Proceedings of the 12th International Coral Reef Symposium, Cairns, Australia, 9-13 July 2012
13E Fisheries: General Section

Status, trend and sustainability of small-scale fisheries in the Philippines

Richard N. Muallil[1,2,3], Reniel B. Cabral[4], Samuel S. Mamauag[1,2] and Porfirio M. Aliño[1,2]

[1]Marine Science Institute, University of the Philippines Diliman, 1101 Quezon City, Philippines
[2]Marine Environment and Resources Foundation, Inc., Marine Science Institute, University of the Philippines Diliman, 1101 Quezon City, Philippines
[3]Mindanao State University – Tawi-Tawi College of Technology and Oceanography, 7500 Bongao, Tawi-Tawi, Philippines
[4]National Institute of Physics, University of the Philippines Diliman, 1101 Quezon City, Philippines
Corresponding author: rnmuallil@gmail.com

Abstract. Implementing management initiatives aimed at promoting recovery of depleted fisheries in the Philippines proved to be challenging in the face of poor fishery-dependent fishing communities. Harmonizing the varied options between resource protection, sustainable use, and welfare of the fishers needs to be considered in fisheries governance. An assessment of coastal fisheries of 25 towns in the Philippines using FISHDA (Fishing Industries' Support in Handling Decisions Application) model was done to afford general rules to be considered in management to be within its fishing capacity. Results showed that the fisheries in 64% (16 out of 25) of the towns are unsustainable. To prevent fishery collapse, these towns need to either protect 56% of their fishing grounds or reduced the number of active fishers by 55%. When 15% of the fishing grounds were protected, as mandated by the law, only 3 of the previously unsustainable fisheries became sustainable. Further, the number of fishers that can be supported slightly improved by 5%. Currently, the average MPA size in all towns is only around 4.5% of the municipal waters with only El Nido and Masinloc exceeding the mandated 15% MPA size. Our findings demonstrated that increasing MPA size, according to the recommendation of the law, will not be enough to avert fishery collapse if not complemented with other measures that reduce dependency on the fisheries. Important recommendations to improve the condition of fisheries based on the ecological and socio-economic attributes of the towns are further discussed.

Key words: FISHDA model, Small-scale or Municipal fishers, Marine Protected Area, Sustainable

Introduction

Coastal fisheries worldwide are in a continually declining state (Pauly 2002). With the subsequent worsening poverty in the fishing communities, coastal resource management (CRM) practitioners are often caught in a dilemma between protecting the resources and prioritizing the livelihood of the fishery-dependent communities. This challenge is higher in developing countries like the Philippines where opportunities outside the fishery are less if not unavailable at all. Poverty and unavailability of alternative livelihood could further increase fishing pressure that undermines fisheries sustainability. Having a science-based estimate of the maximum sustainable yield (MSY) of the fish stocks is of vital importance to address this problem. MSY estimates can be used as basis for (i) livelihood and other related programs to alleviate fishing pressure, and (ii) resource-protection initiatives such as MPA establishment.

Various models have been developed to estimate MSY (Lachica-Aliño et al. 2006) of fish stocks since mid-1990s but mostly too technical in terms of operation and data needs for CRM practitioners in the Philippines (Cabral et al. 2010). Primary mandate on CRM in the country has been devolved to the local government units (LGUs) who mostly lack the technical skills for such a mandate. In this regard, various user-friendly and less complicated tools were developed in the Philippines to assist the LGUs and other CRM practitioners. One of these tools is FISHDA which uses basic ecological, fisheries and socioeconomic information to assess the state and sustainability of the fisheries (De Castro et al. 2007, Cabral et al. 2010). In this study, we applied FISHDA (De Castro et al. 2007) to assess the fisheries of 25 coastal towns throughout the Philippines. Important findings and recommendations including the number of fishers and MPA size requirement for sustainable fisheries are discussed.

Material and Methods

Data collection

Snow-ball one-on-one interviews with 77 to 219 (total, 2,274) small-scale fishers aged 16 to 77 years old were conducted in 25 towns throughout the Philippines (Figure 1). The interviews were carried out by at least 4 local interviewers who were college graduates or had previous experience in doing similar surveys. Nonetheless, the interviewers were trained well on delivering the questions prior to the interviews to minimize interviewer-generated bias as much as possible. The study was conducted from 2009 to 2011.

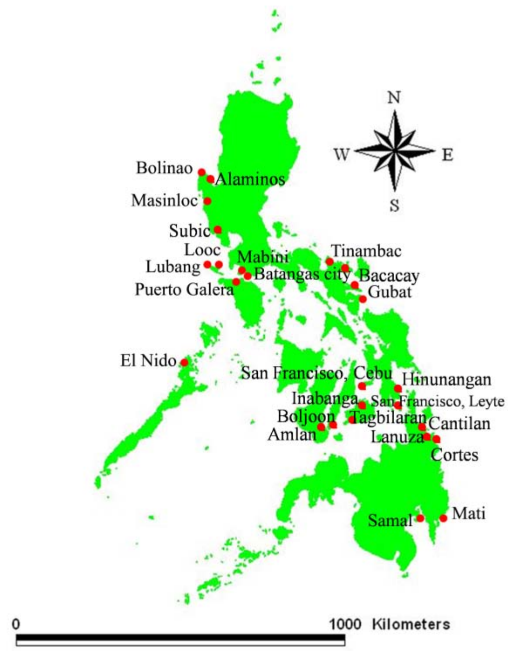

Figure 1: The geographical location of the 25 study sites.

Focus group discussions (FGDs) with key informants who were mostly fishers, local leaders and representative from various people's organizations were also conducted to validate results from one-on-one interviews and to discuss issues and threats confronting the fisheries. Size of municipal waters was estimated from ArcView software. Size of fishing grounds was estimated from FGDs. Generally, the area of the fishing grounds were 70% of the municipal waters in towns with open seas (Bolinao, Cantilan, Cortes, El Nido, Gubat, Lanuza, Looc, Lubang, Masinloc, Mati and Tinambac) and 90% for the rest of towns with close or relatively more sheltered seas. MPA size and number of municipal fishers were obtained from the database of the Marine Science Institute of the University of the Philippines or from the record of respective LGU of each town.

Analysis

FISH-DA (De Castro et al. 2007) was used to model the fisheries of the 25 towns. FISHDA is a simpler and freely distributable version of FISH-BE (Fisheries Information for Sustainable Harvest Bio-Economic model) (De Castro et al. 2007; Cabral et al. 2010). See the Philippine Environmental Governance (EcoGov 2) project (2007) for details about FISHDA and FISH-BE.

Specifically, we determined (i) the fishery's sustainability in 20 years, (ii) number of fishers that can be supported by the fishery, (iii) the minimum size of MPA needed to sustain the fish stocks, (iv) the sustainability of the fishery with no MPA and (v) MPA size of 15% of the municipal waters. The country's law mandates all coastal LGUs to protect 15% of its municipal waters. Data from interviews and other secondary sources were used as inputs to the model (Table 1). Commercial fishers (fishing vessels greater than 3 gross tons) were not included since the study was focused on fisheries within the municipal waters (up to 15 km from the shore) where commercial fishing activities are not allowed by the law. The number of commercial fishers in the model was set to zero. For the rest of the inputs, the default values in the software were used due to unavailability of the data for some sites.

Results

Average daily catch rates per fisher ranged from 2.0 (San Francisco Leyte and Hinunangan) to 16.5 kg (Masinloc) (Table 1). Average normal catch per fisher is only around 4.8 kg/day. However, in Tagbilaran City where there are 6,000 fishers, total daily catch could reach up to 27.6 metric tons (MT) or 0.54 MT/km^2 of the fishing grounds. This could translate to a total annual yield of 149 MT/km^2 in 247 fishing days in a year in Tagbilaran City. Average (±sd) annual yield for all the towns is 14 (±30) MT/km^2.

Number of fishers per km^2 of the fishing ground ranged from 1(Looc and Lubang) to 131 (Tagbilaran City) with an average density of 14±26 fishers/km^2. Fishers spent from 143 to 274 fishing days in a year with 56% of them targeting demersal species such as parrotfishes (Scaridae), emperors (Lethrinidae), snappers (Lutjanidae) and groupers (Serranidae). Major pelagic species caught are tunas and mackerels (Scombridae), jacks and scads (Carangidae) and sardines (Clupeidae). Average (±sd) price of the major catches as sold by fishers ranged from US$ 1.1 (±1.0) to US$ 2.5 (±0.8) per kg in El Nido and Tagbilaran City, respectively.

Town	Fishing ground (km^2)*	MPA size (% of municipal waters)	No. of fishers per km^2 fishing ground	Fishing days/year	Catch/fisher/day(kg)	Fish price/kg(US $)*	% Demersal species in catch
Alaminos	179	8.3	11	240	2.4	1.4	91
Amlan	39	0.2	14	247	3.7	2.1	14
Bacacay	201	2.0	9	207	4.2	1.7	72
Batangas	319	0.0	4	199	2.5	1.6	45
Bolinao	604	0.1	7	227	3.7	1.2	91
Boljoon	98	0.2	8	226	3.3	1.9	32
Cantilan	176	0.2	36	208	6.1	1.7	64
Cortes	201	0.4	3	248	3.0	2.0	83
El Nido	1128	33.7	3	245	6.4	1.1	67
Gubat	316	0.5	4	260	3.0	2.2	86
Hinunangan	163	0.7	4	152	2.0	2.0	69
Inabanga	147	0.1	34	274	2.2	2.1	67
Lanuza	104	0.4	7	165	2.5	2.1	43
Looc	1041	4.7	1	241	5.1	1.7	83
Lubang	800	6.1	1	240	6.8	1.2	31
Mabini	176	1.7	4	221	5.1	1.8	30
Masinloc	146	37.2	9	166	16.5	1.5	27
Mati City	978	0.5	2	251	10.2	2.1	57
P. Galera	106	8.5	3	168	4.8	2.1	36
Samal City	933	5.2	4	270	4.6	1.8	65
San Fran, Cebu	809	0.0	4	237	4.9	1.6	38
San Fran, S. Leyte	104	0.1	4	143	2.0	1.8	47
Subic	68	1.3	19	220	3.7	1.8	63
Tagbilaran City	46	0.2	131	247	4.6	2.5	43
Tinambac	139	0.5	16	167	5.7	1.7	45
MEAN	**361**	**4.5**	**14**	**219**	**4.8**	**1.8**	**56**

Table 1: The fisheries profile of the study sites.
*Conversion rate is US $ 1 = Philippine Pesos P 45.

Results of FISHDA (Table 2) showed that the fisheries in 16 of the 25 towns (64%) are bound to collapse. To support the current number of fishers, an average of 37% of the municipal waters across all towns must be protected and off limits to all fishing activities. At present, only around 4.5% of the municipal waters are protected. For the 16 towns with unsustainable fisheries, 56% of the municipal waters must be protected to avert collapse of the fishery.

Alternatively, reduction of 45% of the active fishers is needed to make the fishery sustainable in all towns. For towns with unsustainable fisheries, the active fishers must be reduced by 55%. In Tagbilaran City where fishers' density is highest, 97% reduction of its active fishers is needed. On the other hand, in the 9 towns with sustainable fishery, the fishery could still support up to 200% of the active fishers.

At no MPA scenario, only the state of the fishery of El Nido has changed which is from being sustainable to unsustainable. The number of the fishers that can be supported though decreased to 51% from 55% in the current state of the fishery in all towns. At MPA size of 15% of the municipal waters, the fishery in El Nido also became unsustainable. On the other hand, the originally unsustainable fisheries in 3 towns (Amlan, Boljoon and San Francisco Cebu) became sustainable. Overall, the number of fishers that can be supported by the fishery increased to 61% of the active fishers from 55% and 51% in the current state of the fishery and fishery without MPAs, respectively.

Discussion

The fisheries in the studied towns are generally overfished and are bound to collapse. Average yield across all towns is approximately 14 (±30) $MT/km^2/yr$, which is almost 3 times higher than the estimated 5 $MT/km^2/yr$ MSY for coral reefs (Newton et al. 2007). Although, the results revealed that 15 of the towns are still below this MSY limit, actual catch rates could be underestimates due to exclusion of highly efficient commercial fishers from the study. Commercial fishing activities within the municipal waters are prohibited by the law but key informants during FGDs still reported its prevalence in all towns even in Tagbilaran City, Amlan and Samal City which have narrow municipal waters.

The finding of our study that 56% of the municipal waters must be allocated as MPAs for the fisheries to become sustainable is very large and may be impossible to implement in many coastal areas in the Philippines where large portion of the population is highly dependent on the fishery. Previous studies using FISH-BE in major bays in the Philippines also suggested variable but generally very large MPA sizes requirement for the fisheries to become sustainable, e.g. 20% of the fishing grounds in Calauag Bay, 55% in Tayabas Bay 23% (Licuanan et al. 2008), 77% in Lingayen Gulf, 38% in Sogod Bay, 23% in Ormoc Bay, 80% in Sapian Bay, 41% in Davao Gulf, 0% in Butuan Bay and 0% in Gingoog Bay (SuPFA 2006),. Therefore, MPA establishment must be complemented with other fishing pressure alleviation measures such as reducing the number of

Town	Actual state			No MPA		MPA size of 15% of the mun. waters	
	Fisheries' sustainability	Sustainable Min. MPA size *	Sustainable maximum # of fishers **	Fisheries' sustainability	Max # of fishers	Fisheries' sustainability	Max # of fishers
Alaminos	(-)	75	25	(-)	23	(-)	28
Amlan	(-)	5	93	(-)	93	(+)	112
Bacacay	(-)	70	30	(-)	27	(-)	35
Batangas	(+)	0	210	(+)	210	(+)	254
Bolinao	(-)	75	25	(-)	25	(-)	30
Boljoon	(-)	10	87	(-)	87	(+)	107
Cantilan	(-)	95	6	(-)	6	(-)	6
Cortes	(-)	20	80	(-)	80	(-)	95
El Nido	(+)	30	108	(-)	68	(-)	82
Gubat	(-)	30	71	(-)	67	(-)	83
Hinunangan	(+)	0	180	(+)	172	(+)	215
Inabanga	(-)	90	12	(-)	12	(-)	14
Lanuza	(+)	0	132	(+)	132	(+)	160
Looc	(+)	0	146	(+)	141	(+)	169
Lubang	(+)	0	342	(+)	318	(+)	366
Mabini	(+)	0	168	(+)	168	(+)	201
Masinloc	(-)	75	42	(-)	23	(-)	30
Mati City	(-)	40	55	(-)	55	(-)	68
P. Galera	(+)	0	195	(+)	180	(+)	225
Samal City	(-)	55	47	(-)	45	(-)	55
San Fran, Cebu	(-)	5	97	(-)	97	(+)	115
San Fran, Leyte	(+)	0	318	(+)	306	(+)	365
Subic	(-)	80	19	(-)	19	(-)	19
Tagbilaran City	(-)	100	3	(-)	3	(-)	3
Tinambac	(-)	75	24	(-)	24	(-)	29
(+) Towns	(+)	**3**	**200**	(+)	**201**	(+)	**208**
(-) Towns	(-)	**56**	**45**	(-)	**32**	(-)	**41**
All	(-)	**37**	**55**	(-)	**51**	(-)	**61**

Table 2: Results of FISHDA showing the sustainability of the fisheries in current state, no MPA and MPA size of 15% of the municipal waters.
* Percent of municipal waters; ** Percent of active fishers
(+), sustainable; (-) unsustainable

fishers in areas with high fishers' population. For example, this study showed that the fisheries in the 10 towns with more than 7 fishers/km^2 of the fishing grounds were all unsustainable.

Town	Increase MPA size	Reduce # of fishers	Diversify livelihood	Capacity building	Strengthen law enforcement	Inter-LGU CRM
Alaminos						
Amlan						
Bacacay						
Batangas						
Bolinao						
Boljoon						
Cantilan						
Cortes						
El Nido						
Gubat						
Hinunangan						
Inabanga						
Lanuza						
Looc						
Lubang						
Mabini						
Masinloc						
Mati City						
P. Galera						
Samal						
San Fran Cebu						
San Fran Leyte						
Subic						
Tagbilaran City						
Tinambac						

Table 3: Major strategies suggested to improve the condition of the fisheries in each town. White, gray and black boxes indicate least, average and most urgent, respectively.

Capacity building and livelihood programs must be pursued to increase chances of fishers of exiting from the fishery and venturing into alternative occupations. These, however, must not be pursued blindly as fishers have been shown to have varying behavior in terms of their willingness to exit the fishery (Muallil et al. 2011, Daw et al. 2012). Muallil et al. (2011)

suggested that fishers who are newer in the fishery could be potential candidates for livelihood programs. Fishers' children must also be provided education and training support to increase their chances of venturing into non-fishing occupations in the future. Older fishers and those who have been fishing longer must be encouraged to become fish wardens in order to increase their participation in marine stewardship and awareness programs. They can help in reducing instances of illegal and destructive fishing activities such as encroachment of commercial fishers to the municipal waters and poison and blast fishing which are still reported in most of the study sites. The fishers during FGDs, cited these unsustainable fishing practices as the major causes of the drastic decline of fish catches starting the 1980s (See also Uychiaoco et al. 2000, White et al. 2000, Aliño et al. 2004, Muallil and Geronimo 2010). According to them, current catch rates are estimated to be less than 25% at best of the pre-1980's level (see also Green et al. 2003).

General strategies specific to the towns to improve the conditions of the fisheries including its level of urgency are outlined in table 3. Generally, aside from MPA establishment and reducing the number of fishers, other strategies like increasing the opportunities for fishers outside the fishery, strengthening law enforcement against destructive and unsustainable fishing practices and coordinating efforts among management bodies seemed to be more urgent.

Acknowledgement

We would like to thank the David and Lucille Packard Foundation, RARE Philippines, and GIZ for funding the study, the LGUs of the study sites and those who participated in the data collection.

References

Aliño P, Nañola C, Campos W, Hilomen V, Uychiaoco A, Mamauag S (2004) Philippine coral reef fisheries: diversity in adversity. in: DA-BFAR (Department of Agriculture-Bureau of Fisheries and Aquatic resources). In turbulent seas: The status of Philippine marine fisheries. Coastal Resource Management Project, Cebu City, Philippines, pp. 65-69

Cabral R, Geronimo R, Aliño P (2010) Fishing industries' support in handling decision applications (FISHDA) tool demonstration guide. in Marine Environment and Resources Foundation, Inc., Marine Science Institute, UP Diliman, Quezon City, Philippines. 23 p

Daw T, Cinner J, McClanahan T, Brown K, Stead S, Graham A, Maina J (2012) To fish or not to fish: Factors at multiple scales affecting artisanal fishers' readiness to exit a declining fishery. PLoS ONE 7(2):e31460 doi:10.1371/journal.pone.0031460

Lachica-Aliño L, Wolff M, and David L (2006).Past and future fisheries modeling approaches in the Philippines. Rev Fish Biol Fisher 16:210-212

Licuanan W, Aliño P, Campos W, Castillo G, Juinio-Meñez MA (2006). A decision support model for determining sizes of marine protected areas: Biophysical considerations. Philipp Agric Sci 89:507-519

Licuanan W. Mamauag S, Gonzales R, Aliño P (2008) The minimum sizes of fish sanctuaries and fishing effort reductions needed to achieve sustainable coastal fisheries in Calauag and Tayabas Bays. Philipp Agric Sci 91:51-60

Muallil, R.N. and R.C. Geronimo. 2010. The 3D RELIEF (Resources, Environment, Livelihoods, Ecosystems and Fisheries) Map: An ecosystem-based management tool for Philippine coastal resources management. in Marine Environment & Resources Foundation, Inc. Ecosystem-based management toolkit for Philippine coastal resource management. Marine Environment & Resources Foundation, Inc., Marine Science Institute, UP Diliman, Quezon City, Philippines, 25p.

Muallil RN, Geronimo R, Cleland D, Cabral R, Doctor MV, Cruz-Trinidad A, Aliño P (2011) Willingness to exit the artisanal fishery as a response to scenarios of declining catch or increasing monetary incentives. Fish Res 111:71-81

Pauly D, Christensen V, Guénette S, Pitcher T, Sumaila U, Walters C, Watson R, Zeller R (2002) Towards sustainability in world fisheries. Nature **418:** 689–695

Philippine Environment Gevernance (EcoGov 2) Project (2007) FISH-BE library of models. in Aliño P (ed) EcoGov 2 Project, Pasig City, Philippines, 100p

Sustainable Philippine Fisheries Agenda (SuPFA) (2006) Terminal Report

Uychiaoco A, Aliño P, Dantis A (2000) Initiatives in Philippine coastal management: An overview. Coastal Management. Coast Manage 28:55-63

White A, Vogt H, Arin T (2010) Philippine coral reefs under threat: the economic losses caused by reef destruction. Mar Poll Bull 40:598-605