Small-scale fishers' adaptations to change: The role of formal and informal credit in Paraty, Brazil

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Abstract

Small-scale fishers in coastal areas of Brazil face numerous challenges, including marginalization by large-scale industrial operations, poor market access, lack of working capital, and pressure to diversify their livelihood base. From the perspective of adaptive capacity, this investigation was carried out in three communities in the municipality of Paraty (Rio de Janeiro State), and sought to determine the main challenges facing local fishers, and fishers' current adaptive and transformative actions against these challenges. Findings revealed that the majority of fishers (55%) own mid-size diesel boats (6–9 m) and face constant pressure to scale-up and diversify operations to take advantage of the growing tourism sector. Such expansion requires financial capital. However, due to fear of losing assets, inability to arrange a co-signer, and lack of adequate collateral, many fishers are reluctant to obtain credit from government-sponsored programs and seek credit elsewhere. Fishers with larger boats are increasingly opting for tourism-related activities through informal credit arrangements. However, of the smaller-scale fisher respondents some 27% have opted to downsize their fishing operations through intrasectoral adjustments. These actions reflect a general trend of aversion to financial liability and vulnerability by way of flexibility, dynamism, and diversification. It is recommended that access to credit should be made easier for small-scale fishers to provide more options to diversify their livelihood base but without exerting additional fishing pressure on already overfished stocks.

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1. Introduction

Small-scale fishers worldwide face challenges maintaining their livelihoods in environments characterized by poor market access, lack of capital, dwindling fishing stocks, and the need to continuously diversify their livelihood base [1]. Since the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, Brazil, the term 'livelihood' has come into common usage. It consists of assets (natural, physical, human, financial, and social capital) activities which determine the living conditions of individuals and households [2]. A livelihood is considered sustainable when it is capable of coping with and recovering from stress and shocks maintaining or enhancing its resilience without undermining its natural resource base [3]. Stress is characterized by continuous or slowly increasing pressure, whereas a shock is a sudden, major increase in pressure outside the normal range of variability [4]. In the context of fishers' livelihood, stresses and shocks can diminish over time and life can appear to return to normal. However, such “equilibrium thinking” [5] does not accurately reflect how households actually respond and continuously adapt to change [6].

The notion of adaptive capacity to change and to cope with and recover from stresses and shocks forms the core of Chambers and Conway's [3] definition of 'sustainable livelihood', and can be extended to 'resilience thinking'. The former holds that the sustainability of livelihoods hinges on the capability of people to deal not only with day-to-day stresses or challenges, but also with truly difficult conditions such as 'lean seasons', natural disasters, or unfavourable public policies. The latter encapsulates 'adaptability' and 'transformability' [7] with elements of options and flexibility which are also required for livelihoods to be sustainable. In this context, adaptability refers to the ability to adapt to changing external drivers and internal processes, thus permitting continued development along a trajectory (i.e., within a stability domain). In contrast, 'transformability' refers to the ability to cross thresholds into a new trajectory, such as when a fishing community is transformed into a community of tourism workers [7–8]. In response to financial and resource uncertainty, fishers often attempt to diversify their livelihoods, making use of their 'natural capital' [9] in order to counter risk and vulnerability [4].

The chronic shortage of financial capital and indebtedness among small-scale fishers in the global south exacerbates the challenge of livelihood diversification. For instance, in many
coastal regions of India, moneylenders and traders have taken advantage of financial crises to gain control of fisheries, completely marginalizing small-scale fishers [10]. Access to easy and flexible credit and other financial services is critical if such vulnerable fishers are to overcome these challenges [11] and succeed in diversifying both within and outside the fishery.

In Paraty, southeastern Brazil, formal institutional credit options are limited to those offered by the Bank of Brazil’s National Program for the Strengthening of Family Agriculture (PRONAF for its acronym in Portuguese). This study sought to determine how small-scale fishers in Paraty have dealt with the challenge of livelihood sustainability and diversification in the face of such institutional constraints and bureaucratic barriers.

In this article, it is argued that the adaptive capacity framework is one of the most suitable means of understanding the nature of adaptability and transformability among the small-scale fishers of southeastern Brazil. Such assertion is pursued by examining the role of credit in both short-term strategies (i.e. for purchasing new fishing gear and maintaining the old ones) and long-term strategies (i.e. for downsizing or diversifying livelihoods) employed by small-scale fishers. The results are presented in three sub-sections, highlighting (i) the need for mobilizing financial capital and availability of credit options, (ii) access to credits by small-scale fishers, and the use of borrowed financial capital, and (iii) fishers’ adaptation and transformation through reducing livelihood assets and activities as well as their diversification. Finally, the implications of the results for future fishery management policies are analyzed.

2. Study area and methods

This research was carried out using a ‘case study’ approach in three coastal communities in the municipality of Paraty, Rio de Janeiro State, Southeastern Brazil (between 22°54’ S to 23°22’ S and 44°31’ W to 44°53’ W) from September to December of 2010 (Fig. 1). Located on the southeast shore of Ilha Grande Bay, Paraty played a significant role as a trading port during the 16th–19th centuries [8]. The municipality has about 40,000 residents, almost three-quarters in built-up urban areas. The rest are dispersed throughout the countryside and coasts, holding various occupations including fishing, tourism and small-scale agriculture. The study area has undergone significant change over the last three decades due to declining fish stocks [12] and the expansion of the industrial fishing and tourism sectors. The small-scale fisheries that these changes are threatening not only provide food and income for both urban and rural inhabitants in the Paraty municipality, but are considered ‘a way of life’ by the people of the region [13].

The communities of Praia Grande and Tarituba and the town of Paraty were selected due to the importance of their fishing
activities as well as similarities in their fish capture and marketing strategies. Paraty, located in the urban core of the municipality of the same name, is the economic center of fish production and marketing in the region [14]. Of the 400 inhabitants of Praia Grande, located approximately 15 km north of Paraty, 100 are full-time fishers. Tarituba, 30 km north of Praia Grande, has 90 full-time fishers and a population similar to that of Praia Grande.

The main catches in the study communities are two shrimp species (sea bob Xiphopenaeus kroyeri and white shrimp Litopenaeus schmitti) [15], and whitemouth croaker (Micropogonias furnieri); otter trawlers and bottom gillnets are used for capturing them. Fishing vessels range in size from non-motorized dugout canoes to mid-size boats (6–9 m in length) to larger diesel boats (> 9 m). Fish markets located in each community purchase the catch directly from fishers. While fishers in Paraty and Praia Grande have fixed buying arrangements with local markets, those in Tarituba keep themselves free from such arrangements due to their willingness to look for better prices elsewhere in the Paraty region. Comparable socio-economic characteristics among the three communities allowed us to analyze the results in an aggregate manner and verify that the needs and challenges associated with credit availability were common to all three communities.

A total of 30 semi-structured interviews were conducted with fishers from the three study communities: 9 in Praia Grande, 9 in Tarituba, and 12 in Paraty. Sample size was determined according to the proportion of fishers in each community, as previously assessed by Begossi et al. [14]. During the first set of interviews and informal conversations with the fishers, specific attention was paid to fishers’ economic and social vulnerability, livelihood sustainability, and credit needs, availability and usage. By living within the study communities, two of the researchers were able to maintain close relationships with the fishers, and asked the same questions to specific fishers at different times.

In addition, 6 fish market owners, the President of the fishers’ association, a representative from the Fisheries Institute of Rio de Janeiro, and a PRONAF agent from the Bank of Brazil were interviewed. This second set of interviews provided complementary perspectives on the credit options available to fishers and current barriers to credit access. Interviews were kept confidential and all data, personal information, quotations and facts were obtained and reported with the direct verbal consent of participants. All interviews were conducted in Portuguese, translated into English and manually coded.

3. Results

3.1. The need for mobilizing financial capital and availability of credit options

Among all livelihood activities in the study communities, fishing is the single most important sector, both as the primary economic activity as well as a complementary livelihood activity. The purchase and maintenance of boats and fishing gear constitutes the basic financial need of small-scale fishers in the Paraty municipality. However, there is increasing pressure for fishers to remain competitive in the face of emerging tourism market. Responding to these pressures requires fishers to expand their financial capital, but as most small-scale fishers have limited savings, they must rely on credit either from government programs or other informal sources.

Fishing boats in the Paraty region can be grouped into three main types, with values ranging from US$1000 to 25000: non-motorized dugout canoes, mid-sized diesel boats (otter trawlers and gill netters), and large diesel boats. As shown in Table 1, 55% of respondent fishers owned mid-size diesel boats; 13% owned dugout canoes and 10% owned large diesel boats. Among interviewed fishers, 22% did not own boats of any kind and worked aboard industrial fishing vessels. In addition to the boats themselves, fishing gear and maintenance constituted the major expenses for these small-scale fishers. For example, fishing nets cost around US$100, motors between US$2500 and 5000, and repairs between US$500 and 2500.

Due to general crisis in the small-scale fishing sector associated with declining fish stocks [12,16] and marginalization related to both industrial fishing and growth of the tourism sector, Paraty fishers, and the local economy as a whole, have undergone remarkable changes over the lifetimes of most small-scale fishers currently active in the area [8]. Local fishers attribute the decline in their fish catch to there being “too many boats”, as one respondent claimed, as well as industrial fishers (trawlers), “killing or keeping of small fish”, and loss of access to some resources due to protected areas, (Fig. 2). The decline in fishers’ wages due to diminishing catches has had a significant impact on
demand for and access to loans to allow fishers to continue fishing or to diversify into other economic sectors.

Consequently, fishers tap into formal and informal credit sources to meet their needs (Table 2). However, in the Paraty region, small-scale fishers face major challenges regarding the acquisition, utilization and repayment of loans. Formal credit at low interest rates was available to fishers through PRONAF in the form of defrayal or investment credits. Defrayal loans were offered at values up to US$ 7500 and could be used to purchase fishing equipment, such as nets and motors, and to conduct boat repairs. These loans charged 4% interest per year and featured a one-year grace period in which the fisher was not required to pay installments and no interest was charged against their debt. Investment loans were also offered at values up to US$15000 and could be used to purchase new fishing boats. These loans charged interest between 1 and 3%, featuring either monthly or quarterly repayment schedules.

Despite their apparent availability and low interest rates, formal financial services, such as those offered by PRONAF, were not the first option of fishers when they needed credit. Respondents listed 4 specific reasons for avoiding PRONAF loans: (i) high degree of bureaucratic requirements (50%), (ii) discomfort or disagreement with repayment options (22%), (iii) fear of losing assets (17%), and (iv) preference for meeting credit needs using family and social networks (11%). PRONAF loan applications were reported to require between 3 and 6 months to process, and applicants were required to prepare and present a written business plan—a challenging task for many fishers who were illiterate. In the case of defrayal loans, applicants were also required to find and arrange a co-signer. In addition, all applicants were required to travel to the Fishers’ Association office with a long list of personal documents. Then, after several days or even weeks, they were to fill out the required PRONAF paperwork and submit it to the Secretary of Fisheries and Agriculture, which granted partial approval before sending the application to the Bank of Brazil for credit history checks. Most small-scale fishers found these complex and stringent requirements to be major hindrances to applying for PRONAF loans.

Another major reason cited for avoiding PRONAF loans were the loan repayment schedules. Fishers found these schedules to be very strict and ill-fitted to the uncertainty, unpredictability, and seasonality inherent in fishing. Indeed, the PRONAF loans were originally developed to support agriculture, which has a productivity cycle very different to that of fishing. As a result, fishers felt discouraged from seeking formal financial services due to fear of losing their assets through defaulted loans, and preferred options that did not incur the risk of losing assets.

About one-third (30%) of the respondents had previously applied for a PRONAF loan but were rejected, with 45% citing the lack of a co-signer as the main barrier to obtaining formal loans (Fig. 3). The PRONAF official explained that the co-signer is intended as a guarantee that, regardless of an applicant’s creditworthiness, the bank can retrieve the loan amount in case of a repayment failure. Co-signers were required to be creditworthy individuals with reliable monthly incomes who can take over the loan in case of default. One interviewed fisher illustrated the problem with this system by asking: “Who would want to be my co-signer?” Even though several sector-based credit programs in Brazil (e.g., Crediamigo) have successfully used the co-signer provision in order to counter the issue of collateral [17], this requirement remains major barrier to fishers obtaining PRONAF loans.

Lack of collateral was another major barrier to securing loans. One major stipulation of the PRONAF program was that neither a fisher’s house nor fishing boat could be used as collateral. While this requirement ensured that applicants could not be left homeless or jobless, few fishers owned any major assets beyond their boat or house—making them functionally ineligible for loans.

Another major cause of loan application rejection was the attempted use of loans for non-fishery-related purposes. PRONAF loans were officially intended only for fisheries-related investments, yet the low interest rates offered by the program made it tempting for fishers to invest their loans outside the fishery, especially in the tourism sector. This was not an often-discussed barrier, as few fishers were willing to disclose their intended uses for their loans.

In addition to formal loans, family and friends were often found to provide small, usually interest-free loans. Additionally, fishers

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Table 2

<table>
<thead>
<tr>
<th>Sector/source</th>
<th>Type of loan</th>
<th>Amount (in US$)</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal</td>
<td>Defrayal (Custeio)</td>
<td>Up to 7,500</td>
<td>4% Annual interest</td>
</tr>
<tr>
<td>PRONAF</td>
<td>Investment</td>
<td>Up to 15,000</td>
<td>1–3% Annual interest</td>
</tr>
<tr>
<td>Informal</td>
<td>Small-emergency</td>
<td>Up to 1,000</td>
<td>No interest</td>
</tr>
<tr>
<td>Family and social network</td>
<td>Purchase of vessel</td>
<td>Up to 30,000</td>
<td>No interest</td>
</tr>
<tr>
<td>Fish buyers, fish market personnel and middlemen</td>
<td>Mostly for purchasing of boat and fishing gear</td>
<td>1,000–15,000</td>
<td>Average monthly payment, according to catches</td>
</tr>
</tbody>
</table>
accessed credit through their connections with fish markets and other business owners. The unscrupulous moneylenders often associated with entrapping fishers in debt with high interest rates [17,18] were generally absent in Paraty; most informal loan arrangements in Paraty involved other wealthier members of the community.

3.2. Access to and use of credits by small-scale fishers

The small-scale fishers interviewed in this study employed multiple methods for financing their boats and fishing gear as well as their maintenance (Table 3). Three-quarters (75%) of fishers indicated requiring some form of financial credit at one time or another. Almost half (46%) of these fishers financed their boats through financial credit arrangements with the previous owner of the boats. While no interest was charged following the handover transaction, this type of arrangement still required a down payment. The remaining debt was paid in installments agreed upon at the time of purchase. As well, depending on the season, a percentage of each catch was also often paid to the previous owner over the course of several years.

Less than one-quarter of the fisher respondents bought their boats through the PRONAF investment program. Though PRONAF charges a low interest rate relative to commercial banks, obtaining the loans was considered difficult, as explained above. The PRONAF program, originally designed for agricultural and rural development, made no provisions for other service sectors, such as tourism. Consequently, although 5 of the 8 boats in the sample bought with PRONAF loans were used for tourism purposes, the applicants were not allowed to state this intention in their loan applications; doing so would have rendered them ineligible for the PRONAF program.

Boats purchased through loans from family and extended social networks (21% of total respondents) were limited to non-motorized dugout canoes. About 25% of the fisher respondents purchased boats using only their own savings. In many cases, fishers began by purchasing small boats using their savings, often accrued through work aboard industrial fishing boats. Some were subsequently able to purchase larger boats after saving for years to meet down payment requirements. Even though 75% of fishers obtained their boat through some forms of financial loan or credit, 70% of these struggled to meet the purchase and loans requirements and waited for years before being able to own a boat.

Regarding the use of credit for gear purchase and maintenance, 35% of fisher respondents opted to bear these costs with their own savings, while 26% benefited from loans from family and extended social networks. The relatively low cost of these items and services and the willingness of family and friends to lend small amount of financial capital allowed many fishers to avoid formal financial services. In the Paraty region, intermediaries in the supply chain such as fish buyers, fish market owners and other middlemen also played an important role in supporting small-scale fishers with modest financial capital. Seventeen percent of fisher respondents received loans intended for gear purchase and maintenance from fish buyers and fish market owners with whom they had working relationships (Table 3). While the fish buyers or market owners provided the financial capital for the fishers to continue fishing, the fishers in turn repaid the loans with a percentage of their catches. Finally, 22% of fisher respondents accessed formal credits through the PRONAF defrayal program.

3.3. Adaptation to change and livelihood diversification

Working from Chambers and Conway’s notion that “a livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities, assets and entitlements, while not undermining the natural resource base” [3: 6], this study examined the role of formal and informal credit in the coping and adaptation strategies of small-scale fishers in the face of recent rapid changes in the local social-ecological systems of Paraty. The objective was to assess fishers’ individual and community adaptive capacity, especially in relation to vulnerability [19] and their changing facets, and coping ability with adversity [6] as a component of their social-ecological systems.

Salagrama and Koriya’s [20] framework of ‘horizontal’ and ‘vertical’ diversification patterns – herein referred to as intersectoral and intrasectoral diversification – is useful here with regards to the dynamic nature of fishers’ livelihoods in Paraty. In this context, intrasectoral diversification refers to cases in which fishers either fully opt-out of the fishing sector or become involved in other economic sectors (such as tourism) while remaining connected, though less involved, with the fishery. Conversely, intrasectoral diversification refers to cases where fishers move, occupationally and socioeconomically, within the fishing sector – either by simplifying assets to reduce production costs or investing in greater assets to increase production and income. In many cases, considerable overlap between intersectoral and intrasectoral diversification can be found.

Only 13% of fisher respondents expressed a desire to remain as full-time fishers and reported that their income was adequate to meet the basic needs of their families. Due to the high operating costs of boats and an inability to finance repairs through credit or savings, 27% of small-scale fishers downsized their fishing operations by replacing their mid-sized, diesel-powered otter trawlers with smaller boats such as dugout canoes. This strategy enabled fishers to cope with financial difficulties while continuing to make a fishing livelihood.

Tourism played a minor role in income generation for this group of fishers. But for the others, tapping into the growing tourism sector has not only reduced socioeconomic vulnerability by diversifying options for income generation, but also created opportunities for human agency (e.g. entrepreneurship and diversification). Among the fisher respondents, 43% attempted intersectoral diversification by entering the tourism sector while simultaneously remaining employed in the fishing sector (Fig. 4). Most fishers venturing into tourism did so by refurbishing their boats to enable tourist transportation during the summer (December through February) and the shrimp fishery closed season (March to May). Notably, 17% percent of fisher respondents reported both intersectoral and upward intrasectoral diversification, having purchased larger boats with the intention of engaging in larger-scale fishing activities and transporting tourists and local passengers (Fig. 4).

Two main livelihood diversification trends were identified among Paraty small-scale fishers. Fishers who had investment capital and larger boats tended to opt for tourism-related activities, while those with small and medium-size boats were far more likely to engage in intrasectoral diversification. Access to credit was a fundamental factor influencing the ability to invest in the assets necessary to diversify livelihoods. The decline in fish catches and

Table 3

<table>
<thead>
<tr>
<th>Source of credit</th>
<th>Boat acquisition (%)</th>
<th>Gear purchase and maintenance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings (personal/household)</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>PRONAF—investment</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>PRONAF—defrayal</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>Family and social network</td>
<td>8</td>
<td>26</td>
</tr>
<tr>
<td>Previous owners of boats</td>
<td>46</td>
<td>0</td>
</tr>
<tr>
<td>Fish buyers and fish market personnel</td>
<td>0</td>
<td>17</td>
</tr>
</tbody>
</table>
prices experienced by local fishers in the past decades has led them to adapt, ‘self-organize’, and demonstrate the flexibility to look elsewhere within and outside the fishery for alternative sources of income and livelihood sustainability.

4. Discussion and conclusion

In recent years, research on the challenges faced by small-scale fishers, their vulnerability and resilience, have increasingly focused on three main areas of inquiry: (i) fishers’ well-being [6,13], (ii) livelihood and food (in)security [8,21,22], and (iii) adaptation to climate change [23,24]. This approach has led researchers to frame fishers’ livelihood in terms of adaptive capacity, a paradigm shift that has permitted new insights into fishers’ ability to (a) address and cope with vulnerabilities [19], (b) to make necessary lifestyle adjustments and demonstrate flexibility [6], and (c) assist in assessing management and development policies [22,26]. In addition to assessing the above indicators or the surrogates of adaptive capacity, this study examined the dimensions of small-scale fishers’ mobilization of financial capital in order to maintain sustainable livelihoods and adapt to changing conditions in fishing and other sectors.

Historically, fishers have confronted and adapted to the vagaries of weather and climate [27] as uncertainty have always been an inherent part of the sector. As a result, changes in ecosystems and associated natural resource areas are expected, along with accumulated experiential learning by various stakeholders and communities coping with and adapting to them [25,28]. With integration to national and global markets, the rate of change in the Paraty social-ecological system in recent decades have been historically unprecedented. Livelihoods of poor and small-scale fishers have become more vulnerable to social and occupational marginalization than before due to the effects of multiple drivers. These drivers include overexploitation and degradation of marine habitats associated with industrial fishing and tourism development [25], limited accessibility to market, and lack of financial capital.

In the sustainable livelihood framework, financial capital is one of the most critical assets for enabling households to seek alternative options and to remain flexible. At the institutional policy level, addressing chronic financial capital shortages in small-scale fisheries has been a low-priority area [24]. Most current interventions relying on government and donor-funded credit schemes have proven largely ineffective in ensuring sustainable livelihoods for marginalized fishing communities [22]. This general failure of the formal, government-sponsored credit schemes is primarily attributable to rigid repayment schedules that do not consider the seasonal variability of fishing, as well as ‘unrealistic expectations of the amount of investment a fishery can support while still generating sufficient returns to allow individual fishers to repay loans’ [22:384]. Formal credit options for small-scale fishers are therefore rare, and where they do exist they are fraught with numerous difficulties. For example, in Chilika Lagoon, India, government-sponsored credit schemes failed because many borrowers succeeded in hiding their identities and escaping repayment [29]. Such difficulty in repayment by borrowers is not only associated with seasonal variability factor in fishery but, more importantly, it occurs due to lack of options and flexibility in credit provision (i.e., the ‘silo’ notion of the creditors about economic sectors for investment).

Traditionally, small-scale fishers have relied on informal credit from various local sources including fish merchants, moneylenders, friends, and family. Paraty small-scale fishers are no exception. These fishers have had a wide range of informal credit options at their disposal, each with inherent advantages and disadvantages. Private moneylenders and fish buyers are key players in the supply chain, allowing small-scale fishers to access markets and key supplies, while also providing an economic buffer during the low fishing season [30]. Another critical source of informal credit, as in many other similar regions of the world, is the fishers’ own family and extended social networks, whom typically charge little or no interest on their loans [18]. However, since the amount of capital that can be mobilized through such sources is typically small, only boat and gear maintenance can usually be supported. Thus, while credit from family and friends can help maintain livelihood security, their role in permitting livelihood diversification is limited.

Flexibility of livelihood strategies plays a vital role in allowing fishers to deal with changes and challenges. Based on a study of two Cambodian fishing communities, Marschke and Berkes [6] concluded that household-level adaptations required responding to a multitude of variables originating at higher political levels. In Kompong Phluk, many households owned back-up fishing gear and used exchange labour during lean times, whereas in Koh Sralao, households tended to diversify into non-fishing activities or engaged in wage labour. Such capacity to diversify was also observed in Paraty, as well as the Piriápolis area of Uruguay. Trimble and Johnson [13] found that although fishers considered their work ‘a way of life’, they were also open to adapting to change. Both areas were in the midst of major socio-economic and environmental transitions.

“that are driving enormous changes in the context and conditions of fishing. Materially, relationally, and aspirationally, the lives of fishers in both places are changing” [13:43].

In Paraty, Brazil, we found that more than one-quarter of small-scale fishers opted to downsize their fishing operations (an adaptive approach), while those with mid-size or larger boats were increasingly diversifying into the tourism sector (a transformative approach). In fact, about 60% of interviewed fishers had diversified into tourism activities while still actively engaged in the fishery sector, indicating a significant magnitude of transformability among the small-fishers in Paraty. Thus, we conclude that:

- Fishers in Praia Grande, Tarituba and the town of Paraty are adaptive to changes and possess significant capacity to deal with external shocks and stresses. However, they require financial capital (and credit) to enable diversification.
• Formal credit programs designed for agricultural communities are not suitable for small-fishers due to high degree of uncertainty in harvests and in other factors.
• The bureaucratic and/or institutional requirements of collateral and co-signers to obtain credit are ill-suited to the needs of small-scale fishers, who typically have few physical assets and little formal education.

Our findings have policy implications. Credit needs of small-fishers, who are vulnerable to asset loss due to uncertainty in fish catches, need to be addressed in innovative new credit arrangements. To accomplish this:

• The formal credit system should be reformed to meet the needs of small-fishers, taking into account the uncertainty of the fish catch, lack of collateral and co-signers, and the need for flexibility. Access to credit that enables fishers to invest in other sectors such as tourism would reduce pressure on fish stocks while providing for livelihood diversification.
• Innovative credit systems should be introduced to enhance small fishers’ adaptive capacity, and to diversify the local economy without leading to increases in fishing pressure on already overexploited resources and jeopardizing the marine habitat and fish stocks.
• Further understanding is needed regarding the role of credit provision (among other ways) to deal with the effects of stresses and shocks on livelihood sustainability, so as to enhance the adaptive capacity and resilience of fishing communities around the world.

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