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Sea level rise due to global warming and the impact on coastal fishers: Capture based aquaculture (CBA)- a method to deal with climate change related salinity intrusions in coastal waters

**Sujitha Thomas, A.P. Dineshbabu, Swathilekshmi P.S. & P.U. Zacharia**

***Mangalore Research Centre of CMFRI***

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One of the major implications of global warming due to climate change is the sea level rise, which is caused by the melting of polar ice and thermal expansion of water. Although there are obviously many challenges to projecting future sea level rise, even a small increase in sea level causes a dramatic impact the on coastal environment. IPCC notes that as much as 33% of coastal land and wetland habitats are likely to be lost in the next hundred years if the level of the ocean continues to rise at its present rate (Fig.1)

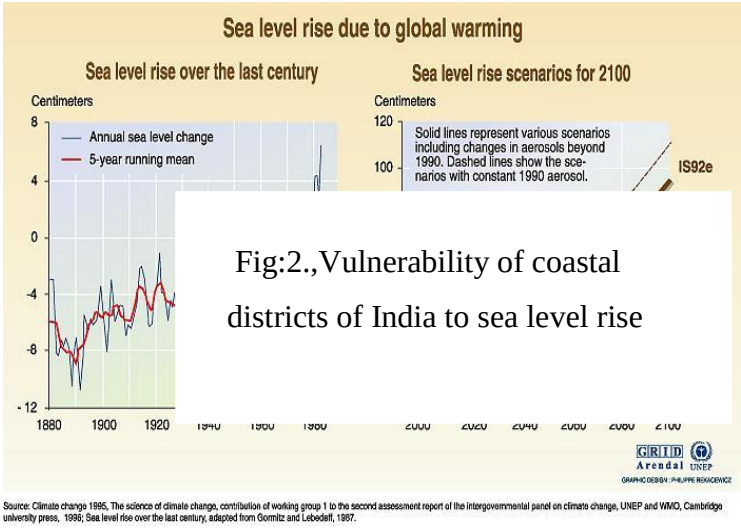


Fig:2.,Vulnerability of coastal districts of India to sea level rise

In Indian scenario, according to the studies conducted by National Institute of Oceanography, mean sea-level-rise trends along the Indian coasts are about 1.30 mm/yr and future projections (global) indicate about 0.48 m (A1B) by the turn of the century. Saltwater/freshwater interface moves further inland which is causing the reduction and extinction of estuarine associated habitats and ecosystems. The estuaries are becoming more saline due to sea level rise and the low influx of fresh water from catchment due to various anthropological and climatic factors. This poses a very serious livelihood issue for the coastal population, depending on the estuarine fishery.

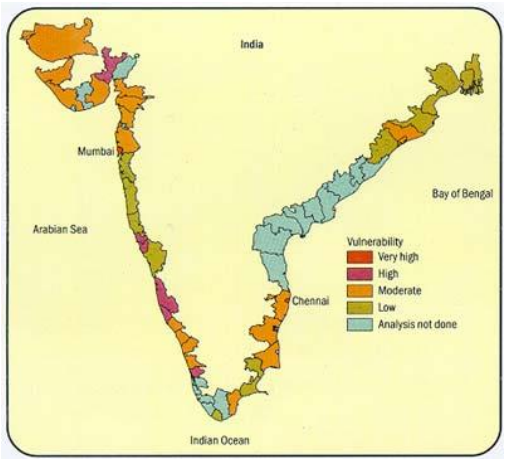


Fig:1.,Global Sea level rise projected under different IPCC climate change Scenarios

The Energy Research Institute (TERI), India projected a map of coastal areas of vulnerability with 1 m rise in Sea level (by constructing weighted index). According to the study the coastal areas of Karnataka have highly vulnerable and moderately vulnerable regions (fig 2).

As a part of the project NICRA, CMFRI, Mangalore conducted climate change awareness survey and it is found that salinization of estuaries along the coast is a reality which is happening over a period of time. The low salinity existing in the estuaries are now getting limited to shorter periods and the estuarine fishery is becoming a undependable avocation. The fisher folk depending on the estuarine fishery are now facing livelihood issues thus forced to forgo their traditional fishery. Results of the study conducted by CMFRI under NATP (ICAR) project in the Netravathi and Sharavathi estuaries also substantiated the problem raised by the coastal population. The study showed that, the salinity gradient in both the estuaries are moving upstream over the past 30 years.

To harness the positive effect of salinity intrusions to the estuaries, Mangalore Research centre of CMFRI has designed and demonstrated small estuarine cages for the fishers living along the estuary. The concept of capture based aquaculture (CBA) was propagated along the coast. CBA is the practice of collecting wild seed and growing to harvestable size in confined areas. Estuaries and coastal waters of Karnataka are known for the abundance of fin fish seed of mullets, *Etroplus* sps , *Sillago* sps. *Lutjanus* sps and *Gerres* sps which are caught in good numbers in seines, cast nets and gill nets operated during monsoon and post monsoon seasons.

Cages of 2.5 m x 2.5 m x 2m was fabricated using netlon material as outer net and nylon net as inner net. PVC pipes were used as floats for suspending the cage in the water. The cages were stocked with *Lutjanus argentimaculatus* seeds collected from wild. The fishes were fed *adlibitum* with trash fish. The fishes obtained a growth of about 0.7-1.5 kg.

To supplement the red snapper, *Etroplus* sps. and *Lates calcarifer* were also stocked. The fishermen community was engaged in the cage setting, cage cleaning, feed sourcing, feed preparation and feeding. Feeding was done with locally available trash fish and also fish waste from fish processing areas/plants. The stocking size was about 80 - 140g and stocking density ranged from 500-700 numbers per cage. Partial harvesting was done when the fishes reached marketable size in the three cages and two cages were left for final harvest. The cages were harvested in June 2011, when mechanised fishing was banned. The *Lutjanus* sps attained a size range of 750 g to 1.9 kg and a total of 150 kg was harvested from two cages along with 150 kg *Etroplus* sp. and 450 kg of sea bass thus realizing a net profit of Rs. 75,000/- Encouraged by the results, during November 2011, the fishermen stocked *Lutjanus* sps in the 13 cages. After a period of 8 months 50% of the fishes stocked were harvested in July 2012. The fishes attained a size of 650- 900 g and it was marketed locally at Rs 280/kg.

Studies along the coast of India has shown that shoreseines, dolnets and other similar nets which are operated at depths between 5-10 m brings in juveniles of many cultivable fishes. This is usually discarded or goes to the fish meal. If a small fraction of this is brought in live condition, it would form a good source of seed for CBA. This CBA cages have gained wide popularity and many fishers are coming forward for cage culture in coastal Karnataka. This methodology of cage farming could be spread along the Indian coast as a method to harness the positive effects of climate change. India has a cover of about 2.7 x $10^{4}$ $km^{2}$ of water spread estuaries with high rate of annual flushing and if this could be utilized for fish production, it would augment the fish production substantially.

Capture Based Aquaculture (CBA) has emerged as the optimal solution to meet the ever growing demand for protein food security, besides providing additional income to rural fishermen

during the lean seasons. For measuring the adoption of sustainable practices in CBA a Farmer Sustainability Index (FSI) was constructed based on a socio economic survey .The overall mean FSI index for all the packages of practice from cage fabrication to harvest was 77.95, indicating a relatively high value of FSI for adoption of CBA practices.

*Reference*

**Fig 1**: Source: Climate change 1996, The scenarios of climate change, contribution of the working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge University press, 1995, adapted from Gormitz and Lebedaff, 1987.

**Fig 2**. Source: TERI. 1996, The economic impact of a one-metre sea level rise on the Indian coastline: method and case studies. New Delhi: Tata Energy Research Institute. ,Report No 93/GW/52, submitted to the Ford Foundation.