The Shifting Habitat of Hilsa: River to Sea

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Hilsa (*Tenualosa ilisha*) is one of the most economically-important fish species in Bangladesh, India, and Myanmar. To some extent, hilsa has also been found to inhabit the waters of Thailand, especially in the Andaman Sea as well as in waters in its eastern part extending as far as Malaysia, Indonesia, and Viet Nam (BOBLME & SEAFDEC, 2015). In view of the wide distribution of hilsa in Southeast Asia, the Southeast Asian Fisheries Development Center (SEAFDEC) and the Bay of Bengal Large Marine Ecosystem (BOBLME) Project of the Food and Agriculture Organization of the United Nations, entered into an agreement for a technical exchange to enhance the capacity of scientists from Myanmar and Thailand, as well as their understanding of the biology and life stages of this species. This article will article will not discuss the outputs of the BOBLME-SEAFDEC Project, but will focus on the status of hilsa production in Bangladesh to understand the shifting phenomenon of the habitat of this species from the rivers to the marine waters.

Since the 18th century, administrators, philosophers, naturalists and scientists have been fascinated by the impressive size of hilsa, its euryhaline behavior and capability to move through extensive distant migration routes between marine feeding grounds and riverine spawning grounds. In Bangladesh, many rivers like the Ganges, Brahmaputra, Padma, Meghna, Hoogly, Irrawaddy, Mahananda, Godavari, Krishna, and Cauvery have been characterized as the major source for the riverine catch of hilsa, while the Bay of Bengal has recently been recording considerable quantities of marine catch of hilsa. The riverine contribution to the country's total hilsa production in 1950-60s was 94% while the marine catch contributed only 6%. This trend has however been reversed in recent decades with 72% comprising the marine catch of hilsa and 28% from riverine catch. Unplanned water control structures in the upstream rivers, disruption of migration routes, degradation of habitats, indiscriminate exploitation of juveniles and broodstocks, and increased fishing pressure in the near shore and estuarine areas with efficient gears have been attributed to have contributed to the decline of the riverine catch of hilsa. In the Meghna River estuary of Bangladesh, which has been reported to account for the highest hilsa landing in recent decades, drift gill, fixed gill and seine nets have been used to catch hilsa. As the global market opportunity for hilsa has expanded to the Middle East, Europe, USA, Canada, Japan, and Australia, the demand for hilsa has been increasing. Therefore, management of its fisheries is something that should be dealt with by countries in cooperation with transboundary countries where this species is known to also inhabit. Lessons on the reasons for the shifting habitats of hilsa could be learnt from this article.

The Habitats of Hilsa during the 18th Century

Fish habitat is a shifting mosaic over years to decades, and even centuries (van der Nat *et al*., 2003). Fish selects habitats that balance its demand for food with energetic costs, predation risk, and competition (Werner *et al*., 1983; Fausch, 1984; Hubert *et al*., 1994). The temporal fluctuations, *e.g.* daily, monthly, annually, decadal and centurial, of the habitats' ecological characteristics, *e.g.* temperature, salinity, dissolved oxygen, acidification, dissolved materials and water flow, affect the extent and quality of the fish habitats. Historically in Bangladesh, hilsa fishery used to dominate in the upstream rivers of the Ganges, Brahmaputra, Padma, Meghna, Hoogly, Irrawaddy, Mahananda, Godavari, Krishna, and Cauvery (**Fig. 1**). Recently however, hilsa is known to inhabit more in the marine waters of the Bay of Bengal.

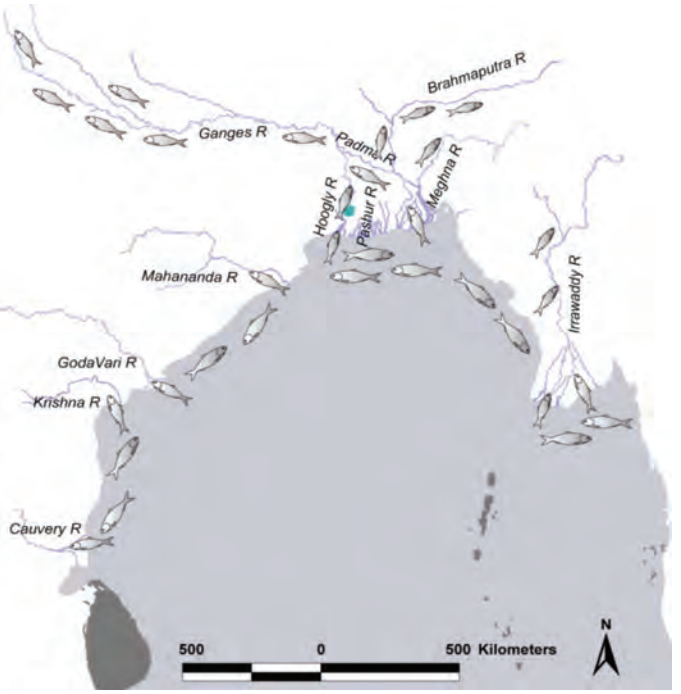

Fig. 1. Distribution of hilsa during the 18th century in the major river basins of the Bay of Bengal

Many researchers and scientists have established that the range of hilsa migration used to cover a distance of about 1920 rkm (river kilometer) from the Bay of Bangal to Agra and Delhi through the Ganges River (Hora, 1941; Quereshi, 1968), 825 rkm up to Mandalay through the Irrawady River (Day, 1873), 780 rkm up to the Tezpur of the Brahmaputra River (Pillay and Ghosh, 1958; Rao and Pathak, 1972), 410 rkm of Hooghly (Day, 1889; Jones, 1957; BOBP, 1985), 50

rkm in the Godavari (Chacko and Ganapati, 1949; Pillay and Rao, 1963; Rao, 1969, Rajyalakshmi, 1973), 275 rkm in Meghna (Quereshi, 1968; Shafi *et al*., 1978), and 420 rkm in Padma (Quereshi, 1968).

Through the years, it has been noted that the construction of barrages and dams without fish pass on various rivers had reduced the river range of the hilsa (Jafri, 1988). Although fish ways or fish passes had been constructed in the weir across the Cauvery River at Coleroon (Wilson, 1909) and at the Mahanadi River at Cuttack (Southwell and Prashad, 1918), but it was observed that such facilities have failed to function in sustaining the migration of hilsa. As a consequence, hilsa had dispersed in the wider areas of the northern part of the Bay of Bengal, thus, the significant increase of the marine catch of hilsa in Bangladesh, Myanmar and India since 1990s (FAO, 2015; DoF, 2014; Hossain *et al*., 2014).

Historical Production of Hilsa in Bangladesh

Records have shown that the riverine contribution of hilsa from 1956-1957 to 1961-1962 was 94% and the marine contribution was only 6% (Ahsanullah, 1964). In contrary, from the total catch of hilsa landing in Bangladesh during 2012-13 of 351,000 metric tons (MT), 72% came from marine catch and 28% from riverine catch (DoF, 2014). Similarly, of the total hilsa catch of 18,593 MT in India during 2013 (FAO, 2015), 78% was represented by marine catch and 22% from riverine catch (**Fig. 2**).

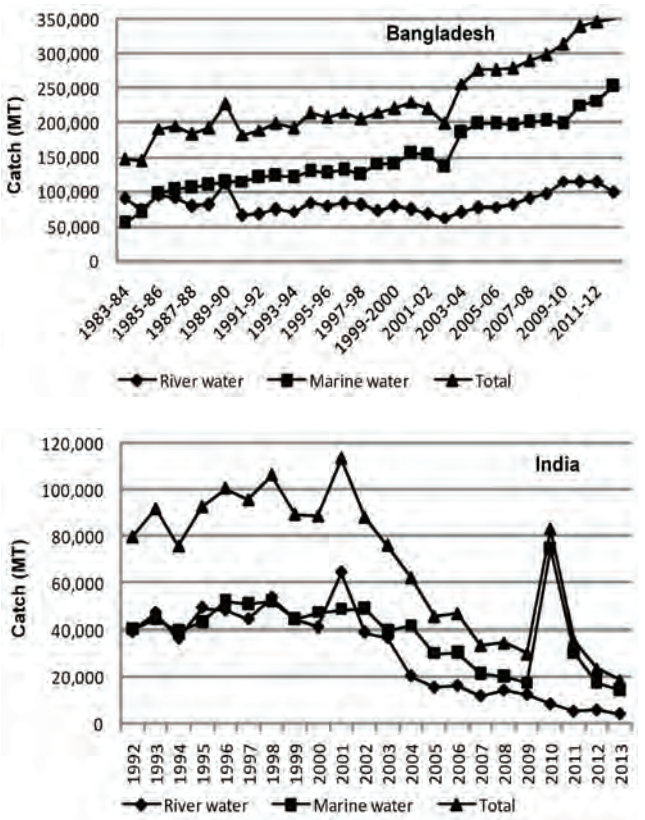

Fig. 2. Hilsa catch from river and marine waters in Bangladesh (above) and India (below)

Source: DoF, 2014; FAO, 2015

The near shore and offshore waters of the Bay of Bengal have been known as the major source for the marine catch of hilsa. Of the total catch of hilsa, the rivers of Meghna, Padma and Pashur in Bangladesh contribute 21% to the hilsa landing, while the Irrawaddy River in Myanmar contributed 3% to hilsa catch and the river of Hoogly in India accounted for only 1% of the hilsa landing. It is assumed that the marine catch of hilsa represents 74%, where the riverine catch accounts for the remaining 26% (**Fig. 3**). It has been reported that the unplanned water control structures in the upstream rivers associated with heavy siltation, degradation of habitats (spawning, feeding and nursing), disruption of migration routes, indiscriminate exploitation of juvenile and brood, and increased fishing pressure in the near shore and estuarine areas with mechanized vessels and efficient gears have contributed to decline of the riverine hilsa catch (Islam *et al*., 1986; Haroon, 1998).

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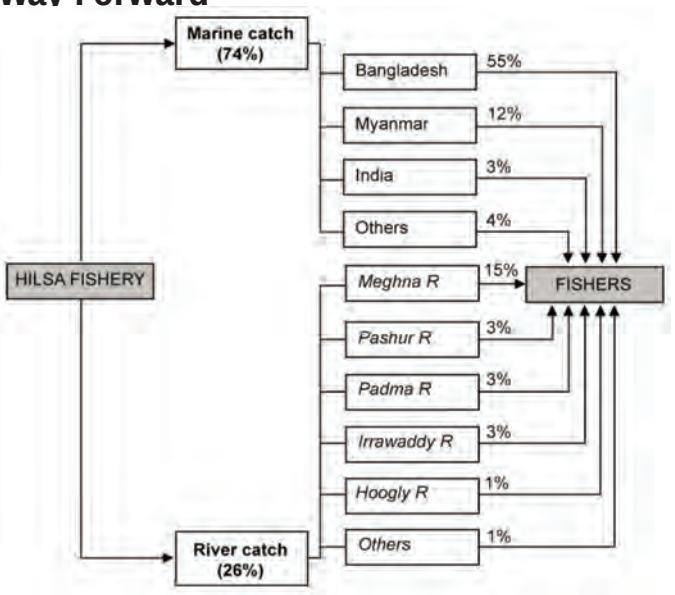

Fig. 3. Present status of marine and riverine catch of hilsa

Typically, hilsa is exploited by deploying drift gillnet, fixed gillnet or seine net in the Meghna River estuary and adjacent waters. The gear characteristics depend on the water current, depth, tidal phase as well as seasonality, and weather condition, but while the drift gillnet moves with the water current, the fixed gillnet is set in specific locations of the river bottom. Meanwhile, the seine net encircles the shallow region of the waters to trap schools of hilsa (**Fig. 4**).

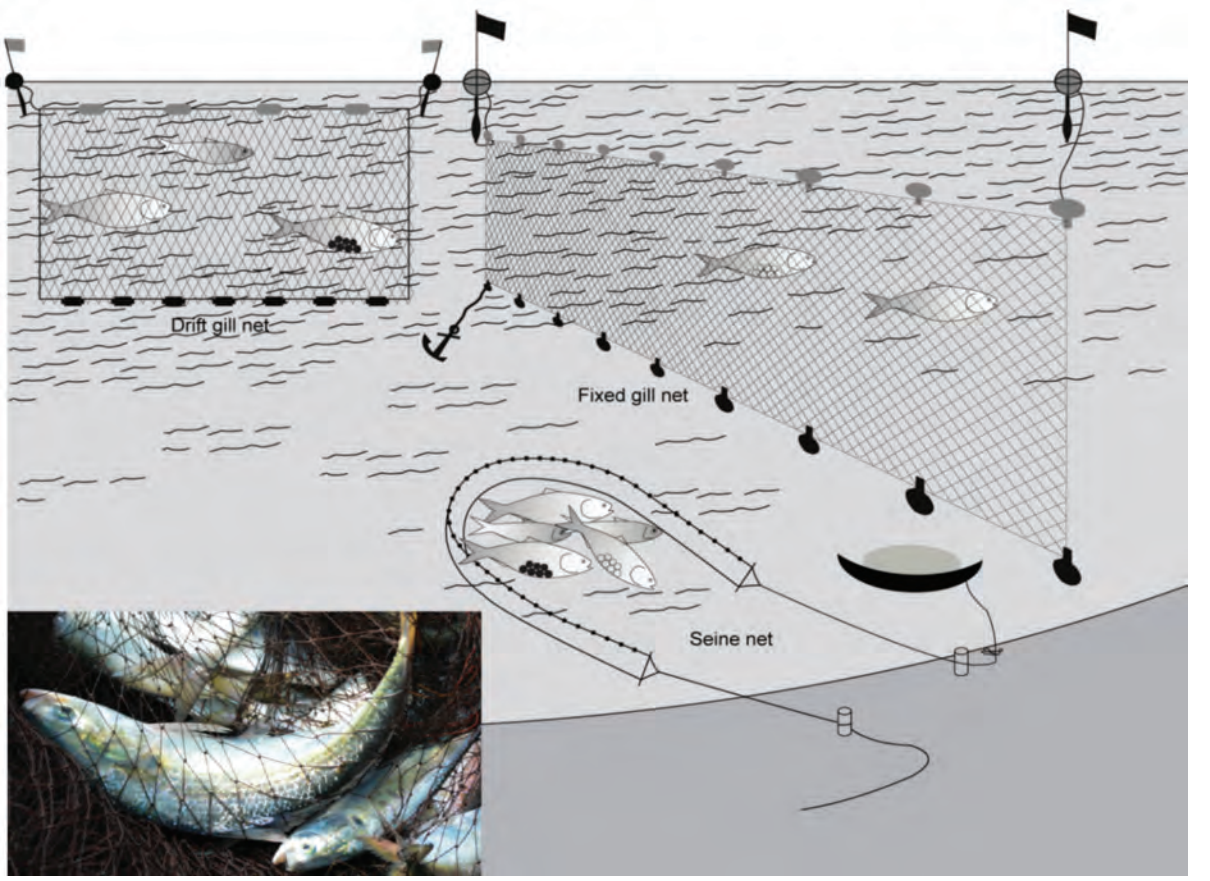

Fig. 4. Hilsa fishing gears in the Meghna River estuary;
Inset: silver shinny live hilsa with transparent watery slime and pleasant odor

The global market opportunity for hilsa in Middle East, Europe, USA, Canada, Japan and Australia (**Fig. 5**) has resulted in increased demand for high quality hilsa. Therefore, while the hilsa resource is not yet over-exploited, it is necessary that management measures should be established for the sustainable utilization of this economically important resource. In this connection, it would be worthwhile to initiate a data-prospecting and data-recovery effort for the catch composition of hilsa since 1950s in the Bay of Bengal and adjacent rivers. The analysis of these data is likely to provide some valuable and original insights into hilsa spatial dynamics, as unplanned water control structures on different rivers could have been instrumental in the remarkable variations in the abundance and distribution of hilsa.

In addition, more essential aspects need to be explored, which could include: where the hilsa disperse after leaving the freshwater ecosystem and where hilsa go after entering

Fig. 5. Hilsa trade and distribution to global destinations

the river; whether hilsa exhibits homing fidelity; and whether hilsa is semelparous or iteroparous by nature or if both patterns exist in the population. Moreover, studies on the occurrence of diseases and parasites in hilsa should also be extensively carried out.

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