculture sector exported the equivalent of 0.1% of the country's GDP.

Figure 4.1. Definition of artisanal fishing in Costa Rica

In accordance with the Law on Fisheries and Aquaculture (Law No. 8436, 2005), artisanal fishing is defined as fishing activity developed in an artisanal manner by natural persons using a boat in continental waters or the coastal zone with autonomy to fish a maximum of five nautical miles from the coast and for commercial purposes.

Pursuant to this law, small-scale fishing is a type of artisanal fishing involving natural persons (without boats) fishing in continental waters or the coastal zone, or natural persons with a boat and autonomy of a maximum of three nautical miles from Costa Rica's territorial sea. Legal persons are not included in the definition of artisanal small-scale fishing.

A fishing license issued by the Costa Rican Institute for Fishing and Agriculture (*Instituto Costarricense de Pesca y Agricultura* or INCOPESCA) is required to practice commercial small-scale artisanal fishing.

For any fishing that occurs in protected areas, islands, wetlands, continental waters, wildlife refuges, and forest reserves, the Ministry of Environment (MINAE, for its acronym in Spanish) must develop a management plan.

INCOPESCA considers medium and advanced-scale fishing to be artisanal as well. However, there are significant differences regarding autonomy compared to the small-scale fishery (40 nautical miles or more for medium and advanced, respectively). Medium- and advanced-scale fishing uses larger boats with internal, fixed motors, and gear and target species differ as well. For instance, advanced artisanal fishing is permitted to practice longlining to catch commercial pelagic species. While these are the official definitions of artisanal fishing, this research focuses on commercial small-scale artisanal fishing only.

Source: Adapted from Solís et al. (2022) and INCOPESCA (2024d).

The exact number of individuals involved in fishing is unknown to the government, and national records are uncertain about the marine stock (Chacón Soto, 2019). According to data from the Central American Fisheries and Aquaculture Organization (OSPESCA, 2011), in 2011, 14,800 individuals directly worked in the artisanal fishing sector in Costa Rica (13,860 men and 940 women) and 6,100 artisanal fishing boats were registered. Meanwhile, the Organization for Economic Cooperation and Development (OCDE, (2019) estimated that in 2007 over 16,000 people worked in fisheries, of which 15,000 were located on the Pacific Coast. The aforementioned organization also estimated that from 2013 to 2015, employment in fisheries diminished by 50%. Moreover, employment in processing-related labor decreased by 64% and by 8% in aquaculture. Solís et al. (2022) consider that 30,000 people are directly and indirectly

involved in small-scale artisanal fishing (including fishing in the ocean, lakes, and rivers, and mollusk extraction). Currently, 1,745 fishing licenses for small-scale fisheries are registered with INCOPESCA (2024c).

Table 4.1: Active fishing licenses by type (updated May 2024)

Fishing type	Number of active licenses in 2024
Small-scale	1,745
Medium-scale	59
Advanced-scale	290
Semi-industrial (sardine)	3
Sport fishing	358
Research	69
Tourism	776
Industrial (tuna)	6
Total	3,306

Source: Prepared by the author based on INCOPESCA (2024c).

As the figures above illustrate, the number of individuals directly involved in fisheries differs vastly from other national and international statistics due to underreporting and limited capacity for systematic data collection. This also suggests significant levels of informality in the artisanal fishing sector. This lack of information is part of the historical marginalization of artisanal fisheries in the country, which are underrepresented and neglected in public data and policies (Salazar Araya, 2012). In reality, the number of individuals who hold a fishing license is low compared to the estimated number of people who own a boat and work as fishers (in fact, it is estimated that one out of every ten fishers holds a permit) (Fonseca Borrás & Solís Rivera, 2023). This informality also results in the criminalization of artisanal fishers and limits the role they can play in national policies due to their 'illegality' (Solís et al., 2022).

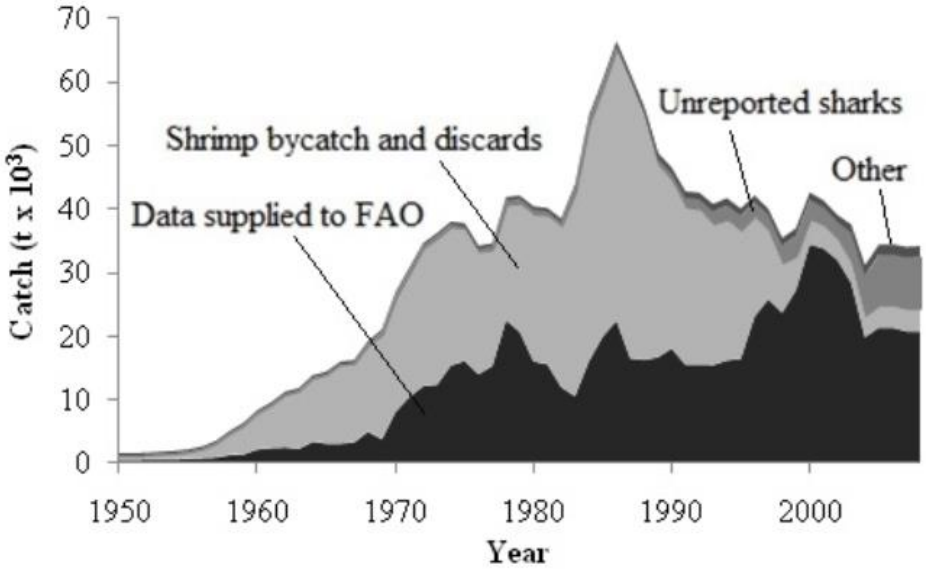
Information on the participation of women in the sector is also scarce. National statistics are not disaggregated by sex, and the role women play in fisheries is usually ignored in academic research and national reports (Solís et al., 2022). In Costa Rica, women participate in shrimp fishing, mollusk extraction, and at various points along the fish-value chain performing tasks that are often not considered part of formal fishing activities (e.g., household chores or childcare), in addition to their relevant participation in community organizations.

According to CoopeSoliDar R.L. (2019), in a study involving 500 women of different ages working in shrimp fishing, mollusk extraction, and fishing in general, the researchers highlighted their crucial contribution to traditional knowledge, low participation in governance structures,

low incomes regardless of season, involvement in two or three productive activities at a time (one of which is taking care of their home and family), inability to pay for childcare, asymmetric access to social security, and occupational risks. The study also mentions that violence against women is taboo in the sector and emphasizes that institutional recognition must be given to their realities as fishers.

Moreover, there is a lack of detailed, up-to-date information on fishery landings over time, creating more obstacles to analyzing possible changes in marine species (Naranjo, 2018). Nonetheless, records show a general decrease in landings from the year 2000 to present, which is mostly attributed overexploitation (Programa Estado de la Nación en Desarrollo Humano Sostenible, 2018) from artisanal, semi-industrial, and industrial fisheries (including illegal, unreported, and unregulated fishing, or IUU).

Figure 4.2: Total fishery catches in Costa Rica (1950-2008) as compared to data provided to FAO*



Source: Trujillo et al. (2012: 13)

Note: 'Other' represents the sum of unreported recreational, subsistence, *piangua* (*Anadara tuberculosa*), and whelk catches.

The socioeconomic and political struggles affecting artisanal fishing have changed slightly over time in terms of socioeconomic conditions, governance, and research. In her article *El sector pesquero costarricense con énfasis en la pesca artisanal* (The Costa Rican fishing sector with an emphasis on artisanal fishing), Chavarría (1988: 41) describes the difficult situation artisanal fishers faced over three decades ago due to fragile work conditions (e.g., limited fishing capacity due to boat size and available and authorized fishing gear), boat ownership (or lack thereof), poor boat condition, high fuel prices, low market prices, and powerful intermediaries, in addition to high levels of informality. Moreover, there was a lack of research in the field to inform policies.

The artisanal fishing sector has been consistently neglected throughout history, motivated by a national socioeconomic development model that promotes industrial fishing and tourism, and government policies that tend to focus on the populous Central Valley (FAO, 2016; UCR, 2018). Salazar Araya (2012: 320-321) argues this point when discussing how the number of individuals working in fisheries and agriculture (compared to the total number of able individuals) diminished in the country by the end of the 1970s:

> Since the end of the 70s prevails a State policy aimed to reduce traditional fishing and peasant activities to boost the industry (in particular private capital) and the service sector. This new economic model is based on "export promotion", particularly non-traditional monocultures (pineapple, melon, oranges, flowers, etc.), electronic devices, and tourism.

This model also transformed the country's land value and demographics, driving up coastal property prices due to tourism and the growing appeal of certain locations for both visitors and residents. These changes had an impact on locals by limiting historical access to land and sea, including related activities such as fishing or enjoying the beach (Núñez Chacón, 2024).

Artisanal fishers and coastal communities are among Central America's most socially and environmentally vulnerable groups. They are threatened by natural hazards (ECLAC, 2018), increased violence (e.g., due to drug trafficking) (Benessaiah & Sayles, 2014; Dudley, 2010; The Tico Times, 2014), and high levels of poverty (Programa Estado de la Nación en Desarrollo Humano Sostenible, 2016). Moreover, an important socioeconomic gap exists between inland and coastal zones in Central America, describing complex dualist socioeconomic logics in which the coastal regions exhibit lower performance in terms of human development indicators as compared to the interior zones (i.e., the Central Valley) (Chamizo García & Ammanzzini, 2014; Programa Estado de la Nación, 2016). In Costa Rica, this dualism is evident in a 'Central Valley-based mentality' (*vallecentrismo*) (Anglin Fonseca, 2018; Cuevas Molina, 2003), based on the idea that Costa Rica as a State started in the Central Valley and this geographical area encompasses the most important social, economic, and political elements defining life in the country. Dualism becomes even more complex within the coastal zones where various levels of socioeconomic development are evident within a reduced geographical space (luxury tourist hotels and real estate development in close proximity to socially and economically fragile communities).

The coastal provinces are the most vulnerable not only to climate change but also to social and economic challenges (see Table 4.2). Despite its importance to coastal economies and its role in national food security, the artisanal fishing sector in Costa Rica exhibits low economic and social development indicators.

Table 4.2: Socioeconomic indicators (according to regional planning parameters), 2023

Region*	Unemployment rate	% of households in poverty conditions	Gini coefficient
Costa Rica (National)	8.4	23.04	0.503
Central	8.0	18.1	0.487
Brunca (mostly Puntarenas)	8.0	34	0.507
Chorotega (Guanacaste)	8.0	26.4	0.515
Huetar Caribe (Limón)	11.6	33	0.484
Huetar Norte	8.7	30.5	0.492
Central Pacific (Puntarenas)	8.7	31	0.498

Source: Adapted from IDS 2023 (Ministerio de Planificaión Naciónal y Política Económica [MIDEPLAN] 2023: 215).

*For planning purposes, Costa Rica is divided into the above six regions encompassing the different provinces.

The coastal provinces exhibit the highest demographic dependence indicators (i.e., individuals under 15 or over 65 who rely economically on those aged 15 to 65) and the largest proportion of uninsured individuals compared to other Costa Rican provinces (FAO, 2016). In fact, Puntarenas province has the highest poverty indicator in the country (29.9% poverty and 9.8% extreme poverty), with unemployment being the main reason (UCR, 2018). As Solís et al. (2022: 31) highlight: "The structural problems faced by the people in coastal zones influence the scarcity of decent job alternatives, education, and access to healthcare. As a result of the lack of opportunities, fishing becomes one of the few work alternatives in these communities".

Poverty is a structural problem within the Costa Rican artisanal fishing sector, and the socioeconomic conditions of those dependent on the industry deteriorate during seasonal bans on certain species. During this period, most artisanal fishers and their families experience a significant reduction in income or receive no income at all. A few receive small subsidies from the government, which are insufficient to cover their basic needs (FAO, 2016), or they must work on different land-based activities. Institutional marginalization is evident in policy approaches focused on tackling poverty instead of understanding the specifics of artisanal fishing not only as a productive activity but as a way of life (Solís et al., 2022).

Regarding policies and trends in productive diversification, aquaculture is becoming an increasingly significant contributor to the national economy (OCDE, 2019) and to Central America as a whole. This activity is portrayed as a productive alternative to artisanal fishing within the socioeconomic development model based on export promotion and the rising importance of the blue economy as the government's development policy. In Costa Rica,

aquaculture production started in the year 1960 and intensified in 1998 with the mass production of tilapia. In 2002-2015, tilapia represented 88% of all aquaculture production (OCDE, 2019). According to INCOPESCA (2024e), national aquaculture production (excluding oysters) reached a maximum of 22,050 metric tons in 2019 but dropped to 16,759 metric tons in 2022.

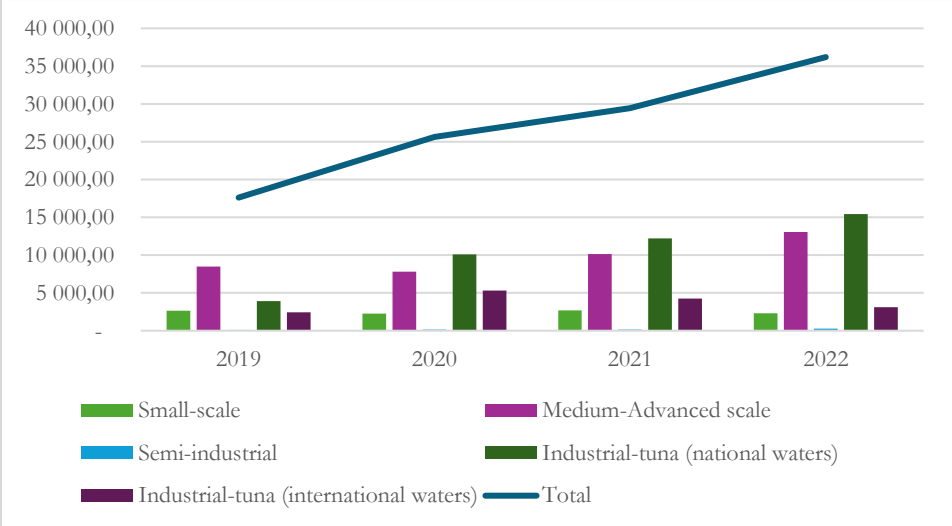
Lastly, concerning environmental issues, artisanal fishing in Costa Rica faces significant pressure. The criminalization of fishers arises from State-imposed restrictions on fishing permits and excessive regulations, as well as from certain environmental organizations advocating radical conservation approaches. Salazar Araya (2012) argues the issue is not so much about specific laws limiting artisanal fishing, but rather the direct and indirect effects of environmental laws or those regulating other productive activities such as semi-industrial and industrial fishing, real estate, and new marines along the coast.

A brief overview of semi-industrial and industrial fisheries

Semi-industrial and industrial fishing mainly take place on the country's Pacific coast. According to INCOPESCA (2024d), the former involves natural and legal persons working onboard a ship to catch shrimp, sardines, and tuna by means of purse seine nets. Semi-industrial shrimp fishing utilizes trawler nets. In 2016, 36 semi-industrial fishing licenses were registered; however many of these licenses expired in 2019, and it is unclear whether they will be renewed due to the 2013 Constitutional ruling banning shrimp trawling (see Resolution No. 2013010540, October 2012) (OCDE, 2019). To date, only three ships are currently registered as semi-industrial for sardine fishing (INCOPESCA, 2024c).

Industrial fishing, on the other hand, is defined as an activity practiced by natural or legal persons onboard ships that catch, freeze, and pack but are not considered factory ships. Costa Rica does not have a national industrial fleet; these vessels are foreign and operate in the EEZ (Economic Exclusive Zone) and international waters, mainly catching tuna (OCDE, 2019). In 2024, 14 foreign industrial vessels were registered in Costa Rica (INCOPESCA, 2024b).

Figure 4.3: Landings by fleet type in tons (2019-2022)



Source: Adapted from INCOPESCA (2019, 2020, 2021 & 2022).

Interestingly, data on the number of individuals involved in semi-industrial and industrial fishing is even more scarce than that for artisanal fishing. The data differs greatly from one source to another, and most numbers are mere estimations. For instance, Bolaños (2020) estimates that 3,110 people were either directly or indirectly involved in semi-industrial shrimp fishing in Costa Rica in 2013. In contrast, the research "*Caracterización Socioeconómica del Sector de Pesca de Arrastre Semi-Industrial de Camarón en el Pacífico Central Costarricense*" (Socioeconomic Characterization of Shrimp Trawler Semi-Industrial Fishing in Costa Rica's Central Pacific), published in 2016 by Marviva and the Department of Economics of the National University-Costa Rica (UNA), identified only 590 people involved in the semi-industrial shrimp sector in 2015. However, this study is limited in that it utilizes data collected two years after the ban on shrimp trawling. It also focuses on the semi-industrial shrimp sector, excluding other sectors such as sardine or tuna.

Due to the lack of available data, the aforementioned research by Marviva and UNA can serve as a guide to understanding the socioeconomic conditions of the individuals involved in semi-industrial fishing. According to the study, the sector is comprised of a middle- to young-age workforce (the average household age is 35) with a low level of formal education (30% of those surveyed had not finished high school and only 4% held university degrees). Moreover, incomes are not uniform along the value chain, with crewmembers and shrimp peelers receiving the lowest pay.[4] Even the differences between these two groups are significant; for example, a crewmember (fisher) may receive an average minimum monthly income of US $200-250, while a shrimp peeler may receive approximately US $70 per hired task (which is based on a target weight of shrimp to be processed, regardless of the time required to complete the task) (Escuela de Economía de la Universidad Nacional, 2016). While data related to the sector is scarce, this information helps to shed light on the context of those employed in semi-industrial fisheries.

Additionally, while *Encuesta Estructural de la Pesca Artesanal y la Acuicultura en Centroamérica* 2009 – 2011 (Structural Survey of Artisanal Fishing and Aquaculture in Central America 2009-2011) (OSPESCA, 2012) specifically states that the survey does not encompass industrial fishing or industrial fish processing, in Central America, 95% of workers in processing and packing plants are women employed under unstable labor conditions, further highlighting the gender gap in the fishing sector.

In closing, it is important to mention that semi-industrial and industrial fishing can involve illegal practices such as fishing close to or inside protected areas. Even some medium- and advanced-scale artisanal boats illegally operate within these restricted zones (Rodríguez & Rosero, 2018). This represents challenges not only for conservation and national security, but also for the governance of fisheries in terms of understanding the realities of each sector.

[4] The license holder can receive an average minimum monthly income of US $1,500-1,600 (Escuela de Economía de la Universidad Nacional, 2016).

4.1.2. The effects of climate change in Costa Rica

Climate change at the national level

More frequent and intensifying weather events affect Central America's productive activities, especially in coastal communities (Programa Estado de la Nación, 2016). In these areas, 61% of households rely on artisanal fishing as their only source of income; approximately 135,400 people work in artisanal fisheries across the region (OSPESCA, 2011).

As a whole, the region is frequently impacted by cyclones, droughts, intense storms, and ENSO (El Niño Southern Oscillation) (ECLAC, 2018). According to ECLAC (2018), the environmental impacts of climate change in Central America include changes in temperature and sea level, coral bleaching, delays in the onset of the wet season, and irregular rainfall. Of these effects, Corrales (2010) highlights the rising sea level, with some climate scenarios forecasting a one-meter rise on each of Costa Rica's coasts. Additionally, warmer seawaters negatively affect marine biodiversity in the region; for example, the Mesoamerican coral reef (the second largest coral reef in the world, covering the southern part of Mexico, Belize, Guatemala, and the northern part of Honduras) was threatened by strong bleaching episodes in 1998 and 2005 (Corrales, 2010).

In particular, Costa Rica is highly vulnerable to the effects of climate change (Ministerio de Ambiente y Energía [MINAE], 2018). The country's geography as a narrow territory with two coastlines, and its location within one of the world's most vulnerable regions in terms of climate, increase its vulnerability to climate change variability and phenomena, including storms, hurricanes, and floods (IPCC, 2014). In 2010, DARA's Climate Vulnerability Monitor, which categorizes countries based on five vulnerability levels (i.e., low, moderate, high, severe, and acute), reported a moderate level for Costa Rica; however, it predicts Costa Rica's vulnerability to rise to 'high' by 2030 (DARA, 2012) (see Table 4.3 below).

Table 4.3: Central America and the Dominican Republic: Climate vulnerability monitor, vulnerability level for 2010 and 2030

Country	2010	2030
Belize	Acute	Acute
Costa Rica	Moderate	High
El Salvador	Severe	Acute
Guatemala	Moderate	High
Honduras	Severe	Acute
Nicaragua	Moderate	High
Panama	Moderate	Severe
Dominican Republic	High	Acute

Source: Adapted from ECLAC (2018: 29).

Over the decades, Costa Rica has experienced significant changes in rainfall and precipitation patterns. These climate change-related effects significantly impact the country's economy. For example, from 2005 to 2018, Costa Rica recorded financial losses of US $3.134 billion due to direct damages from natural phenomena (Ministerio de Hacienda, 2020). In 2017 alone, Tropical

Storm Nate temporally displaced 11,517 people, with a total cost in terms of human and material damages of approximately 1% of the GDP for that year (US $577 million) ((Ministerio de Ambiente y Energía [MINAE], 2018). By 2030, losses of US $7 billion per year are expected in the country (Ministerio de Ambiente y Energía [MINAE], 2018). For a small economy like Costa Rica, this number is significant.

In terms of economic production, reports forecast a reduction in agricultural productivity. For instance, in the most optimistic scenario (B2),[5] a yield reduction of 9.78% is expected for corn, 16.56% for beans, and 11.91% for rice by 2030, with implications for food security due to the importance of these three products in the local diet (ECLAC, 2018). Climate change also affects human health; concerns are rising about increasing cases of vector-borne diseases (i.e., dengue and malaria), cardiorespiratory diseases (i.e., asthma and heart disease), gastrointestinal diseases (i.e., diarrhea), and parasitic infections (i.e., abdominal angiostrongyliasis) due to climate change consequences, with a forecasted economic impact of approximately US $63 million per year (ECLAC, 2018: 141).

By the end of the century, a temperature rise of 3°C is expected for Costa Rica, with varying effects around the country (e.g., the Pacific slope is expected to experience a rise of up to 4.5% compared to 2.5% for the Caribbean). By 2080, rainfall is expected to increase by 50% in the Caribbean; meanwhile, the northern part of the country and the Pacific coast will experience reduced rainfall of up to 65%.

While all seven provinces are vulnerable to the effects of climate change, the coastal zones are particularly more vulnerable than the country's Central Valley. For example, in 2011, the Ministry of Environment and the National Meteorological Institute published a report on the climate change vulnerability of each of the seven provinces, analyzed from the perspective of three major sectors: infrastructure, services, and human condition. The results showed that while the four inland provinces (i.e., San José, Alajuela, Heredia, and Cartago) are vulnerable in terms of infrastructure and services, the provinces located in coastal zones (i.e., Limón, Guanacaste, and Puntarenas) are also highly vulnerable in terms of human well-being. This highlights the asymmetry of the effects of climate change within the country, with the most socially vulnerable zones facing even worse conditions (Retana et al., 2011).

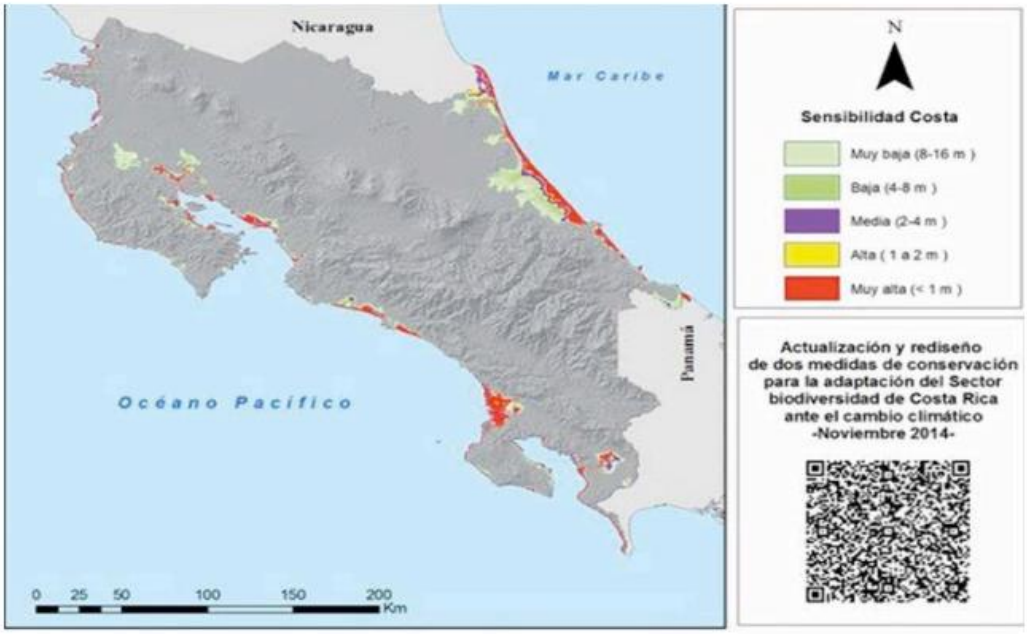
Climate change at the coastal level

Costa Rica boasts roughly 1,300 km of coastline (1,100 km along the Pacific and 200 km along the Caribbean). These coastal regions are most heavily affected by climate change, with frequent and abundant rain in the Caribbean and a longer dry season on the Pacific. Between 1977 and 2006, the country's northern Caribbean region was highly exposed to tropical cyclones. Additionally, the lowlands and coastal areas of Guanacaste as well as northern Alajuela, Heredia, and Limón provinces experienced more recurrent and abundant floods. The Pacific coast, in turn, experienced a significant concentration of droughts between 1974 and 2004 (ECLAC, 2018).

[5] Scenarios described by the IPCC (Nakicenovic et al., 2000). Regarding the B2 scenario, ECLAC (2018: 34) explains that it is a "world with a predominance of local solutions for economic, social, and environmental sustainability, as well as intermediate economic development and change in technology."

Looking ahead to 2100, the Pacific coast is projected to experience a one-meter rise in sea level, affecting residential-commercial zones, mangrove swamps, and salt marshes (Global Facility for Disaster Reduction and Recovery [GFDRR], 2011). In the case of Puntarenas, it is estimated that a rise of only 0.3 meters will cause the water to penetrate the coast by approximately 150 meters, affecting 105 hectares of tidal flood area (i.e., 60% of the residential zone). If, however, the sea level was to rise by one meter, 90% of the residential area will be affected by floods (GFDRR, 2011) (see Figure 4.4. below).

Figure 4.4: Sea level rise (SLR) projections for Costa Rica



Source: BID & CATIE (2014).
Note: Zones marked in red imply SLR of greater than one meter.

In terms of the Caribbean, the sea level is expected to rise by 5.5 millimeters per year, with a projected sea level rise of 81 millimeters by 2040. This means that water will invade land by four to eight meters, depending on the coast's morphology (Quesada & Molina, 2016). Changes in the sea level entail socioeconomic consequences for people living in these regions, mainly those close to the coast, such as artisanal fishers and their communities, as their livelihoods rely on the sea.

Climate change at the fishery level

The effects of climate change linked to sea level rise, coastal erosion, rising acidity, sea surface temperature rise, and more frequent and intense weather phenomena directly and indirectly affect marine and coastal ecosystems, with related consequences for fishing (BIOMARCC-SINAC-GIZ, 2013).

For instance, according to BIOMARCC-SINAC-GIZ (2013), places like Barra del Colorado and Cahuita are affected by sea level rise, potentially impacting wetlands and lagoons. In Cahuita, the

rising sea surface temperature also affects coral reefs inside Cahuita National Park due to heat stress. In fact, by 2030-2039, under climate scenarios B1 and A2, coral reefs in Cahuita, Cabo Blanco (near Cabuya), and Marino Ballena National Park (near Dominicalito) are expected to experience some degree of heat stress. This will also impact and increase pressure on seagrass in Cahuita and Marino Ballena National Parks. The study further showed that Cahuita National Park and Marino Ballena National Park are two protected areas with the most oceanic and coastal vulnerability.

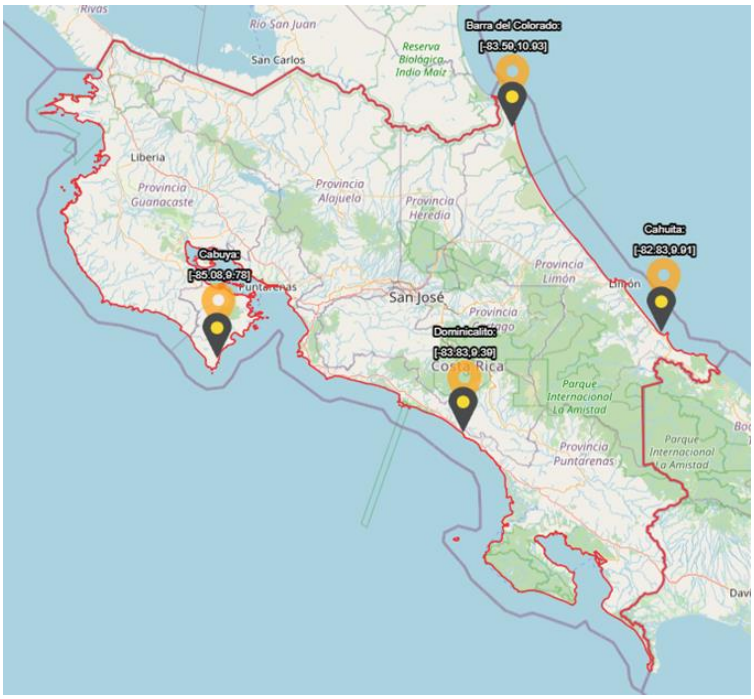
Another example is the Gulf of Nicoya, one of the most important fishing hotspots in the country, and a highly researched area in terms of ecology and climate change effects. As Ross Salazar et al. (2018: 23-24) highlight, the increase in salinity level, sea surface temperature, and related variables such as evaporation and heat—which are related to low levels of precipitation—influence vertical stratification in internal and external Gulf waters. As a result of this stratification, there is less nutrient transport in seawater. Additionally, stronger winds and tides will erode the coast in the area, affecting coastal and marine ecosystems. Climate change consequences and the effects of *El Niño* and *La Niña* negatively impact marine productivity and destroy crucial ecosystems like coral reefs.

In addition to problems like overexploitation (Fernández Carvajal, 2013), climate change is also considered a potential cause of reduced fish catches due to changes in local fish stocks and distribution, which has ecological and socioeconomic consequences for the coastal communities and artisanal fishers (Moreno-Díaz & Alfaro, 2018).

4.2. Study sites: *Barra del Colorado, Cahuita, Dominicalito, and Cabuya*

In selecting the four study communities, I based my choices on geographical position (to represent the diversity of each coast), remoteness (with two communities situated in remote areas and the other two not), the significance of artisanal fishing to the local economy, poverty level, and proximity to marine or land conservation areas, which affect fishing activity. With these aspects in mind, I proceeded to consult with experts and documentation to define the case study areas for this research.

Figure 4.5: Location of selected communities



Source: Instituto Geográfico Nacional (n.d.).

4.2.1. Study sites on the Caribbean coast

- ***Barra del Colorado***

Barra del Colorado is located on the country's northern Caribbean coast, 100 km from San José, the capital city. The village is situated in the province of Limón, and belongs to the canton of Pococí, district of Colorado.[6] It has a population of 1,017 inhabitants (Sistema Nacional de Áreas de Conservación [SINAC], 2017) and is considered a medium-low zone in terms of socioeconomic indicators. This medium-low performance stems primarily from low employment alternatives, low incomes, high dependence on artisanal fishing, poor infrastructure, and a weak local government (Arboleda-Julio & Aguirre-Rosales, 2016). The community's most important economic activities include agriculture and artisanal fishing (with a small contribution from sport fishing). The community's primary income source is artisanal fishing (Sistema Nacional de Áreas de Conservación [SINAC], 2017).

Barra del Colorado was once an important locality for transporting goods between Costa Rica and Nicaragua. In the early 20th century, this zone was fundamental for the transportation of logs. Later, in the mid-1950s, it increased in importance in the logging industry (Girot Pignot, 1989). During that time, the main economic activities were agriculture (e.g., coconut and some subsistence crops), livestock, and fishing for self-consumption. In the 1960s, the lobster fishery gained importance and was positioned as one of the main economic activities alongside sport

[6] In accordance with Costa Rica's Constitution (Article 168), the country is administratively divided into provinces, cantons, and districts.

fishing (González Álvarez & Villalobos Chacón, 1999). Nowadays, this zone is mainly recognized for its vast biodiversity. According to SINAC (2017), the zone is home to different migratory birds, green sea turtles (*Chelonia mydas*), and manatees (*Trichechus manatus*), among other animals, and a vast number of plant and trees species.

The village itself is situated inside Barra del Colorado Wildlife Refuge (*Refugio Natural de Vida Silvestre Barra del Colorado* in Spanish). This zone belongs to the Northern Caribbean Wetland, a Ramsar site. Its location inside a protected area has consequences for the community's socioeconomic dynamics due to environmental regulations. Barra del Colorado is located in one of the rainiest and most humid regions in Costa Rica, with extended areas covered by wetlands (Sistema Nacional de Áreas de Conservación [SINAC], 2017). The zone has a complex geography defined by lagoons and multiple canals, where wetland ecosystems are typical (Sistema Nacional de Áreas de Conservación [SINAC], 2017), which also limits access. Here, the Colorado River is important as a main course of water and fundamental for the ecosystems and cabotage.

The community is divided into two small villages by the Colorado River: Barra del Colorado Norte and Barra del Colorado Sur. Most inhabitants live in Barra del Colorado Norte, and the primary public services, including elementary and high schools, medical services, churches, and a few small grocery stores, are located in that section. Barra del Colorado Sur is important in terms of tourism with a small landing strip (for sporadic local flights). There are also a couple of small hotels, a police station, and a few homes. Crossing the river is a daily activity that takes less than ten minutes by boat; informal taxi boat services run by community members are available throughout the day. The Colorado River plays a crucial role in the community's history and present-day life.

Figure 4.6. A typical house on the river in Barra del Colorado Norte

Source: Photograph taken by the author.

In terms of artisanal fisheries, according to Solís-Rivera et al. (2022), in 2016, there were 200 artisanal fishers in the area. This number is not gender specific. However, in my interviews of the local fisher association leaders, they estimate about 100 men between the ages of 25 and 50 years work in artisanal fisheries; only 31 of them held a fishing license at the time of my fieldwork (INCOPESCA, 2024a). About 200 women were identified as working as shrimp peelers, 79 of which are members of the Association of Female Shrimp Fishers and Peelers (*Asociación de Mujeres Pescadoras y Procesadoras de Barra del Colorado*). In total, 29 boats are registered and have fishing licenses. There are two trade associations: the Association of United Small-Scale Artisanal Fishers of Barra del Colorado North Caribbean (*Asociación de Pescadores Artesanales de Pequeña Escala Unidos de Barra del Colorado Caribe Norte*) and the Association of Female Shrimp Fishers and Peelers of Barra del Colorado.

Figure 4.7 "*El bus*". Public transportation (for people and merchandise)

Source: Photograph taken by the author.

Figure 4.8: Boats are the main form of transportation in the area

Source: Photograph taken by the author.

Note: Many people in the area own small boats with outboard motors, and the informal taxi boat service is commonplace.

The most commonly caught species in the area are lobster (*Panulirus argus*), shrimps (*Xiphopenaeus kroyeri*, *Penaeus schmitii,* and *P. monodon*), fat snook (*Centropomus parallelus*), sharks (usually silky shark, great hammerhead shark, scalloped hammerhead shark, and bull shark), mackerel, and snook. To catch these species, artisanal fishers commonly use boats measuring seven to ten meters in length with outboard motors and a horsepower ranging from 15 to 250. The larger boats have wider beams (approximately two meters) with higher hulls for increased stability, which allows the fishers to go deeper into the fishing zone, but also protects against weather variability.

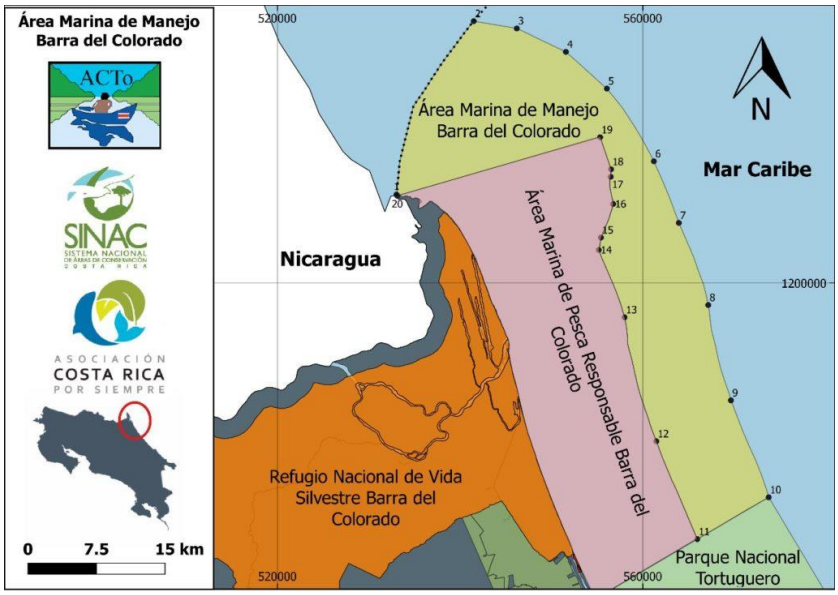
Some fishers also use artisanal fishing gear, such as fishing cord, cane and pole, fishing lines, nets, *nasas* (handmade lobster traps), and trammel nets. Some technological devices are common, including GPS devices or GPS apps on cellphones, as well as apps to check the weather conditions, ocean currents, and tides.

In 2019, a Marine Area for Responsible Fishing and Management Plan were created by the government and locals to promote better management of fishing resources while protecting biodiversity in the area. The purpose of this Marine Area is to ensure long-term sustainable artisanal fishing practices. The community agreed to this governance model in a public vote promoted by the Local Council (COLAC)[7] with the support of an environmental NGO and state environmental institutions (Departamento de Extensión y Capacitación, INCOPESCA, 2019). Later, in June 2020, the government of Costa Rican created the Marine Management Area (*Área Marina de Manejo Barra del Colorado)* to fill a gap in legislation regarding protected areas in this part of the country, which is known for its rich biodiversity (ACTo-SINAC, 2017). The objective of this area is to protect zones of transit and the reproduction of several species (i.e., fish, sea turtles, stingrays, sharks, lobsters, shrimp) while assuring sustainable and participative use of the ecosystem and promoting scientific research (Executive Order No. 42422, 2020).[8]

[7] COLAC (*Consejo Local Marino Costero* in Spanish) refers to a participative and environmental governance mechanism that brings together diverse local and national stakeholders (i.e., public, private, and civil society) (see Article 23, Law of Biodiversity No. 7788). In the case of Barra del Colorado, several organizations are involved: local fisher associations, INCOPESCA, the National System for Conservation Areas (SINAC), and COOPESOLIDAR R.L. (a national NGO), with the financial support of FAO (Departamento de Extensión y Capacitación, INCOPESCA, 2019).

[8] See Executive Order No. 42422: https://faolex.fao.org/docs/pdf/cos220662.pdf

Figure 4.9: Marine Area of Responsible Fishing and Marine Management Area



Source: Vargas Ramírez (2020).

Note: Orange represents the Barra del Colorado National Wildlife Refuge; pink represents the Marine Area of Responsible Fishing; and green represents the Barra del Colorado Marine Management Area.

One major concern in the region is overfishing, in addition to poor environmental conditions as a result of river pollution, where sediment from extensive pineapple, banana, and oil palm plantations upstream is affecting the ecosystems (Chacón Soto, 1996; SINAC, 2017). Climate change also has its effects on the region: modified rainfall patterns lead to changes in the reproductive seasons of marine species, affecting the local fish stock (Rodríguez, 2020); rising air temperatures affect the amount of water and oxygen in the river; and rising sea levels lead to reduced coastlines and an impact on clean water for human consumption due to seawater intrusion (ACTo-SINAC, 2017). Another environmental aspect to highlight is the accelerated erosion and sedimentation process of the Colorado River (SINAC, 2017), which affects local ecosystems and could impact the transportation of goods and people and, of course, fishing.

Because community members rely on artisanal fishing, these issues pose a threat to their income. In 2013, the Constitutional Court of Costa Rica issued a ban on renewing and issuing new fishing licenses for shrimp trawling (Resolution No. 201310540). The court requested scientific studies and legal reforms aiming to prove and guarantee the sustainability of this fishery across the country. This resolution was issued without taking into consideration the artisanal fishing practices developed in the community and the significant adverse effects it would have on the inhabitants.

Figure 4.10: View of a wetland from a natural canal in Barra del Colorado

Source: Photograph taken by the author.

In conclusion, Barra del Colorado was selected as a case study for this research due to its remote location, which defines its historical and political development; the obstacles it faces to develop other economic activities, such as agriculture, due to constant flooding; and because of its location inside a marine conservation area and, more recently, a marine management zone. This geographical position creates a complex situation for locals in terms of productive development, including type of economic activities or alternatives for developing infrastructure in accordance with environmental rules.

It is important to note the struggles that exist regarding land ownership in the area as many inhabitants live on lands that are not legally registered or that are listed as Protected Areas (ACTo-SINAC, 2017). Other lands in the area are supervised by the Administrative Board for Harbors and Economic Development of the Caribbean Region (JAPDEVA in Spanish), limiting their use and ownership by community members (Naranjo-Elizondo, n.d.). Additionally, unlike the Pacific coast where there are several landing sites, only a few formal landing sites exist along the Caribbean. Barra del Colorado is one of them; Puerto Limón and Cahuita are others that receive some landings on a smaller scale (Herrera-Ulloa et al., 2011).

- ***Cahuita***

Cahuita is a community located on the country's southern Caribbean coast, 200 km from the capital city. The village is situated in the province of Limón, and belongs to the canton of Talamanca, district of Cahuita. The Multidimensional Poverty Index (2022) ranks Talamanca as one of the poorest areas in Costa Rica (Programa de las Naciones Unidas para el Desarrollo [PNUD], 2022). The district of Cahuita spans a size of 235.64 km^2 and has a projected population of 13,341 inhabitants (Municipalidad de Talamanca, n.d.; Instituto Nacional de Estadística y Censos [INEC]; 2022), while the village itself has an estimated population of 1,100 (Seguridad Pública, 2019). Cahuita is known around the country for its beautiful beaches; Cahuita National

Park is the top attraction for tourism and a direct and indirect source of income for the community.

Two key aspects define this community: environment and culture. Environmentally, ongoing issues stem from the history of the national park, its governance model, and its diverse impacts on the community. Culturally, the area is distinguished by its Afro-Costa Rican population, who have historically resided in the area and represent one of only a few Afro-Costa Rican fishing communities in the country.

During the 19th century, Cahuita was a favored turtle hunting and fishing site for the *Miskito* people (an Indigenous group from Nicaragua) and other turtle hunters arriving from Panama (fishers from San Andrés Islands, Providencia, and Bocas del Toro) (Aguilar Bonilla & Peytrequín Gómez, 2020). Fishing is historically practiced in this community, especially by Afro-Caribbean descendants (Suárez Toro, 2021).[9] However, in 1978, a significant portion of Cahuita was declared a national park without community consultation, which changed the economic landscape due to new environmental restrictions. Hence, activities such as logging, turtle hunting, turtle egg collection, coral reef extraction, fishing, agriculture, and commercial activities, as well as commercial and sport fishing, were restricted within the borders of the new national park (Weitzner & Fonseca Borrás, 2000).

The community took action against the government (Barguil Gallardo, 2009), and in the mid-90s, a co-management area was established, making Cahuita the first site to be subject to this type of marine governance structure in Costa Rica (Solís, Fonseca & Madrigal, 2006). Today, the country considers this community a positive example of local organization and advocacy.

Figures 4.11 & 4.12: Infrastructure at Cahuita National Park

Source: Photographs taken by the author.

The community has a rich Afro-Caribbean heritage. A significant number of its inhabitants are black and identify themselves as Afro-Costa Rican. Both English and Spanish are spoken in the community; for many older community members, English (*Limonense* Creole English) is their

[9] In her book *Tona Ina: La misteriosa luz del mar en el Caribe. Crónicas* (2021), María Suárez uses the storytelling method to analyze the history of the Afro-Caribbean community in Cahuita. Suárez hypothesizes that African slaves first arrived from Ghana to the coasts of Costa Rica in 1710 after the shipwreck of two Danish ships off the coast of Cahuita.

native language, while Spanish was imposed as the official language of the State (Portilla-Chaves & Perry-Price, 2022). This ethnic and linguistic wealth is also evident in local food and music. During the interviews, a strong sense of identity and pride in being a local *cahuiteño*—especially among Black community members—was powerfully expressed.

It is important to mention that historically, the Afro-Caribbean descendants of fishers in the community have been permitted to practice artisanal fishing in the park as part of the co-governance model implemented here.[10] The interviewed locals call this authorization *tolerancia* (tolerance). However, in recent years, disagreements with the environmental law put at risk the ability to fish inside the park (Solís et al., 2022). In some interviews, the fishers expressed that despite this tolerance, park authorities could be restrictive, and at times they avoid fishing inside the park due to undue pressure.

In line with national patterns of productive transformation, tourism is the most important economic activity in Cahuita, with atomized foreign capital investing in small and medium-sized hotels and other tourist infrastructure. According to SINAC (2017), by 2017, 792 jobs were directly or indirectly related to tourism in the district, and accommodations and food services represented 27.9% of the economic activity in the area. However, public infrastructure in the community is still underdeveloped; most roads are not paved, and there is no hospital (only a small clinic) and no police station. If needed, locals must call the police based in Puerto Viejo, the nearest town.

Hotels and tourist facilities are small to medium in size (unlike on the Pacific coast, where one can find large hotel chains). The community has access to drinking water; however, quality is often a concern as it primarily comes from wells (while the water is drinkable, many prefer to buy water or use water filters). There are elementary and high schools and public transportation services. Access to the community is possible by car and public transport.

The community struggles with drug-related issues (mostly cocaine and marihuana) due to its location in a region known for both domestic and international drug trafficking and local consumption challenges (Seguridad Pública, 2019). Nevertheless, the community is primarily safe, and there is a sense of collective support among the locals, likely because they are aware of the importance of tourism to the community and strive to keep a safe and clean environment.

Artisanal fishing continues to be either the main or a complementary source of income for a number of community members. In 2000, approximately 15 people worked as artisanal fishers in Cahuita (Weitzner & Fonseca Borrás, 2000). In my interviews in 2022, the president of the fishers' association estimated that 45 people worked as artisanal fishers, 13 of them women. The age range of the fishers is diverse—from adolescents to over 70 years old. It is important to mention that not all fishers in the community are members of the association. Despite these numbers, only eight people were registered and held an active fishing license for small-scale fishing at the time of my fieldwork (INCOPESCA, 2024a).

[10] See Executive Order No. 40110-MINAE. *Reglamento del Modelo de Gobernanza Compartida del Parque Nacional Cahuita.* http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&param2=1&nValor1=1&nValor2=83425&nValor3=107178&strTipM=TC&lResultado=1&nValor4=1&strSelect=sel

Figure 4.13: Harbor (for tourism) and landing site in Cahuita

Source: Photograph taken by the author.

Regarding the most commonly caught species in the area, lobster is among the most significant (Brenes, 2007). Lobster is mostly caught during the months of November to January, with high variation among seasons. During the rest of the year, artisanal fishers focus on species like octopus, mackerel, snapper, and kingfish. Some of the prime areas for catching snapper are near the borders of protected areas, such as Tortuguero, Gandoca-Manzanillo, and Cahuita. This proximity impacts fishing activities, particularly during the low lobster season (Brenes, 2007).

The fishing gear utilized by local fishers is artisanal in nature, even when compared to the other study sites: small boats (usually under ten meters) with small to medium outboard motors (40-150 horsepower), fishing wire, and simple fishing rods. Some fishers use handmade traps (*nasa*) or special handmade rods called *lazos* and *garabatos* for catching lobster (see Figure 10). A few fishers are or were scuba divers; however, they do not use diving tanks but instead practice breath-hold diving (for catching lobster and octopus). The fishing journey usually takes one day, leaving early in the morning and returning late in the afternoon.

Figure 4.14. Artisanal fishing gear

Source: Photographs taken by the author

Note: Left *nasa* (artisanal lobster trap) and right *lazo* (artisanal lobster rod)

Figure 4.15. Artisanal fisher decorating his boat

Source: Photograph taken by the author.

Given its location along the Caribbean coast, the weather can change quickly, and heavy rains and floods are common, which directly or indirectly affect fishing regularity according to the informants. Moreover, Cahuita has visible effects of climate change, especially those related to sea level rise, sea temperature rise, acidification, heavy rains, drought risk, coral bleaching, and coastal erosion. According to BIOMARCC-SINAC-GIZ (2013), from 1992-2011, the Caribbean

zone experienced a sea level rise of 1-2 mm per year, and it is expected to rise up to 2.8 mm per year from 2010 to 2040.

The effects of sea level rise are evident in the national park, where certain infrastructure has undergone adaptation, such as rerouting walking trails and building elevated pathways for tourists to avoid the constant flooding due to seawater invasion. During my visits, I also observed that certain gray infrastructure (i.e., small concrete walls or sandbags) had been built or adapted in the rest of the community as well.

In 1991 a strong earthquake shook the province of Limón, also affecting this community. Critical infrastructure (e.g., roads, bridges, etc.) and homes were destroyed. The community was isolated for several days after the collapse of an important bridge. The earthquake changed the geomorphology of the entire coastline with a tectonic uplift (Quesada-Román, 2021). During the interviews, some fishers believed this phenomenon negatively affected long-term fishing activity because of "changes in the sea." Quesada-Román (2021) refers to some studies about a possible relationship between the earthquake and recent coastal erosion. Nevertheless, further research is needed, and there is no scientific evidence of the long-term effects of the earthquake on fisheries in the zone.

In summary, Cahuita was selected as a case study for this research due to being a small community that has radically transformed its economy with a primary focus on services (tourism), to which a co-management preservation model has been applied. Moreover, the community is surrounded by several conservation areas, restricting the available fishing grounds. Lastly, this community offers a critical cultural aspect given that the fishing tradition is linked to the community's Afro-Costa Rican inhabitants who display a powerful sense of identity where race and fishing are intertwined, characterizing the community's socioeconomic and historical context (Solís et al., 2022).

4.2.2. Study sites on the Pacific coast

- ***Cabuya***

With a fishing history that dates back 30 years (Villalobos et al., 2014), this small community is one of 15 artisanal fishing communities located in the northern Pacific, near the Gulf of Nicoya in the province of Puntarenas. This fishing village belongs to the canton of Puntarenas and the district of Cóbano. It is located 180 km from Costa Rica's capital city. Accessing the community from the Central Valley is difficult and expensive due to the distance, which includes a one-hour ferry ride from the port city of Puntarenas. This also affects the distribution of the artisanal fishing products.

Geographical aspects such as the village's remoteness and its location between two tourist hotspots (the towns of Montezuma and Santa Teresa), in addition to its proximity to the Cabo Blanco Absolute Nature Reserve (*Reserva Natural Absoluta Cabo Blanco*), one of the most

restrictive environmental protection models in the country,[11] have influenced its socioeconomic and environmental history (Moraga López 2012; Morales-Ramírez et al., 2014).

Cabuya is a small village of only 303 inhabitants spanning an area of 3.3 km^2. It has two primary economic activities: artisanal fishing and, more recently, tourism (including sport fishing) (Dirección de Planeamiento y Desarrollo, 2016). Public services in the area are limited: there is only one kindergarten and elementary school but no high school; there is no local medical clinic or police station; bus service is unreliable, and, despite the existence of roadways for vehicular access, due to the weather conditions are often challenging. While it is a small village, there is a large foreign presence with citizens from various parts of the world who reside here as either pensioners or local business owners (i.e., hotel owners or participants in the sport fishing industry) (Moraga López 2012). Cabuya is situated between two major tourist hotspots in Costa Rica, meaning a significant number of their productive activities are linked to tourism. Recently, due to pressure from this sector, tourism has gained importance in this community as well with an increased number of small hotels and improved restaurant services.

The number of individuals working in artisanal fishing is minimal. According to the president and secretary of the fishers' association, the organization had a total of 40 members in 2022: 30 men and ten women. The women are also part of the Association of Mollusk Collectors (*Asociación de Molusqueras*). The artisanal extraction of mollusks in the area is primarily for self-consumption, but a small number may be sold to the local or national market upon request. According to INCOPESCA (2024a), only five fishers hold a license, while the women working as mollusk collectors were issued an identification card by INCOPESCA.

During peak fishing season, fishers from other nearby towns like Cuajiniquil and Puntarenas also fish in Cabuya. As a result, the fishing activity intensifies during a 'good season' until catches decline (Villalobos-Rojas et al., 2014).

[11] In accordance with Costa Rican law, an absolute natural reserve must have absolute protection due to the special ecosystem conditions involved (rarity, singularity, fragility). These zones are limited to activities like education and research (Alpízar Rodríguez, 2017).

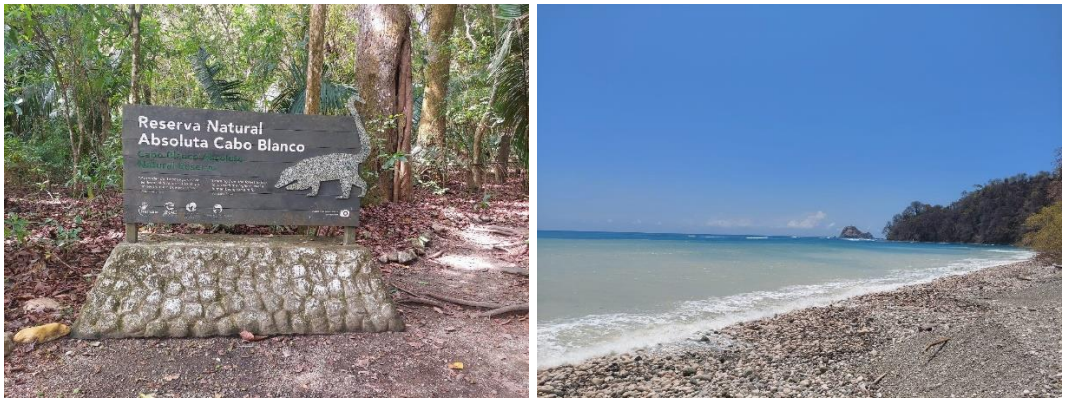
Figure 4.16 and 4.17: Landing site at low tide (left) and freshly caught fish (Pacific red snapper)

Source: Photograph taken by the author.

The most commonly caught species include snappers (mostly Pacific red snapper and spotted rose snapper), tuna, comber, mahi mahi, and pink brotula (Villalobos-Rojas et al., 2014). The fishing gear utilized by local fishers comprises fishing lines and cane fishing poles. Boat length averages five to eight meters. A few fishers use technology like GPS to identify their current position at sea and define fishing points; however, use of GPS on cellphones or fishing apps like Nautic is more common. During my interviews, some fishers acknowledged being familiar with fish finder devices.

As previously stated, the community is located near a protected area (Cabo Blanco Absolute Natural Reserve), which imposes important limits on artisanal fishers, most of whom fish without a license (Diario Extra, 2020).

Figures 4.18 & 4.19: Cabo Blanco Absolute Natural Reserve



Source: Photograph taken by the author

The community is usually impacted by heavy rainfall, but flooding is not a threat in this area. The dry season tends to be more intense and lasts longer than only a few years ago, increasing the risk of fire. Red tides occasionally spread in the Gulf of Nicoya with effects on fishing—killing diverse fish species and affecting mollusk extraction (Gocke et al., 1990; Servicio Nacional

de Salud Animal [SENASA], 2020). The presence of red tide in these waters is considered a consequence of coastal eutrophication and climate change (Calvo-Vargas et al., 2016).

During the interviews, the fishers mentioned higher-than-normal temperatures as an environmental concern affecting their activity. They also identified warmer seawaters, high UV radiation, and intensely warm days as areas of concern.

Figures 4.20 & 4.21. Red tide in the Gulf of Nicoya during the fieldwork in 2022

Source: Photograph taken by the author

In summary, Cabuya was selected as a case study for this research for four reasons: first was its geographical location near the Gulf of Nicoya, one of the most productive and exploited fishing zones in Costa Rica. Second, the community's challenges in selling the fish products due to its remote location and the growing pressures from tourism were also key factors in its selection. Third, it is located in close proximity to a highly protected nature reserve; and fourth, it was selected because of local interest in establishing a Marine Area of Responsible Fishing.

- ***Dominicalito***

Dominicalito is located on the southern Pacific coast in the province of Puntarenas, canton of Osa, district of Bahía Ballena. It is located between Manuel Antonio National Park and Marino Ballena National Park, 208 km from the city of San José. It has a population of 1,500 (Grupo de Trabajo Interinstitucional para el Plan de Ordenamiento Pesquero, 2018).

The history of artisanal fishing in Dominicalito dates back to approximately the 1930s (CoopeSoliDar R.L. & Asociación de Pescadores Mar Nuestro, 2015), and today is the primary economic activity for this community, although some residents also work in tourism in the nearby towns of Dominical or Uvita (popular tourist destinations). The community itself does not have the infrastructure to promote tourism as an alternative productive activity, especially during the low fishing season (December-March) (Silva Lucas, 2019).

Figure 4.22: Main entrance to the village

Source: Photograph taken by the author.
Note: The welcome sign reminds visitors that the community is for the enjoyment of the families living there and to keep artisanal fishing alive.

The broader area in which the community is situated is a popular tourist destination for surfing and whale watching. Access by car or public transportation (i.e., bus) is easy as National Highway 34 runs through the community; in fact, the road separates the community from the landing site. It is important to note that there is a considerable distance of about 1.5 km from the community to the coastline, which also influences socioeconomic dynamics such as the ability to quickly move and safeguard gear. It also disrupts the relationship between the fishers, their families, and the sea (CoopeSoliDar R.L. & Asociación de Pescadores Mar Nuestro, 2015).

Figure 4.23: Distance between Dominicalito and the landing site

Source: Instituto Geográfico Nacional (n.d.).

Note: The orange arrows show the distance from the village's main entrance to the landing site (straight yellow line). National Highway 34 (*Costanera Sur)* separates the village from the coast.

Dominical is a popular destination for surfing and partying, while Uvita is one of the top destinations in Costa Rica for whale watching. Dominicalito is nestled between these two towns, and the pressure from tourism is evident in real estate development dynamics: high housing prices due to foreign capital interested in buying homes. In addition, there is increased pressure on artisanal fishing from semi-industrial and sport fishing and tourist activities. The fishers interviewed were candid in expressing these concerns during the interviews and conversations.

Despite the importance of tourism in this zone and the economic dynamism, Dominicalito is located in a region with a high multidimensional poverty index (PNUD, 2022). The community struggles with pressure from economic growth, drug trafficking, and organized crime (CoopeSoliDar R.L. & Asociación de Pescadores Mar Nuestro, 2015). The village is located along one of the primary drug trafficking routes from South America to North America and Europe via the Caribbean (Silva Ávalos et al., 2020).

There are 15 active fishing boats (known as *panga* in Spanish) in Dominicalito, and ten fishers occasionally arrive from Puntarenas in five to seven additional *pangas*. Dominicalito has 40 to 50 artisanal fishers (Martín Parada et al., 2018). During the interviews with the president and secretary of the fishers' association, they estimated that about 90 men and seven women were registered with the association; however, only ten fishers (men) were actively working in mid-2022. According to INCOPESCA (2024a), ten fishing licenses are active in Dominical

(Dominicalito is not registered). The artisanal boats used in the area are similar to the other study sites in terms of size (eight to ten meters in length) and motor power (40 to 60 horsepower).

The most common fishing techniques employed include fishing lines, handline fishing, and trammel nets. According to the interviews and Martín Parada et al. (2018), some of the most commonly caught species include snapper, mackerel, white seabass, croaker, and snook. Similar to the other research communities, fishers leave early in the morning and return late in the afternoon; others leave late in the afternoon and take advantage of the lower temperatures at night. Fishing in Dominicalito usually takes between one and a couple of days; extended trips to sea are not common here.

Figure 4.24: Artisanal fishing boat at the landing site

Source: Photograph taken by the author.

Figure 4.25: Young boy helping to load fish onto a truck

Source: Photograph taken by the author.

Despite the broad fishing grounds and abundant species, artisanal fishers in Dominicalito would often come into conflict with commercial vessels fishing either close to the coast or in deeper water, impacting their catches. To combat this, a protected Marine Area of Responsible Fishing (the same governance model implemented in Barra del Colorado) was created to promote sustainable fishing and ensure industrial boats remain far from shore. However, some fishers still struggle to fish as they lack licenses to operate in the zone. Moreover, fishers from the community of Ballena (now a national park in which fishing is not permitted) visit the area to fish, but also lack licenses (Grupo de Trabajo Interinstitucional para el Plan de Ordenamiento Pesquero, 2018).

Heavy rains usually impact the area where the community is located (IMN, 2008) and some flooding is common, however it does not represent a significant risk for locals. On the other hand, the water supply in the community is fragile, with constant shortages due to the dry season and, at times, due to the effects of the heavy rains on infrastructure. During the interviews, informants expressed concerns about rising temperatures and higher humidity levels (Katchan, 2018). Meanwhile, the fishers highlighted that the heavy rains and stronger winds make going out to sea safely more challenging. According to the Coastal Risk Screening Tool projections (Climate Central, 2021), by 2100, Dominicalito and the nearby beaches and villages will be mostly underwater.

In summary, Dominicalito was selected as a case study for this research because of its condition as a Marine Area of Responsible Fishing, its location between two national parks, the importance of fishing to the local economy, the fragile socioeconomic landscape, and the effects of productive transformation (e.g., pressure from real estate and tourism).

In conclusion, the four selected communities aim to demonstrate the heterogeneity of artisanal fishing communities in Costa Rica. Meanwhile, they provide an opportunity to reflect on shared challenges regarding social, economic, environmental, and political aspects. Although each study site is exposed to the effects of climate change, its consequences can be unequal and shaped not only by geographical and environmental factors, but also by historical context, as will be reflected in the following chapters on vulnerability, resilience, and adaptation.

5. Vulnerabilities of Costa Rican artisanal fishers in the context of climate change

"Fisheries and agriculture move the world;
people would die without them,
though we [the artisanal fishers] are the most marginalized."[12]
Ricardo, fisher from Cahuita with 50 years of experience

5.1. Introduction

It is almost midday in Dominicalito. As I walk the beach near the *recibidor* (fish landing site), I observe a large truck loaded with the catch of the day. A few fishers remain, loading their fish onto the truck. The *recibidor* is an old house without facilities for processing or storing the fish. Nearby, fish bones and entrails are scattered on the ground and there is a strong smell of decomposed fish as the breeze blows in from the sea. The path connecting the *recibidor* with the main road (the *Costanera*, a national highway) is long and in poor condition, riddled with holes and mud. The majority of the fishers walk this path every day carrying their heavy, expensive gear.

On the opposite side of the *recibidor* is a second road, almost in the same condition, but this one leads to a small restaurant with a beautiful ocean view. The restaurant is popular in the area, and immediately I notice that most patrons are tourists. On the way back to the main road, I pass by a few homes in disrepair where the locals reside; nearby a couple of "For Sale" signs are posted on empty plots near the shore.

This depiction highlights some of the everyday realities that shape the lives of artisanal fishers and their communities: rising socioeconomic inequality, poor infrastructure, and tension with other productive sectors and economic activities like tourism and real estate.

In addition to the precarious socioeconomic conditions and environmental exposure associated with living near the coast, the inherent unpredictability of fishing further exacerbates the fishers' socioeconomic and environmental vulnerabilities, heightening the uncertainty of their future (Espinoza-Tenorio et al., 2022). Coastal communities and artisanal fishers are particularly exposed to environmental elements, such as extreme weather phenomena, coastal erosion, pollution from agriculture, and the pressures of urbanization, due to their geographical location in zones where economic and political interests diverge. Here, climate change is part of their socioeconomic and environmental context with both direct (e.g., warmer waters) and indirect (e.g., impacts on fish value chains due to changing fish stocks) consequences, asymmetrically affecting the fishers based on their vulnerabilities and ability to respond to changes.

This chapter analyzes the vulnerabilities of the Costa Rican artisanal fishers at the four study sites within the context of climate change. The purpose is to understand the diversity of socioeconomic, political, and environmental factors affecting their lives and influencing their

[12] Original quote: *La pesca y la agricultura son las dos actividades que mueven el mundo. Sin la pesca y la agricultura la gente se muere de hambre y somos los más marginados.*

interaction with the effects of climate change. This chapter also reflects on the different aspects shaping the vulnerabilities of the fishers to better understand the factors influencing their potential responses to the effects of climate change. These vulnerabilities are analyzed from a situated perspective (i.e., taking into consideration the context), which contributes to a reflection on climate change as a global phenomenon but with particular effects and responses based on specific local realities. The aim is to offer a critical approach to the vulnerabilities of the fishers to understand not only the ecological or environmental factors in climate change adaptation but also its socioeconomic and political realities.

One overriding question guides the discussion in this chapter: What are the principal vulnerabilities of the artisanal fishers and to what extent do these vulnerabilities affect their daily lives? To respond to this question, the chapter is organized into three main sections: the first is dedicated to the vulnerabilities of the fishers identified at the research sites. For this, the biophysical, social, economic, technological, and governance factors explained in the analytical framework will guide the discussion. The use of quotes is common to illustrate the opinions and concerns of the fishers themselves. To better understand the similarities and differences, this section first discusses the common findings for each coast before making a site-specific analysis. The second section examines the extent to which these vulnerabilities impact the community and the daily lives of the artisanal fishers, while the third section presents the key conclusions.

5.2. Vulnerabilities of the artisanal fishers in the studied communities

5.2.1. Common findings: Caribbean coast

To begin the discussion on factors influencing the lives of the artisanal fishers, in terms of the biophysical context, the fishers from both communities expressed concerns about warmer ocean waters and their impact on the ecosystems and their productive activity. The fishers agreed that coastal fishing has become increasingly difficult due to rising sea surface temperatures, making it more challenging to locate the fish. As a result, they are often forced to venture further offshore, which is not always feasible. When speaking with the older, more experienced fishers, they would mention that ten or 20 years ago, fishing near the coast was easier:

> The fish go deeper into the sea. There is less bait. The schools of sardines rise from the depths and swim toward the beach and the fish follow them, but when the water gets too warm, they stop following them. Then, we must go further out to sea, and fishing becomes more difficult.[13]
>
> Miguel, fisher from Cahuita with 35 years of experience.

Additionally, hydrological phenomena like heavy rains and floods usually impact both communities; however, the informants seemed unworried about these effects, mentioning that rain water drains quickly due to the soil morphology and geography, and the impact on infrastructure and daily life is not severe.

In relation to social vulnerabilities, both communities have lower levels of formal education as compared to national standards. Only 33% of the fishers interviewed had completed high school,

[13] Original quote: *Que el pescado va más profundo. Hay menos carnada. Como los peces, es una cadena alimenticia, las bandadas de sardinas van para la playa y van subiendo de las profundidades. Pero los peces las siguen, y ya cuando el agua está demasiado caliente ya no las siguen. Eso hace que tenga que ir más afuera y que sea más difícil pescar.*

while 19% mentioned having not finished at all. However, all of the fishers interviewed did mention they could read and write. Additionally, 48% of the informants said they had received specialized training in the last three years. The most common training is the *Zafarrancho* course on emergency response onboard. This course is a requirement for all fishers in accordance with Costa Rican regulations.

During our conversations, the fishers pinpointed organizational capacity as a major problem due to trust issues among the fishers. When discussing the fishers associations and other local organizations, the fishers highlighted a lack of cohesion, individualistic behavior, and weak commitment. According to the interviewees, this is due to widespread disappointment in public institutions (the government is historically absent from their communities and lives) and the lack of clear incentives to participate (e.g., subsidies, gear support, and training opportunities). On the other hand, in relation to conflicts among users and resource competition, I identified concerns about tourism and sport fishing in both Caribbean communities.

Furthermore, secrecy among artisanal fishers is common (Olsen & Thuen, 2013), particularly regarding the location of the best fishing sites. In both communities, the fishers mentioned they are cautious about sharing information on their favorite fishing spots and gear (e.g., fishing nets) due to the risk of theft.

Regarding occupational health and safety in relation to fishing activities, the fishers on the Caribbean coast were adamant about highlighting the differences between fishing in the Caribbean and the Pacific, particularly in comparison to fishers in the Gulf of Nicoya, an area they consider to be calmer and more accessible as compared to the choppy waters of the Caribbean.

For the purposes of this analysis, illegal fishing can be understood as a lack of individual fishing licenses. According to INCOPESCA (2024a), in 2023, 31 active licenses for small-scale fishing and 21 for tourism were registered in Barra del Colorado; meanwhile, in Cahuita, there were only eight licenses registered for small-scale fishing and one for tourism. The number of licenses for small-scale fishing is extremely low compared to the total number of fishers identified in Chapter 4.

On the other hand, infrastructure development is homogenous. Essential services like electricity, access to public transportation, education, sanitation services, internet access, and even basic transportation infrastructure (e.g., roads) are present in both communities. However, there is a minimal presence of public security (i.e., police) in Barra del Colorado and none at all in Cahuita.

From an economic perspective, in terms of asset ownership, in both communities the average number of boats owned by the fishers interviewed was one, with a few fishers owning no boats at all or more than one. Surprisingly, homeownership is high in both communities, with only two fishers in Cahuita stating they did not own their homes. Homeownership is essential for resilience and reduces vulnerability due to stability and the potential to diversify income allocation instead of paying rent.

With reference to technology, particularly in terms of catching power, I was unable to identify a process of industrialization in either community that could be understood to have the potential

to increase catching power. The boats, gear, and fishing practices are considered artisanal in terms of size, complexity, and power, as I explained in Chapter 4. For instance, the average boat length in Barra del Colorado is 8.7 meters and only 7.3 meters in Cahuita. The fishers in Barra del Colorado explained that they need larger boats to navigate the challenging weather and sea conditions they frequently encounter.

Likewise, the capacity of landing sites can be considered basic or nonexistent in both communities. There are only a handful of sies to deliver and store the fish in Barra del Colorado, and no facilities at all in Cahuita. Here, the fishers process the fish at sea or on the beach and keep it in a freezer at their own homes if they do not sell it immediately.

The governance dynamics within the communities are shaped by the high levels of informality (i.e., lack of fishing licenses), organizational weaknesses within the fishers associations, and the exclusion of the fishers and communities from decision-making processes. However, both communities are formally organized under fishers associations and actively participate in a local governance mechanism called local conservation area councils (*Consejos Locales de Áreas de Conservación* or COLAC). As explained in the previous chapter, these councils are coordinated by the National System of Conservation Areas (SINAC in Spanish) and bring together representatives of protected areas, community education councils, associations for development, water management associations, local governments, and artisanal fishers, among others, to discuss matters related to the conservation of their communities (these organizations are created in communities with protected areas). The intention of these institutions is to foster a participative dialogue on the management of the protected area and/or the zone for responsible fishing (where applicable).

The fishers interviewed were optimistic as regards this institution, as it is considered a space where all voices can be heard and more democratic solutions to the community's issues can be discussed. However, the fishers highlighted weaknesses such as the constant absence of critical stakeholders (e.g., local government representatives) and difficulties in arranging meetings due to scheduling conflicts.

Barra del Colorado

Barra del Colorado is frequently affected by flooding. The community is located in a low-lying area no higher than 219 meters above sea level, and is divided into two sections by the Colorado River (*Barra del Colorado Norte* and *Barra del Colorado Sur*). Due to its location in a tropical humid climate with frequent heavy rainfall, floods have become a commonplace occurrence. According to the informants, flood waters can rise up to 50 or 60 centimeters.

Despite this, the interviewees expressed that they are accustomed to the flooding and are not particularly concerned, as most have adapted their homes by using stilts. Others have implemented strategies such as elevating furniture by placing it on large plastic boxes (e.g., beer bottle crates) at the threat of a flood. The fishers are, however, concerned about the rising water level and more frequent floods (instead of one per year, they now experience two or three during the same timeframe). The fishers and key informants interviewed explained that the rising water level is due to sedimentation in the river, which has the added consequence of having to deal with a significant amount of foul-smelling mud after flooding occurs. They also pointed out

other effects, such as the risk of well contamination (common infrastructure in the community) or the effects on public health due to wastewater mixing with the flood waters.

Sedimentation is a critical concern for the fishers and other villagers in Barra del Colorado for three main reasons: 1. It affects the community's adapted infrastructure by elevating the level of the land as compared to the height of the stilts; 2. The accumulated sediments jeopardize navigation of the river (the primary form of transportation connecting the community with other nearby villages and towns); and 3. Fishing in the river becomes more challenging when the water is heavily laden with sediment, which results in darker waters and reduces fishing potential since fish avoid muddy waters. Water pollution, particularly of the Colorado River, was also a common concern among the fishers interviewed, who emphasized the effects of upstream agricultural activities and the possible presence of residual pesticides in the river.

A strong sense of connection to the area contributes to a deeper understanding of the local weather, which makes a significant difference in fishing effectively, especially compared to fishers coming from other communities. For instance, in Barra del Colorado, strong winds are a key factor in whether the fishers choose to venture out to sea (Sainsbury et al., 2021). The waters on the Caribbean coast are known to be choppy and the fishers must first pass through the mouth (*bocana* in Spanish) of the Colorado River to reach the sea. However, navigation can be a challenge when the wind is strong or in poor weather conditions. As a result, the fishers in this community are cautious and demonstrate a respect for nature as several have died attempting to navigate through this area. In fact, I detected a distinct sense of pride when some talked about the knowledge and skills they have acquired to be able to cross the *bocana*.

Figure 5.1: Satellite image. Mouth of the Colorado River (*bocana*)

Source: Instituto Geográfico Nacional. (n.d.).

In terms of social vulnerabilities, particularly in relation to generational changes, while I identified an aging workforce across all four study sites (i.e., the average age of fishers is 50.8 years), Barra del Colorado is the one exception due to the scarcity of alternative livelihoods. Many more young people between the ages of 20 and 40, especially males, are involved in artisanal fisheries.

Regarding community facilities for delivering and storing the fish, there are a couple of fish landing sites in the village that are owned by private citizens. Here, the fishers decide where to take their catch based on preference or previous commitments. The infrastructure of these sites is more modern than that of other communities, and they are located adjacent to the river. As stated, these landing sites are privately owned—the fishers association itself has no facility to process and store fish.

Figure 5.2.: Private fish landing facility in Barra del Colorado

Source: Photograph taken by the author.

While in all four study sites, I identified a high dependence on fisheries as a factor of social vulnerability, in Barra del Colorado, fishing activities are crucial due to the scarcity of alternative livelihoods stemming from its geographical isolation and environmental conditions (i.e., its location inside a national wildlife refuge surrounded by tropical forests, canals, and mangroves with fewer opportunities to reach different markets and attract foreign visitors and investors). Unfortunately, this also gives rise to scenarios of unfair competition in terms of costs compared to other sites with easier access to the community and fisheries.

Interestingly, the participation of women in the fishing sector in Barra del Colorado is high. According to the leader of the Association of Female Shrimp Fishers and Peelers (*Asociación de Mujeres Pescadoras y Procesadoras de Barra del Colorado*), 79 women were registered with the association at the time of my fieldwork, compared to 100 members of the fishers association for men. Additionally, approximately 200 women work in shrimp processing and the female fishers association is evidence of the sector's importance. According to the then-leader of the women's association and community activist, only a handful of men have participated in the organization

and also work in shrimp processing. She emphasized that there is no restriction on men taking part in the organization and that the division into two associations was a strategy for more political presence and robust advocacy.

As Luisa, a local leader, highlighted, the labor of women in fisheries is multifaceted. Besides caring for the home and family, they are also responsible for processing, entering into and complying with commercial contacts, and distributing the fish. According to Luisa, despite the importance of the work done by women, it is usually overlooked within the sector and by governmental and non-governmental institutions.

> Cleaning the house, taking children to school, preparing meals, and participating in meetings. Then the husband returns from work, and we must cook for him and wash his clothes. Our husband can rest, and we must keep up with the chores, preparing dinner, and helping the children with homework. Then the evening arrives, at 9, and we are still working. This work is not paid. We also participate in fishing activities because if they bring shrimp or snapper, we help process the fish and even sell it if it is a small amount. That is why I say to many women that our workload is heavier than the fishing work.[14]
>
> Luisa, President of the Association of Female Fishers and Peelers.

As regards economic factors, I detected a strong tension between users and sectors, in particular, the growing pressure for diversification driven by sport fishing. Sport fishing has long had its place in the economic history of Barra del Colorado; however, concerns arise when the activity is broadly touted as a viable alternative for diversification. Some of the fishers interviewed highlighted the unrealistic nature of this expectation as it would require them to radically transform their activity: adapting their boats to comply with the law; purchasing advanced gear and technological equipment for deep-sea fishing; and undergoing customer service training, to name a few.

> Right now, we are up against the major ecologists, the environmentalists. For example, they get a lot of resources—according to them to protect the environment, but they do very little—what they do is come into the communities to see what resources they can protect without considering the community's food security. This is a risk we are facing now; for example, Marviva and FECOOP, they just want to protect the product [the fish] for sport fishing. Okay, but people don't live on sport fishing alone. For example, if I wanted to switch to sport fishing, I would need to make an investment, which I don't have…in other words, I can't switch to sport fishing […].

[14] Original quote: *Limpiando la casa, llevando los chiquitos a la Escuela, viene el almuerzo, vienen las reuniones. Viene el marido de nuevo y hay que tenerle comida y ropa limpia. Todavía el marido llega, descansa y nosotros seguimos en el trabajo de la casa, alistando la cena, ayudando a los chiquillos con las tareas y llega la noche, son las 9 y todavía la mujer está haciendo trabajo en la casa y ese no es pagado. Y participamos en la pesca porque si traen camarón, traen pargo nosotros estamos allí ayudándole a ellos a limpiarlo a venderlo si es muy poco (…). Entonces yo le digo a muchas, el trabajo de nosotros es más grande que el que va a pescar.*

> For sport fishing, I would need to change my boat, change motors, get communication equipment because sport fishing happens far offshore. Artisanal fishers can't switch to sport fishing; only people with money can.[15]
>
> Alberto, fisher from Barra del Colorado with 17 years of experience.

This skepticism regarding productive transformation stems from the government's lack of financial support and the high cost of adapting an existing boat or of purchasing a new one and other equipment.

Although competition with industrial and semi-industrial fisheries is not an issue in the community, the fishers interviewed mentioned concerns due to the presence of external fishers (from other communities) and their lack of knowledge of local conditions, in particular, the dangers of navigating the mouth of the river. They also criticized the use of illegal gear by these fishers.

Regarding unfavorable market conditions, in all four communities, the artisanal fishers emphasized the low prices they receive compared to the prices found on the national market, with abysmal differences of 300% and even 900% for high-value products like lobster or shrimp.[16] Barra del Colorado is even more problematic due to its geographical isolation and the high cost involved in transporting the fish. Most fishers rely on one of two intermediaries (i.e., the owners of the landing sites), who also play an important role as a source of informal credit through *el alisto* (money loaned by the intermediaries to buy bait and fuel), leading to a higher dependence of the fisher on the intermediary.

Another important factor in understanding economic vulnerability is homeownership. While all of the fishers interviewed said they "own a home," legal tension exists with the State given that significant portions of the land belong to the Administrative Board for Harbors and Economic Development of the Caribbean Region (JAPDEVA in Spanish). As a result, land and homeownership become significant issues for some fishers and the community as a whole, despite having lived there for many years and having invested in building or repairing their homes.

As regards the governance dimension, despite the significant presence of the fishers association in the community, I identified political tension due to the exclusion of the community and the fishers association from decision-making processes. For instance, artisanal fishers were not consulted when the government banned shrimp trawling (Departamento de Extensión y

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[15] Original quote: *Nos enfrentamos en este momento a los grandes ecologistas, ambientalistas. Por ejemplo, ellos consiguen muchos recursos, dicen ellos para la protección del ambiente, pero es muy poco lo que hacen, pero lo que hacen es llegar a las comunidades a ver cómo protegen algún recurso sin tomar en cuenta la seguridad alimentaria de las comunidades. Entonces ese es un riesgo que tenemos en este momento, por ejemplo: Marviva, FECOOP, porque ellos solamente quieren proteger el producto para la pesca deportiva. Ok, pero en las comunidades la gente no vive solo de la pesca deportiva. Por ejemplo, en este momento yo, para pasarme a pesca deportiva tendría que hacer una inversión que no la tengo, o sea, no me podría pasar. (…)*
Para la pesca deportiva ocuparía cambiar embarcación, cambiar motores, tener equipos de comunicación, porque la pesca deportiva es más al fondo. La pesca deportiva es una opción a la que los pescadores no pueden pasarse, solo la gente con plata puede estar ahí.

[16] The prices mentioned by the fishers during the interviews were compared to end-user prices at supermarkets or restaurants at that time. For instance, one fisher mentioned that a kilogram of frozen processed shrimp can be sold at 1,000 colons (US $1.80); meanwhile at the supermarket, a kilogram of frozen shrimp costs between 10,000–12,000 colons (US $18.20–21.80), while the price of fresh shrimp can exceed 20,000 colons (US $36).

Capacitación, INCOPESCA, 2019; Pomareda, 2021). This ban was oriented toward trawling in general, but artisanal practices were not excluded, and Barra del Colorado, a community highly dependent on shrimp fishing, was severely affected. According to the informants, despite evidence about the sustainability of their practices (see Naranjo-Elizondo, n.d.), the government did not change its decision.

> After that, shrimp fishing was banned. We are not at all like the semi-industrial fishers in the Pacific. Trawler fishery was banned, and we also practiced trawler fishing here, but in an artisanal manner, so another fishery we can't use. Maybe we can recover [our rights], we are working on that; we have nothing to do with the Pacific or semi-industrial fishing. We are artisanal fishers, a completely different fishery. Studies have been done; in fact, the last study was done during the September-October season to show that this fishery is sustainable, because the Constitutional Court said that if you could prove the sustainability of the fishery, it would reconsider the ban. We want to prove that our fishing is sustainable; we already have studies from 2017 and 2018 and another from last year.[17]
>
> José, President of the fishers association and fisher with 32 years of experience.

Another example in which rules and regulations fail to consider the particularities of this fishing community is the restriction on buying fuel affecting the villagers of Barra del Colorado. As I explained above, this community is isolated and situated inside a protected area. The only modes of transportation for reaching the community are by plane (uncommon and expensive) or boat, and while all of the boats require fuel to operate, there are no gas stations nearby. The closest gas station is located at a distance of 50-55 kilometers from the community, and to get there means travelling by boat and then by bus or car (aDiarioCR.com, 2021). The law does not permit the transportation of fuel on the river nor the storage of fuel by individuals (Article 6, Law 9096).[18] In addition, only government officials are permitted to transport fuel inside a protected area. As a result, community members, including the fishers, must use informal alternatives to fuel their boats. In fact, they usually hide the fuel inside their boats, which carries a high risk not only for them, but also for the ecosystems.

The presence of government institutions in the area is also limited; for instance, I was keenly aware of the small police presence given the community's proximity to the border with Nicaragua and the penetration of drug trafficking from the southern parts of country. New facilities to host government institutions were built a few years ago in *Barra Sur*; however, the informants noted that only one or two officials are stationed there, and the facilities are underused. Moreover, because of its geographical isolation, accessing environmental and fishery

[17] Original quote: *Después de eso nos eliminaron la pesca de camarón, nosotros no teníamos que ver nada, absolutamente con la pesca semi-industrial en el Pacífico. Lo que se prohibió fue la pesca de arrastre y nosotros pescamos camarón con arrastre también aquí, artesanalmente, entonces nos eliminaron esto. Entonces, otra que no podemos utilizar. Tal vez, tal vez podamos recuperar, estamos pulseando eso a ver si nos permiten seguir pescando, no tenemos nada que ver con el Pacífico ni nada que ver con la pesca semi-industrial, nosotros somos pescadores artesanales, una pesca muy diferente. Ya se han hecho estudios, casualmente, ahora en la temporada septiembre-octubre se hizo el último estudio para demostrar que la pesca es sostenible, porque el mismo voto de la sala constitucional dice que si se demuestra que la pesca es sostenible con ese arte que se reconsideraría volver a otorgar los permisos. Eso es lo que queremos demostrar que la pesca de nosotros sí es sostenible, ya se habían hecho estudios en 2017 y 2018 y ahora se hicieron estos otros el año pasado.*

[18] See: Law regulating the commercialization, storage, and transportation of fuel in marine and fluvial zones under the authority of the Costa Rican State. Available at: http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=74441&nValor3=0&strTipM=TC

institutions to update data and inspect equipment is even more challenging for the fishers in this community compared to the other research sites, further restricting the potential for formalization and access to training and finance.

Cahuita

Regarding the community's biophysical context, I readily identified coastal erosion along the coastline and inside Cahuita National Park during my fieldwork to the area. Some gray infrastructure has been built to help manage this erosion (e.g., relocating trails inside some parts of the national park and placement of small concrete walls or sandbags near the coast). Some of the fishers interviewed also mentioned coastal erosion as a possible effect of climate change but not as a primary concern compared to other consequences, such as warmer waters.

Ecosystem degradation is a widespread concern among the interviewed fishers and key informants. Some of these concerns are directly related to the marine environment, such as the threat of coral bleaching and pressure on coral reefs due to tourism in the zone, as well as concerns regarding water pollution due to banana plantations and other agricultural activities.

In the interviews, the tension with nearby banana plantations was evident from an environmental, socioeconomic, and historical perspective. The informants perceived the plantations as major historical receptors of government favors and also part of the socioeconomic and political exclusion structure established in the country affecting the community, particularly Afro-Costa Ricans.[19] According to one fisher in Cahuita:

> Banana plantations are like a storm for the sea. The entire plantation ends up in the rivers, and so do the chemicals they use […] everything goes into the sea. But because of the money the government gets, they'll never stop it. The government will never stop it because they get lots of money. And we are affected. When they say the fishers are doing this or that…no, we fish with string.[20]
>
> Luis, fisher with 54 years of experience.

On the other hand, regarding tension with other productive activities and the consequences of infrastructure on the ecosystems, the fishers raised concerns about the new port facilities built by the foreign-owned APM Terminals company in Limón. According to an informant:

> I used to fish at a depth of two meters, which is where you can earn the most, but truth is, it's becoming more challenging because the water there gets more polluted […] Other fish deeper at sea, where it is deeper and perhaps cleaner. But with APM Terminals, the sediment pushed by

[19] Carlos Luis Fallas (Calufa) wrote the book *Mamita Yunai* (1941), which tells the story of abuse and mistreatment suffered by the employees of the United Fruit Company ("Yunai") and its impact on Costa Rican society and politics at the time.

[20] Original quote: *Una época dura, le voy a decir: lo tiene la bananera. Es la primera tormenta para el mar. Toda la bananera está en los ríos, y los químicos que usaban, porque a mí me agarraban y me hicieron preguntas y preguntas, todo eso se va al mar (…) Pero por la divisa que agarró el Gobierno, nunca ellos van a parar eso. El gobierno nunca va a decidir quitar esa visa, porque ganan un montón de plata. Y eso nos afectó. Cuando hablan de los pescadores, que van a… Nosotros pescamos con cuerda.*

> APM pollutes the seabed and when the sea is choppy, it goes everywhere, making it more difficult for the fish to find the bait. Fish hate sediment in the water.[21]
>
> Alejandro, fisher with 13 years of experience.

The impacts of the APM Terminals gave rise to debates among government officials, locals, environmental organizations, and the academic sector. While the Government, the managing company, and the environmental organization responsible for the environmental impact assessment acknowledged only a limited impact on the ecosystems and proposed several actions aimed at minimizing the consequences (Echeverría, 2017), other studies highlighted the impact on the beach morphology near to where the terminals were built, in addition to coastal erosion affecting Limón and nearby areas like Cahuita (see O'neal Coto, 2015; Vargas-Hernández & Barrantes-Castillo, 2018; Martínez et al., 2022).

In terms of infrastructure, specifically landing and storage facilities, Cahuita has a single location where fishers leave their boats once they make land. The fish is processed at sea or once they reach land and is stored in small coolers or freezers in the fishers' homes. On the other hand, they may sell the product directly to specific buyers along the coast each day.

Figure 5.3: Landing facilities

Source: Photograph taken by the author.

Regarding gender participation in fishing activities, approximately 32 men and 13 women work as artisanal fishers in Cahuita (not all are members of the fishers association). During my fieldwork, the association was led by a former fisherwoman whose leadership was solid and who fostered close relationships with the other fishers.

[21] Original quote: *(…) Yo pescaba a dos metros sobre el agua, que es donde uno puede ganar más, pero la verdad es que se complica un poco porque es la parte que más se ensucia, y agarraba anzuelos artificiales y sardinas. Otros pescan más adentro, con más nivel y tal vez más limpio. Pero con todo este tema de APM Terminals, el sedimento que APM Terminals mandó se ensucia el fondo, y cuando el mar se mueve ese sedimento sube y hace que el pescado no vea cosas artificiales que mandas, el pescado detesta el sedimento.*

Lastly, in terms of governance, despite the fact that the fishers interviewed revealed political tension among the members of the fishers association, it is important to note the association's role in improving the well-being of fishers, as well as its participation in the COLAC. The interviewees acknowledged the existence of local organizations, while also emphasizing the lack of cohesion due to internal tensions and communication struggles among the members. There were two notable exceptions in which the whole community was more actively involved and integrated, specifically issues related to access rights for locals to Cahuita National Park and local security. Moreover, due to the limited access to individual fishing licenses, under the direction of a Costa Rican NGO, the fishers association has been working on a mechanism called *12 Remos* (12 Oars), a governance tool aimed at demonstrating good fishery practices to be considered for a potential collective license (this tool will be described further in Chapter 6).

5.2.2 Common findings: Pacific coast

Like the Caribbean, from a biophysical perspective, the Pacific fishers' concerns centered on warmer waters and the consequences to their productive activity and the ecosystems. Common complaints expressed in the interviews included the struggle to locate fish near the shore due to warmer surface waters, as was the necessity to venture further offshore as a result. As Ezequiel, a fisher with 30 years of experience, said: "No, no. The fish are deeper out at sea, far from here, and we cannot find them."[22]

Generally, the fishers on the Pacific coast tend to link the effects of climate change to weather phenomena. For example, stronger winds influence the tides and hinder the ability to set out to sea, further increasing the risks of being on the water on small, uncovered boats amidst unstable weather conditions. The fishers in both study sites along this coast often expressed concerns about how difficult it was to "read the weather".

Another biophysical concern that the fishers associate with climate change, and one that only affects the Pacific, is red tide, which is regarded as a biological hazard. The fishers link the blooming of red tide to warmer waters and are concerned not only about its direct effects, such as on mollusk extraction, but also about its prolonged duration, with the red tide often lasting one or two months. Even after the algae has dissipated, they must wait to ensure the quality of the fish and mollusks improve.

While the fishers acknowledged the existence of climate change, they seemed uncertain about its true meaning. They would tend to address the phenomenon through its adverse effects on fishing, the community, and the planet. As Lucas, a young fisher from Cabuya with ten years of experience, said: "There are many issues, global warming, more storms, so many different things happening on the planet, there is constant change…droughts, places where there had never been intense snowstorms, rain, strong winds…".[23] Or Carlos Alberto, an experienced fisher in Dominicalito, who explains:

> The weather, the currents, it all affects the currents […] Bad weather results in stronger winds […] and the tides get bigger. There are tides here that…and as you see now, this tide shouldn't

[22] Original quote: *No, no. El pez se profundiza o está más afuera, y diay, uno está descontrolado, no lo halla.*

[23] Original quote: *Muchas cosas, calentamiento global, muchas tormentas, muchas cosas diferentes en el planeta, que está cambiando…Sequías, lugares donde nunca había habido tormentas grandes de nieve, lluvias, fuertes vientos…*

> be this high, it should be lower, but because of this weather, it comes all the way up [to the landing site].[24]
>
> Carlos Alberto, fisher with 42 years of experience.

Hydrological phenomena such as flooding are common in both communities. However, the fishers and key informants in the communities did not consider floods to be a threat since the water drains quickly after heavy rains.

On the other hand, in terms of social vulnerabilities, I noticed a certain tension in both communities resulting from pressures from socioeconomic activities like sport fishing or tourism. While the fishers I interviewed acknowledged the positive contribution of tourism, such as more local restaurants to buy local fish, I also noticed a sense of displacement, particularly because the type of tourism in the researched areas is motivated by conservation (there are one or more national parks nearby).

This tension is further demonstrated in the struggles that exist between the fishers association and local government regarding land ownership (e.g., obstacles in formalizing paperwork or local projects to move the landing facilities away from the coastline). Some of the fishers interviewed (including local leaders and key informants) briefly mentioned the local government's interest in developing tourism-related infrastructure on these sites (e.g., building a marine).

Similar to the Caribbean, infrastructure development is comparable in both sites. The communities have access to essential services like electricity, some access to public transportation, education, sanitation services, internet, and basic transportation infrastructure (e.g., roads). However, police presence in both communities is small compared to the surrounding area and the risks they face (e.g., organized crime and drug trafficking).

In contrast to the Caribbean, where semi-industrial and industrial fishing is not a significant issue, the fishers I interviewed on the Pacific coast emphasized the competition they face from artisanal fishers from nearby areas, as well as from semi-industrial and industrial fishing operations.

The lack of fishing licenses is an important factor triggering socioeconomic vulnerability. Like in the Caribbean, the number of registered and active licenses in the two study communities on the Pacific is low compared to the total number of fishers I estimated during my fieldwork. According to records maintained by INCOPESCA (2024a), in Cabuya there are only five registered licenses for small-scale fishing, three for tourism, and one for sport fishing. Meanwhile, in Dominical (which includes Dominicalito), ten licenses for small-scale fishing are registered and active, two for sport fishing, and 14 for tourism.

From an economic perspective, specifically in terms of competition with tourism and sport fishing, both communities experience high pressure from tourist development and human expansion. This can be explained by their strategic locations: within relatively easy reach of the

[24] Original quote: *En el sentido, tal y como está el tiempo, corrientes, perjudican a las corrientes, el mal tiempo, el asunto de […] el mal tiempo viene siendo un asunto de viento y todo eso, ahí todo eso va metido y la marejada, grandísima. Aquí hay mareas que…tal y como esta marea, no tiene que llegar ahí, tiene que llegar más abajo […] Y ellas por estos tiempos que vienen, ellas hasta aquí [más cerca de la pescadería].*

capital and in close proximity to beautiful beaches with large, luxurious infrastructure projects. There is also a significant foreign presence, marked by clear stratification. For example, individuals from the United States and Western Europe typically own businesses such as hotels and restaurants, while Nicaraguan citizens predominantly work in construction, hospitality, caring for wealthy foreign families, or are also involved in fisheries.[25] According to a local leader in Dominicalito:

> The Americans build houses in the mountains; the water becomes polluted and affects us, the people of the lower class, the middle class. We can't afford to live in the mountains in big mansions far away from other people.[26]
>
> Diana, Secretary of the fishers association.

There is growing political and economic interest in strategic locations near the beach (including the existing fish landing sites). For instance, in Dominicalito, during my visits to the community, several houses were up for sale. The local leader explained that some local families decided to sell and leave the area in pursuit of better job opportunities in nearby communities due to the economic effects of COVID-19. This paved the way for foreign citizens to buy land and properties in prime locations at low prices, but once the homes were purchased, the leader emphasized a significant increase in prices:

> Spaniards and Canadians bought the homes, and the locals left to live not far from here. They left the community; they live in other coastal communities or closer to the sea […] I don't think this is good for the community. Development has its pros and cons. It's good because it attracts more tourism, but the cost of living on the coast increases, as does the price of land and everything else.[27]
>
> Diana, Secretary of the fishers association.

In Cabuya, this pressure is not as obvious, but tourist development in the neighboring communities of Montezuma, Mal Pais, and Santa Teresa could intensify the pressure for infrastructure expansion as the area gains popularity among foreigners and tourists seeking nearby yet less crowded places to settle.

Regarding unfavorable market conditions, the presence of intermediaries was a common concern among the fishers I interviewed. However, I did identify some key differences between the study sites regarding the organization of the artisanal fishers association in relation to fish sales. In Cabuya, the association receives the fish and sells it to intermediaries or directly to consumers, while in Domincalito the intermediaries control the price of the fish; in particular,

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[25] During my fieldwork near Dominicalito, I noticed that the presence of undocumented Venezuelan migrants has increased over the last year (2021-2022). These migrants arrive in groups, crossing by land on their way to the United States. They are in transit, do not stay long, set up temporary camps, and usually beg for money or sell candy or snacks to make money.

[26] Original quote: *(…) los gringos vienen a construir a las montañas, las aguas se contaminan, y más a nosotros de clase baja, clase media, las otras clases. Que no tenemos la forma de irnos a las montañas y construir grandes mansiones donde esté lejos de los demás.*

[27] Original quote: *Españoles, canadienses, que han comprado las casas de habitación y las personas se han ido del lugar, no tan largo. Y han dejado la comunidad; o se han ido para las costas, para la zona marítimo, terrestre. (…)*
Diay, yo pienso que es algo no tan bueno, porque ya comienza todo. El desarrollo tiene su pro y contra. Es bueno porque viene más turismo, pero también el problema es que aumenta el costo de las cosas, los terrenos, todo.

one large intermediary from Puntarenas, which is involved not only in purchasing the fish, but also in providing financing to the fishers (through *el alisto*) and owning many of the boats.

Many fishers in both communities also identified overfishing as a factor impacting their economic activities. Besides, unlike the Caribbean, my conversations with the fishers revealed a sense of competition with industrial and semi-industrial fisheries over catches, access to economic resources, and the need for more political recognition from the government. The fishers shared that in the past, industrial boats operated closer to the shore (in Dominicalito). They also noted that semi-industrial fishing has a stronger political presence and explained that the government's lack of interest in small-scale artisanal fisheries is due to their minimal contribution to the economy.

> The sea gets choppy and still we must go to bring back food; we are living in hard times. For years, the State has promised to support artisanal fishing and the coastal areas, but to date, it is just a promise. The fishers are never satisfied with the State's actions to support them. On the contrary, there are more rules every day restricting artisanal fishing and instead favoring industrial fishing.[28]
>
> Adrián, fisher from Dominicalito with 25 years of experience.

> I am also worried about the many institutions looking to do away with artisanal fishing. If that happens, it would become illegal, we would be working outside of the law, and we would be punished for it. We have the right to catch our product; it is artisanal. We catch about 200-300 kilos of tuna a day; meanwhile, an industrial boat, a big one, catches 70-100 tons of tuna.[29]
>
> Lucas, fisher from Cabuya with 10 years of experience.

Governance mechanisms and structures are key to understanding vulnerabilities. In these two communities, governance of the local organizations appeared weak due to fragmentation of the fishers associations and difficulties in engaging with other community spaces. However, it is also crucial to highlight the efforts of these associations in handling concerns related to local pressures from tourism and sport fishing and in protecting fishing activities regardless of the context of informality, in addition to other organizations concerned with broader community issues, such as emergency brigades and cultural or security organizations.

[28] Original quote: *El mar se pone bravo y el que va porque realmente tiene que traerte comida para acá, pero de verdad son tiempos difíciles… y por años el Estado siempre ha querido, ha prometido ayudar a la pesca artesanal, ha prometido ayudar a los pescadores de las zonas costeras y hoy por hoy nunca eso ha sido una realidad cumplida. Con un hecho de que los pescadores se hayan sentido satisfechos de lo que el Estado haiga hecho a favor de ellos nunca; al contrario, cada día más establece más pero, más reglas, más circunstancias que realmente desaniman al pescador, y favorecen inclusive porque esto es un hecho, el Estado siempre ha favorecido a las pescas industriales(...)*

[29] Original quote: *También me preocupa que hay muchas entidades que quieren desaparecer la pesca. Si desaparece la pesca seríamos ilegales, estaríamos haciendo, estuviéramos rompiendo la ley y seríamos más perseguidos de lo que somos. Que nosotros tenemos la libertad de sacar nuestro producto que es artesanal, nosotros en un día de pesca sacamos 300-200 kilos de pescado, de atún y un barco industrial, grande, se lleva, 100 – 70 toneladas de atún.*

Cabuya

Specifically within the social context, noticeable tensions emerged among users in the community where sport fishing is gaining popularity, driven by significant foreign investment and promotion by foreign citizens. Moreover, during the interviews, I was able to identify tension related to the nature of each activity (Kadagi et al., 2020). According to the informants, while sport fishing promotes a more sustainable form of fishing that 'gives back' (i.e., catch-and-release fishing), causing only 'minor harm', artisanal fishing is regarded as an extractive activity, where fishers harvest fish as a resource intended to be sold. In a context where conservation is dominant and initiatives like sport fishing are portrayed by the government and environmental NGOs as an alternative for diversification, some artisanal fishers have concerns about the future of their activity and the deterioration of their image and reputation. As the former leader of the fishers association in Cabuya explained:

> Some people have sold their land and bought good equipment [i.e., boats], or a foreigner comes and pays to be taken on a fishing trip and then leaves the boat in charge of the locals who use it for work. So, we have an increasing number of boats here; but the poor fisher must make a living from fishing, but now they don't have enough space for it and there are conflicts among the locals. They [her sons] are fishing for tuna right now, they go far offshore and have even caught several marlin; however, the idea of tourism is catch and release. And those working in tourism are not happy when they catch [marlin] and even threaten to report them. So, that is when I start to worry. It is artisanal fishing; they make a living from it, but now there is a rivalry because the sport fishing sector is getting money to catch and release, and as a result, they get a lot of money. I worry that a day will come when every species will be reserved for sport fishing. Fishing tourism is growing more and more and not leaving room for the artisanal fishers.[30]
>
> Isabel, former leader of the fishers association.

In terms of fishing facilities, Cabuya was the only site along the coast with a facility equipped with drinking water and equipment to clean and freeze the fish. The *pescadería* (fish market) or *recibidor* (literally, receiver) is managed by the fishers association; however, it cannot own the land it is on due to national legislation and its proximity to the coast. The landing site is old but functional. It has access to electricity, drinking water, sanitation services, three or four old, medium-sized freezers, and space for processing the fish (the men are responsible for this task). Buyers from the community and surrounding areas come to purchase fish, more evidence of the socioeconomic and cultural significance of these sites.

[30] Original quote: *Hay personas que han vendido un terreno y se hacen de buenos equipos, o viene un extranjero y los patrocina con dinero para que los lleven a pescar y les dejan esa panga a cargo cuando no está el extranjero, ellos trabajan. Entonces ya está la embarcación en Cabuya, allí…sucesivamente se va engrandeciendo…Pero el pobre pescador, el que no puede, tiene que vivir de la pesca, que no tenga espacio para hacerlo, pero el pleito es, ha habido problemas porque los mismos en la comunidad…Ellos están haciendo pesca de atún ahorita [sus hijos], van lejísimos y han capturado como varios marlin, y el turismo lo que hace es verlos y los libera. Entonces, al ir ellos y capturarlos el que está ganando aquí, el que está ganando por turismo, eso lo ve mal. Entonces ya lo ven mal, y les dicen que ya los vamos a acusar porque traen marlin, entonces allí eso es lo que me da como cosa. Es una pesca artesanal, ellos tienen que vivir de eso, pero ya es una rivalidad porque ellos están ganando nada más por ir a ver y liberar y ya se vienen y tienen el poco de plata, entonces lo que me da miedo es que va a llegar el día en que van a decir, el pargo se va a ver y se va a liberar; el gallo, el pez gallo se ve y se libera…Y la pesca turística está creciendo más, entonces, como está creciendo más van aplastando al más pequeño.*

Figure 5.4: Freezers in the *pescadería* (landing site)

Source: Photograph taken by the author.

Geographical distance also represents a struggle, albeit to a lesser extent, in Cabuya. While reaching the community takes time and resources, there are a number of viable transportation modes, including bus, car, boat, and plane, and the community is situated between two popular tourist destinations. All of these factors influence the potential for competition, accessing different markets, and receiving more external investment and visitors.

Like in Cahuita, the artisanal fishing association abides by the *12 Remos*. Despite these efforts, it is not certain that they will be granted the license or any other alternative formalization.

On the other hand, the direct participation of women as fishers in this area is low. There is a group of five or six women who work in mollusk extraction (down from 15 when the association was founded). They have an identity card as *molusqueras* (mollusk collectors) and are members of the fishers association. This extraction is primarily focused on clams and is generally for self-consumption or sale to specific buyers, always at a small scale. The work, however, is seasonal and often inconsistent even during the high season.

The leader among the mollusk collectors explained that the activity is historically developed in the community, especially for self-consumption, and there is no schedule or prior collection arrangements. Extraction depends on the season, tide (it is done during low tide), and their free time. The leader further explained that clam extraction is important not only for food security and providing additional household income, but also for cultural reasons and local identity. There is concern about future restrictions, however, as they collect the clams in the vicinity of Cabo Blanco Absolute Nature Reserve. Other than this, the growing struggle to find clams is evidence of the possible implications of warmer temperatures on fisheries as the collectors mentioned having to dig deeper to find them.

Dominicalito

From a social and economic perspective, particularly regarding infrastructure development and landing sites, there is an old structure near the coastline that is in no condition for processing and storing fish. Here, medium-sized trucks with containers of ice wait for the catch of the day to arrive. During several visits, I observed the poor condition of the structure in terms of hygiene and the physical safety of the fishers and other individuals involved in processing, storing, and transporting the fish.

Figure 5.5: Fish landing site in Dominicalito

Source: Photograph taken by the author.

Other than this, one important factor shaping the fishers' vulnerability is the community's distance from the coastline, separated from the sea by a national highway. This compels the fishers to constantly move their gear and equipment for security reasons, also putting their own safety at risk. This distance negatively impacts the fishers' safety, economy, and community identity since the direct connection with the sea has been severed (Pelage et al., 2023).

Regarding tension among users and sectors, the informants emphasized that pressure from tourism on real estate has led to a rise in luxury constructions (e.g., large homes and hotels), which have affected the forest near the community, increased land prices, and negatively impacted access to clean water.

Additionally, despite having access to public services like electricity, public transportation, education, sanitation services, and the internet, the community struggles with access to water. According to the local leader and fisher, this is a historical struggle in this community due to scarcity during the dry season and pipe damage during the wet season.

The community of Dominicalito exemplifies the asymmetries that exist between artisanal and semi-industrial fishing. Before the creation of the Marine Area for Responsible Fishing in 2018,[31] semi-industrial fishing vessels harvesting shrimp and sardines would fish in the waters across from Dominical (Grupo de Trabajo Interinstitucional para el Plan de Ordenamiento Pesquero, 2018) with potential adverse effects on the artisanal fishers. The creation of this zone contributed to the designation an area encompassing 89.8 km^2 for artisanal fishing only.

Regarding gender dynamics in Dominicalito, 90 men and seven women were registered with the local fishers association at the time of my fieldwork. It is important to note that these numbers are estimates, and not all of those registered are currently active as artisanal fishers. However, it was interesting to see the strong leadership of the secretary of the fishers association, a young woman highly involved in local politics.

Lastly, rising public insecurity and criminal activity related to drug trafficking, both on land and at sea, increase the uncertainty fishers face when deciding whether or not to venture out to sea. Additionally, they experience pressure to become involved in drug trafficking, particularly in providing transportation. While I did not directly see any such a case in the community, there are some recently documented cases in national newspapers involving individuals from the broader area (Villalobos, 2024). Despite the potential for an alternative livelihood, drug trafficking is of course illegal and dangerous, exposing the fishers to prison, harm, or even death if something goes wrong during transportation.

5.3. Examination of shared factors

5.3.1. Biophysical

During my conversations, the fishers primarily understood climate change through its impacts rather than its formal definition. I posed the following question to each fisher: *What is climate change?* And regardless of their age, gender, or location, many fishers responded with doubt and uncertainty about the meaning of the concept. However, without a doubt, climate change is a widespread concern and a phenomenon with adverse effects on fishing, the community, and the planet.

It is important to note that in every interview I had with the fishers, they all acknowledged the link between warmer water and climate change. However, when asked about declining fish stocks—specifically, how finding fish now compared to ten or 20 years ago—they also acknowledged that overfishing is a significant issue. They recognized that declining stocks are not only the result of warmer water but also of intense fishing. This is also supported by academic literature that highlights the complexity of the effects of climate change and the compounded impacts of other activities on ecosystems within the context of climate change (see Daw et al., 2009; Yusuf et al., 2015). This also presents a challenge for research and academia in a country like Costa Rica, where fish stock studies are limited, and there is a lack of clear

[31] See Agreement AJDIP/219-2018 at: https://www.incopesca.go.cr/pesca/pesca_responsable/ampr%20dominicalito/archivos/AJDIP-219-2018_creacion_ampr_dominicalito.pdf

understanding regarding the quantitative and qualitative characteristics of marine ecosystems (Naranjo, 2018; OCDE, 2019).

The effects of climate change are also recognized in relation to the high variability in weather patterns and the challenges fishers face in distinguishing between the wet and dry seasons ("reading the weather"). As a result, the fishers struggle to plan their fishing days and strategies and can no longer associate specific weather with a given month or period when particular species would migrate or were once more abundant. As a result, an already uncertain activity like artisanal fishing becomes even more uncertain, increasing the general vulnerability of the artisanal fishers.

> Even the tarpon (*sábalo*); there are seasons we used to think were good for fishing tarpon, but we caught nothing. It is caught in a different season. Now people from the community are dealing with the uncertainty of whether we should go fishing or not. Do we risk it or not. For example, some fishers have their gear to catch lobster, but they are coming back empty because there's nothing to catch. This is usually lobster season, an opportunity to make money to get the kids ready for school.[32]
>
> Verónica, 24-year-old fisher and conservationist in Barra del Colorado.

5.3.2. Social

Some of the social issues related to social capital and assets that I observed during my interviews and fieldwork in the four study sites include a low level of education compared to national standards, where only 37% of the fishers interviewed had completed school and 27% specifically mentioned not having finished at all; and an aging workforce, where the average age among the artisanal fishers interviewed was 50.8 years, with the exception of Barra del Colorado.

Tension arising from trust issues among the fishers was evident in discussions about organizational capacity. Struggles related to organization and finding common ground were typical concerns across the four research sites, with some fishers criticizing individualistic behaviors and a lack of commitment to the fishers associations and other local organizations. A few pointed out that some of these trust issues and lack of cohesion result from a general disappointment in government institutions and the lack of clear incentives to participate in local organizations.

In terms of perceived risks, the fishers emphasized concerns about poor occupational health and safety conditions related to the dangers of fishing activities. These included accidents from handling fishing gear, such as injuries from hooks or fishing lines, physical injuries from lifting heavy weights, and the risks of being on a small boat during harsh weather conditions. Several fishers shared stories and anecdotes about fatal accidents caused by harsh weather at sea, where fellow fishers fell off the boat and narrowly escaped death or even drowned. The fishers I interviewed acknowledged that fishing is a risky activity, and it becomes even riskier without health or gear insurance.

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[32] Original quote: *Otra cosa tal vez, los mismos sábalos, hay temporadas que se creía se podía pescar sábalos y no se pesca. Se pesca en otra temporada, entonces ya las personas de la comunidad hemos estado en esa incertidumbre de vamos a pescar o no vamos a pescar. Nos arriesgamos o no nos arriesgamos. Imagínese que ahorita tienen el equipo de langosta en el mar y lo que están haciendo es que lo están trayendo porque no están sacando y se suponía que ya para estos tiempos siempre ha sido que hay langosta para estas épocas, la salvación para alistar a los chiquillos para ir a la Escuela.*

Regarding gender dynamics and specifically the participation of women in the sector, I identified three main elements to highlight from my conversations and interviews with both female and male fishers and also from direct observation during my fieldwork: 1. A small number of women are directly involved in fishing (i.e., at sea); 2. There is an established division of work (men fish at sea and women work mostly on land); and 3. There is a strong female leadership in the fishers associations, which was evident in all the four communities.[33]

The four women I interviewed had vastly different life stories, different ages, and diverse levels of education (only one went to university). Two were married (to fishermen), one was divorced (but formerly married to a fisherman), and one was a single mother. All were directly involved in artisanal fishing (e.g., they would once fish with their husbands or either their fathers or brothers were fishers). I identified two common traits during my interviews and conversations with these women: strong personalities, in that they were not shy to talk and to give their opinions and they also had a well-developed capacity for organization; and a strong attachment to artisanal fishing and to their homes as the main motivations for participating in the association. The family influence (see Szymkowiak, 2020a) is vital to understanding the participation of women in fisheries: they fish with either their spouses or fathers.

In my interviews with both female and male fishers, I did not encounter any explicit instances of discrimination. However, some male fishers did express strong opinions about physical performance and concern for the health issues of women and the dangers of being at sea, yet were not explicitly opposed to women working as fishers. The interviewed women expressed that they are treated with respect by their fellow fishermen both at sea and on land.

As many of the local leaders highlighted, the labor of women in fisheries is multifaceted. In addition to caring for the home and family, they are also responsible for processing, entering into and complying with commercial contacts and distributing the fish. Despite this, their work is often overlooked within the sector and by governmental and non-governmental institutions.

5.3.3. Economic

Competition from tourism, particularly conservation tourism, and sport fishing is increasing across all four research sites. This trend is accompanied by a heightened interest from previous governments and key governmental organizations in expanding land and marine protected areas. The fishers are aware of the potential benefits of tourism compared to artisanal fishing, such as higher, relatively constant income. Nevertheless, the fishers are skeptical about productive transformation due to the lack of financial support from the government and the high costs related to adapting or buying new boats and equipment.

The majority of the fishers interviewed acknowledged the direct and indirect impact of tourism on their activity, such as restaurants buying more local fish for tourists visiting the community.

[33] Galappaththi et al. (2022:1112) reviewed 54 cases around the world and developed an interesting typology of governance tasks performed by women. They identified seven forms of participation: "leadership role and active participation in the decision-making process; relational networking and informal collective action; exercising agency and fostering legitimation; resource monitoring; participation in meetings; knowledge contribution to decision-making; mass mobilization and activism". The authors acknowledge that research on governance and gender in fisheries is scarce.

Despite this, there is widespread concern regarding the displacement of artisanal fishers. In addition, fewer people are interested in working as full-time artisanal fishers due to economic reasons related to low income and growing uncertainty compared to working in tourism.

While tourism, sport fishing, and artisanal fishing take place in the same geographical space (i.e., along the coast and at sea) and are all productive activities, their goals are very different. Tourism and sport fishing prioritize the experience as a source of income, such as whale watching or catching high-value species with minimal harm, followed by their release. Environmental protection efforts focus on preserving the natural resources deemed important for the country, while also aiming to generate income through the protection of these resources and the experiences offered to tourists visiting the area. Meanwhile, artisanal fishing is an extractive activity in which income is generated through the capture and sale of fish. It is important to highlight the monetary value of these activities, which also impacts competition. Compared to artisanal fishing, these alternative activities offer more attractive revenue potential, which is one of the reasons driving diversification or prompting fishers to leave artisanal fishing all together.

There is a high dependence on fisheries in these communities, a sign of scarce livelihood alternatives. Despite the increasing importance of tourism, the socioeconomic and demographic characteristics of the communities also define income alternatives: small communities with few employment options. Many fishers mentioned that besides working full-time in fisheries, they also work in agriculture or have some knowledge of gardening or construction. During a bad or low season, or when they are unable to fish due to the weather or other reasons, they look for a *chamba* (short-term informal job lasting one to several days) to ensure they have income to buy food and pay the bills.

In terms of unfavorable market conditions, the artisanal fishers interviewed emphasized the low prices they receive compared to the end-user prices at national supermarkets. In communities like Barra del Colorado, Dominical, and Cabuya, the informants pointed out the disadvantages of dealing with intermediaries and the lack of alternatives to sell the fish directly to big buyers. In Barra del Colorado, it is even more problematic because of the community's isolation and the high costs related to transporting the fish.

Other than the low prices paid to artisanal fishers, it is important to mention the high level of competition at supermarkets due to imported frozen seafood products, such as tilapia from China and Vietnam, pangasius from Vietnam, and shrimp from Argentina and China, and national alternatives from aquaculture and sea farming, including tilapia, pink snapper, and shrimp, all at relatively low prices, making it more difficult for artisanal fishing products to compete under these conditions.

Due to the absence of formal licenses, the fishers do not have access to institutional support, such as fuel subsidies, motor purchases, or assistance after a fishing ban takes effect. This is also a reason given by the fishers for not having access to formal lines of credit since they are technically considered "illegal." During the interviews, only two fishers mentioned being formally indebted (with a bank), mainly as a result of the COVID-19 pandemic or an extreme weather event, after which they needed to repair their homes. They also mentioned struggling to make the loan payments due to low incomes.

An analysis of the high costs of fishing gear and equipment reveals an interesting paradox: while regulations on artisanal fishing and the challenges of obtaining the necessary gear impose constraints, the vulnerable socioeconomic conditions of the fishers further limit their ability to abide by these laws. During my conversations and interviews, the fishers also expressed frustration over the difficulty of complying with legal requirements regarding gear and equipment due to the prohibitive cost of fuel, the challenge of purchasing new motors or affording repairs, and the struggle to buy the necessary gear at affordable prices.

5.3.4. Technological

Regulations on artisanal fishing are strict regarding gear and where at sea they are permitted to fish to be considered artisanal fishers. I consider these two factors to be the main reasons for the slow change in fishing practices and the low modernization process identified in the sector, in addition to the economic aspects explained above regarding access to credit and savings and high fishing costs. The fishers are aware of the sector's slow technological change; however, they also acknowledge important milestones over the last 30 to 50 years: from hand-carving wooden boats to purchasing fiberglass boats (today, all of the boats used at the research sites are made of fiberglass); from using simple string (*mecates*) to fishing lines, more effective hooks and, for a few of the fishers interviewed, even changes in bait from small fish or shrimp to artificial lures like poppers or crankbaits. From the interviews, I was unable to identify a direct relationship between age and the type of gear utilized.

The overall area and offshore distances where artisanal fishers are permitted to fish are relatively close to shore and defined by regulation. The maximum distance is three nautical miles from the shoreline. This regulation can undermine resilience and adaptation strategies to find new fishing grounds. The fishers interviewed are aware of this dilemma and are critical of the regulation since there is a need to fish deeper at sea, beyond the three nautical miles permitted by law. It is important to mention that if the community is under a Marine Zone for Responsible Fishing or located near a protected area, the permitted fishing area is defined by the limits of these zones in accordance with the specific management plan.

5.3.5. Governance

At present, weak governance structures characterize the situation of artisanal fishers in the study communities. This context is influenced by the factors discussed previously, such as the lack of fishing licenses and training, high gear and fuel prices and informality, and no State support in the form of subsidies or access to affordable credit. Despite the formal existence of fishers associations, the current and former leaders I interviewed expressed the difficulties they faced in organizing the fishers and encouraging active participation in the association.

In the literature, Islam & Chuenpagdee (2022: 6-7) write about "dormant fisheries association" as an issue in terms of poor management. In the case of the study communities, more than dormant, I observed a passiveness in the performance of these organizations. While they do advocate for their members, some of their efforts can be considered "light" compared to expected actions, such as active participation in community and regional organizations, constant presence in national forums like the legislative assembly, or active participation in protests. In other words, they formally exist but do not always react. Moreover, association members rely

heavily on the board and leadership. I even observed paternalistic or maternalistic behaviors, particularly with the board and president, who were expected to assume all leadership roles and responsibilities.

As stated previously, illegal fishing can be understood as a lack of individual fishing licenses in the communities under study. I identified two main reasons for this: 1. Some fishers did not renew their licenses on time and lost them; and 2. The government, and particularly the institute of fisheries (INCOPESCA), has been reluctant to grant new individual licenses since 2012[34] (Solís et al., 2022). All the fishers interviewed mentioned having a fisher's identity card (*carné de pescador*), but only 16% stated they currently have or have had in the past a fishing license linked to a boat that enables them to use specific fishing gear. The fishers without a fishing license acknowledged their situation and are aware of the possible consequences if the Coast Guard were to catch them (e.g., they could confiscate their boats and gear). However, the need to fish is more important, and so they decide to take the risk.

Another governance issue I identified is the exclusion of artisanal fishers from the decision-making process, especially regarding fishing regulations (e.g., bans and type of gear), the expansion of conservation areas, and local community planning (e.g., to develop tourist projects nearby or on the site of the historical landing sites). One of the main concerns for the fishers is the future of artisanal fishing in their communities and the country as a whole. They expressed that the government's long-term disregard for artisanal fishers, the pressure from tourism, and the creation of more protected areas without taking artisanal fishing into consideration seems to be a systematic effort to push the activity out of existence.

In terms of monitoring, control, and surveillance, I observed a limited presence of government institutions in all four communities, including little or no police presence. I found this to be interesting, especially given the high importance of Dominicalito, Cahuita, and Cabuya for tourism and the growing presence of drug trafficking in these areas, in addition to the isolated geographical position of Barra del Colorado near the border with Nicaragua.

However, as I will discuss in Chapter 6 regarding resilience and self-organization, while there is little to no presence of government institutions, the communities appear to be highly organized in formal terms, with different local institutions (e.g., local development associations, water management organizations, religious groups, etc.) and a strong sense of solidarity and communal support on matters of local security.

5.4. Effects of these vulnerabilities on the community and artisanal fishers

As explained in the analytical framework, the extent of these vulnerabilities within the communities and among artisanal fishers is asymmetrical and subjective, as they affect individuals differently depending on their unique contexts and specific moments in time. Individuals can be prone to potential harm in different ways and with different intensities. Thus,

[34] The Treasury Inspector's Office (*Contraloría General de la República*) issued an instruction restricting INCOPESCA from granting new licenses without scientific support. INCOPESCA has not been able to do the research to support new licenses. See:
https://cgrfiles.cgr.go.cr/publico/docs_cgr/2012/SIGYD_D_2012022416.pdf

vulnerabilities are not completely set, and there is always the potential for changes in the nature and scope of concerns based on the socioeconomic context and structural transformations.

Despite the argument of Islam & Chuenpagdee (2022) that biophysical factors are the most dominant source of vulnerability, in the case of the study sites, it was interesting to discover through the interviews and observations, that while concerns exist regarding changes in weather patterns and warmer waters, the fishers' primary focus was on the socioeconomic dimension, which has significant effects on their fishing practices, way of life, and uncertainty surrounding the future. Another interesting takeaway is that, despite concerns about the lack of assets, the consequences of inadequate equipment and gear, and the struggles in finding good fishing spots, the technological factor did not emerge as a key concern.

Table 5.1: Summary: Main concerns of the fishers as perceived from the interviews

Factors	Fishers' concerns
Biophysical	• Diminishing fishing stocks • Climate change • Pollution • Future of fishing activity
Social	• Distrust among fishers • Poor occupational health and safety issues at sea • Uncertainty • Pressures from the government • Lack of institutional support • Lack of knowledge of the artisanal fishing sector • Future of the artisanal fishing sector (e.g., an aging workforce) • Competition among sectors
Economic	• Low prices • Lack of alternative livelihoods • Uncertainty • Lack of assets (e.g., material resources, financing) • Competition with other fishing sectors (e.g., semi-industrial fishing) • Informality
Technological	• Restrictive regulations on fishing gear • Limited autonomy for fishing • Slow technological change

Governance	• Weak local governance • Lack of institutional coordination • Restrictive laws • Exclusion from decision-making processes • Lack of fishing licenses • Uncertainty • Pressures from the environmental and tourism sectors

Source: Prepared by the author.

Some of the factors analyzed in this chapter affect the fishers at specific times with possible short-term effects, such as red tide or heavy rains and flooding; even sea level rise was acknowledged but is not considered a threat to survival as of yet. The fishers also expressed concerns regarding resource sustainability, but this was not a primary concern.

However, most of the fishers agreed that socioeconomic and governance aspects related to excessive regulations, pressure from the government and environmental organizations, lack of institutional support, and low prices have critical effects on their present and future lives. As a result of these concerns, their uncertainty about what to expect increases not only as a result of changes in fish stocks but also because of political and socioeconomic changes in which the future existence of artisanal fishing as a livelihood seems threatened.

5.5. Conclusions

Coastal regions are considered zones of transition and tension due to their natural wealth, strategic geographical position, and high exposure to natural and climate phenomena (Crossland et al., 2005). In this context, climate change affects marine and land ecosystems and interacts in complex ways with the elements that have shaped their environmental and historical vulnerabilities.

Despite the global nature of climate change, its effects are localized, and individual responses are based on one's own environmental, economic, political, social, and cultural realities. These realities define one's vulnerabilities, concerns, priorities, and potential responses in a scenario where climate change is not the only factor impacting one's life.

This chapter explored the main vulnerabilities of the artisanal fishers in the research communities to understand their context. This contributes to identifying their concerns and better understanding how climate change affects their lives. A situated approach based on biophysical, social, economic, technological, and governance factors explored the fishers' vulnerabilities.

Although the analysis did not attempt to measure the vulnerabilities, the qualitative approach applied based on interviews and observations aided in deciphering some of the fishers' primary concerns. For analytical purposes, I employed a typology of factors influencing vulnerabilities. It is important to mention that vulnerabilities can overlap and are not only related to one factor

(e.g., informality can also affect access to loans, subsidies, political representation, and participation), which is evidence of the complex and situated nature of vulnerabilities.

Regarding the artisanal fishers' primary vulnerabilities, despite the diversity of factors identified in the study sites, those related to social, economic, and governance are most concerning to the fishers. For instance, the pressures from State regulations and conservation (e.g., reduction of fishing zones due to the creation of protected areas) were common vulnerabilities identified during a discussion on these factors. The lack of access to fishing licenses and, as a result, higher informality, is another critical element limiting the fishers' potential for political recognition and access to rights. Moreover, it fosters criminalization of the sector. These were frequent concerns among the fishers, mainly when reflecting on their prospects and the survival of artisanal fishing as a livelihood and a way of life.

Despite the direct effects of climate change on their activity, such as warmer waters, and the indirect consequences of this, such as struggling to locate fish, the fishers' primary vulnerabilities are not necessarily linked to climate change alone. The fishers interviewed do acknowledge the impacts of this phenomenon, however, their main concerns are more oriented toward their ability to fish (e.g., having sufficient economic resources or political support and recognition to access the sea as artisanal fishers). In this context, the effects of climate change are not immediately severe but seem to have a gradual impact, with specific episodes affecting the communities and the fishers. Thus, these findings aim to contribute to a critical approach to resilience and climate change adaptation, suggesting that the effects of climate change might not always be the primary concern in these communities where other vulnerabilities have a more immediate effect.

6. Resilience as a framework for understanding the daily lives of Costa Rican artisanal fishers in the context of climate change

Interviewer: Do you ever see yourself not fishing?
Fisher: I would die, I would die… it is part of what
keeps me alive. I would die; I would get sick.
When I have nothing, I can at least fish
for tarpon, or mackerel, anything.
But I always make time for fishing.
I would die without fishing.[35]
Alberto, fisher from Barra del Colorado with 17 years of experience.

6.1. Introduction

As I walk along the river in Barra del Colorado Norte, I come across an old wooden structure with weathered beams worn by time and the elements. Stepping inside, I find a few old, dusty tables and abandoned fishing gear scattered across the floor. Neighbors tell me this place once served as a waiting area for shrimp peelers—mostly women—who would gather here, preparing to process the catch as soon as the fishers arrived. Shrimp season involved not only fishers and shrimp peelers but also a significant portion of the community that depended on artisanal fishing. Shrimp season was once a major event, both economically and socially. The women I interviewed nostalgically recalled how processing shrimp was more than just work; it was a bonding experience for the community, bringing people together through the collective effort required for manual preparation.

Today, the abandoned structure is a reflection of the 2013 national ban on shrimp fishing. The ban had a significant impact on the community, which was no longer permitted to harvest this high-value resource in a place where livelihood alternatives are limited due to geographical isolation and environmental restrictions. Despite this, artisanal fishing in Barra del Colorado has remained the primary source of income over time, serving as a testament to the resilience of both the practice and the broader community.

Resilience is a broad and complex concept with multiple dimensions. The fact that resilience is not always explicitly expressed in conventional, often materialistic terms does not mean that an individual or group lacks resilience altogether. Building on the previous chapter's discussion of vulnerabilities to further reflect on the context of the fishers, this chapter examines the factors that either strengthen or undermine the resilience of the fishers in the study sites. The fishers in the research communities experience resilience unevenly; it shaped by the socioeconomic, political, and environmental context affecting their capacities to either handle or not handle undesired change. It is possible to identify resilience, even if it does not align with theoretical

[35] Original quote:
Interviewer: ¿Se imagina del todo no pescando?
Fisher: Seguro me muero, seguro me muero… es parte de lo que lo mantiene vivo a uno…Me muero, me enfermo. Cuando no hay nada por lo menos me voy a traer un sábalo por allí, un jurel, algo, pero uno saca el rato. Se muere uno…

models or mainstream Western discourse, which often emphasize tangible and explicit actions (Pelling, 2011).

In the previous chapter, I discussed the vulnerabilities of the artisanal fishers. This analysis contributed to understanding the political, environmental, social, and economic factors of the context giving shape to the fishers' resilience and adaptation (as will be discussed in Chapter 7). For analytical purposes, this chapter examines resilience through the experiences of the fishers I interviewed during my fieldwork, contributing to a reflection on specific dimensions of this concept and how it influenced my understanding of it.

The research question guiding this chapter is: What are the components of resilience for the artisanal fishers? To answer this question, in this chapter, I present information on the common findings on each coast before diving into community-specific resilience actions. Then, I make a comprehensive reflection on the resilience of all four study sites. My analysis of the fishers' resilience is guided by tangible (i.e., natural systems, people and livelihoods, institutions and governance) and intangible elements (i.e., changes in individual fisher behaviors, self-organization and social learning, identities, and self-perception) as explained in the analytical framework. These two categories contribute to understanding the nature of resilience and allow for a deeper analysis of the intangible aspects, usually overlooked in resilience studies, which tend to focus on the material (Brown, 2013; Shah et al., 2017).

6.2. Resilience of the artisanal fishers in the study communities

6.2.1. Common findings: Caribbean coast

On the Caribbean coast, I identified an important element that strengthens the tangible resilience of the study communities, namely local governance mechanisms like COLAC and fishers associations. While not a direct response to the effects of climate change, both provide a forum for discussion on climate change issues or analysis by community members. Both institutions have already discussed environmental matters and, when weather phenomena impact the community, these organizations generally step up to coordinate with local and national authorities to support the affected population.

On the other hand, certain aspects related to geographical position and weather conditions seem to undermine the capacity for resilience of the fishers along this coast. For instance, the gradual, uneven development of gray infrastructure is influenced by the urgency of the impact of weather events on daily life in these communities. For this reason, I was able to identify more gray infrastructure in Barra del Colorado than in Cahuita, as explained in Chapters 4 and 5. Needless to say, this infrastructure requires significant financial investment from the villagers.

Additionally, livelihood changes resulting from productive diversification processes are not necessarily planned, as will be discussed in the chapter dedicated to adaptation, but rather the result of socioeconomic pressure from productive changes in both communities, such as from conservation and tourism. For most fishers, diversification within or outside the fishery has been reactive, hindered by overarching concerns regarding a lack of financial support to upgrade boats and gear and assume the costs related to a new productive activity; and weak institutional

support, mainly from national institutions like INCOPESCA, in terms of training opportunities and financial and bureaucratic access to fishing permits.

Barra del Colorado

In Barra del Colorado, geographical isolation affects the cost of goods in the community and limits opportunities for market diversification. Both the fishers and broader community pay more for food, face restrictions on fuel transportation, risk their personal and legal safety, and face limited sale opportunities of fish and other products, which are controlled by intermediaries. Similarly, as discussed in Chapters 4 and 5, tensions regarding land tenure heighten the general sense of uncertainty in relation to their assets and well-being.

Moreover, the community adopted alternatives for self-organization through formal local institutions and informal support networks comprised of relatives and friends, both inside and outside the community. Social learning like home construction or preparation for flood season by elevating furniture or electrical appliances are further evidence of the response and coordination of community organizations and neighbors when dealing with floods.

The active labor of formal institutions like the fishers association can further strengthen the fishers' resilience through representation at local and national forums and coordination with specialized institutions (e.g., ministries, INCOPESCA, SINAC, etc.) and private organizations (e.g., NGOs), particularly regarding the negative impact of the shrimp fishing ban and management alternatives for artisanal fishing in the area. However, it is important to note that concentrated leadership (i.e., strong leaders burdened with too many responsibilities and exhibiting paternalistic or maternalistic behaviors) and a low level of commitment from the fishers to the fishing association weaken the association's capacity to be a meaningful actor in the context of governance.

The ban on shrimp trawling significantly weakened the community's resilience, as it halted a key source of income from harvesting a high-value species. Moreover, sport fishing as a livelihood alternative has not been widely accepted by the fishers due to the negative impact on the fishers' well-being: a high initial investment is required to develop the activity, but the lack of financial resources and institutional support makes it difficult to cover the cost. It is also seen as a threat to the fishers' identity and to that of the community as a whole.

Regarding governance mechanisms like the Marine Zone for Responsible Fishing, I observed a positive perception among the fishers interviewed regarding the establishment of this area and its significance for sustainability. However, a few did express that this delimitation could undermine their capacity to fish further out at sea in the future if needed. The fishers in Barra del Colorado navigate a complex reality, as they live and work within a highly protected area, which restricts productive diversification and diminishes opportunities for alternative sources of income.

Cahuita

In Cahuita, I discovered two aspects that I believe strengthen intangible resilience among the fishers and community: a strong identity as Afro-Costa Rican fishers and social learning and self-organization derived from the co-management model established for Cahuita National Park. The strong sense of identity I observed among the informants and the community as a whole helps to sustain the activity as an integral part of their heritage and culture. Similarly, the successful co-management model could foster social learning about environmental conservation values and ideas, while also facilitating the participation of the various local organizations that interact within this model. This collaboration strengthens informal communication networks within the small community.

Due to the challenges in obtaining fishing licenses, the fishers in this community have been following a best practices model known as *12 Remos* (12 Oars). The initiative is promoted by Coope SoliDar, a Costa Rican cooperative organization that works closely with the fishers association. The aim of *12 Remos* is to empower the fishing sector through information, action, and gradual participation from other artisanal fishing communities (Solís et al., 2022). The initiative encompasses 12 steps aimed at identifying and implementing best practices in the artisanal fishing community. The steps are accomplished gradually and once all 12 have been completed, the goal is formalization and full access to their rights through the figure of a collective license (a proposal made by the cooperative to the government). However, as of yet, there is no assurance that the government will accept the proposal and grant this type of license or that the fishers association will have access to the formalization of some of their members.

Figure 6.1: *Los 12 Remos* (The 12 Oars)

Source: Prepared by the author based on Solís et al. (2022: 44)

Intangible resilience in the form of changes in individual behaviors and fishing schedules is possible with the right gear and suitable sea and weather conditions. Conversely, the absence of gray infrastructure in an area significantly impacted by sea level rise and coastal erosion may undermine the fishers' resilience in the medium and long term. This is particularly relevant to the loss of essential infrastructure, such as fish landing sites, and the detrimental effects on coastal properties, including housing and local tourism. These challenges could, in turn, lead to negative economic consequences and potential forced displacement.

6.2.2. Common findings: Pacific coast

Regarding changes in individual fishing behaviors that strengthen resilience, greater predictability in weather patterns can increase the feasibility of daily fishing trips and allow for more flexibility in adjusting fishing schedules. For example, fishers may choose to go out in the evening or at night to avoid high daytime temperatures, which can impact both their health and fish availability near the sea surface. Similarly, according to the fishers on both coasts, the Pacific waters are known for being less choppy than on the Caribbean, particularly in the Gulf of Nicoya, which also provides more flexibility in adapting fishing behaviors.

Conversely, I was able to identify certain elements that could undermine the tangible resilience of the fishers, including competition with tourism and tourist businesses; certain pressures on the fisheries, especially in the Gulf of Nicoya; and a lack of cohesion in local organizations like the fishers associations. Tourism presents an opportunity for diversification both within and beyond the fisheries sector; however, in both communities, the informants expressed concern about the displacement of artisanal fishing due to tourism, as well as the resulting tension over fishing grounds, land rights, and conservation-driven restrictions. Fishing pressure is a primary concern in this area (Gulf of Nicoya) given its long history of fishing, ongoing environmental challenges affecting the Gulf's waters, and its biological significance. These factors have direct consequences for fish stock health and overall ecosystem well-being. Meanwhile, weak cohesion lessens cooperation, negotiation, and coordination with local, national, and even international stakeholders.

Cabuya

In Cabuya, two of the aspects I identified that simultaneously undermine and strengthen resilience is competition with tourism and related businesses, and productive diversification. These sectors represent opportunities for increasing resilience by offering temporary or permanent livelihood alternatives to the fishers and the rest of the community. At the same time, the fishers are concerned about the negative effects of socioeconomic changes on artisanal fishing, particularly the risks of displacement by sport fishing and conservation initiatives and the threat of losing their local identity as a fishing community.

Similar to Barra del Colorado, despite sport fishing being portrayed as an attractive livelihood alternative by the government and even some conservation organizations due to a less intense workload for fishers and prospects of higher income, the informants expressed concern about their financial capacity to handle the productive conversion and the weak institutional support in accessing licenses, permits, funding, and proper training.

While a few fishers and other community members have made the transition to sport fishing, most fishers remain dedicated to artisanal fishing. In fact, I observed a certain tension between these two sectors, which can weaken intangible resilience in terms of self-organization (e.g., affecting the fishers association or informal work networks) and social learning (e.g., applying sustainable fishing practices) among the fishers and community.

On the other hand, formal local organizations such as the artisanal fishers association contribute to the fishers' resilience by providing a certain degree of institutional support, mainly through small, low-cost loans (i.e., *el alisto*) to buy gear and bait, but also by representing the fishers in other governance mechanisms, such as COLAC or local governmental institutions. Access to the *alisto* reduces uncertainty for fishers by providing financial support during the low season when their incomes decline. The fishers association in this community also receives, processes, and sells the fish directly to the community or nearby businesses like restaurants and hotels, thereby avoiding the costs associated with intermediaries and ensuring higher incomes for the fishers.

Dominicalito

The existence of a governance figure like the Marine Area for Responsible Fishing can be considered a strengthener of resilience as it bans trawler fishing near the shore and protects the health of the ecosystems and fish stocks. During the interviews, the fishers and informants recognized the positive impact of the Marine Area in reducing fishing pressures, which has allowed them to fish closer to the shore.

Tourism is another essential economic activity in the area. More locals are becoming involved in the sector, which offers an alternative livelihood that is particularly attractive during the high season. However, the growth of tourism, along with the influx of foreign capital and citizens, also negatively affects the community by creating land tensions and driving up the local prices for goods. It also negatively impacts fishing by drawing fishers—especially young fishers—away from the sector in search of a better income and more stability. This has an impact on the local identity of Dominicalito as a fishing village. Similar to the other study sites, tourism can strengthen resilience by offering alternative livelihoods. However, it also can undermine resilience by making it more difficult and expensive to fish with limited economic resources and institutional support, pushing fishers out of an activity that is considered part of their culture.

On the other hand, I identified an external factor related to infrastructure that could undermine the community's resilience: its distance from the sea. As explained in Chapters 4 and 5, the community is located at a distance of five kilometers from the coastline and on the opposite side of a national highway, increasing logistics costs for the fishers in terms of physical effort required to transport their gear (particularly motors) every time they go on a fishing trip. This also increases their exposure to criminals in an area with growing security concerns. Being far from the sea distances the fishers and the community from their natural landscape, as fishing is more than just a job—it is a way of life. This separation can negatively impact their sense of identity.

Finally, the lack of adequate infrastructure at the landing site (a structure with minimal sanitary conditions to land and process the fish) also undermines resilience by limiting control over fish quality and handling at the start of the value chain. This increases reliance on intermediaries,

who ultimately define prices and dictate the terms of fish delivery. Unlike in Cabuya, where the fishers association provides small loans for buying bait or gear, the local fishers association does not offer this service. The fishers depend on financial support from the intermediaries, fostering a problematic dependency that leads to uncompetitive fish prices, reduced income, and growing indebtedness.

6.3. Examination of shared factors

6.3.1. Tangible resilience

Natural systems

Regarding natural systems, there were two common elements that stood out across the four study sites. First, is the lack of information about fish stocks used in decision-making processes. As explained in Chapters 4 and 5, the country, and particularly institutions like INCOPESCA, does not have the resources to research and better understand the conditions of national fisheries. Some estimations are based on projections and are site-specific (e.g., the Gulf of Nicoya) and species-specific (Josephy et al., 2023). For other areas and species, the lack of information presents a challenge in terms of fishery management and conservation. Although the fishers did not explicitly express this concern in the interviews, in Barra del Colorado, they did voice the seeming injustice of the shrimp ban, citing the authority's lack of knowledge about local fisheries and the unfair comparison with the semi-industrial shrimp fishery in the Pacific. In addition, the government has disregarded the community's efforts to research the shrimp fishery to gather evidence of its sustainability (see Naranjo-Elizondo, n.d.).

> After that, shrimp fishing was banned. We are not at all like the semi-industrial fishers in the Pacific. Trawler fishery was banned, and we also practiced trawler fishing here, but in an artisanal manner, so another fishery we can't use. Maybe we can recover [our rights], we are working on that; we have nothing to do with the Pacific or semi-industrial fishing. We are artisanal fishers, a completely different fishery. Studies have been done; in fact, the last study was done during the September-October season to show that this fishery is sustainable, because the Constitutional Court said that if you could prove the sustainability of the fishery, it would reconsider granting licenses.[36]
>
> José, fisher from Barra del Colorado with 32 years of experience.

Meanwhile, in Cabuya, a Costa Rican NGO collaborated with a group of women and a biologist to inventory the mollusks, aiming to allow mollusk collectors to continue their work near the national park and prevent the government from banning an activity traditionally carried out artisanally by a small group of women. These two cases are examples of the lack of scientific information available in making environmental and fishery management decisions.

[36] Original quote: *Después de eso nos eliminaron la pesca de camarón, nosotros no teníamos que ver nada, absolutamente con la pesca semi-industrial en el Pacífico. Lo que se prohibió fue la pesca de arrastre y nosotros pescamos camarón con arrastre también aquí, artesanalmente, entonces nos eliminaron esto. Entonces, otra que no podemos utilizar, tal vez, tal vez podamos recuperar (…) estamos pulseando eso a ver si nos permiten seguir pescando, no tenemos nada que ver con el Pacífico ni nada que ver con la pesca semi-industrial, nosotros somos pescadores artesanales, una pesca muy diferente. Ya se han hecho estudios, casualmente, ahora en la temporada septiembre-octubre se hizo el último estudio para demostrar que la pesca es sostenible, porque el mismo voto de la Sala Constitucional dice que si se demuestra que la pesca es sostenible con ese arte, que se reconsideraría volver a otorgar los permisos.*

In addition to the lack of information on fish stocks, the insufficiency of detailed information on the socioeconomic aspects of each fishing sector (i.e., artisanal, semi-industrial, and industrial) also negatively impacts the decision-making process as there is no clarity as to the conditions of the fish and the characteristics of the individuals working in the fisheries (Mason et al., 2022).

The second factor related to natural systems is the transformation in fishing practices. During the conversations, the fishers acknowledged the slow modernization—or no modernization at all—of their fishing practices, pinpointing economic and governance restrictions as the causes. Difficulties in accessing loans or the inability to save money to purchase new gear were cited as reasons for not upgrading boats or equipment. In terms of governance, an interesting finding was that some fishers criticized the restrictions placed on artisanal fishing, particularly the limitations on using certain gear and equipment (e.g., larger boats and more powerful motors) and the prohibition on fishing beyond three nautical miles from shore.

> Another thing that affects us, and that in no way has to do with technology or climate change, is the marine area we have for fishing. As artisanal fishers, according to the law, we have an autonomy of three miles and in three miles, we can't catch anything. Just imagine if the law or the coast guard enforced that law and forced us to fish within those three miles; in these times, we couldn't catch anything because sharks and lobsters are out further than that. On only a few occasions, can lobster be found within three miles; the schools of red snapper are six or seven miles from the beach.[37]
>
> José, fisher from Barra del Colorado with 32 years of experience.

People and livelihoods

Another factor of tangible resilience is related to socioeconomic characteristics like income, living conditions, savings, knowledge, and the fishers' livelihoods in terms of diversification, income dependence, or competition with other sectors or even within the same sector.

As we will discuss in more detail in the chapter on adaptation, diversification within the study sites is reactive and organic, influencing the fishers' capacities for long-term measures and undermining their resilience. For instance, due to seasonal changes or the impact of harsh weather on the community, the artisanal fishers interviewed are forced to seek alternative employment, whether related or unrelated to fishing (e.g., working for other fishers with more capital vs. working as farmers or in construction). These jobs are usually informal and last only a few days. As soon as they can, the fishers return to fishing. Here, diversification is imposed by external circumstances, requiring the fishers must react quickly with limited opportunities for long-term diversification strategies, even if they have engaged in these alternative activities for an extended period.

Of the fishers interviewed, only seven stated they had made the conscious choice to diversify. This process resulted from beneficial opportunities that were presented to them, and having

[37] Original quote: *Otra cosa que nos está afectando mucho y ya eso no tiene nada que ver con tecnología o cambio climático es el espacio marino que tenemos para pescar, como pescadores artesanales por ley nosotros tenemos una autonomía de tres millas y en tres millas no podemos pescar. Imagínese que si la ley o el guardacostas nos obliga a pescar dentro de esas tres millas en estos tiempos no podríamos pescar nada porque el tiburón lo pescamos fuera de las tres millas, la langosta fuera de las tres millas. En pocas ocasiones la langosta entra a menos de las tres millas, el pargo, los bancos de pargo están a 6, 7 millas de la playa.*

access to capital played a crucial role in their decision to diversity. The diversification process for these fishers was successful because they had a steady income, which allowed them to save and invest in additional assets. Regarding diversification, limited access to capital was one of the main obstacles to acquiring modern gear or exploring alternatives sources of income.

On the other hand, the COVID-19 lockdowns significantly impacted the fishers' resilience, particularly in terms of livelihood and diversification strategies, by reducing the potential for fish sales. During that period, the fishers were compelled to seek alternative livelihoods. Some turned to farming or construction; others assisted fellow fishers or took on any available work. However, all of them continued fishing to sustain their families, while also selling what they could to friends or neighbors through informal community networks. Although this diversification was not the result of the effects of climate change, it is important to understand that limitations in market alternatives has undermined their resilience in general.

The uncertainty inherent in artisanal fisheries was a constant concern expressed during the conversations, especially as it relates to income and the effects on living conditions. The fishers emphasized that, unlike other land-based productive activities, fishing is a gamble, marked by uncertainty and chance. Luck and the right conditions (e.g., weather or fishing grounds) are two factors that play a part in a good or bad catch or season. Despite the fishers' uncertainty regarding how much they might catch or the income they might earn, they acknowledged that, economically speaking, fishing has its attraction in that it is possible to earn money quickly (i.e., every week or even every day), which helps to resolve daily solvency issues.

> There are bad, terrible days even; but then in one or two days, you can earn the money you didn't earn in 15 days at sea. In fishing, you don't have a stable income and may earn 100 or 200 thousand colons a week or a month […]. It varies. And what you can earn in a month, you can also earn in just one day.[38]
>
> Michael, fisher from Cabuya with three years of experience.

Interestingly, the fishers recognize that this can be a double-edged sword, with some fishers choosing to spend the money on alcohol, gambling, drugs, or prostitution, all behaviors that are well-documented in the literature on artisanal fisheries (see Tumwesigye et al., 2012; Dörner-Paris et al., 2017; Kyei-Arthur & Kyei-Gyamfi, 2023). They expressed that some of these issues still exist within their communities but that they are much less frequent.

During the interviews, I was unable to gather specific data about incomes, not due to unwillingness from the fishers, but because many stated that calculating an average fishing income was difficult given the uncertainty of the activity and the resulting income instability. This unpredictability also impacts their potential to save, to acquire assets like land, to access loans, or to plan for future projects. As one fisher states: "[Income] is inconsistent precisely because sometimes, after two months of work, you can barely pay the bait and gear; but when

[38] Original quote: *(…) hay días malos, pésimos, peores; pero en cierta parte, en un día, dos días, te puedes ganar lo que no ganaste en 15 días. La pesca por eso, te digo, que no es un… no es que tenés un salario fijo y te vas a ganar 100/200 mil pesos [colones] por semana o por mes (…) Esto varía mucho. A como lo puedes ganar en un mes, lo puedes ganar en un día.*

the season is good…that's the opportunity to balance income"[39] (Michael, fisher from Cabuya with three years of experience).

Thirty-two percent of the fishers interviewed did not specify their income in the survey or conversations, while 35% estimated they receive an average monthly income of between 101,000 colons (US $180) and 400,000 colons (US $725). Eleven percent receive less than 100,000 colons per month (in this case, they received financial support from the State), and only 3% stated their income is over 1,000,000 colons (US $1,810).

Given the wide range of incomes and the significant number of fishers who did not specify an income at all, it is challenging to draw conclusions about a low average income based on this data. However, I was able to identify factors that could influence the low income earned by the fishers in the four study sites, including the unpredictability surrounding the catch, low fish prices, the presence of intermediaries who set the prices paid to the fishers, and a lack of subsidies, incentives, or access to insurance when a poor season leads to income poverty. This poverty impacts the fishers' living conditions and resilience by limiting their access to tangible alternatives during the low season (e.g. short-term diversification) or when fishing is not feasible due to weather conditions or other unforeseen circumstances.

Nevertheless, it is worth noting that despite these issues, in all four research sites, the majority of the fishers surveyed do have access to healthcare (73%) and also own their home (70%), which is relevant in terms of spending behavior where housing and food are generally considered priorities (Sujarwo & Setiawan, 2022). Access to these two components can strengthen resilience as their hard-earned money can be used for other purposes (e.g., savings, gear acquisition, education, leisure, etc.).

Shifting focus, training or knowledge are also key components of resilience as they can spark problem-solving ideas, improve practices, and even foster new knowledge creation. The different research communities have ample experience in fishing; the fishers interviewed have an average experience of 28 years in the sector, and some have even fished for over 50 years, having started at a very young age. A common theme, regardless of age, was how the fishers relied on their experience and knowledge of the area and of how 'to read and understand' the weather (Pelage et al., 2023). They used technology and empirical knowledge to decide when to go out fishing or how long to stay before returning to shore.

During the conversations, I asked the fishers about training opportunities over the last three years. I chose this specific time period to determine how frequently and recently their last training was (e.g., courses, workshops, certification processes, etc.). Of the fishers interviewed, 59.5% said they had not received any training during that period, while 40.5% said they had taken at least one course.

The most common course taken by the fishers was *zafarrancho* (a required basic training for any person wanting to work on a boat), followed by seafood handler training. The majority of the fishers expressed interest in having more training opportunities related to fishing practices, while

[39] Original quote: *Eso es muy inconstante [ingreso], exactamente porque, hay veces, pasan dos meses que apenas salís con los "alistos" y todo; pero cuando son las pescas buenas, esa es la clase de balance que yo hago.*

also highlighting the challenges of accessing training near their communities due to distance and the limited resources provided by institutions to reach them. Additionally, there is a limited course offering by INCOPESCA. On the other hand, since access to smartphones and the internet is common in these communities, for some, social media channels like YouTube or Facebook are useful resources for self-learning and knowledge refreshment.

For instance, improvisation and creative solutions were just two of the fishers' strategies for responding to high gear costs. The fishers have extensive knowledge and skills in boat and equipment repair and maintenance. Moreover, locating gear is not always easy in the national market and so the fishers depend on informal networks to acquire the required gear (e.g., a friend or a friend of a friend involved in the fishing industry).

Regarding competition, the fishers interviewed mentioned tensions within the fishing community when it comes to fishing spots, noting a sense of selfishness in sharing information about these locations. Some even commented on the use of violence, such as stealing or damaging buoys as a means of preventing other fishers from accessing a particular area. They also expressed concerns about the arrival of fishers from neighboring communities who use illegal fishing practices, such as trawler nets or blast fishing.

> Other fishers come to the village and use trawler nets. We don't use them anymore to protect and fight against climate change, giving the fish at sea more opportunities to live and reproduce and return to their habitat. But, sometimes the *porteños* [popular term for people from Puntarenas] come and take everything […].
>
> […] Sometimes, we find fishing boats out there at sea, catching, exploiting, and taking the resource we don't catch because we want to help protect it.[40]
>
> Jonathan, fisher from Cabuya with 24 years of experience.

While the fishers recognize that these tensions can weaken the artisanal fishing sector, they show more concern for the competition with other sectors like tourism, environmentalism, and sport fishing. In this context, artisanal fishing—an extractive activity typically regarded as low value—competes with tourism, protected areas, and sport fishing for both resources and the physical space where these resources are located. This competition undermines resilience by creating divisions among the fishers and the broader community, while also imposing new restrictions on their ability to continue fishing.

During the conversations, the fishers expressed criticism of tourist licenses due to specific restrictions, such as being unable to use the same boat for both fishing and tourism. This restriction forces fishers to own two boats, which presents an additional economic burden. The need to purchase and maintain a second boat or make specific adaptations for tourism (including adding a roof in some cases, insurance, and first aid equipment), further compounds the financial strain on the fishers. This aspect will be discussed further in our analysis of productive

[40] Original quote: *Que vienen acá, tiran trasmallos. Nosotros no pescamos con eso para proteger y tratar de que, luchar un poco contra el cambio climático, tratando de darle más oportunidad a los peces, que vengan otra vez, que se reproduzcan, que vuelvan al hábitat; pero diay no, los porteños a veces llegan y se llevan todo (…)*
(…) Y a veces encontramos las lanchas pescadoras de afuera, que están sacando, explotando, sacando el recurso que nosotros no estamos aprovechando para cooperar un poco.

diversification in Chapter 7. Across all four research sites, the fishers associations have advocated for new fishing licenses and some alternatives have been proposed, such as a collective license instead of individual. However, not much progress has been made along these lines.

Institutions and governance

I identified three main elements regarding the performance of institutions and regulations in the artisanal fishing sector: the lack of institutional coordination; the scope of regulations that put at risk the artisanal fishing sector; and the existence of participatory governance mechanisms.

The lack of institutional coordination was evident in the fishers' concerns about the performance of the Ministry of Environment and INCOPESCA and the potential for effective collaboration. For instance, the fishers mentioned that whenever a new protected area is established, the fishers are not actively involved in the initiative, and coordination in terms of the management of the marine resources within these areas is poor. Moreover, they highlighted that part of the issue stems from the fact that each institution has its own distinct, even conflicting, objective: the Ministry of Environment is focused on environmental protection while INCOPESCA's objective is the management of marine resources. This can lead to competition in terms of power for decision making.

> Well, MINAE [Ministry of Environment] is fighting to protect everything and INCOPESCA is focused on the commercial dimension, and how to ensure people can continue fishing, because if it were solely up to MINAE, there would be no artisanal fishers […]. So, that's the problem we have with INCOPESCA and MINAE; but in addition to that, there are many foreign environmental organizations that come here pushing to protect resources. They are displacing us little by little by saying you can't fish for this, you can't fish for that, and that is a big problem for us but we don't receive any compensation, we don't get compensated for leaving the activity.[41]
>
> José, fisher from Barra del Colorado with 32 years of experience.

Moreover, as discussed in Chapter 5, the fishers interviewed have a pessimistic view of INCOPESCA, seeing it as an institution that is more interested in semi-industrial and industrial fishing than in the artisanal sector.

Regarding the scope of regulations, the fishers bemoaned the rising number of restrictions on fishing. These restrictions are typically related to bans on certain fisheries (e.g., shrimp); the use of specific gear; safety and administration (e.g., licenses, motors in good condition, first aid kits onboard, etc.); or fishing in certain areas as a result of environmental regulations. It is important to note that the fishers' complaints stem not only from the regulations themselves, but also their lack of capacity to comply with the regulations. The problem, according to the fishers, is their lack of material capacity, particularly financial resources. Many informants agreed that

[41] Original quote: *"Diay, que el MINAE lucha por proteger al 100% y el INCOPESCA, una situación que tienen que ver con la parte comercial, lógicamente tiene que ver cómo adecuar a que las personas podamos seguir pescando, porque si aquí fuera por parte del MINAE no hubiera pescadores artesanales. (…) Entonces es el problema que tenemos entre el INCOPESCA y el MINAE y, además de eso, hay muchas organizaciones ambientalistas que son externas, que no son del país, que también vienen aquí, todavía a presionar para que se protejan los recursos. Nos están eliminando, poco a poco nos están eliminando de que no se pesque esto que no se pesque lo otro y eso es un gran problema para nosotros, pero a uno no le dan ninguna indemnización, no le retribuyen nada por eliminar la pesca."*

regulations are important for keeping ecosystems healthy; however, it is also a challenge to deal with new requirements when one does not have the proper assets.

As regards the existence of fishers associations in all four communities, while their creation was not directly in response to climate change, they can still be analyzed within the context of this phenomenon as they address various environmental issues. One example of this is their participation in COLAC, which concerns itself with local environmental governance. Specifically, I examined the fishers associations within the scope of this study due to their coordinating role when extreme weather events impact the community. These associations play a key role in organizing and collecting food for the fishers and other affected community members, as well as coordinating with government officials. The potential of these organizations must still be explored in terms of climate change (Villasante et al., 2022); however, I detected during the interviews that climate change is a concern for the association leaders but only within broader environmental worries.

In terms of participatory governance mechanisms, the fishers interviewed had positive perceptions of two governance mechanisms: the Marine Areas for Responsible Fishing and the COLAC (local councils). Both mechanisms were previously discussed in Chapter 5 in the context of vulnerabilities and will be also analyzed in Chapter 7 regarding adaptation as spaces with the potential to promote climate change adaptation measures.

Barra del Colorado and Dominicalito form part of Marine Areas for Responsible Fishing. Here, the communities and the government define the marine area collectively, along with NGO leadership. The marine space is divided into several areas where fishing is permitted based on gear type utilized. The fishers and community participate in the delimitation process, but ultimately, the government makes the final decision. The active participation of the fishers is key as these areas aim to incentivize more sustainable fishing over time to ensure healthy ecosystems and promote the fishers' well-being. Therefore, it is important for the fishers to understand and agree to the regulations governing fishing activities.

Meanwhile, Cahuita, Barra del Colorado, and Cabuya have established a COLAC, which brings together several local and government institutions to discuss sustainability and environmental protection. This mechanism can be established in communities with a national park. The idea is to build a participatory space for hearing the concerns of different community stakeholders regarding management of the national park. Participation is not mandatory and, in terms of power, the government makes the final decision. However, the fishers interviewed find it to be a valuable space to exchange ideas and improve relations with other local institutions and the national government.

> […] and we are part of a group called COLAC, the Local Council for Coastal Governance, we are closer to the authorities now. They now visit the community and don't feel as rejected. […] In the beginning, it was like that; sometimes at the meetings, there are strong discussions, but afterwards, everything goes back to normal and everyone speaks to everyone else. […] We have exchanged experiences and they say how we can work with the coast guard, with INCOPESCA, and SINAC. We say we have built an open and participatory dialogue, that when they want to seek solutions for the community, we have to look at both sides. When they come to the

> community, they don't come to impose things on us; they bring ideas and the community itself, the women's and fishers associations always contribute opinions and solutions.[42]
>
> Luisa, local leader from Barra del Colorado.

The COLAC is an institution that strengthens resilience in the context of climate change. However, climate change is not one of the main topics discussed within the COLAC, which is more focused on immediate concerns such as the relationship between the fishers, the community, and the protected area, or the effects of local land planning policies.

While the fishers did acknowledge that this mechanism is far from perfect, they say it provides a space to speak and be heard. It also offers an opportunity to build local political alliances when the government's position threatens local interests (for example, in Cahuita, the decision to set a fixed rate for visitors to enter the national park instead of the customary voluntary contribution faced heavy opposition from the community). In all three communities where the COLAC is present, it is perceived as an opportunity to strengthen local organizations and increase political presence.

These mechanisms are seen as key elements of the fishers' resilience, as they contribute to strengthening local organizations and enhancing political representation on environmental issues. Moreover, these spaces can provide a platform to consolidate local leadership and organization in other areas of interest for the community, such as local and coastal planning, tourism, and security. While climate change is discussed within these institutions, their primary concerns are socioeconomic and political issues affecting the immediate realities of the fishers and the community.

6.3.2. Intangible resilience

As discussed in the analytical framework, resilience encompasses not only the tangible aspects of life, but also the "inner worlds", comprising the ideas, behaviors, beliefs, fears, values, and perceptions that shape the resilience of the fishers (Pelling, 2011: 85). These inner worlds shape the perceptions of change and can affect the decision-making process of the fishers with material and immaterial consequences. Thus, I identified four elements of intangible resilience in the four study communities: changes in individual behaviors, self-organization and social learning, fishing as a way of life (identity), and self-perception of resilience.

Changes in individual behaviors

I identified positive changes in the fishers' behaviors in all four communities, specifically in relation to fishing practices. The fishers highlighted their openness to diversifying target species and using technology to improve their fishing activities, including fish processing and distribution. Despite several socioeconomic vulnerabilities and limitations, these changes were

[42] Original quote: *(…) y conformamos un grupo que se llama COLAC, que es Consejo Local Marino Costero, ha habido un acercamiento más con ellos [se refiere a las autoridades]. Ahora ellos vienen a la comunidad y no se sienten tan rechazados. (…) Al principio era así, en las reuniones a veces hay discusiones bien fuertes, pero después vuelve a su normalidad y todo el mundo hola, hola (…) Nosotros hacemos intercambio y nos han dicho que cómo nosotros podemos trabajar con guardacostas, tanto con INCOPESCA y con SINAC de esa manera. Nosotros le decimos que ha habido un diálogo abierto y participativo, que cuando se quiere buscar soluciones para la comunidad hay que dar de los dos lados. Como ellos vienen, tampoco nos vienen a imponer cosas, nos traen alguna idea y la misma comunidad, la asociación de mujeres y de pescadores siempre participan, dando opiniones buscando soluciones.*

possible due to a combination of factors, including savings to invest in gear or technology like smartphones; institutional and economic support from fishing institutions (e.g. subsidies, donations, training); and NGO support in the form of training and community donations.

Another key element is the existence of informal local support networks within the community, where ideas are shared and disseminated (e.g. exchanging experiences at sea). These changes contribute to strengthening resilience as the fishers can adjust their daily practices based on changes at sea, including warmer waters, shifting currents, and more demanding market regulations.

Self-organization and social learning

Self-organization refers to "the propensity for social collectives to form without direction from the state or other higher-level actors" (Pelling, 2011: 89). As discussed in the section on governance in Chapter 5, I identified local formal organizations slow to react in all four communities. These communities are formally organized by means of fishers associations, and a significant number of the fishers interviewed understand the political relevance of the formal organization. However, in all four cases, I detected a sense of being part of the organization without taking any responsibility for it.

Interestingly, despite the existence of formal organizations in all study sites, many of the fishers and key informants interviewed were skeptical about the community's capacity for formal organization. Although the fishers recognize, at least in theory, the social and political relevance of belonging to a social organization, in practice and in terms of participation, some are still reluctant and do not seem interested in engaging actively. As Diana, a local leader in Dominicalito, explains:

> Managing the association has been tough. There aren't as many fishers now as there were ten years ago. It has been really difficult because the people focus on other things and don't want to get involved in the fishers association.[43]

In the context of climate change, these organizations play a key role as recipients of aid when an extreme weather event impacts the community, or as recipients of training and other projects aimed at upskilling (e.g., citizen science to collect data for fish stock management and governance, boat maintenance, food hander certifications, etc.). Moreover, the fishers associations represent the sector in terms of local governance, particularly environmental governance, and have a voice when protected areas are extended or new fishing regulations are implemented.

I was also able to identify a degree of informal self-organization in the communities in the form of neighborhood support networks. The informants acknowledged that a sense of solidarity usually prevails, especially when unexpected situations impact the community, including weather events, the death or illness of a community member, COVID-19 lockdowns, and local security issues. The villagers informally organize and collect money, collaborate with food in case of

[43] Original quote: "*Llevar lo de la Asociación ha sido muy complicado, ahorita no hay muchos pescadores, no hay tantos pescadores como hace 10 años atrás. Entonces realmente ha sido muy complicado porque las personas se enfocan en otras cosas y no quieren meterse mucho en lo que es la Asociación de Pescadores.*"

emergency, and provide transport or locally exchange fish and other products. In terms of security, despite the lack of police presence in the communities of Cabuya, Dominicalito, and Cahuita, there was a strong sense of cohesion in keeping the peace and a safe environment for both the locals and tourists. The main channel used was informal communications (e.g., casual conversations) between neighbors, but they also use technology, like WhatsApp or phone calls.

Identity: Fishing is more than a job

> Interviewer: What does it mean to you to be a fisher?
> Fisher: Well, it is part of my culture. It is my culture, it means a lot.
> It's an activity where you leave in the morning
> without knowing if you'll catch anything or not.
> Then, in the afternoon,
> you thank God for what he gave you and yes,
> it's a culture; it's a way of living.[44]
>
> Alberto, fisher from Barra del Colorado with 17 years of experience.

In the interviews with the fishers, I asked how they became a fisher and what fishing meant to them. These questions were aimed at understanding the context in which they became involved in fishing and their thoughts regarding their occupation. The influence of where they grew up and their family and friends was essential in becoming fishers at an early age (around the age of ten). A common response was that they began fishing due to a lack of alternative employment opportunities and because it seemed like a good way to earn quick money.

I discovered a strong sense of identity linked to fishing in all four communities. This identity has been well documented in academic literature (see Trimble & Johnson, 2013; Young & Bellwood, 2016) and sets fishing apart from other terrestrial occupations. There is a sense of pride and joy connected to fishing and life at sea. Both the men and women interviewed referred to the freedom of being at sea. Ricardo, an experienced fisher in Cahuita, talks about what being an Afro-Costa Rican artisanal fisher means to him:

> When you're born in a town or a country that discriminates against you, you learn how to survive, and being an Afro-Costa Rican fisher implies being a survivor. We learn how to fish; our descendants learned how to fish because we didn't have many alternatives, and the sea was always generous with us. When everyone else discriminated against us, the sea was always generous; that is why it is so intrinsic—fishing for Afro-descendants.[45]

Despite recognizing the dangers of fishing, most of the fishers interviewed agreed that once at sea, they would forget about their problems on land. The adrenaline, satisfaction, and joy they felt from catching fish made the risks worthwhile. They also mentioned the fulfillment of

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[44] Original quote:
Interviewer: *¿Para usted qué significa ser pescador?*
Fisher: *Diay, parte de mi cultura. Esa es mi cultura, para mí significa mucho, es un recurso en el cual uno sale en la mañana sin saber si va a traer o no y en la tarde viene, le da gracias a Dios por lo que Dios le dio ese día y sí, es como una cultura, es una vivencia.*

[45] Original quote: *Cuando usted nace o se cría en un pueblo o un país donde sos discriminado, aprendes a subsistir y ser un pescador afrodescendiente es ser un sobreviviente. Nosotros aprendimos a pescar, nuestra descendencia aprendió a pescar porque no tuvimos muchas oportunidades y el mar siempre fue generoso con nosotros. Cuando todos nos discriminaban el mar fue generoso, por eso es por lo que es tan arraigado, la pesca en el afrodescendiente (…)*

providing for their families, not only financially but also by catching the fish with their own hands.

Next, I asked about the possibility of leaving fishing behind. While many expressed a desire to find more stable employment, they also acknowledged the deep connection to fishing, emphasizing that it would not be easy to stop entirely. Isabel, a fisher and local leader in Cabuya, expressed her motivations for participating in the fishers association and fighting for the right of her sons to be artisanal fishers:

> In Cabuya, we have only a few artisanal fishers, because they are just discovering [tourist fishing] now, but if it grows, I think even my sons will change to that kind of fishing, but what they can do, it's a pity, they like fishing, they grew up fishing. It a tradition, cultural […] as hard as it gets, they are there, they keep fishing.[46]

As explained in previous chapters, fishing is not just a job; it is deeply embedded in the fishers' culture and identity, both as individuals and as a family and community. This strong sense of identity shapes the fishers' perception of their work, and influences their decision-making regarding whether to remain in or leaving the activity. It also contributes to understanding the political and socioeconomic context of artisanal fishing (Holland et al., 2020).

Self-perception of resilience: Low or high resilience

Perceptions (including self-perceptions) are important to understanding resilience as they influence decision-making when undesired shocks or changes affect a person or a group (Satumanaptpan & Pollnac, 2020). Personal background such as age, gender, financial status, and years of experience all influence self-perception, as do intangible aspects such as motivations, beliefs, ideas, and values.

As presented in the analytical framework, Satumanaptpan & Pollnac (2020) discuss resilience and categorize perceived resilience into two types: low resilience through coping strategies (e.g., reducing expenditures at home), and high resilience, implying transformation strategies (e.g., diversification or migration). In terms of low perceived resilience, the fishers mentioned some actions that can be categorized as coping strategies, since their main aim is to solve a present issue. Some of these actions included borrowing money from boat owners or the fishers association to pay the *alisto* and purchase fishing gear, or seeking a side job, such as occasional jobs in gardening, farming, or construction, when fishing was not possible or became more difficult (e.g., on bad fishing days, a bad fishing season, or in inclement weather). They also mentioned other strategies such as reducing home expenses, using savings, and fishing with a different boat skipper or ship owner. Regarding high resilience, diversification was identified as a key strategy in all four communities.

In these communities, I found a combination of both types of perceived resilience, and I am unable to say that one community has a low perceived resilience while in another it is high. Moreover, because this perceived resilience is not static, a person can experience a high or low

[46] Original quote: *(…) Cabuya estamos en medio con el poquito artesanales y es porque están descubriendo eso ahorita aquí (la pesca turística), pero si eso crece, creo que hasta mis hijos se volcarían a esa pesca, pero qué les queda y es que es una lástima, a ellos les gusta, han crecido en eso. Ya es como una tradición que se trae, cultural. (…) por más que se les ponga difícil, allí están…insisten en pescar.*

self-perceived resilience in different moments of their life, conditioned by material aspects and intangible elements, some of them constant while others change over time. Similarly, diversification or migration can sometimes be imposed instead of a choice (i.e., no alternative but to leave the fisheries sector). However, considering these categories carefully can contribute to a deeper understanding of resilience, the factors influencing development and consolidation of the process, and its scope.

6.4. Conclusions

They still (want to) fish: Is that not enough to be considered resilient?

The four study communities are examples of the historical resilience of artisanal fishing communities worldwide. Despite a context of historical, political, and socioeconomic marginalization characterized by a lack of material resilience (i.e., capital, insurance, savings, livelihood diversification), I detected a strong motivation to continue fishing, not only because it may be the only productive activity available to them, but also due to the deep connection they have with fishing and the sea. This connection and the emotions and passion they feel for fishing are also relevant factors in perseverance despite the precarious situation they face in terms of the law and government support, challenges in locating fish, the dangers of the sea, and market and environmental pressures.

Fishing is part of the fishers local and personal histories, identities, and culture. Of course, there is also an economic motivation to keep going, which, for a handful of the fishers interviewed, has been highly lucrative, but for the majority, the activity has enabled them to make a life, sometimes with complications. Despite this, I discovered an interesting insight during the conversations with several fishers—the expression *mi pesca* (my fishing) when talking about their activity. This expression refers not only to the catch per se but also to the activity as something that intrinsically belongs to the fisher.

As explained in the analytical framework, resilience is the ability or capacity of a system to absorb disturbances before it changes to a completely different state (Adger, 2006). Resilience makes adaptation possible through tangible and intangible resources. In the case of the study sites, despite the adverse material conditions experienced by the fishers (including extreme weather events and ecological changes in marine systems), their motivations, ideas, beliefs, and emotions also contribute to keeping artisanal fishing alive no matter what (Satumanatpan & Pollnac, 2020), further evidence of the resilience of these fishers. The argument that they are not resilient because of material limitations hinders their agency and the importance of the immaterial such as values, motivations, and beliefs in the complex world of the artisanal fishers.

7. Adaptation of the artisanal fishers in the context of climate change

Nowadays, fishers don't only fish;
there are other alternatives.
There were few alternatives [in the past];
it was either working at sea or hacking away in the mountains.[47]
Gabriel, local leader and retired fisher from Dominicalito.

7.1. Introduction

As I arrive at Cahuita National Park, my eye is immediately drawn to the elevated walkway stretching before me. As I step onto it, I cannot ignore the way the sea is steadily claiming more and more of the land. Along the path, several notice boards provide general information in both English and Spanish detailing the park's history, visitor rules, and ongoing environmental initiatives. Faded maps and photographs reveal a stark reality: the park is changing, shaped by the relentless forces of climate change. These boards emphasize the threat of sea level rise and coastal erosion to the park's survival and share the steps taken to adapt: building elevated walkways and working on coral reef restoration projects and farming to mitigate the damage. As I venture deeper along the trails, I see firsthand what these efforts are trying to combat. The tide is high, and in some places, the water has already swallowed sections of the park, making them impassable. The elevated walkways are not just a convenience; they are a necessity.

Outside the park, as I wander around the coastal community, the signs of coastal erosion are even more evident. I am struck by the absence of gray infrastructure to combat the advancing sea, especially by the restaurants, homes, and businesses along the coast. While the locals express concern, there is little in the way of concrete measures to adapt and mitigate the short- and long-term consequences of the encroaching waters.

Coastal and fishing communities around the world are examples of resilience and adaptation (Armitage et al., 2017; Bahri et al., 2021), and the artisanal fishing communities in Costa Rica are no exception. Despite the multidimensional vulnerabilities they face daily, various short-, medium-, and long-term modifications have enabled them to continue living and fishing in their current environment. In this context, adaptation extends physical changes, such as infrastructure or equipment, to include shifts in daily practices and local organizational dynamics.

This chapter will explore the adaptation of the artisanal fishers in each study community. The objective is to analyze the different measures the fishers are implementing to adapt to climate change. This includes an understanding of why some measures are more or less common than others and how they differ from the literature regarding climate change adaptation in artisanal fishing communities around the world. Some elements may appear repetitive in relation to

[47] Original quote: "*Hoy en día los pescadores no son solo pescadores, ahora hay muchas facilidades. No había muchas opciones [en el pasado]; era el mar o volar cuchillo en la montaña*."

Chapters 5 and 6; however, it is important to recognize that vulnerabilities, resilience, and adaptation are interconnected, with each concept influencing the others (Lei et al., 2014).

The reflection in this chapter is guided by the question of how artisanal fishers adapt to climate change. To approach this question, the chapter discusses adaptation from the perspective of the typology presented in the analytical framework, which is based on three types of responses: coping mechanisms, adaptative strategies, and management responses. First, I discuss the shared adaptation experiences I identified on each coast, before taking a deeper look at each study site individually. The aim is to identify both the common and distinct elements in each case and to understand how the individual contexts define the adaptation experiences of each community. I then introduce a section on maladaptation intended to understand how some responses, despite being well-intentioned, could negatively impact the individuals involved, whether directly or indirectly, in the medium or long term. Lastly, I present conclusions on why climate change and climate change adaptation, while relevant concerns for these communities, are not perceived as immediate priorities in the face of other more pressing daily challenges that demand their attention first.

7.2. Adaptation of the artisanal fishers

7.2.1. Common findings: Caribbean coast

Along this coast, there are several asymmetries in terms of infrastructure adaptation strategies, specifically gray infrastructure, that can be explained by the distinct geographical context of each community. For example, Barra del Colorado is located on the banks of a river, where heavy rains typically cause flooding throughout the year, thereby influencing the type of infrastructure built in this community (e.g., stilt houses). On the other hand, while some parts of Cahuita are noticeably affected by coastal erosion and sea level rise, other areas of the community are not immediately impacted. Here, adapted gray infrastructure is scarce and basic (i.e., small concrete or sandbag walls).

The rapidly changing, choppy waters of the Caribbean Sea are a common feature on this coast and a determining factor in the type of gear utilized for fishing (as are the strict regulations on fishing practices to be considered artisanal). According to the informants, within the fishery, technological change has been slow despite transformations in boat material and size and the use of more powerful motors to enable venturing further out to sea and increasing stability.

In conversations with the fishers, particularly the younger and older fishers, they cited overfishing and the impacts of certain gear choices as key contributors to ecosystem degradation. The fishers explained the importance of gear regulations for fishery sustainability, such as changes in mesh size to avoid catching the smaller, younger fish (i.e., juveniles) and gear with exclusion mechanisms like the *nasas* used to catch lobsters (and avoid catching other fauna).

Regarding adaptative strategies aimed at diversification, tourism, in general, is portrayed as a livelihood alternative, and the fishers have perceived pressure from the government and environmental organizations to exit their current activity. In this area, conservation drives potential tourism alternatives: sport fishing in Barra del Colorado and natural parks in Cahuita. However, the main reason for this diversification proposal is not due to the effects of climate

change, but rather socioeconomic transformations in each community that align with the country's development trends.

Barra del Colorado

Regarding infrastructure adaptation, at the community level, I was able to identify the construction of gray infrastructure (e.g., elevated walkways and stilt houses) as a specific response to periodic flooding. Given its location in the rainy Caribbean, where the flat terrain and heavy rainfall have historically contributed to flooding, it is not feasible to attribute the floods directly to climate change. However, according to the informants, the unpredictability of flooding throughout the year has increased due to changing weather patterns, as I explained in previous chapters.

I also identified other adaptations in infrastructure during my conversations with the fishers and key informants: a shift in construction materials from wood and palm leaf roofs to concrete with metal roofing, both of which are more resistant and provide more warmth. The use of fans is common in all homes and only one of the interviewed fishers mentioned having air conditioning. Moreover, it is a common practice to secure some areas of the riverbank with sandbags to prevent erosion, including areas where the fishers strand their boats.

Figure 7.1.: Elevated walkways and stilt houses

Source: Photographs taken by the author.

Over the last ten or 20 years, the construction of wells has been commonplace due to the struggles to obtain drinking water. This is a typical problem in coastal communities, but more so for Barra del Colorada as it is located inside a wildlife refuge. With the creation of the ASADA (*Asociación Administradora de Sistemas de Acueductos y Alcantarillados* or Communal Aqueduct and Sewer System Administration Association in English)[48], the community all but abandoned the construction or maintenance of the wells; however, according to the fishers, some neighbors have recently taken them up again due to the effects of heavy rains on the ASADA electrical system. As a consequence of heavy rains, hurricanes, or tropical storms, power outages affect the pump system, resulting in the inability of the community to access water. Two of the fishers interviewed, specifically those with more financial resources, have a private well for domestic use, although the neighbors can access the water if needed. Only one of the fishers interviewed stated having a power generator.

Figure 7.2: Domestic well and rainwater storage tank outside a fisher's home

Source: Photograph taken by the author.

Regarding market diversification as an adaptative response, while sport fishing has been promoted as a livelihood alternative, it has been unsuccessful in inciting change. Some of the fishers and local leaders I interviewed expressed skepticism due to the financial resources required to initiate in the activity (e.g., purchasing expensive new equipment and gear), as well as for fear of the eventual displacement of artisanal fishing, not only as an economic activity but as part of their identity. Some explained that sport fishing is not a realistic alternative for many fishers—it is merely an idea promoted by the tourism sector and environmentalist groups aimed at eliminating the art of artisanal fishing.

[48] ASADAs are non-profit organizations responsible for managing community aqueduct and sewer systems under an administrative delegation model established in agreement with the Costa Rican Institute of Aqueducts and Sewerage (Dirección de Agua, 2023).

In terms of fishing practices (i.e., fisher behaviors), one of the main adaptations that can be linked to climate change is fishing deeper at sea—further from the coastline—and the resulting need for technical adjustments to existing boats, including larger boat sizes and more powerful motors to handle the harsher conditions in deeper waters. Technology such as GPS and smartphone apps to check the weather forecast, wind speed, and tide level are often employed. On this topic, the fishers expressed a new challenge in understanding the local weather conditions, and technology has contributed to a safer and more efficient fishing practice.

Moreover, the context in which this fishery is developed, specifically choppy waters and heavy winds, requires further adjustments to boats, gear, and equipment. However, many of the fishers interviewed agreed that there have been no significant changes in gear over time. They noted that the most important change, although not directly related to climate change, is the type of net they use, which has a larger mesh size than what was used in trawler fishing, especially for catching shrimp. Some fishers explained that the absence of gear changes could result from the challenging sea conditions in this part of the country. For instance, the implementation of *nasas* was unsuccessful since they have to fish further out at sea. As one young fisher who is also involved in fisheries management in the community explains:

> […] The gear does not change; for example, to eliminate the use of fishing lines to catch lobster, they tried to use *nasas,* but they don't work here. Why? Because we come back to the same argument: we cannot compare the conditions of the sea here to that of the Gulf [Pacific], because here you can feel like you're in the river [calm], and you don't know where the mouth of the river is. But then tomorrow, you have to deal with tides two or three meters high. So, *nasas* aren't recommended for abrupt changes in the sea. So, making changes in the gear and equipment used to fish is difficult. In other words, gear and equipment that are easier to use are not recommended here because of the sea conditions.[49]
>
> Verónica, fisher with 10 years of experience.

Similarly, as a result of the shrimp trawling ban in 2013, the fishers have modified their fishing behaviors by harvesting other species and combining fishing with other unrelated economic activities, like agriculture and construction.

From a management perspective, the designation of specific areas for artisanal fishing—where semi-industrial or industrial fishing are not permitted—as well as zones designated for species reproduction, can also be considered an adaptation measure. Thus, in response to fishing pressure and the effects of climate change, such as rising ocean temperatures, these zones are viewed as essential for sustaining artisanal fishing amid evolving environmental and climatic conditions.

[49] Original quote: *Vieras que muy poco, o sea, el equipo, no se cambia porque, principalmente, porque aquí se trató de hacer, para eliminar las líneas de langosta, utilizar nasas, pero aquí no funciona. Pero por qué, porque volvemos al mismo caso, aquí no podemos comparar las condiciones del mar de acá con las del Golfo [Pacifico] ... porque aquí puede estar como el río, que usted ni sabe dónde es la bocana, mañana puedo tener el mar a dos metros, tres metros…entonces nasas no es un equipo como que recomendado para ese tipo de cambios que tiene el mar, entonces como que cuesta mucho que se haga alguna actualización en el equipo para poder hacer las pesquerías porque no funcionan. O sea, equipos más fáciles de usar no son recomendados para la manera que es el mar acá.*

Cahuita

In terms of infrastructure adaptation in this community, due to coastal erosion and seawater intrusion, gray infrastructure has been built in some parts of the community, which includes elevated walkways within the boundaries of the national park and concrete walls in certain areas of the broader community. Some tourist sites near the beach also use sandbags to bolster walls and prevent erosion. The only infrastructure I was able to identify that can be directly linked to the effects of climate change are the concrete walls near the fish landing site, which also indirectly serve to protect the boats. However, it is important to mention that the landing site is a small space completely exposed to the open sea, and there are few options to protect the boats in case of an extreme weather event.

Figure 7.3: Fish landing site

Source: Photograph taken by the author.

In terms of coping mechanisms, I noted some changes in fishing schedules, as well as the diversification of fishing spots. The fishers explained that they usually prefer to fish in the late afternoon; some even fish at night if the weather permits. These behaviors are aimed at avoiding the dangerously high temperatures, UV radiation, and warmer waters during the day. By fishing early in the morning or late in the evening, the fishers take advantage of cooler temperatures and less sun exposure, thereby protecting their health and increasing their chances of catching more fish near the coast.

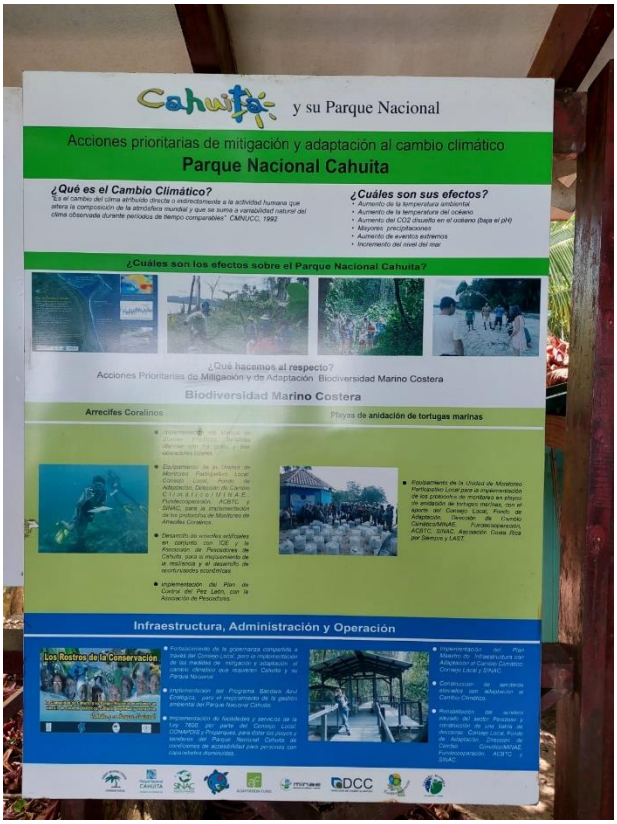
The fishers in this community also mentioned the use of GPS and smartphone apps for weather forecasting. However, when asked about gear modernization (i.e., technological changes), like in Barra del Colorado, the consensus was that few changes have been made over time, with the most important modifications being boat material and size, motors, and the use of fishing poles instead of simple lines. The interviewees identified fishing in deeper waters as an adaptative strategy in an area where the practice has traditionally been concentrated near the shore. However, this still represents a challenge for some fishers as technical adjustments are required in terms of boat size and motor power. As one young experienced fisher and tourism entrepreneur remarks:

> With global warming, we have to fish further out at sea. Now, I leave around six [in the evening], and have to wait and throw the net to see if I can catch even one mackerel. In the past, you used

> to catch fish with just one hit [one throw of the net]. Now it is different; now we have to stay the whole night to catch 30 kilograms of mackerel.[50]
>
> Francisco, fisher from Cahuita with 12 years of experience.

As discussed in Chapters 5 and 6, this community has a local council or COLAC in place. In the context of climate change, this co-governance institution could potentially contribute to strengthening local environmental governance, by implementing mitigation and adaptation measures in the community and nearby national park. This response involves several actions linked to managing the protected area, biodiversity conservation, and developing infrastructure adapted to climate change inside the park. Interestingly, the artisanal fishers have worked in collaboration with the national park on initiatives such as artificial coral reef farming and natural biocontrol of the invasive lionfish.

Figure 7.4.: Adaptation measures to climate change in Cahuita National Park



Source: Photograph taken by the author.

The designation of specific fishing zones is also considered an adaptation measure, although it is met with some skepticism from the fishers. For instance, a former local leader reflected on the possible negative consequences of designating specific areas for artisanal fishing in the

[50] Original quote: *Con todo lo del calentamiento global y que ahora tenemos que ir más lejos a pescar. Ahora salgo a las casi 6 [de la tarde] a esperar unos minutos y tirar el trasmallo, a ver si acaso pasa una macarela. Cuando antes usted llegaba a la costa y era un solo hit, nosotros le decimos que era una sola apuesta y recogía. Ahora no, ahora tiene que salir toda la noche para sacar 30 kilos de macarela.*

context of the community as it could be viewed as an act by national park authorities to ban fishing inside the park altogether, originally permitted as a cultural concession for the descendants of Afro-Costa Rican artisanal fishers. This could reduce the community's permitted fishing grounds where fishing far from shore is still uncommon for many fishers due to technical limitations.

> It's like a boomerang—you throw it and it comes back to you. The national park has always wanted to kick us out, always, but it hasn't because we don't have any other place to go. Once the marine zone for responsible fishing was established, we are telling the park that we have a zone for responsible fishing. Sometimes, you need to look beyond the end of your nose to see further.[51]
>
> Ricardo, fisher from Cahuita with 50 years of experience.

I make mention of this concern not because it is a current challenge in the community, but because it shows a critical position regarding measures that is worth considering when designing adaptation responses. Moreover, it is a good example of possible maladaptation, where a measure aiming to improve adaptation in the short term can undermine the well-being and livelihood of the fishers in the medium and long term (see Schipper, 2020).

7.2.2. Common findings: Pacific coast

Coastal erosion is not a primary concern in these communities and I was unable to identify any gray infrastructure linked directly to climate change. However, warmer seawater is a major concern influencing the fishers' behaviors as regards seeking new fishing grounds or shifting fishing schedules to fish during cooler temperatures. To implement these behavioral changes, technical adaptations such as introducing GPS apps or devices, larger boats, more powerful motors, and improving gear capabilities were necessary.

Moreover, on this coast, productive diversification is not the result of climate change but rather socioeconomic pressure marked by the seasonal nature of fishing, where tourism is becoming more significant for the local economy. In this scenario, activities like sport fishing or whale watching are portrayed as an attractive higher-income alternative for the fishers, who choose to exit the fishery entirely or return to it during the low tourism season in the area.

In terms of management, specific zones have been designated for artisanal fishing in Dominicalito, while in Cabuya, this concept is still in the early phases.

Cabuya

In Cabuya, I was unable to identify any gray infrastructure built in response to climate change. While coastal erosion does affect the community, it is not with the same intensity as on the Caribbean coast. Floods are expected as a result of heavy rains; yet the interviewees explained that rain does not severely impact community infrastructure (e.g., houses, roads, etc.) as the water drains quickly. In the words of a former local leader:

[51] Original quote: *Es un boomerang, lo tiran y te regresan. El parque siempre ha querido sacarnos, siempre. No nos ha sacado porque no tenemos otra parte donde sacar recurso. Una vez declarada una zona de pesca responsable le estamos diciendo al Parque que tenemos una zona de pesca responsable que es apta para pesca. Hay veces no hay que ver hasta la nariz, hay que ver más allá.*

> No, floods do not happen here. That is probably because we are positioned like this [on a slope], and all the rainwater runs to the sea. It may rain, and it could look like a river, but the rain stops and it drains quickly.[52]
>
> Isabel, former local leader from Cabuya.

Similar to the other communities, the fishers recognized changes in boat material and motor power, in addition to introducing technology like GPS for fishing. These changes are not directly related to the effects of climate change but contribute to adapting fishing practices to new conditions, such as fishing further at sea to diversify catching sites and searching out cooler waters. Nevertheless, regarding the type of gear utilized, there was agreement among the informants that it has changed only slightly, and that the modernization process in terms of new gear is still in the early stages in a community where fishing lines and fishing poles are still the chosen tools.

Regarding diversification as an adaptative strategy, sport fishing has also been promoted in this community as a livelihood alternative. However, similar to Barra del Colorado, it is seen as unrealistic by many fishers and local leaders who are also concerned about the costs of productive transformation and the potential for displacement of artisanal fishing. This concern is not only focused on livelihoods in terms of income, but also on the effects on local culture and identity. Isabel, a former local leader and artisanal fisher explained that:

> There are about three or four big [sport fishing boats] and we are located between Mal País and Montezuma and Montezuma brings [tourists] to see things here. We are surrounded. There is almost no artisanal fishing in Mal País, everyone works is tourism. There is also no artisanal fishing in Montezuma. There is still some in Tambor and here in Cabuya. Tourist fishing is growing here, but if it grows any more, I think even my sons will switch to it, but what else can they do? It's a pity; they enjoy [being artisanal fishers,] they grew up in it. It's like a tradition, part of the culture. [My ex-husband] has not left artisanal fishing, regardless of how hard it gets, there he is; they insist on fishing. Of course, they look for other alternatives and different types of fishing; but you start noticing competition. [53]

Another productive adaptation in fishing behaviors is the diversification of fishing spots, where the fishers fish further out at sea and work earlier in the morning, later in the afternoon, or even at night in response to warmer waters and higher daytime temperatures. The fishers interviewed acknowledged that due to the warmer conditions during the day and the calmer seas at night, they prefer to fish during cooler times of the day. According to one retired fisher who now rents out his boat:

> Now, it has changed a lot; the majority [of fishers] use GPS. They know the distance from the coast; it can be night or day, and they know where they are. But some years ago, they didn't have

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[52] Original quote: *No, aquí no se inunda. Porque seguro estamos así [inclinado] y todo se va para el mar…Vea, puede llover y se corre aquí como ríos, pero para la lluvia y está escurrido…*

[53] Original quote: *Hay como 3 ó 4 grandes, que están haciendo y tenemos alrededor Mal País y Montezuma y Montezuma trae gente de Montezuma a ver cosas, entonces estamos como encerrados. Mal País no tiene pesca artesanal casi, ya…allí están totalmente para turismo, Montezuma cero pesca…Tambor es el que ahorita está y Cabuya estamos en medio con el poquito artesanales y es porque están descubriendo eso ahorita aquí (la pesca turística), pero si eso crece, creo que hasta mis hijos se volcarían a esa pesca, pero qué les queda y es que es una lástima, a ellos les gusta, han crecido en eso. Ya es como una tradición que se trae, cultural. Mi exesposo no ha dejado esa pesca por más que se le ponga difícil, allí está…insisten en pescar. Claro que sí buscan otras maneras, otras pescas, pero ya allí, si ya yo siento que es como competir (…)*

> that and it was much riskier. People used not to fish at night. Nowadays, it is more common because, like I say, they know where they are. Telephone service is available 15 to 20 miles from the shore.[54]
>
> Fabricio, fisher from Cabuya with 12 years of experience.

On the other hand, I struggled to identify management adaptations within the community of Cabuya. Generally speaking, the community is highly organized with several local initiatives, including the fishers association. As discussed in the previous chapter on resilience, specifically as it relates to governance, while formally established, the fishers association faces difficulties to act due to a lack of internal cohesion and economic resources. However, it is important to mention their participation in initiatives like the COLAC, which provides a space to discuss main environmental concerns within the community and proposes measures to handle them.

Dominicalito

Like Cabuya, I was unable to identify adaptation regarding gray infrastructure. However, it is important to mention that due to the shortage of drinking water during both the wet and dry seasons, the community has installed a couple of large water tanks, which help to supply this vital liquid. According to key informants, the water shortages are the result of a combination of factors: intense dry seasons, high water demand due to booming real estate nearby, and, during the wet season, the destruction of the pipelines by heavy rains.

Regarding changes in gear and equipment, the fishers mentioned using larger boats and more powerful motors for fishing deeper at sea. Technology is seen as an ally, particularly GPS devices or smartphone apps for locating new fishing spots and keeping track of fishing gear at sea. While discussing the modernization of artisanal fishing in the community, one local leader and experienced fisher reflected on the changes:

> It's not like it was before; nowadays, the fisher has more access to technology. Before, we didn't work with GPS or anything like that; in fact, to return to a fishing spot, the fisher relied entirely on his knowledge. Now, with the GPS, that kind of knowledge is not needed; it's a matter of dropping a pin and finding it again immediately.[55]
>
> Gabriel, fisher from Dominicalito with 30 years of experience.

The informants also indicated that fishing practices have changed. Trawler fishing is no longer permitted due to the Marine Area for Responsible Fishing, and they recognized that this is essential to ensuring healthy marine ecosystems. Moreover, the materials and use of certain gear have also changed; for instance, hook shape, net material, and mesh size (i.e., it is larger to target adult species and minimize bycatch). Nevertheless, they are also aware that not all fishers follow

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[54] Original quote: *Y ahora ha evolucionado mucho, que la mayoría anda GPS. Saben a qué distancia están Y puede ser de noche o de día, que ellos, puede estar oscuro totalmente, que ellos saben dónde están ubicados. Pero hace unos años atrás que no había eso, era mucho más riesgoso. La gente casi no pescaba de noche. Ahora es más común, porque como le digo, están ubicados donde están y la señal del teléfono llega como unas 15-20 millas afuera (…)*

[55] Original quote: *Ya no son los tiempos de antes, ahora el pescador que tiene más tecnología para las cosas, antes no se trabajaba con navegadores ni nada de eso y para volver a un punto de pesca era puro conocimiento. Ahora con navegador ya no se necesita conocimiento, nada más de marcar y llegar inmediatamente*

the rules on authorized fishing gear, which creates unfair competition while negatively impacting the ecosystems.

Regarding productive adaptation, sport fishing and, especially, tourism are portrayed by local authorities and environmentalists as alternatives for diversification. Tourism is a key economic activity for the community and neighboring areas. However, I detected a sense of skepticism regarding the feasibility of this diversification alternative due to the lack of financial resources and excessive government regulations. As one middle-aged fisher who also works in tourism explains:

> [Tourism] is good; it is good. But, like I said, the coastguard, institutions, INCOPESCA, etc., can be obstacles to tourism development because of excessive demands: insurance, more boat equipment, and that each person going on a [fishing tour] needs to have a personal fishing ID. Even though I have my license, now everyone must have one.[56]
>
> Donald, fisher from Dominicalito with 40 years of experience.

From a management perspective, the existence of a Marine Zone for Responsible Fishing was positively perceived by the majority of the fishers interviewed as a tool to promote sustainable fishing practices, eliminate the use of trawler boats (e.g., national shrimp fishing boats), and designate specific areas for artisanal fishing. As one local leader and retired fisher explains:

> You know that artisanal fishers cannot go beyond the three miles because that is the autonomy granted by the law. Of course, there are those that do not respect that, but like I told you, climate change has not affected us much, possibly because of the area for responsible fishing we have here. What I mean is that because we no longer have the shrimping boats, which are no longer fishing now—that was the best thing that could happen in Costa Rica and in other places too. Those boats negatively impact the sea; they take everything. But, here in Dominicalito, we haven't experienced much impact because of the area for responsible fishing. Most of the fishers don't go beyond the limits of this area; there is one part reserved for reproduction […] so currently the fishers don't go to sea for several days at a time.[57]
>
> Gabriel, fisher from Dominicalito with 30 years of experience.

Despite this, I did detect some concerns about the effectiveness of these designated areas, particularly when not all fishers comply with regulations. Additionally, there were apprehensions about the risks of restricting artisanal fishing to specific zones, which will be explored further below.

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[56] Original quote: *Sobre eso es bueno, es bueno [se refiere al turismo] y sí hay pero, como le digo los guardacostas, instituciones, INCOPESCA, etc., etc., influyen mucho para para contrarrestar lo que es el turismo porque ahora(sic) exigiendo demasiado: póliza, más equipamiento al bote y que cada persona que vaya a hacer un tour (de pesca) tiene que andar su carnet de pesca personal; aunque yo tenga mi permiso y cada persona tiene que andar.*

[57] Original quote: *Usted sabe que el pescador artesanal no puede salirse de las tres millas porque esa es la autonomía de la licencia, claro hay algunos que no respetan eso, hay de todo…Pero actualmente como te dije, el cambio climático no nos ha afectado mucho tal vez, por el área de pesca responsable que tenemos. O sea, al no tener, al no tener embarcaciones como barcos camaroneros, que de por sí ya no están pescando, eso fue lo mejor que pudo haber pasado en Costa Rica y en otras partes también…El barco es un impacto que le hace al mar grandísimo, ellos arrasan con todo. Entonces, aquí en Dominicalito no se ha sentido tan grande, por medio del área que tenemos. Casi que los pescadores no se salen del área, hay una parte donde hay criaderos (…) entonces ahora el pescador actualmente ya no hace giras (…)*

7.3. Examination of shared factors

As seen above, adaptation has been uneven among the research communities. For example, in Dominicalito and Cabuya (Pacific coast), I struggled to locate infrastructure built in response to the effects of climate change, while in Barra del Colorado and Cahuita (Caribbean coast), infrastructure changes that can be viewed as adaptations to climate change are easy to detect. The divergences observed between coasts and within the communities can be understood in the context of the communities' inherent heterogeneity (Castello et al., 2013) due to exposure, vulnerabilities, and responses based on their own political, economic, environmental, and social realities. It is important to note that not all of the measures identified are direct responses to the effects of climate change; however, they can be analyzed as regards scope in the context of climate change since, in this research, climate change is not studied as an isolated phenomenon.

On the other hand, in all four communities, I identified a process of productive diversification among the fishers. Typically, this diversification process occurs on two levels: within and outside the fishery (Brugère et al., 2008). Within the fishery, productive diversification occurs by expanding the range of target species and fishing locations, as well as working in related sectors within the same area. For example, fishers will not only catch the fish but will also prepare and sell seafood products like *ceviche*. All of the fishers I interviewed in the different communities target an average of three species. They mentioned a preference for high-value species like lobster, shrimp, tuna, and red snapper; however, they also recognized that targeting a broader range of species could contribute to greater stability across seasons and help maintain a more consistent income.

Meanwhile, diversification outside the fishery involves integrating other economic activities into their livelihoods. The fishers will either exit the fishery entirely to focus on a new activity or they will alternate fishing with other productive activities, particularly during the low season. Only eight of the fishers interviewed said they are fully dedicated to fishing, while another eight fishers also partially work in sport fishing, fishing tourism, or hold paid positions in the fishers association (see Table 7.1).

Another common response from the fishers is to seek temporary employment when poor weather conditions impact the community (e.g., tropical storms, hurricanes, strong winds, or heavy rains), or when *El Niño* or hazardous biological phenomena like red tide affect the seawaters. In this case, diversification is temporary. As Luis, a fisher from Cahuita with 54 years of experience, explains: "I like farming; I like building wells; I like working at home building things […]. I'm always thinking about things to do. I always look for alternatives when the sea is not good for fishing; I look for an alternative to survive".[58]

[58] Original quote: *"Me gusta mucho la agricultura, me gusta hacer pozo, me gusta trabajar en casa construyendo algo (…) Siempre me gusta pensar algo. Siempre busco alguna alternativa cuando el mar está malo para mí, busco otra alternativa para sobrevivir."*

Table 7.1: Productive activities of the fishers across study sites

Productive activity	Number of fishers
Works full-time in fisheries	8
Fully retired	1
Retired from artisanal fishing but works in another sector	7
Agriculture/farming	3
Tourism (includes fishing tourism and sport fishing)	7
Sells food	4
Other activities (security, babysitter, occasional employment)	6
Fishers association (paid position)	1

Source: Prepared by the author.

Of the fishers interviewed, seven chose to exit artisanal fishing to go to work in tourism. Only one fisher said he was fully retired, but has two fishers working for him, taking care of his boat. Twenty-one fishers also work part-time in sectors like tourism, agriculture, security, construction, food preparation and sales, or occasional employment (i.e., gardening, construction).

This diversification outside the fishery was a conscious choice for only three of the fishers interviewed. They describe it as a planned process after having access to capital to start a new business. For the majority of the fishers working part-time in other sectors, it was not necessarily a choice or a planned process. In this case, during a low season or when poor weather impacts the community, they will look for a temporary source of income. A few also mentioned that they do these activities in their free time for extra money. For these reasons, this diversification can be considered reactive; however, it appears to be gradually integrating into the fishers' broader livelihood strategies.

In all four sites, the fishers acknowledge the importance of tourism as a productive alternative. However, they are critical of their ability to transition to this sector, particularly due to the regulations—considered by the fishers to be excessive in most cases—and the lack of economic resources to meet these requirements. For instance, obtaining a tourism license is not a difficult exercise; however, in order to be granted one, they must comply with specific boat and safety equipment requirements, which are typically expensive. They emphasized that diversification requires support from institutions (i.e., the State) and access to resources (e.g., capital and training), which they do not receive currently.

Similarly, the fishers interviewed highlighted migration as another viable alternative, particularly for young people, due to the low incomes from fishing and the attraction of other sectors like tourism, where there is more potential for a stable, higher income. In fact, some fishers spoke about colleagues who had migrated to other parts of the country. A few continued to work in the fisheries, while others diversified within the fisheries sector (e.g., mobility along the value chain). Others diversified outside fishing and started working in farming or tourism. However, these fishers mentioned that they still connect with artisanal fishing through close relatives who work in the sector or by fishing as a recreational activity on the weekends or their days off.

I also identified other adaptative strategies related to diversification, but more focused on behavioral changes. For instance, expanding the range of target species, seeking out new fishing locations, and employing new technology and gear, like different bait, higher quality fishing hooks, and fishing lines. These changes were common despite the skepticism and feelings of abandonment expressed by the fishers, particularly stemming from the lack of institutional support, limited access to capital, or challenges related to the ability to save.

During the conversations, I asked the fishers if their fishing practices had changed over the last ten years and, if so, what changes had occurred? These questions were intended to identify perceptions of transformation in their fishing practices over time and also to reflect on whether these transformations are seen as modernization of artisanal fishing in these communities. In this case, modernization can be understood as using new practices, gear, and technology focused on more effective and sustainable fishing. I did not use the word 'modernization' directly to avoid any potential bias, and to determine whether the topic would be brought up organically as the fishers reflected on changes in their practices. Interestingly, the opinions were evenly divided among the fishers interviewed: 46% answered that they believed no changes had occurred, while 46% answered that some changes had occurred, and 8% did not answer the question.

For the fishers interviewed, modernization implies having more powerful motors and boats, boats with roofs, and new gear for targeting different species (e.g., modern fishing poles). This perception of modernization can be related to the potential for fishing deeper at sea and under harsher weather conditions due to the pressure from the tourism sector, sport fishing, and protected areas. This idea of modernization can also be influenced by access to social media and the internet, where some may compare their fishing practices to those of other countries. This was evident when some fishers mentioned watching TV programs about fishing (e.g., fishing in extreme places) or related videos on YouTube.

Regarding the consequences of the use of certain gear, there is a definite awareness of positive changes in fishing practices and fishing gear to maintain healthy fish stocks. The fishers interviewed mentioned their intention to regulate the size of the nets and mesh, or the importance of not using explosives (blast fishing). On the other hand, the intensification of efforts in the context of these communities could be interpreted not in terms of using more gear, but of catching species of different values. There are no specific targets and high-value species like lobster, shrimp, or red snapper are caught in the same area as others of lower value, called *chatarra* [literally, scrap], such as grunts (*roncadores*).

Despite targeting high-value species, all of the interviewees agreed that they do not focus on only one type of fish, but are open to catching several different species, including those of less value, since it creates the opportunity to receive more income.

Similarly, I detected a sense of environmental awareness in the fishers, particularly regarding marine pollution and the effects of some fishing practices on marine ecosystems. For instance, not throwing trash away while at sea, properly disposing of harmful waste like batteries, and using nets with a larger mesh size to avoid harvesting juvenile species.

Regarding behaviors related to the use of technology, and despite the critical perception in terms of modernization, the fishers expressed a positive sentiment about the use of some technological

devices. For instance, GPS has done away with certain practices such as eyeballing a location (*calcular a ojo* in Spanish), whereby the fishers would use two geographical reference points on land to triangulate their position at sea. A few of the older fishers take pride in still being able to do this, but they prefer to use the GPS app on their smartphones given its precision. GPS also facilitates fishing in poor weather conditions or at night when visibility is low. The fishers agreed that forecasting apps and those that report wind speed and tide behavior are useful and among the most commonly used regardless of age.

The fishers interviewed further agreed that the main technological change is possibly the use of smartphone applications to locate fishing points, access weather forecasts and sea current information, and for communication while at sea.

In addition, changes in fish handling practices contribute to maintaining the highest quality of the catch and ensuring food safety. These include the adequate use of ice, cleaning the fish at sea or upon arrival at the harbor, and delivering the catch at the *pescaderías* or *recibidores* (fish landing sites). The fishers, particularly the older generations, understood the need for these changes due to regulations in the form of phytosanitary requirements.

Artisanal fishing in Costa Rica is typically developed as an activity that requires only short periods of time spent at sea—on average one day in the study communities—due to regulations regarding distances and areas designated for artisanal fishing. The fishers leave early in the morning and spend most of the day at sea, although this is not a hard rule and depends on weather conditions and target species. Nevertheless, changing fishing schedules to avoid the warmest hours of the day was an important strategy implemented across the research areas. This measure is categorized as a coping mechanism as it is considered an ever-changing short-term strategy.

Table 7.2: Typology of adaptation strategies identified in the four research communities

Adaptation strategy	Response category	Form	Time Period (short term/ long term)	Origin (Planned or organic)	Proactive / reactive	Localization (localized/ widespread)
Gray infrastructure	Adaptative strategy	Infra-structural	Long term	Organic	Reactive	Localized
Diversification of target species	Adaptative strategy	Behavior	Long term	Organic	Reactive	Localized
Diversification of fishing areas (e.g., deeper at sea)	Adaptative strategy	Behavior	Long term	Organic	Reactive	Localized
Use of technology (e.g., smartphones, GPS, apps)	Adaptative strategy	Behavior/ technical	Long term	Organic	Reactive	Localized

Changes in gear and equipment (e.g., larger boats, more powerful motors)	Adaptative strategy	Behavior/ technical	Long term	Planned (gear) and organic	Proactive/ Reactive	Localized
Definition of fishing zones	Management response	Co-governance	Long term	Planned	Proactive	Localized
Changes in fishing schedules (e.g., fishing at night)	Coping mechanism	Behavior	Short term	Organic	Reactive	Localized

Source: Prepared by the author.

Lastly, regarding maladaptation, as discussed in the analytical framework, this phenomenon occurs when a measure intended to adapt to new conditions has a direct or indirect negative effect on the people or communities where the adaptation occurs (see Schipper, 2020). In the context of this research, I believe it is important to mention potential cases of maladaptation that I identified to understand their complexity.

For example, my intention in describing the concerns regarding the possible negative impact of certain adaptation measures aimed at designating artisanal fishing zones under the Marine Zones for Responsible Fishing was to highlight the criticism of some fishers and informants within two specific communities. Informants in Dominicalito pointed out that despite the existence of these areas, some fishers still use prohibited gear like trawler nets, which affect the ecosystem and the fishers who respect the rules established for fishing inside the area. This is a potential example of maladaptation since a governance mechanism is established, yet not all of the stakeholders are committed to more sustainable fishing practices (Woods et. al., 2022). This lack of commitment could negatively impact the fishers and ecosystems, increasing their vulnerability and undermining their resilience (Criddle, 2012).

Similarly, as previously mentioned in this chapter, in terms of the potential for establishing a Marine Zone for Responsible Fishing in Cahuita, an experienced fisher and former local leader reflected on the possibility of being denied the ability to fish inside the national park if a marine zone was created, further restricting access by Afro-Costa Rican descendants to the marine area located inside the park. According to this particular fisher, a marine zone in this community could be seen as a double-edged sword: on the one hand, there is no denying the intention of protecting the ecosystems and promoting sustainable fishing; however, on the other, this governance tool can create an opportunity for the national park authorities to remove them from the area entirely, alleging that they now have a designated fishing zone. In this case, the governance mechanisms would reduce their fishing grounds and affect their identity as fishers, since fishing inside the national park was a way to recognize their heritage as Afro-Costa Rican artisanal fishers. This issue has been discussed in the literature regarding the unforeseen effects of some governance mechanisms on general well-being (see Szymkowiak, 2020b; Dorji et al., 2023).

7.4. Conclusions

The analysis of the adaptation of artisanal fishers in this chapter demonstrated that adaptation to the effects of climate change is primarily reactive, occurring at different speeds and with different scopes (generally slower than other fishing communities around the world where climate change threatens their existence). Some measures that have been implemented are not necessarily a direct response to climate change, but do contribute to managing its effects (Castro & Sen, 2022). Furthermore, not all adaptation measures were purposefully implemented; however, they can be considered 'side effects' of the fishers' and the communities' political and economic realities, which further illustrates the complexity in which climate change is only one of many factors. This detail is important as it diverges from mainstream academic literature and policy positions emphasizing the need for imminent, direct, and rapid adaptation in coastal communities—"adaptation now" (Taylor, 2014: 3). Despite their reactive nature, these measures are considered adaptations as they contribute to keeping the practice of artisanal fishing alive in these communities with important socioeconomic, political, and environmental pressures and changes.

Despite these adjustments, it is important to highlight the need for adapting infrastructure in the context of coastal erosion, sea level rise, and more frequent and intense weather phenomena (i.e., heavy rains or tropical storms). This can take the shape of coastal development and ensuring adequate drinking water supply.

During the interviews, there was little doubt that the fishers are aware of and concerned about the effects of climate change and adaptation; however, they are more preoccupied with solving day-to-day issues and pressing concerns. Expecting fishers to concern themselves with adaptation to climate change when they are facing the potential loss of their livelihoods due to more immediate political and economic constraints is a difficult ask even when they recognize climate change as a threat to their activity (albeit not an immediate one). Ultimately, priorities are shaped by the immediate context. In this regard, it is important to examine how these priorities are identified and defined as this reflects broader discussions of justice in terms of who, where, and under what conditions one can be concerned about climate change. This also encompasses the availability of time and resources necessary to adapt to its diverse and uneven effects (Santha, 2023).

8. Conclusions

When adaptation to climate change is just one of many concerns, but not the priority

This research was initially focused on climate change adaptation, but I soon discovered something unexpected. The research was guided by the question *What does adaptation to climate change mean for Costa Rican artisanal fishers?* and I expected to find that climate change was a primary concern for the study communities (Barra del Colorado, Cahuita, Cabuya, and Dominicalito), and that adaptation initiatives were commonplace. However, following months of fieldwork, I discovered that while climate change is recognized as a concern for the artisanal fishers in all four communities, it is not their primary burden. More immediate structural challenges take precedence, such as making ends meet, obtaining fishing licenses, or navigating pressures from environmental conservation and tourism.

One of the central arguments is that the fishers cannot prioritize concerns about climate change and adaptation to it when more immediate challenges directly impact their fishing activities. Limited or slow responses to the effects of climate change do not mean a lack of (or diminished) agency on the part of the fishers. Instead, as Coulthard (2012) also argued, it demonstrates that their priorities differ from the agenda of the politicians, policymakers, and researchers (including myself). When climate change does directly impact the fishers, the response is reactive, looking to resolve the consequences as soon as possible. However, establishing medium- and long-term responses is more challenging amid the context of diverse political, environmental, and socioeconomic pressures that threaten the very existence of artisanal fishing as a livelihood.

Regarding adaptation within these communities, it is less a direct response to climate change and more a reaction to the complex interplay of political, social, economic, and environmental factors shaping the fishers' lives—where climate change is just one of many challenges and not the most pressing. In a broad sense, successful adaptation is occurring in each community, as artisanal fishing remains the primary source of income for many locals, demonstrating resilience, despite the array of vulnerabilities they face. However, the fishers' speed, timing, and specific strategies diverged from mainstream ideas on adaptation, as evidenced throughout the empirical chapters of this thesis.

Thus, in seeking to answer the research question, two distinct worlds emerge. The first is a world of urgency and presentism promoted by politicians, academia, and climate specialists, where climate change is the primary concern and adaptation to it occurs naturally and in fixed ways as presented in national and international political and mainstream academic discourses. The second is the real world—the local reality— where adaptation to climate change is not necessarily a top priority; not because it is irrelevant, but because there are other immediate concerns (Bavinck et al., 2018) affecting the artisanal fishers and to which they are focusing their adaptation efforts.

To answer the research question, I reflected on the vulnerabilities of the fishers and the extent to which these vulnerabilities affect their daily lives, their resilience, and their adaptation. These

three elements contributed to an analysis of the political and situated nature of climate change and to the identification of development aspects related to poverty, socioeconomic inequality, and social exclusion that might strengthen or undermine the ability of the fishers to keep artisanal fishing alive.

Regarding the main vulnerabilities of the fishers, despite the diversity of factors identified in the study sites, those related to social, economic, and governance are most concerning for the fishers. For instance, the pressures from State regulations and environmental conservation, such as the reduction of fishing zones due to the creation of protected areas, were shared vulnerabilities across the study sites. The lack of access to fishing licenses, leading to higher informality, is another critical element limiting the fishers' potential for political recognition and access to rights.

Despite the direct effects of climate change on their activity, such as warmer waters, and the indirect consequences of this, such as struggling to locate fish, the fishers' main vulnerabilities are not necessarily linked to climate change alone. The fishers interviewed acknowledged the impact of climate change; however, their main concerns are more oriented toward their ability to fish, such as having sufficient financial resources or political support and recognition to access the sea as artisanal fishers. In this context, the effects of climate change are not immediately urgent in the four communities but seem to have a gradual impact, with specific episodes affecting the communities and the fishers, including red tide, hurricanes, tropical storms, and floods.

On the other hand, the four study sites are examples of the historical resilience of artisanal fishing communities worldwide. Despite a context of historical, political, and socioeconomic marginalization marked by a lack of material resilience (i.e., capital, insurance, savings, livelihood diversification), I discovered a strong motivation to continue fishing, not only because it may be the only productive activity available to them, but also due to the deep connection the fishers feel to fishing and the sea. This connection and the emotions and passion they feel for fishing are core components of their resilience and relevant factors in their perseverance despite the precarious situation they face in terms of the law and government support, challenges in locating fish, the dangers of the sea, and a highly competitive market and environmental pressures. Fishing is part of their local and personal history, identity, and culture. Of course, there is also an economic motivation—fishing has permitted the majority to make a living, albeit with complications during the low seasons.

As explained in the analytical framework, resilience refers to the ability or capacity of a system to absorb disturbances before it changes to a completely different state (Adger, 2006; Goldman et al., 2018). Resilience makes adaptation possible through tangible and intangible resources. Despite the adverse material conditions experienced by the fishers, including extreme weather events and ecological changes in marine systems, their motivations, ideas, beliefs, and emotions behind fishing also contribute to keeping artisanal fishing alive no matter what (Satumanatpan & Pollnac, 2019). This is further evidence of the resilience of these fishers. The argument that they are not resilient because of material limitations undervalues their agency and neglects the importance of immaterial resources such as values, motivations, and beliefs in the complex world of the artisanal fishers.

Meanwhile, the analysis of adaptation showed that adaptation to the effects of climate change is primarily reactive, occurring at different speeds and scopes (and likely at a slower rate than other fishing communities in Costa Rica and around the world, where climate change is an immediate threat to their existence). I discovered that some measures were implemented not necessarily as a direct response to climate change, but that climate change had contributed indirectly to their adoption (Castro & Sen, 2022). Similarly, not all adaptation measures are implemented purposefully or proactively, but rather are 'side effects' of the fishers' political and economic reality, which is further evidence that climate change must be studied from the perspective of the historical context of a group or community. This detail is important as it diverges from mainstream academic literature and policy positions emphasizing the need for imminent, direct, and rapid adaptation in coastal communities—"adaptation now" (Taylor 2014: 3).

Despite their reactive nature, these measures are considered adaptations as they contribute to keeping the practice of artisanal fishing alive in the communities facing important socioeconomic, political, and environmental pressures and changes. An example of this is the shift in fishing behaviors in terms of target species and fishing equipment, including more advanced gear and larger boat sizes. These changes are not necessarily a direct response to climate change, but are the result of reduced fishing grounds due to the expansion of tourism, conservation areas, and competition with other artisanal fishers and fishing sectors (i.e., semi-industrial fishing), in addition to changes in market preferences and prices. As I discovered throughout this process, the adaptation of fishing behaviors in an uneven process.

It is important to highlight the need for infrastructure adaptation in the context of coastal erosion, sea level rise, and more frequent and intense weather phenomena, including heavy rains or tropical storms. This can take the shape of coastal development and ensuring adequate drinking water supply. Moreover, the management responses for co-governance, such as the fishers associations, local governance councils, and Marine Zones for Responsible Fishing, are still behind in terms of including climate change concerns in their agendas. While these institutions do recognize that climate change is a problem, their concerns typically focus on socioeconomic and political issues affecting the immediate realities of the fishers and their communities.

Similarly, the fishers themselves are aware of and concerned about climate change effects and adaptation; however, they are more preoccupied with solving day-to-day issues and pressing concerns. Expecting fishers to concern themselves with adaptation to climate change when they are facing the potential loss of their livelihoods due to more immediate political and economic constraints is a difficult ask, even when they recognize climate change as a threat to their activity (albeit not an immediate on). Ultimately, priorities are shaped by the immediate context. In this regard, it is important to examine how the fishers identify and define their priorities as this reflects a broader discussion of justice in terms of who, how, where, and under what conditions one can be concerned about climate change. This also encompasses the availability of time and diverse tangible and intangible resources necessary to adapt to its diverse and uneven effects (Santha, 2023).

The four research sites are illustrative of the diversity of artisanal fishing communities in Costa Rica. Concurrently, they provide an opportunity to reflect on shared social, economic,

environmental, and political challenges. Although each study site is exposed to the effects of climate change, its consequences are uneven and shaped not only by geographical and environmental factors, but also by historical context, as discussed in the empirical chapters.

In terms of successful adaptation as described above, understood in this research as the continued viability of artisanal fishing as a primary income, Barra del Colorado has adapted successfully, and a majority of the residents still earn a living primarily from artisanal fishing. However, as explained in previous chapters, it is important to note that this community faces strict environmental regulations given its location inside a protected area, thereby limiting the potential for productive diversification.

Meanwhile, in the case of Cahuita, Cabuya, and Dominicalito, while adaptation has occurred in the sense that artisanal fishing is still a source of income for many in the community, the number of individuals that depend exclusively on artisanal fishing is declining. Tourism and environmental initiatives have changed the socioeconomic landscape by offering more lucrative opportunities for locals.

The uneven effects of climate change on artisanal fishing are evidence of the heterogeneity (Castello et al., 2013) of the activity, even in a small country like Costa Rica. Recognizing this dissimilarity is important in understanding how a global phenomenon like climate change affects the fishers livelihoods. The research also reflected on how the artisanal fishers and the communities where they live deal with climate change when it is not an immediate threat, but rather has rapid, occasional impacts, contributing to an understanding of the diverse realities in artisanal fishing and responses in contexts where climate change is not considered an emergency.

Moreover, this dissertation provides evidence of the social and political dimensions of climate change. Climate change cannot be studied in isolation; it interacts with other elements to shape people's lives. It is fundamentally a development issue, highlighting that while climate change can exacerbate hardships, structural aspects such as poverty or inequality play a significant role in determining how individuals respond to change, in general, and to the effects of climate change, in particular. This could also be viewed in relation to "climatism" as Mike Hulme argues in *Climate Change isn't Everything: Liberating Climate Politics from Alarmism* (2023). Hulme criticizes the political attention given to climate change when there are other political, historical, economic, cultural, ecological, and social aspects affecting people's lives and well-being. It is important to emphasize that Hulme's approach does not deny climate change and the effects of human action on the climate. Rather, it is critical of the emphasis placed on the climate and the blame attributed to it, questioning the overemphasis on climate change itself. Hulme argues that the climate is not the only thing that matters and is not always the most important. His proposal focuses on a more "contextually sensitive, diverse, and pragmatic approach to incorporating the challenges of climate change into everyday politics" (Hulme, 2023: 10).

From a theoretical perspective, the concepts of vulnerability, resilience, and adaptation contributed to understanding if and how the fishers respond to changes impacting their lives and livelihoods. However, the theoretical and practical challenge lies in differentiating between them as they often overlap. These concepts proved useful in understanding the factors affecting the fishers' lives, the elements influencing how they cope with changes, and how they react to

shocks. However, beyond the technicalities of developing methods to measure these three concepts, a political approach is also necessary to understand how power relations, in the context of an individual or group, strengthen or undermine the potential for improved well-being. From a policy perspective, this could contribute to a more accurate analysis of the context and how individuals define priorities and respond (or not) to environmental changes.

In the case of Costa Rica, the country has long been recognized for its environmental and conservation initiatives. Climate change is part of the international and national agenda, which has long been focused on mitigation and only more recently has shifted to adaptation. However, there are disparities in terms of policies on adaptation to climate change. For instance, the State considers the agriculture sector to be a priority. In contrast, policies for the adaptation of coastal communities and artisanal fishing are scarce, as all the experts interviewed agreed. When such initiatives do exist, they often take a technocratic approach with standardized solutions that typically fail to address the specific needs of the community, individuals, or groups, and overlook the historical poverty or exclusion of these areas. Often, the vulnerabilities of the artisanal fishers stemmed not from the local manifestations of a changing climate but from technocratic policies (Gupta & Bavinck, 2017) of the state purporting to respond to climate change.

From a broader perspective, this research aimed to analyze the social and political dimensions of climate change and its power dynamics. Climate change is a global force that holds an important place on the international political, geopolitical, and scientific agenda, but it cannot be studied as an isolated and technical issue disconnected from the realities of local communities. Further studies must analyze how climate change interacts with political, economic, and even cultural aspects, with the understanding that despite the mainstream political discourses that maintain climate change is an urgent topic, it is not always about climate change, and it is not always the main priority for every community.

9. References

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Organization of courses and workshops

Online course for diplomats, academics, and experts: Introducción al Derecho del Mar. (*Introduction to the Law of the Sea*). From October 16th, 2024 to November 14th, 2024. Universidad Nacional. Costa Rica.

In- person workshop: *International Workshop on Ocean Governance* held on June 3rd and 4th, 2024 in Heredia, Costa Rica. Universidad Nacional. Costa Rica.

Online course for diplomats, academics, and experts: Diplomacia Azul (*Blue Diplomacy*). From April 25th, 2024 to June, 13th, 2024. Universidad Nacional. Costa Rica.