ARTICLE IN PRESS

Marine Policy xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Marine Policy

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

Adaptations to maintain the contributions of small-scale fisheries to food security in the Pacific Islands

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ABSTRACT

In several Pacific Island countries and territories (PICTs), rapid population growth and inadequate management of coastal fish habitats and stocks is causing a gap to emerge between the amount of fish recommended for good nutrition and sustainable harvests from coastal fisheries. The effects of ocean warming and acidification on coral reefs, and the effects of climate change on mangrove and seagrass habitats, are expected to widen this gap. To optimise the contributions of small-scale fisheries to food security in PICTs, adaptations are needed to minimise and fill the gap. Key measures to minimise the gap include community-based approaches to: manage catchment vegetation to reduce sedimentation; maintain the structural complexity of fish habitats; allow landward migration of mangroves as sea level rises; sustain recruitment and production of demersal fish by managing 'source' populations; and diversify fishing methods to increase catches of species favoured by climate change. The main adaptions to help fill the gap in fish supply include: transferring some fishing effort from coral reefs to tuna and other large pelagic fish by scaling-up the use of nearshore fish aggregating devices; developing fisheries for small pelagic species; and extending the shelf life of catches by improving post-harvest methods. Modelling the effects of climate change on the distribution of yellowfin tuna, skipjack tuna, wahoo and mahi mahi, indicates that these species are likely to remain abundant enough to implement these adaptations in most PICTs until 2050. We conclude by outlining the policies needed to support the recommended adaptations.

1. Introduction

Fish[1] is widely recognized as a cornerstone of food security in the Pacific Island region [10,42,43,99], where it provides 50–90% of animal protein for coastal communities in many Pacific Island countries and territories (PICTs). Most of this fish has traditionally come from small-scale coastal fisheries, which have contributed to food security both directly through subsistence fishing and indirectly through incomes earned from artisanal fishing. These activities include bottom fishing (hook and line) in lagoons and reef slopes; spearfishing on reef flats and shallow coral habitats (including at night with torches); gillnetting in intertidal and shallow subtidal habitats; trolling and drop-line fishing for tuna and other large pelagic fish in nearshore waters; and gleaning on intertidal and shallow subtidal reefs and sand flats, as well as in mangrove and seagrass habitats [31,84]. The collection of sea cucumbers has also contributed significantly to the income of communities across the region [87]. However, poor management and limited monitoring of sea cucumber fisheries has led to overharvesting, with concomitant severe declines in stocks [78,86,88]. The aquarium trade also provides livelihoods in a number of PICTs

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[1] Fish is used here in the broad sense to include finfish and invertebrates.

http://dx.doi.org/10.1016/j.marpol.2017.05.019
Received 2 January 2017; Received in revised form 27 April 2017; Accepted 12 May 2017
0308-597X/

(e.g., Fiji, French Polynesia, Kiribati, Marshall Islands, Solomon Islands and Vanuatu). In this trade, small, colourful, fish species are typically supplied by artisanal fishers, whereas giant clams and corals are usually produced by small-scale aquaculture operations [100,105,106,107].

Most of these small-scale activities have focused on demersal fish and invertebrates associated with coral reef ecosystems, and to a lesser extent on those associated with mangrove, seagrass and intertidal flat habitats [84]. More recently, there has been increased diversification of small-scale fisheries into targeting large pelagic fish, including tuna, in nearshore waters of several PICTs across Melanesia, Micronesia and Polynesia (Fig. 1). Despite this diversification, a gap is emerging in several PICTs between the amount of fish recommended for good nutrition – 35 kg per person per year [99] – and coastal fish catches [10,11]. This gap is being driven largely by rapid population growth, which is expected to double for the region as a whole by 2050,[2] and also by reductions in fisheries production due to over-exploitation and/or degradation of coastal ecosystems at some locations [84].

An assessment of the vulnerability of tropical Pacific fisheries and aquaculture to climate change co-ordinated by the Pacific Community [8,13] has demonstrated that shortfalls in coastal fisheries production are likely to be exacerbated further by continued greenhouse gas (GHG) emissions. In particular, the productivity of coral reef fisheries is expected to decrease by 20% by 2050 under a 'business as usual' (high) GHG emissions scenario, due to the effects of ocean warming and acidification on the biological and physical structure of coral reefs [54,84], and the distribution, fitness, availability and catchability of demersal fish [85]. In addition, the areas of mangroves in PICTs are expected to decrease by 50–70% by 2050 under a high GHG emissions scenario, due mainly to sea-level rise and more intense storms. Increased runoff from higher rainfall, more intense storms, and increasing sea surface temperatures associated with global warming are also likely to reduce the areas of seagrass habitats in PICTs by 5–35% by 2050 [111].

Here, we describe practical adaptations that should assist small-scale coastal fishers to help supply the fish needed for good nutrition of Pacific Island populations in the face of rapid population growth and the effects of climate change on coastal fish stocks and habitats. These adaptations were selected using a framework that addresses the main short-term drivers of fish availability (population growth, fishing pressure and habitat degradation) and longer-term climate change. They were also selected to: 1) minimise the gap by supporting the sustained production of fish from coral reefs, mangroves and seagrasses; and 2) fill the gap, mainly by making it easier for small-scale fishers to access the region's rich tuna and other nearshore pelagic fish resources. We conclude by describing the policies needed to support the implementation of these adaptations.

We do not discuss the complementary adaptations to climate change and supporting policies recommended for industrial tuna fisheries, aquaculture or freshwater fisheries to maintain or increase the contributions of these operations to local food security because they have been documented elsewhere [12,14,41,58,60,79].

2. Adaptation framework

We used the framework shown in Fig. 2 to identify two types of practical, planned adaptations.

1. 'Win-win' adaptations, where investments help address, for example, the effects of rapid population growth on the availability of fish

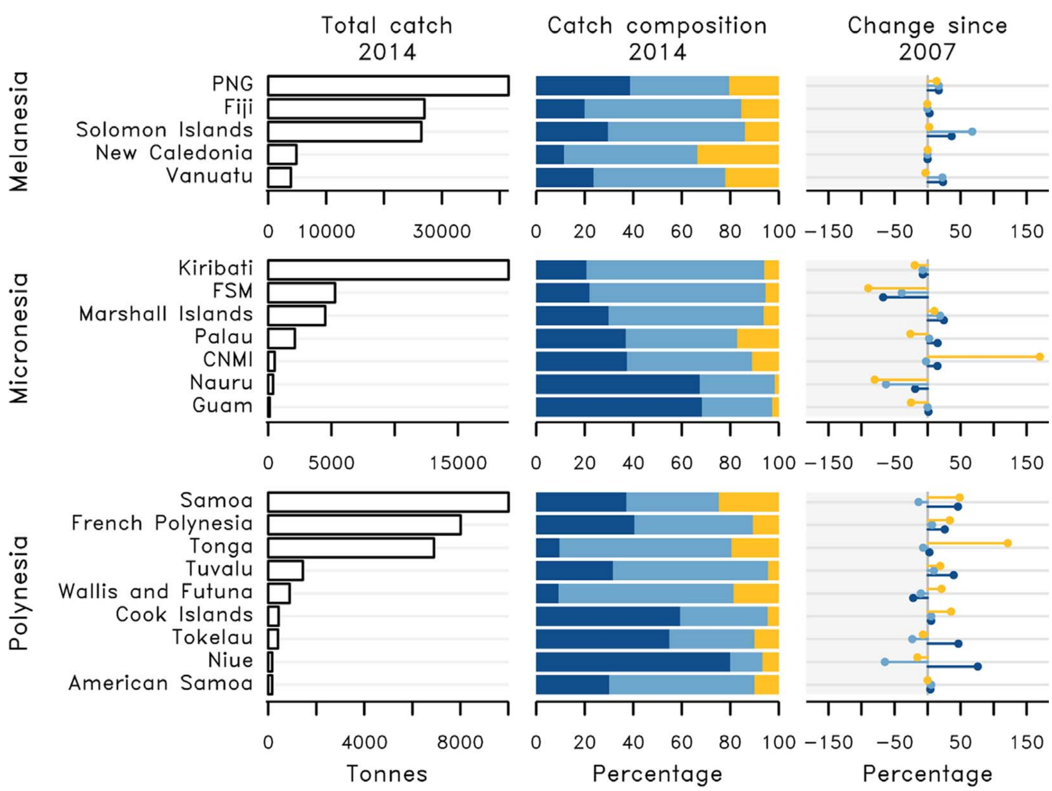

Fig. 1. Total coastal fisheries catch (tonnes) for Pacific Island countries and territories (PICTs) in 2014 (left), together with the estimated percentage of demersal fish (■), nearshore pelagic fish (■) and all invertebrates (■) comprising the total catch in 2014 (centre) and the percentage change in each catch component since 2007 (right). Based on information in Gillett (2009) [42], Gillett (2016) [43], Pratchett et al. (2011) [84] and the Supplementary Material. Note differences in scale for total catch between PICTs in Melanesia, Micronesia and Polynesia. See Supplementary Tables 1 and 2 for details of estimated catches in each PICT in 2007 and 2014, respectively. PNG = Papua New Guinea; FSM = Federated States of Micronesia; CNMI = Commonwealth of the Northern Mariana Islands.

[2] http://prism.spc.int/regional-data-and-tools/population-statistics