



Economic analysis of mangrove and marine fishery linkages in India



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ABSTRACT

Mangroves support and enhance fisheries by serving as a breeding ground and nursery habitat for marine life. The mangrove-fishery link has been well established in the ecological literature. This paper, however, employs an economic analysis to examine the role of mangroves in increasing marine fish output in India. Using secondary data on marine fish production and fishery resources, two distinct but related issues are analysed: i) the effectiveness of mangroves in increasing marine fish production, and ii) the marginal effect of mangroves on fish production or the contribution of a hectare of mangrove area to fish output in India. The results based on econometric analysis indicate that i) mangroves contribute significantly to the enhancement of fish production in the coastal states of India, and ii) the marginal effect of mangroves on total marine fish output is 1.86 tonnes per hectare per year, which translates into a percentage contribution of mangroves to commercial marine fisheries output of 23 percent in India in 2011.

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1. Introduction

The essential ecological support function that mangroves provide for commercial, recreational and subsistence fisheries, by serving as a breeding ground and nursery habitat for marine life, is well documented in the literature (Hutchison et al., 2014). Studies from across the world indicate that the relative contribution of mangrove-related fish species to total fisheries' catch is significant in most cases. The more recent studies (excluding the small-island studies) estimate mangroves' contribution to fisheries in the range of 10–32 percent (Aburto-Oropeza et al., 2008; Ronnback, 1999). There are, however, hardly any studies that estimate the contribution of mangroves to commercial fisheries in India. One exception is the study by Untawale (1986) that directly associates about 60 percent of commercially important coastal fish species to mangrove environments in India. Therefore, this study attempts to empirically analyse the relationship between mangroves and commercial marine fisheries in India.

Mangrove forests in India are largely located in the deltas of the rivers Ganges, Mahanadi, Godavari, Krishna and Cauvery as well as

on the Andaman and Nicobar group of islands. The extent of mangrove cover in India is 4,740 square kilometres, which accounts for 0.14 percent of the country's total geographical area. As detailed in Table 1, West Bengal, Gujarat, Andaman and Nicobar Islands and Andhra Pradesh have the highest mangrove cover among all coastal regions accounting for 44, 23, 13 and 8 percent of the country's total mangrove cover, respectively. Kerala, Karnataka, Daman and Diu and Pondicherry have the lowest extent of mangrove cover, i.e. less than 10 square kilometres each. Over the period 1987 to 2015, mangrove cover increased significantly in Gujarat (by 680 square kilometres) while it increased moderately in all other coastal regions except for Andhra Pradesh and Andaman and Nicobar Islands, in which mangrove cover declined over time (FSI, 2015).

Marine fish production in India was 3,443 thousand tonnes in 2013–14, which accounted for 36 percent of total fish production in the country. West-coast regions produce a significantly higher proportion of total marine fish compared to their east-coast counterparts (i.e. 64 percent in 2012–13) and Gujarat and Kerala are the leading marine fish producers in the country, producing more than 500 thousand tonnes each in 2013–14 (DADF, 2014). Although inland fish production accounts for a higher proportion of total fish production in India, it is the preference for marine versus inland fish that determines consumption; e.g. inland fish is preferred in the eastern states of the country, whereas marine fish is preferred

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Table 1
Details of mangrove area, mangrove-dependent marine fish catch and fish species in the coastal regions of India.

Coastal Regions of India	Mangrove Area in 2015 (in Sq. km.) ^a	Mangrove-Dependent Marine Fish Catch in 2014 (in '000 tonnes) ^b			Mangrove-Dependent Fish Catch as% of Total Marine Fish Catch in 2014 ^b	Examples of Fish Species Found in Mangroves ^c
		Demersals	Crustaceans	Molluscs		
Andhra Pradesh	367	71	35	3	32	Catfishes, snappers, tilapia, snails, crabs, prawns and molluscs.
Odisha	231	41	20	2	45	–
Tamil Nadu	47	179	44	22	37	Penaeid prawn species, catfishes, pomfrets, barramundi, mangrove red snapper, catfishes and perches.
West Bengal	2,106	26	16	0	56	Several penaeid and non-penaeid prawn and shrimp species.
Pondicherry	2	26	4	2	50	Mangrove red snapper, silverbellies, pomfrets, croakers, catfishes, rays, penaeid prawns, brachyuran crabs, bivalves and gastropods.
Goa	26	7	8	1	11	Sharks and several molluscs, crabs and prawns notably one armed fiddler crabs and horse shoe crabs.
Gujarat	1,107	206	156	57	59	–
Karnataka	3	102	29	27	33	–
Kerala	9	84	51	49	32	Rays.
Maharashtra	222	89	95	13	57	–
Daman & Diu	3	21	2	3	56	–
Andaman & Nicobar Islands	617	–	–	–	–	–

Note: Demersals include sharks, skates, rays, eels, catfishes, cods, snappers, breams, perches, goatfishes, threadfins, croakers, silverbellies, big-jawed jumper, pomfrets, halibut, flounders and soles; Crustaceans include penaeid and non-penaeid prawns, lobsters, crabs and stomatopods; Molluscs include mussels, oysters, clams, other bivalves, gastropods, squids, cuttlefish and octopus. Total marine fish catch includes demersals, crustaceans, molluscs and pelagic fish species. '–' indicates information could not be accessed from sources within the public domain.

Source: ^a FSI (2015); ^b CMFRI data – <http://www.cmfri.org.in/fish-catch-estimates.html>; ^c Singh et al. (2012).

in the southern states (FAO, 2005). Moreover, marine fish comprises of several commercially important fish species such as cuttlefish, squid, lobster, shrimp and certain types of finfish, which also make up the bulk of marine fish exports. Marine fish exports accounted for roughly 29 percent of total marine fish production in 2013–14 (DADF, 2014). Furthermore, a majority of commercially important marine fish species are mangrove-dependent.

Table 1 also gives examples of commercially relevant fish species that are commonly found in mangroves in the coastal regions of India. These include crustaceans such as prawns and crabs, molluscs, and demersal finfish such as snappers, catfishes, pomfrets and croakers among others (Singh et al., 2012). It is important to note that it is the demersal, crustacean and mollusc fish species that are predominantly mangrove-dependent while pelagic fish species are less dependent on mangroves¹. The table also provides information on fish catch within the mangrove-dependent demersal, crustacean and mollusc categories across coastal regions. It is interesting to note that mangrove-dependent fish catch as a percentage of total marine fish catch (that includes all four fish categories) is significant in most of the coastal regions that also have significant mangrove cover. Since only the fringe area of mangrove forests typically serves as a breeding ground and nursery habitat for marine life, it is difficult to directly infer a correlation between overall mangrove area and the percentage of mangrove-dependent fish catch in each of the mangrove regions. However, as shown in Fig. 1, state-level mangrove-dependent fish catch increases positively with mangrove fringe² (correlation coefficient is 0.14). Note that all data points to the right of the 40 km mangrove fringe mark belong to West Bengal. This state is characterised by relatively low marine fish landings

¹ Pelagic fishes including certain species of clupeids (hilsa shad), anchovies (setipinna), carangids and mullets have been documented to be found in the Indian mangrove waters (Singh et al., 2012), however they comprise of a small number of total pelagic fish species landed in India (CMFRI, 2015), the majority of which are not mangrove-dependent.

² Here, mangrove fringe is defined as the square root of mangrove area as has been done in other studies (e.g. Aburto-Oropeza et al., 2008).

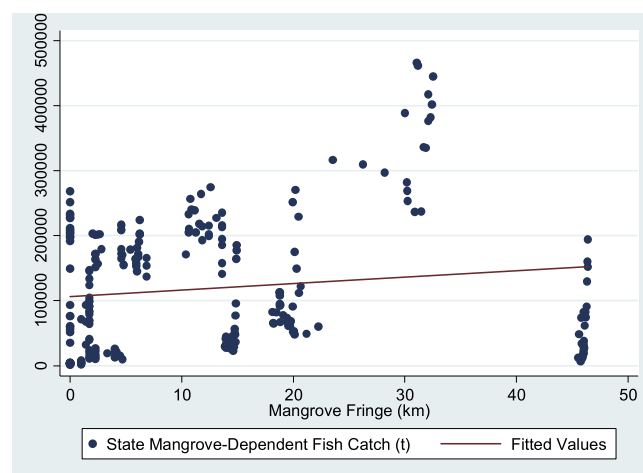


Fig. 1. Relationship between Mangrove-Dependent Fish Catch and Mangrove Fringe.

Note: Data points represent state-level mangrove-dependent fish catch for the period 1987–2011; solid line shows the model fit; mangrove fringe is defined as the square root of mangrove area; data sources include CMFRI for fish catch and FSI for mangrove area, which are described in more detail in Section 2.2.

despite high mangrove cover primarily because it places higher emphasis on inland fish production compared to marine fisheries due to its consumer preference for fresh water fish, and also due to other problems faced by the state with regards to marine fishing including a shallow estuarine area that makes fishing operations difficult (Dutta et al., 2016). Thus, if West Bengal were to be excluded from the figure, the trend line would be steeper upwards indicating a higher positive correlation between state-level mangrove-dependent fish catch and mangrove fringe (with a correlation coefficient of 0.48).

It is important to note that Indian marine fisheries are predominantly coastal/territorial, i.e. fishing occurs mainly within the territorial waters of states. In excess of 90 percent of total marine fish

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