



# How important are coral reefs to food security in the Philippines? Diving deeper than national aggregates and averages



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## ABSTRACT

How important are coral reefs for food security and to what extent does coral reef conservation contribute to the food security of the coastal communities in the Coral Triangle? Based on the national fish production and consumption data from the Philippines and some data from Indonesia, Clifton and Foale (2017) [12] argued that the pelagic fisheries are far more important than coral reef fisheries for the food security of the Philippines and Indonesia. While it is true that, in totality, populations in both the Philippines and Indonesia rely heavily on pelagic fisheries for animal protein, this commentary demonstrates that coral reef fisheries contribute substantially to the food and livelihood security of coastal communities, which make up the poorest and most food insecure sector of the economy. There is also significant growth potential in nearshore fisheries that can be captured by working to recover currently degraded coral reef ecosystems. Nonetheless, research and institutional reforms in all sources of fish protein (pelagic, demersal, and aquaculture) are urgently needed to improve not only food security but also the lives and livelihoods of coastal fishing households in the Coral Triangle.

## 1. Introduction

The Coral Triangle, which includes Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor-Leste, is only 1.1% of the earth's surface but is home to a third of the world's coral reefs. The Coral Triangle Initiative on Coral Reef, Fisheries, and Food Security (CTI-CFF) was formed in 2007 to conserve the coastal and marine resources of this region and improve the income, livelihood, and food security of its people [15,11,12,17,25].

Recently, Clifton and Foale [14] argued that “the food security narrative of the CTI-CFF, together with the focus of published scientific work on fish in the Coral Triangle, appear to largely ignore a suite of pelagic species that are far more important for food security than coral reef-associated species in both Indonesia and the Philippines.” They based their argument – that pelagic fish species are far more important than coral reef-associated species in the food security of the Philippines – on the composition of the country's fish production and fish consumption. They concluded that coral reef fisheries could only account for as much as 21.9% of the total fish production in 2014 based on BFAR's fish production data (DA-BFAR [6]) and that dietary consumption of pelagic fish is about five times higher than for marine demersal fishes [20].

While it is true and we agree that the CTI-CFF needs to improve its programs for other maritime food sources (not just small pelagic fish but also incorporating initiatives pertaining to mariculture), we argue that, by relying solely on national aggregate data and averages, Clifton and Foale missed out the context of these numbers and underestimated the importance of coral reefs to food security in the Coral Triangle, particularly in the Philippines.

The Food and Agriculture Organization of the United Nations defines food security as when “all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” [21]. As of 2012, the poverty incidence in the Philippines as a whole was 25.2%, but poverty amongst fishing households was the highest among all economic sectors (i.e., fishers, farmers, children, self-employed and unpaid family workers, women, youth, migrant and formal sector, senior citizens, and individuals residing in urban areas) at 39.2% [35]. Despite having direct access to fisheries resources, coastal fishing communities are the poorest sector in the country and are likely the most food insecure [35,17]. If part of the goal of the CTI-CFF is to improve food security of the entire population, it is vital to pay attention to the food security needs of the coastal fishing communities in the Philippines.

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## 2. How important are coral reefs for food security at present?

Clifton and Foale [14] used two sources of information to answer this question: (a) fish consumption and (b) contribution of reef fish to total fish production (capture fisheries and aquaculture). We provide additional data to show that Clifton and Foale underestimated the contribution of coral reefs to food security by relying only on the proportion of reef species in national fisheries statistics and national statistics on food consumption.

The “dietary consumption” values used by Clifton and Foale [14] came from Dey et al. [20] and the BFAR's Philippine Fisheries Profile for 2014. The data from Dey et al. [20] is actually extracted from the FAO Food Balance Sheet for 2003 which, in turn, is calculated from production data reported to FAO and not from individual or household surveys of consumption (p. 93–95). FAO cites the entries in the Food Balance Sheet as “per caput supply” and not “per capita consumption” as used in Dey et al. [20]. The second source of consumption data cited by Clifton and Foale is from the 2014 Philippine Fisheries Profile, which are annual reports produced by the Philippine's Bureau of Fisheries and Aquatic Resources. These information do come from household surveys conducted by the Philippine Food Nutrition Research Institute [24]. However, it is unclear to what extent coastal communities and fishing households were included in the FNRI surveys.

Clifton and Foale [14] cited 2014 data from DA-BFAR's annual Philippine Fisheries Profile reports and argued that reef fishing could have only accounted for less than 21.9% of the total fish production for that year (including aquacultured fish but excluding seaweeds). This falls within the range of estimated contribution of reef fishes to Philippine marine capture fish production from 12% to 38% (Table 1). This range of estimates from literature depended on the definition of “reef-associated” species. Some of the commercially important small pelagic fishes such as scads are classified also as reef-associated based on the Fishbase database and from literature (e.g., *Selar crumenophthalmus*, *Decapterus macrosoma*, *Decapterus punctatus*; [38,42]). In Hawaii, akule or bigeye scad (*S. crumenophthalmus*) and opelu or mackerel scad (*D. macarellus*) are managed as part of coral reef ecosystems [46]. Geronimo and Cabral [26] used the classification of reef fishes from Fishbase and Newton et al. [36] which categorized also some of the small-pelagic fishes found in reef lagoons and along reef slopes and crests as “reef-associated”.

Aside from the effect of species classification on the apparent percentage contribution of reef fishes to total fish production, national fish production statistics are also known to underestimate subsistence fish catches [39]. Subsistence fishing, which mostly catch habitat-associated fauna, directly contribute to food supply of many coastal households but these data are rarely reported in catch statistics which are mostly from port-based landed-catch surveys. Catch reconstructions for the Philippines estimated that subsistence catches add about 17.5% to the total official production statistics in 2006 [37]. Part of subsistence activities is gleaning which are often done on reef flats and associated

habitats in the intertidal area (e.g., seagrass beds, mangrove areas, mud flats, etc.). Surveys in Danajon Bank in Central Philippines showed that a quarter of the fishing effort and catches are attributed to women [27]. Dependence on gleaning as a source of income ranges from 36% to as high as 72% in communities surveyed in various areas in Visayas and Mindanao in the Philippines and supplements food requirements of fishing households [19,9]. These highlight the importance of reef and other demersal fauna on the most food insecure sectors of Philippine society.

In generating national fish production estimates, DA-BFAR relies mainly on port-based landed-catch monitoring data. This means that fishers who do not land their catches in established fish ports, or those who directly sell their catches within their local community, or those who do not sell the fish at all, are not accounted for in the national statistics. It should be noted that information on status of small pelagic fishes are more readily available than those for reef-fish or other coastal habitat-associated species since small pelagic fishes are often landed in fish ports and sold in markets. An alternative source of information on the contribution of reef fish to fish catches come from household surveys. Muallil et al. [33] surveyed 6488 fishers in 44 coastal towns and municipalities in the Philippines. The average catch rate ( $\pm$  S.D.) for these respondents was 5.3 ( $\pm$  3.6) kg per day per fisher; 53% of the fishers had non-motorized boats or no boat at all, 44% of the respondents used nets, 40% used hook and lines, and 16% used spears, fish corrals, and pots with < 1% being gleaners. A great majority of non-motorized boats in the sites surveyed refer to small paddle boats/outriggers less than 5 m. The lack of motorized boats for more than half of the respondents strongly suggests that they are highly dependent on easily accessible coral reef-associated species and nearshore demersal species. In fact, the composition of these fishers' catches also demonstrates their high reliance on demersal fishes, highlighting the importance of coral reef-associated species and other demersal species in the food and livelihood security of small-scale fisheries in the Philippines (Fig. 1). In a second study, Lavidés et al. [28] conducted a survey of 2655 fishers in six marine key biodiversity areas in the Philippines (consisting of 61 villages) and demonstrated a high dependence of fishers on reef-associated species, with reef-associated fishes comprising 52–94% of total catches. While the study of Lavidés et al. [28] focuses on reef fin-fish disappearances, they did not limit their respondents who target mainly reef fishes ([28]; Table S6). A more detailed study in Danajon Bank in Central Philippines showed that 31.3% of total harvest by surveyed fishers are reef-associated and 48.4% are from pelagic fishes (Bacaloso and Wolff [4]). While not nationwide in coverage, these household surveys give a glimpse of the importance of reef fisheries on food supply for communities that need it the most. The limited information available on reef fishing further highlights the need to continue efforts to incorporate reef fisheries in the broader fisheries management institutions and protocols.

**Table 1**

Contribution of reef-associated fishes to the total marine wild capture fish production in the Coral Triangle. Values are underestimated as subsistence fisheries are not taken into account.

	Geronimo and Cabral [26] % reef associated fishes based on FAO 2007 data	Teh et al. [43] % reef associated fishes from Sea Around US catch database, 2005 data	Cruz-Trinidad et al. [17] % inshore reef fish (conservative estimate, reef-associated small pelagics was removed from the estimate)
Indonesia	31%	21%	15%
Malaysia	30%	13%	17%
Papua New Guinea	1%	1%	1%
Philippines	38%	34%	12%
Solomon Islands	32%	9%*	32%
Timor-Leste**	0.4%	2%	0.4%
Coral Triangle	30%		14%

\* Estimated based on regional averages.

\*\* Barbosa and Booth [5] estimates a 27% contribution of subsistence reef fishing to total fish production in Timor-Leste.

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