Ocean Acidification Threatens Marine Ecosystems and Livelihood Security in Bangladesh

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Rising atmospheric carbon dioxide ($CO_2$) leads to lower oceanic pH and increase sea surface temperature (SST).

When $CO_2$ dissolves in seawater it forms carbonic acid ($H_2CO_3$), which dissociates to form equilibrium with hydrogen ions ($H^+$), bicarbonate ions ($HCO_3^-$) and carbonate ($CO_3^{2-}$). This equilibrium is dominated by bicarbonate, ($CO_2$ $\approx$ 1%, $CO3^{2-}$ $\approx$ 8% and $HCO_3^-$ $\approx$ 91%, of total dissolved inorganic carbon.

Source: Havenhand 2012
Have there been recent changes in ocean acidification?

Ask the coral of the Bay of Bengal
Historical trends: pH and SST

SST showed increasing trend, whereas water pH has decreasing trend in the northern Bay of Bengal, Bangladesh

An average pH of 7.8, 7.6 and 7.3 in the years of 1970-1979, 1980-1989 and 1990-1999, respectively, clearly indicates a declining trend.

Data source: National Oceanographic Data Center (NODC) (http://www.nodc.noaa.gov/OC5/ WOA09/)
Hossain et al. 2013
Lower oceanic pH and increase SST are unfavourable for the growth, survival and reproduction of marine calcifiers such as coral reefs, molluscs and other shelly organisms.
Among the 66 coral species in 1997, only 40 species were recorded in 2008, which indicates 26 coral species lost in 11 years, posing serious threat to the coral biodiversity in the northern Bay of Bengal Bangladesh.

Lowering the oceans’ pH levels results coral bleaching, slow growth and decrease coral species diversity.
Oysters, mussels, barnacles from the Moheshkhali Island, Bangladesh (2013)
Increased pH (2004-2012) reduced oyster spat settlement and growth in the northern Bay of Bengal
Catch per unit effort (CPUE) reduced in the northern Bay of Bengal during 1986-2010, which indicates declining trend for the net CPUE and lower production of marine capture fisheries in the northern Bay of Bengal.

Negative value shows a decline in CPUE from the previous year and positive value indicate increase in CPUE from the previous year.
Fish species abundance in the GBM estuary

Water pH was the most important hydrological factors followed by dissolved oxygen, transparency and water temperature on species distribution at the Ganges-Brahmaputra-Meghna River estuary, northern Bay of Bengal

＞ Hussain (1971) reported 475 finfish species from the coastal and marine waters of the Bay of Bengal

＞ Islam et al. (1993) reported 185 species of finfish and shellfish

＞ Chwdhury et al. (2011) recorded 98 finfish, 23 species of shrimps and prawns, 13 crabs, 11 species of molluscs, 3 echinoderms and 4 other crustaceans from the Naaf River Estuary

＞ Hossain et al. (2013) identified 53 finfish species from the Ganges-Brahmaputra-Meghna River estuary
Habitat shifting of reef-based organisms

- Spawning, feeding and nursery grounds of reef-based organisms may shift and thus affect species diversity, abundance and distribution.
- Reef fisheries (fish, shrimp, crab, lobster), many of which are commercially important, may face probable extinction, if reefs disappear.
Aggregated effects can, in the long run, modify the ecosystem functioning and services with significant implications on food security, nutrition, coastal livelihoods and multi-billion dollar fishing industry.
Cause-effect analysis of ocean acidification

**PROBLEM**

- Decrease water pH
- Organic matter breakdown
- Nutrients, algal bloom
- Temperature
- Salinity
- Dissolved oxygen
- Carbon sequestration in ocean water

**CAUSES**

- Global warming
- Increase atmospheric CO₂
- Fossil fuel combustion

**EFFECTS**

- Coastal livelihood in peril
- People become homeless, income less, food less
- Damage natural barrier
  - Coastal erosion
  - Salinity intrusion
  - Wave/current damper
- Decline Fisheries
  - Finfish, Shrimp, Crab, Molluscs, Seaweeds
- Cyclone and storm
  - Severe & frequent
  - Decrease fishing day
  - Increase fishing cost
  - Decline fish catch

**AFFECT KEY ECOSYSTEMS**

- Coral reefs
- Molluscs bed
- Seaweed bed
- Seagrass bed
- Mangrove forest
- Hamper oceanic food chain
- Organism's physiological disturbance
- Change organisms interactions

**ATMOSPHERE**

- Industrial revolution
- Fossil fuel combustion

**OCEAN**

- Decrease water pH
- Organic matter breakdown
  - Nutrients, algal bloom
- Temperature
- Salinity
- Dissolved oxygen
- Carbon sequestration in ocean water
However, impacts of ocean acidification on marine fauna and ecosystem processes are poorly understood, and virtually limited science works have done in the northern Bay of Bengal, Bangladesh.

Therefore, adequate research and continuous monitoring programme is required to determine the current and future costs of ocean acidification in Bangladesh.

Development and implementation of specific action plans and adaptation strategies to deal with ocean acidification is a priority.
THANK YOU ALL