Marine Policy 56 (2015) 98–105

Contents lists available at ScienceDirect

Marine Policy

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

Optimising the use of nearshore fish aggregating devices for food security in the Pacific Islands

Johann D. Bell [a,b,*], Joelle Albert [c], Serge Andréfouët [d], Neil L. Andrew [b,e], Michel Blanc [f], Philip Bright [g], Deidre Brogan [f], Brooke Campbell [b], Hugh Govan [h], John Hampton [f], Quentin Hanich [b], Shelton Harley [f], Arthur Jorari [g], Marcus Lincoln Smith [i,j], Scott Pontifex [g], Michael K. Sharp [g], William Sokimi [f], Arthur Webb [b]

[a] Betty and Gordon Moore Center for Science and Oceans, Conservation International, 2011 Crystal Drive, Suite 500, Arlington, VA 22202, USA
[b] Australian National Centre for Ocean Resources and Security, University of Wollongong, NSW 2522, Australia
[c] WorldFish, PO Box 438, Honiara, Solomon Islands
[d] Institut de Recherche pour le Développement, B.P. A5, 98848 Noumea, New Caledonia
[e] WorldFish, Bayan Lepas, Penang 11960, Malaysia
[f] Fisheries, Aquaculture and Marine Ecosystems Division, Secretariat of the Pacific Community, B.P. D5, 98848 Noumea, New Caledonia
[g] Statistics for Development Division, Secretariat of the Pacific Community, B.P. D5, 98848 Noumea, New Caledonia
[h] Locally Managed Marine Areas Network, PO Box S-37, Suva, Fiji
[i] Cardno, PO Box 19, St Leonards, NSW 1590, Australia
[j] Department of Biological Sciences, Faculty of Science, Macquarie University, NSW 2109, Australia

ARTICLE INFO

Article history:
Received 26 November 2014
Received in revised form
20 February 2015
Accepted 20 February 2015

Keywords:
Pacific Islands
Fish aggregating devices (FADs)
Food security
Tuna
Small-scale fisheries
Co-management

ABSTRACT

It is widely recognised that anchored, nearshore fish aggregating devices (FADs) are one of the few practical ‘vehicles’ for increasing access to tuna to help feed the rapidly growing rural and urban populations in many Pacific Island countries and territories (PICTs). However, considerable planning, monitoring and research is still needed to understand and fulfil the potential of nearshore FADs. Investments are required to (1) identify the locations where FADs are likely to make the greatest contributions to the food security of rural (coastal) communities, and yield good catches near urban centres; (2) integrate the use of FADs with other livelihood options available to rural communities and remove any blockages preventing such communities from harnessing the full range of benefits from FADs; (3) assess whether exclusion zones for industrial fishing provide adequate access to tuna for small-scale-fishers; (4) determine if small-scale fishers are able to catch sufficient tuna to meet the protein needs of rural communities; (5) evaluate whether FADs add value to coral reef management initiatives; and (6) improve the design and placement of nearshore FADs. This paper describes these investments and outlines other steps that governments and their development partners need to take to establish and maintain nearshore FADs as part of national infrastructure for food security of PICTs.

1. Introduction

Pacific Island people have an extraordinary dependence on fish[1] for food. Fish consumption in Pacific Island countries and territories (PICTs), which is based mainly on small-scale subsistence and commercial fishing for fish associated with coral reefs, and large pelagic fish (including tuna), is several times higher than the global average [1,2]. Fish typically supplies 50–90% of dietary animal protein for coastal communities [1,2] and in 10 PICTs per capita fish consumption in these communities exceeds 70 kg yr^{-1}.

As the human populations of PICTs grow, governments have been encouraged to provide access to at least 35 kg of fish per person per year [3], or maintain higher traditional levels of fish consumption where they occur [1], for two reasons. First, fish is rich in protein, essential fatty acids, vitamins and minerals [4], and is a logical cornerstone for food security given the high levels of subsistence and scarcity of arable land on many of the islands. Second, increased access to fish provides a healthy alternative to the nutritionally-poor imported foods now pervading Pacific diets [5,6]. Greater consumption of fish and other traditional foods is needed to combat the high prevalence of non-communicable diseases in the region [7].

* Corresponding author at: Australian National Centre for Ocean Resources and Security, University of Wollongong, NSW 2522, Australia. Tel.:+612 4221 4883/+61 412 657319.
E-mail address: b.johann9@gmail.com (J.D. Bell).

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

http://dx.doi.org/10.1016/j.marpol.2015.02.010
0308-597X/

Table 1
Indicative quantities of fish needed for food in 2020 and 2035, and surpluses (+) or deficits (−) in coastal fish supply, relative to the recommended 35 kg per person per year or traditionally higher levels of fish consumption, for two groups of Pacific Island countries and territories (PICTs) (after Ref. [7]).

PICT	Coastal fish production ($t\,yr^{-1}$)[a]	2020		2035	
		Fish needed for food (t)[b]	Surplus (+)/deficit (−) (t)	Fish needed for food (t)[b]	Surplus (+)/deficit (−) (t)[c]
Group 1: countries and territories expected to have a fish deficit					
Papua New Guinea[d]	81,260	81,860	−600	108,500	−30,090
Solomon Islands[e]	27,610[f]	25,400	2,210	35,600	−7,990
Samoa[g]	14,000	15,600	−1,600	15,700	−2,190
Kiribati[g]	12,960	10,900	2,060	13,400	−890
Vanuatu[e]	3,730	10,800	−7,070	14,000	−10,400
American Samoa[g]	1,100	2,100	−1,000	2,400	−1,340
CNMI[e]	750	2,100	−1,350	2,300	−1,580
Guam[e]	710	6,900	−6,190	7,400	−6,710
Nauru[g]	130	700	−570	800	−670
Group 2: countries and territories with difficulties distributing fish to urban centres					
Fiji[e]	77,000	31,100	+45,900	33,700	+40,610
FSM[g]	45,220	7,600	+37,620	7,100	+36,540
French Polynesia[g]	45,380	18,800	+26,580	20,000	+23,790
Tonga[e]	17,430	3,600	+13,830	3,900	+12,920
Tuvalu[g]	9,530	1,300	+8,230	1,500	+7,700
Wallis and Futuna[g]	2,800	900	+1,900	900	+1,800
Niue[g]	170	100	+70	100	+60

[a] Based on median estimates of sustainable fish harvests of $3\,t\,km^{-2}$ of coral reef [46,47], and other sources of information [7].
[b] Based on population projections by the Statistics for Development Division, Secretariat of the Pacific Community.
[c] Calculations for 2035 include a 2–5% reduction in the production of coastal fisheries due to the effects of climate change [18].
[d] Fish needed for food based on providing 35 kg per person to people living within 5 km of the coast, and 28 kg per person for people living in coastal urban areas (see Supplementary material for details). Note that estimates differ from those in Ref. [7] because they do not include the fish needed by the nation's inland population. There will also be difficulties transporting fish from remote coral reefs to population centres.
[e] Fish needed for food based on recommended fish consumption of 35 kg per person per year.
[f] Includes 2000 t of freshwater fish.
[g] Fish needed for food based on recent traditional levels of fish consumption for rural and/or urban populations which are greater than 35 kg per person per year [1,2].

For many PICTs[2], the problem is that the production of fish from coral reefs will not yield the recommended 35 kg of fish per person per year, or continue to supply the traditionally higher quantities of fish, as human populations grow (Table 1). Several other PICTs[3] will have problems distributing fish from remote reefs to urban centres.

To provide access to the recommended quantities of fish, these PICTs will need to allocate more of the tuna caught within their waters to local food security. Across the region, tuna will need to provide 12% of all fish required for food security by 2020, and 25% by 2035 [7]. Although the amount of tuna needed in 2020 and 2035 represents only 2.1% and 5.9%, respectively, of the present-day industrial catch from the combined exclusive economic zones (EEZs) of PICTs [7], there are considerable challenges involved in distributing this tuna to the growing coastal and urban communities.

One of the most practical 'vehicles' for improving local access to tuna is installation of nearshore fish aggregating devices (FADs) (Fig. 1). Nearshore FADs are based on observations that tuna and other large pelagic fish are attracted to floating objects and often stay in their vicinity for several days. Nearshore FADs differ from the drifting FADs and large anchored FADs used by industrial tuna fleets [8–10] because they are usually placed closer to shore in depths of 300–700 m.

Nearshore FADs increase the supply and consumption of fish in rural communities [11] and have been progressively improved over the past 20 years to increase their working life and reduce their cost. Analyses of the cost:benefit of nearshore FADs in Cook Islands and Niue show that the value of tuna and other pelagic fish caught around them exceed their costs by 3–7 times [12]. Other studies, comparing catch-per-unit-effort (CPUE) and fuel consumption ($L\,h^{-1}$) of small-scale fishers operating with and without nearshore FADs demonstrate that: (1) CPUE near FADs is 7 to 23 $kg\,h^{-1}$ greater, and (2) average fuel consumption by fishers operating around FADs is 0.5 $L\,h^{-1}$ lower, than when fishing is not associated with FADs [13,14]. Recent research also shows that nearshore FADs provide returns on investment (internal rate of return) ranging from 80% to 180% [15,16].

There is also recognition that regular use of nearshore FADs could have two other possible benefits. First, it provides communities with the opportunity to transfer some of their fishing effort from coral reefs to oceanic fisheries resources—an intervention expected to help prevent over-exploitation of coral reef fish and maintain the normal representation of important functional groups of fish (e.g. herbivores) associated with coral reefs [17] required to assist these ecosystems to adapt to climate change [18–21]. Preliminary analyses in the Federated States of Micronesia and Vanuatu indicate that 50% to 75% of fishing effort can be transferred from reefs to FADs [16,22]. Second, nearshore FADs could enhance the success of coral reef management initiatives, e.g. those by the local marine managed area (LMMA) networks [23,24] and Micronesia Challenge[4], by providing practical ways for people to continue to catch pelagic fish when regulations are introduced to help coral reefs recover from overfishing and other local stressors, e.g. through designation of temporal or spatial fishing closures.

Despite the promise that nearshore FADs hold for improving access to tuna and other pelagic fish for coastal and urban communities, and for improving the management of coral reefs, extensive planning, monitoring and research are needed to reap all the potential benefits of FADs. Indeed, considerable caution is required to implement FAD programmes so that they do not fall into the same category as the many technically viable and seemingly sensible 'solutions' littering the region that have failed

[2] American Samoa, Guam, Kiribati, Nauru, Commonwealth of the Northern Mariana Islands, Papua New Guinea, Samoa, Solomon Islands and Vanuatu.
[3] Fiji, Federated States of Micronesia, French Polynesia, Niue, Tonga, Tuvalu and Wallis and Futuna.
[4] www.micronesiachallenge.org.