



## Perceptions of multi-stresses impacting livelihoods of marine fishermen

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### ABSTRACT

Multiple stresses adversely affect fish catch and livelihoods of marine fishermen. Perceptions regarding these stresses in the fishing community can vary, which can consequently determine adaptation responses. However, there are limited attempts to understand these perceptions and the factors which might be influencing them. This study, first, identifies the specific stresses impacting livelihoods of the fishing community in Maharashtra (India) through the literature and Focus Group Discussions. Thereafter, a household survey is used to examine the factors influencing the perceptions of these stresses. Further, a composite stress perception index, comprising of two factors representing climatic and non-climatic or general stresses, is built. The index suggests that a majority of the community perceive greater risks from the non-climatic stresses compared to changes in temperature and rain. It is found that the perception of stresses varies significantly with the regional background. However, the relation of various other socio-economic factors is not uniform with the perceptions of different stresses. This study is one of the first to comparatively analyze climatic and non-climatic stresses in fishing, and suggests the need for effective implementation of current policy measures to reduce the stresses along with awareness generation regarding impact of climate change in the community.

### 1. Introduction

Marine ecosystems are threatened by multiple stresses, including pollution, trawlers, habitat loss and climate change, which can adversely impact fish populations [1]. This has consequently affected marine fish catch and fishing livelihoods around the world [2–5]. Awareness or perceptions regarding livelihood stresses can play a significant role in communities' decisions to adapt to them [6]. Thus, it is important to understand the multitude of factors that might be influencing these perceptions.

Studies which empirically assess factors associated with perceptions of risks, such as climate change and other environmental stresses, among farmers [7–10] and general public [11,12] exist. There are also qualitative studies describing factors influencing perceptions of livelihood risks in communities [such as [13,14]]. In the literature on fishing, few earlier studies [15,16] describe the health risk perceived by fishermen because of (mercury and other chemicals) contamination in their fishing sites. But, these studies do not report stresses/risks which can affect the livelihoods of the community. Nursey-Bray et al. [17] is one of the rare studies which presents the perceptions of climate change risks and its impacts on the livelihoods of lobster fishers in Tasmania.

They found that the fishermen's perceptions are distant from the scientific observations on climate change in the region. On the other hand, a recent study [18] in Brazil showed that fishermen perceive some of the livelihood stresses such as changes in rainfall, air and ocean temperatures in accordance with the scientific evidence. But again, these are descriptive studies and do not assess the factors which can lead to such perceptions. In India, Karnad et al. (2014) [19] analyzed perceptions of declining catch and the factors driving them. The study, however, did not examine perceptions of stresses leading to this decline. There are also few studies, in other Asian countries such as Bangladesh and Philippines, on perceptions of the fishing community about changes in fish catch [20], productivity [21] and their drivers [20]. Overall, attempts to understand perceptions of livelihood stresses in marine fishing and their associated factors are limited. The present study aims to fill this knowledge gap by examining the perceptions of multi-stresses which might be impacting catches of marine fishermen and the socio-economic factors influencing them. This study contributes to the literature on livelihood risks and has implications for designing awareness generation programmes. Awareness and perceptions of stresses can consequently affect adaptation decisions in communities [22].

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Multiple stresses, that is, increasing pollution, trawlers, decreasing mangroves and climate change are considered in this study. Impacts of pollution, trawlers and declining mangroves on marine ecosystem have been discussed in the literature [1,4,5] as well as widely in public reports/media. But, while a bulk of scientific literature indicates the impacts of climate change on marine fishing [2,23,24], it is hardly discussed in the media, especially in developing countries like India. It seems that impacts of climate change on marine fishing have not been highlighted as an issue of concern among the general public. Thus, it becomes all the more important to understand fishermen's perceptions specifically about climate change as well as relative to other stresses, and the factors affecting them. Findings of such analyses can help design climate change awareness programmes for fishing communities. Further, climate change is generally studied through patterns of change in temperature and rain [25]. Thus, this study attempts to analyze perceptions of climate change and also its constituent parameters, that is, temperature and rain, among marine fisherfolk. Agglomerating the perceptions of the multiple stresses, a composite 'stress perception index' is also built in this study. This is done to further investigate the factors influencing the overall perception of stresses. Also, as it is a weighted index, it is helpful to understand the relative perceptions regarding climatic and non-climatic/general stresses in the fishing community.

This study analyses the perceptions of marine fishermen in the state of Maharashtra, India. Maharashtra is a coastal state in western India along the Arabian Sea. The focus of the paper is specifically on the stresses which can impact fish catch of the community in the area. The next section describes the conceptual framework of the study, which includes a detailed account of the stresses in the region according to the literature and the community. It also presents the socio-economic factors which might influence perceptions of stresses, as identified from the literature. Section 3 pertains to the data and methods used in the study. The results are presented in Section 4. The paper concludes in Section 5.

## 2. Background and conceptual framework

### 2.1. Evidence of stresses in the study site

The various stresses which persist in the area and affect fish catch of the community are identified both through the literature and Focus group Discussions (FGD) with the community. The FGDs are used to evaluate if the stresses noted in the literature are experienced by the community in actuality. This helped in identifying the stresses which are hindering the livelihoods of marine fishermen based specifically in the study sites. These insights from the literature and FGDs are discussed in the following two sub-sections.

#### 2.1.1. From literature

The literature indicates that pollution in the sea, declining mangroves, increasing trawlers and change in climate can adversely affect fish population and catch [1]. An extensive review of the literature by Islam and Tanaka [4] shows that aquatic pollution (from chemicals, sewage, oils, metals, organic compounds and plastics) has had detrimental effects on the marine ecosystem around the world. This includes loss of habitat, mortality, decline in species diversity and population. Nagelkerken et al. [5] has showed through their review that mangroves serve as spawning sites and habitat for various marine species and hence, its destruction has resulted in lowering fish catch in many regions. Trawlers, too, wreck the marine ecosystem by trapping non-target specie and juvenile fish, thereby resulting in large quantity of by-catch [26] and affecting catch of other fishermen [27]. As climate change can alter ocean temperatures, it can affect ocean primary productivity and change distribution and abundance of marine fish species [2]. Change in rainfall can also influence fish population [28] as spawning periods can correspond to monsoon [29,30].

Studies which provide evidence of various stresses being prevalent in the sites of the current study are described in Table 1.

#### 2.1.2. From focus group discussions

Three FGDs with marine fishing communities located in urban, semi-urban and rural areas of Maharashtra<sup>1</sup> helped in understanding the communities' perception about the stresses identified in Section 2.1.1. Each FGD included 10–15 fishermen who have been engaged in fishing since the last 5–40 years. The communities were also enquired about any other stress which they might perceive to be affecting their fish catch. It is found that the stresses experienced by the communities in the study area mostly align with the literature (except in case of mangroves). The FGDs further assisted in obtaining any other relevant details regarding the stresses.

The FGDs revealed that the communities' strongly feel sea pollution to be the most important stress impacting their livelihood. The seas have become highly polluted in the past years. Effluents from cities, industries, ports and oil rigs are the major contributors to pollution in the seas, according to the communities. Pollution has majorly affected availability of fish. Debris in the sea also damage their fishing nets.

The semi-urban fishing community seemed to be the most concerned about the destruction of mangroves. Mangroves are fish habitats and are important locations for spawning. Destruction of mangroves because of various developmental activities has severely affected fish populations. Although the literature indicates that mangrove cover in Maharashtra has increased in recent times [35,36], the communities perceived that they have declined and have been impacting their livelihood. These perceptions are especially prevalent among the older generations of the community. Additionally, pollution, in the form of chemicals, sewage, plastics and other debris, has affected the mangroves.

All the three groups perceive trawling to be a destructive method of fishing. They perceive that such methods of fishing should be regulated, through seasonal bans and restrictions on owning multiple trawlers by a single fisherman.

The fishing communities perceive changes in climate. Temperature has increased, and rain has decreased accompanied by delays in monsoon. All the communities noted that change in rainfall and delays in monsoon affect fish spawning which consequently affects their livelihoods. The communities also perceive that increase in temperature can affect distribution and availability of fish species. However, during the FGDs only a limited number of participants of the three communities, who were experienced and aged, were able to explain the effect of temperature on fish distribution. They described that fish population change their spatial location and depth in the sea according to temperature. However, they were not able to gauge the effects of declining chlorophyll, resulting from warming as noted from the literature [49,50], on fish populations.

Thus, based on the literature and FGDs, the following stresses are identified to be affecting the communities in the study sites: (i) increase in pollution, (ii) decrease in mangroves, (iii) increase in trawlers, (iv) change in climate, including (v) increase in temperature and (iv) decrease in rain.

### 2.2. Identifying factors driving perception of stresses

According to the 'risk perception' literature, various socio-economic factors can shape perceptions of stresses (impacting livelihoods) of individuals. The factors specifically tested for their association with perception of different stresses in this study are discussed in the following paragraphs. They include: (i) region, (ii) level of education, (iii)

<sup>1</sup> The FGDs are held with communities with different regional backgrounds, as 'region' is considered to be a factor affecting perception of stresses in this study. The details are described in Section 2.2.

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