Marine Policy xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Spatial management in small-scale fisheries: A potential approach for climate change adaptation in Pacific Islands

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A B S T R A C T

Small-scale fisheries are undeniably important for livelihoods, food security and income around the globe. However, they face major challenges, including global market and demographic shifts, policy changes and climate variations that may threaten the wellbeing, health and safety of fishing communities. Over the years, various forms of spatial management have been implemented in small-scale fisheries as a potential solution to problems afflicting these systems. The benefits of such approaches can be numerous for both ecosystems and coastal communities. In addition to the persistent challenges influencing small-scale fisheries practices, the emerging effects of climate change pose serious risks to coastal ecosystems and fishing communities, especially in low-lying islands. Despite a growing recognition of both the benefits of spatial management and the adverse effects of climate change on small-scale fisheries, integration of these concepts in a consistent and comprehensive way has not yet occurred. Spatial management has the potential to foster small-scale fisheries adaptation to climate change, however, in the face of such a global and transboundary phenomenon, management strategies will need to be carefully designed and implemented. First, key considerations for climate-informed spatial management in small-scale fisheries were identified. Second, these key considerations were illustrated in two selected case studies in Pacific Island countries and territories (i.e. Fiji and Papua New Guinea). Finally, the challenges associated with spatial management in a changing climate are discussed and ways forward for advancing this type of management as a climate adaptation approach for small-scale fisheries in the Pacific and beyond are proposed.

1. Introduction

1.1. Small-scale fisheries: characteristics, contribution and challenges

People around the globe, whether adjacent to coastal areas or inland, rely on marine resources as a primary source of protein, [1,2]. In addition, millions of people, including small-scale fishers, are highly dependent on these types of resources for their livelihoods and income. When compared to industrial fleets, small-scale fisheries are extremely intricate social-ecological systems that can be identified by their relatively small spatial footprint – due to fishing trips close to shore and primarily for local consumption; the diversity of gear types used; the various species targeted; and the multitude of cultures, practices and governance systems existing worldwide [1–4]. The decentralized nature of small-scale fisheries often limits the influence of governments or other governing bodies and, thus, results in informal self-governing systems or locally-specific arrangements. Despite their small spatial footprint at the local level, small-scale fisheries are major contributors to food supply, food security, employment and livelihoods globally. Small-scale fisheries employ about 90% of the fishers worldwide and supply half of the marine fish caught for human consumption [1,2,4]. In the Pacific region, small-scale fishers represent a vast majority of the population and, beyond its economic and social benefits, fishing plays an important cultural role [5,6].

While small-scale fisheries are undeniably important, they face a number of major challenges, including global market shifts, policy changes, climate variation, and demographic shifts that may threaten the wellbeing, health and safety of fishers [7–10]. In addition to the major enduring challenges small-scale fisheries face, global climate change has become an increasingly important threat to their existence. Climate change causes increases in air and ocean temperatures, rising sea levels, changes in precipitation patterns, and increasing intensity and variability of extreme events. In turn, these impacts drive changes in ecosystems upon which coastal communities depend for their livelihoods and cultures, including coastal erosion and inundation, coral bleaching, changes in fish distribution and abundance, saline

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http://dx.doi.org/10.1016/j.marpol.2017.09.030
Received 16 March 2017; Received in revised form 1 September 2017; Accepted 25 September 2017

Box 1
Common small-scale fisheries spatial management in Pacific Island countries and territories.

- Locally Managed Marine Area (LMMA)
- Community Managed Area (CMA)
- Marine Protected Area (MPA)
- Marine Reserve
- Marine Sanctuary
- Customary Tenure
- Tabu Area
- Village-based managed areas (VMA)
- Territorial User Right for Fisheries (TURF)
- Exclusive Economic Zone (EEZ)
- Marine Spatial Planning (MSP)

contamination of freshwater, increasing risk of disease, decreasing safety at sea, and disruption of fishing operations and infrastructure [4,11,12]. Climate change impacts pose particularly serious risks to low-lying islands, especially in Pacific Island countries and territories [11,13–15] due to the comparative smallness, remoteness, geographical location – close to the tropics – and archipelagic character of many of the islands [16].

1.2. Spatial management: a common practice in the Pacific

Given small-scale fisheries' deep connections with local geographies and communities' strong sense of place [17,18], various spatial management approaches have been designed and applied to small-scale fisheries (e.g., Locally Managed Marine Areas (LMMAs), Territorial Use Rights for Fishing (TURFs), and customary tenure, etc.) (Box 1) to address the problems afflicting these systems and maintain the benefits provided by the oceans [19,20]. Historically, small-scale fisheries in Pacific Island countries and territories (PICTs) have had strong connections to specific places, and communities have been using variations of traditional spatial management for many centuries [21]. The effectiveness of traditional spatial management practices, like 'tabu areas' and village-based marine reserves, in Fiji, Samoa, and Vanuatu, or 'Ahupua'a' (i.e. watershed management) in Hawai'i, for example, indicate the potential for spatial management as an approach for social-ecological adaptation [21,22]. In fact, many contemporary spatial management approaches implemented in PICTs have been largely inspired by traditional systems and incorporate existing practices. In the past few decades, hybrid systems using traditional and contemporary management methods, like Locally Managed Marine Areas (LMMA), large marine reserves or co-managed Marine Protected Area (MPA) networks, have been implemented as a way to simultaneously conserve biodiversity and livelihoods [23,24].

1.3. Spatial management: an integrated approach that benefits social-ecological systems

Spatial boundaries have long since played a significant role as delineators and dividers of institutions, management authorities, cultural identity, etc. [25]; it is thought that spatial management can make complex issues more manageable by anchoring them into specific spaces directly associated with governing and enforcing institutions, and by ascribing legitimacy and responsibility to relevant actors [20,26]. Likewise, the importance of well-defined and enforced boundaries has been extensively argued for in the common-pool resource literature as a condition for successful small-scale fisheries management [27–31]. Increasingly, such approaches have expanded in the world's oceans to define territories and delimit spaces for specific uses, practices and values. The benefits of spatial management are numerous for both ecosystems and coastal communities, such as small-scale fishers [32–36]. By allocating a specific marine area to an individual, a community, or for a specific purpose, spatial management can foster fine-scale and locally-appropriate decision-making, informed by local science and local ecological knowledge [37]. In turn, it can directly benefit habitat and resource conservation by providing potential areas in which fishery stocks can recover and spillover to surrounding fishing grounds for example, and which can mitigate the impact of uses on sensitive ecological areas [38]. In addition, spatial management has a potential to reduce current and future conflicting uses and competition over ocean space (e.g., tourism vs. fishing; small-scale vs. large-scale fishing) [39] by creating efficient spatial and temporal distribution of fishing activities [38,40]. Finally, instead of targeting a specific species, spatial approaches can offer multi-species management strategies and, hence, increase opportunities for ecosystem-based management. By providing management flexibility and opportunities to switch fisheries as a risk aversion strategy, multi-species management can increase social-ecological adaptation [38]. These management approaches can also benefit local fishery-dependent communities by supporting livelihoods and employment, protecting food security for the communities that rely on the resource as well as incentivizing sustainable fishing behaviors and ocean stewardship [41,42].

1.4. Research goal: fostering climate-informed spatial management

However, similar to other management approaches in small-scale fisheries, spatial management may not always result in expected social-ecological benefits without understanding the key considerations that foster adaptation, and carefully designing management strategies [43], especially in the context of climate change. In addition, addressing the challenges of using static boundaries to manage resources in a constantly changing world are salient efforts that can inform the development of practical and innovative climate-informed spatial management [7,44]. Now, more than ever, it is critical to design spatial management strategies that will reflect the changes and impacts driven by climate and integrate opportunities for social-ecological adaptation in Pacific Island countries and territories. In this article, key considerations for small-scale fishery spatial management in the context of climate change are identified, across learning, designing, and managing phases informed by an inductive literature review. Second, the application of these key considerations in two PICTs examples, one from Fiji and another form Papua New Guinea, are explored. Finally, the challenges associated with spatial management in the face of climate change are discussed and potential ways forward for advancing this type of management as a climate adaptation approach for small-scale fisheries in the Pacific are proposed.