Impact of Plate Tectonics to The Coastal Fisheries and Environmental Dynamics in The North-East Coast of India

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Abstract: *Indian subcontinents were witnessed massive endogenetic movement throughout the past. The Great Himalayan region was witnessed several of magnitudes of tectonic movement. These tectonic movements can make a huge variety in slope changes. Not only this, but also mangrove region is also a geologically sensitive region because of presence of destructive plate margin. Sometime the slope elevation is gradually increases and sometimes slope elevation is decreases. Due to seasonal variation and slope variation especially for tectonic instability and huge mass wasting, the position of snow line may change. A lot of Perennial Rivers are formed from this region as a result of glacier melting on snow line. As the position of snow line varies, the amount of ice melting and water discharge also differs throughout time to time. There is another factor which makes changes the nature of river velocity as well as erosion power in mountain region. The factor is dynamic in nature at mountain slope. Eroded materials from the mountain region is carried out through the Ganga and deposited in lower segment of Hooghly estuaries. Subarnarekha and Mahanadi is also deposited eroded materials in their estuaries. As a result, huge amount of nutrients in form of biotic and abiotic components are deposited in north-east coastal parts of India which may provide a scope for growing many fisheries. Deltaic formation at Hooghly, Subarnarekha and Mahanadi estuary is resulting decrease of depths on those coastal shelf areas. So, huge amount of pelagic fishes are well attracted because of incoming sun light and availability of both phyto and zoo-plankton. On the other hand different waste materials are deposited in form of heavy metal which may damage the fishes of these fisheries. This present study is focusing on the understanding of morphological dynamics on coastal region, long-term sediment transport, turbidity distribution pattern, impact of sediment transported pollutants etc. Beside this Harmful Algal Bloom (HAB) is caused due to increasing surface run off in form of industrial wastage and major brick factory beside this coastal region.*

Key Words*: Endogenetic movement, Estuary, Biotic component, Abiotic component, Perennial River, Pelagic fish, Turbidity.*

1. INTRODUCTION:

The coast line of India is around 7516 km long, spanning across 9 States, 2 Union and 2 Island territories. Out of the total length of Indian coast line, West Bengal coast line occupies a length of around 220 km and Odisha has a length of around 480 km. The coastal zone of these two states has diverse types of fisheries and the local community and island dwellers greatly depend on the fishery resources of the state. There are several fish landing stations in West Bengal and Odisha, where the data on fish diversity and landing quantum are available. It has been observed that the diversity is gradually decreasing in both the maritime states and a compositional variation is also observed.

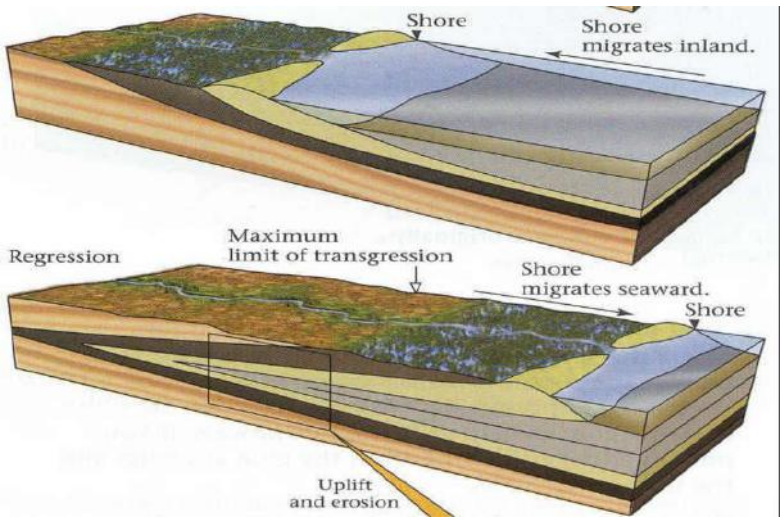


Fig.1 Plate surface

2. STUDY AREA:

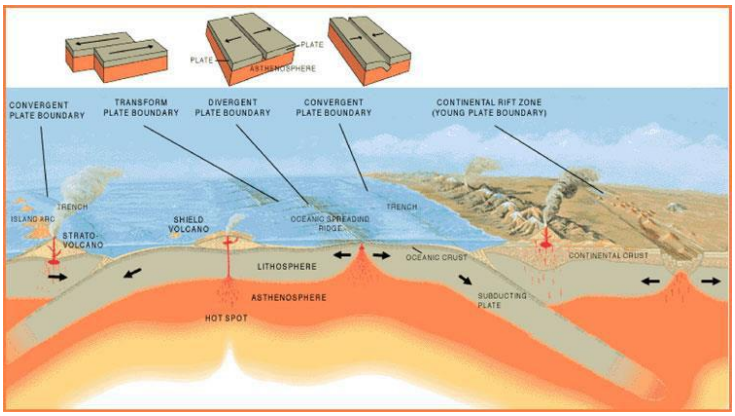
Fig.2 Map area location

3. WHAT IS PLATE TECHTONICS:

It is a scientific theory describing the large-scale motion of 7 large plates and the movements of a large number of smaller plates of the Earth's lithosphere, over the hundreads of millions of years. On the otherhand, it is a theory that Earth's outer shell is divided into several plates that glide over the mantle, the rocky inner layer above the core.

4. WHAT IS PLATE BOUNDARY:

There are three general types of plate boundaries: divergent, convergent, and transform. Each general type has multiple 'species': divergent boundaries can be spreading ocean ridges or continental rift zones; convergent boundaries can occur between two oceanic plates, an oceanic and continental plate, or between two continental plates. Transform boundaries are places where two plates of the Earth are sliding past each other. This type of fault arises because of the nature of long, divergent zones. Various forces cause divergent zones to become offset, rather than be one continuous rift zone. Transform faults are those boundaries that connect one spreading center with another.



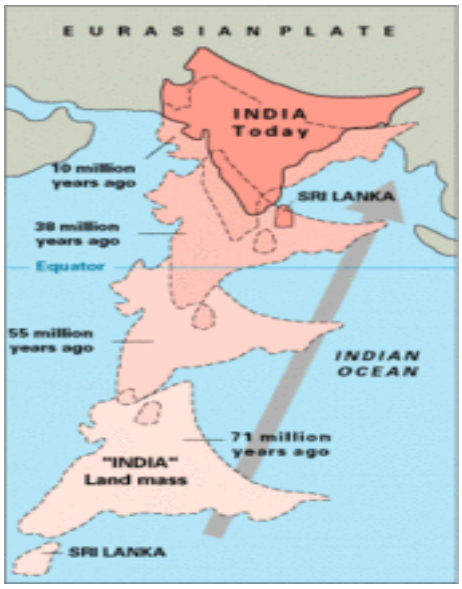


Fig.3 Plates zone

5. SEDIMENTATION DYNAMICS:

Sediment budget analysis techniques developed by the U.S. Army Corps of Engineers. The basic procedure combines information on shoreline and tidal inlet volume changes with computed estimates of the long shore wave energy flux to arrive at long shore sediment transport rates that balance the sediment volume transported into and out of littoral cells. As the Himalayan region is experiencing a great tectonic movement and the area is not so far from north-east coast so the land elevation of the all river system coming from the Himalaya is diversified and thus the river erosion, carrying and depositional capacity also may varied. As a result of it, Delta formation is may affect. So the depth of the coastline and continental shelf and also estuarine area may vary. On the other hand, variation of relief elevation of this area is created huge magnitudes of surface runoff changes. By which huge amount of agricultural runoff, industrial runoff, municipal runoff are accumulate with this river water and deposited in lower basin and coastal region of north-east India. The off shore area of north-east coast is very fertile due to Gangetic alluvium and also industrially advance for huge mineral based industries. So the amount of wastage materials is huge and due to dynamic land elevation, all the pollutants are mixing up with the sediments.

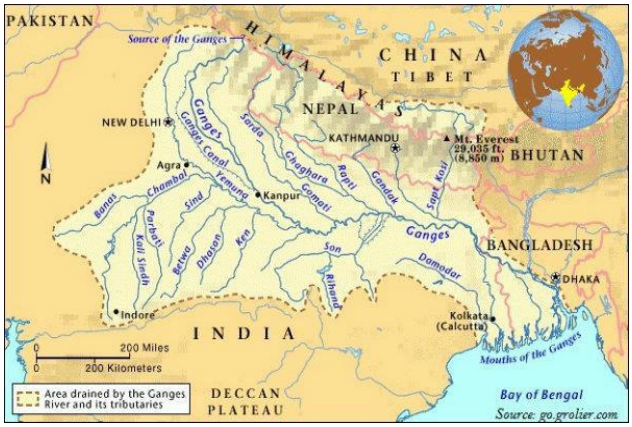


Fig.4 Map area plateau

6. ENVIRONMENTAL DYNAMICS:

Sediment pollutants are creating adverse effect on coastal environment as well as coastal fisheries. These pollutants are came from vast industrial belt of Odisha state and huge agricultural land of West Bengal. Many tidal rivers also caring these agricultural sediment pollutants through runoff. These rivers are Matla, Gosaba, Jalangi, Ichamati, Bidyadhari etc. These pollutants make the coastal environment so vulnerable for living elements especially fishes. On the other hand, the amount of sediment deposition also varies with the change of land elevation. So the depth of coastal zone may differ in different time (season). That is why, coastal environment of North-East coastal zone and all fisheries of this region may affect.

7. CONSEQUENCES TO FISHERIES:

1. Fish species are wiped out.
2. Fishes are affected by various diseases due to heavy wastage metal.
3. Amount of fishes is fluctuating day by day.
4. Many ornamental fish species are now endangered.

8. RESEARCH METHODOLOGY:

The entire network of the present study includes assessment of fish diversity (using Shannon Weiner Species Diversity Index as proxy), scaling of threats on fish diversity, and development of conserv9ation oriented management action plan. The various steps for this approach are listed here.

A) The coastal environmental diversity will be assessed from the catch primarily from the observing stations. The species wise catch (in tonnes) will be transformed to Shannon Weiner Species Diversity Index to know the condition of the environment in terms of stress.

B) Assess the threats operating on fish community through stakeholders meet and interactive with local people.

C) Scaling the threats with score to develop conservation oriented management. The scores may be categorized in to various types as listed:

1) Siltation and sedimentation
2) Deterioration of water quality
3) Harmful algal bloom
4) Capital dredging of river beds

5) Velocity of River water in estuary and sea mouth
6) Dynamics of water temperature in coastal part and sea mouth trough water mixing.

D) Analysis the data with the help of various statistical methods like ANOVA, Regression, co-relation, sampling etc.

9. RESULT AND DISCUSSION:

On the basis of above discussion and analysis, present study symbolize towards few mitigation for overcoming the problem which are listed below:

1. Government level action plan is needed to mitigate the situation of unscientific and rapid use of chemical fertilizer and pesticides for high agricultural productivity.
2) Introducing social forestry and agro-forestry along with coast line and estuarial and brackish water (high tide and low tidal area) zone.
3) Introducing wastage management plan with five **R** (Reuse, Recycle, Reclamation, Refuse, Rot or Composting).
4) Sketching a well-defined draining pattern to remove all pollutants from agri-commercial sector, industrial sector, municipal area etc.
5) There is need of a brief and scientific environmental protection plan which is taken by respective government department
6) Growing people awareness and alertness through various environmental campaigns, like as people interaction, meeting with local stake holders, organizing govt. level workshop and seminar etc.
7) Season based and bio fertilizer based agriculture must be introduced.
8) Industrial Wastage Landfill (IWL) is an essential and effective tool to solve the above problem.
9) Vertical and Horizontal farming are the two modern agricultural concept which can be used at the lower Ganga and Himalayan region as an effective measure.

10. CONCLUSION:

It is now a great challenge to maintain environmental sustainability and protecting the flow resources (fish) parallel with tectonic movement which creates so many physical impact on this zone. This zone is geologically as well as seismically very unstable and always moving in nature, so the landform formation and associated anthropogenic activates are also dynamic. So this plate not only creates an adverse impact but also emphasis a good impact on environment on coastal life. Due to huge sedimentation, the depth of sea may decrease and thus the sunlight goes through from it and reaches the sea floor. As a result of it, huge Zoo and Phyto plankton may attract to this area. So good and enriched fisheries can grow for this favorable condition.

REFERENCES:

1. Alagarsamy, R. (2006). Distribution and seasonal variation of trace metals in surface sediments of the Mandovi estuary, west coast of India. *Estuarine, Coastal and Shelf Science, 67*(1–2), 333–339.
2. Behera, L., Sain, L. K., Reddy, P. R., Rao, I. B. P., & Sarma, V. Y. N. (2002). Delineation of shallow structure and the Gondwana graben in the Mahanaddelta, India, using forward modeling of first arrival seismic data. *Journal of Geodynamics, 34*(1), 127–139.
3. Bhandari, G.N. and Das, S.C. 1998. A study of beach erosion for appropriate protection of Digha Coast. In: Mukherjee, Ananda Dev; Datta, Kalyan Kumar; Sanyal, Pranabes. (eds.), Coastal Zone Problems, Proceedings of National Workshop (March 20-22, 1998. Jadavpur University). Pp. 51-60.
4. Chakraborty, S.K. 2010. Coastal Environment of Midnapore, West Bengal: Potential Threats and Management, Jour. Coast. Env. Vol. 1, No. 1, pp. 27-40. 2010.
5. Chakraborty, S; Zaman, S; Pramanick, P; Raha, A.K; Mukhopadhayay, Chakravartty, D and A. Mitra. Acidification of Sundarbans mangrove estuarine system. Discovery Nature, (*ISSN: 2319-5703), 2013,* Vol.6 (14), pp. 14-20.
6. Chakraborty, K. 1984. Dynamics of Flora and fauna Diversity in the Mangrove of Sundarbans. Ind. J. of Forest. Pp. 220-232.
7. Chakraborty, K. 1986. Fish and fisheries resources in the mangrove swamps of Sundarbans, West Bengal- an in-depth study. Indian Forester. Vol.112 (6): pp. 538-542.
8. David, A. 1956. Effect of Calcutta Sewage upon Kulti estuary. J. Asiatic Soc. Vol.1 (4): pp. 339-363.
9. Dwivedi, S.N. 1993. Long term variability in the food chains, biomass yield and oceanography of the Bay of Bengal ecosystem. Large Marine Ecosystems: Stress, Mitigation and Sustainability (Eds. Sherman, k; Alexander, L; Gold, B.D) Blackwell Publishing Co. pp. 43-52. 1993.
10. Fischer, W; Whitehead, P.J.P. 1974. FAO Species identification Sheets for Fishery purposes Eastern Indian Ocean (fishing area 57) and Western Central Pacific (fishing area 71). Vols. 1-4 Rome: FAO. 1974.

11. Gao, P. (2008). Understanding watershed suspended sediment transport. *Progress in Physical Geography, 32*(3), 243–263.
12. Hora, S.L. and N.K. Nair. 1944. Suggestions for development of saltwater Basabadha fisheries in the Sundarbans. Fishery Dept. Pamphlet. No. 1. Department of Fisheries, Government of Bengal, Calcutta.
13. James, I. D. (2002). Modelling pollution dispersion, the ecosystem and water quality in coastal waters: a review. *Environmental Modelling & Software, 17*, 363–385
14. Jhingran, V.G. 1982. Fish and Fisheries of India. Hindusthan Publishing Corporation (India), Delhi. 2nd edition. Mascarenhas, A. (2004). Oceanographic validity of buffer zones for the east coast of India: a hydrometeorological perspective. *Current Science, 86*(3), 399–406.
15. Mishra, S.S., Pradhan, P., Giri, S. and Chakraborty, S.K, 2002. Environmental Perturbation with regards to water quality and fishery resources of river Rupnarayan; a potential threat from a thermal power plant, West Bengal, India. In. Sustainable Development and cold water fish genetic resources. (Eds. S.R. Verma.), Nature Conservators. 7. Pp. 155-172.
16. Mitra, A. (1998). Status of coastal pollution in West Bengal with special reference heavy metals. Journal of Indian Ocean Studies. 5 (2): 135-138.
17. Mohanty, S.S; Pramanik, D.S; Dash, B.P. 2014. Primary productivity of Bay of Bengal at Chandipur Odisha, India. International Journal of Science and Research Publication. 4(10).
18. Mukherjee, A.D. and Chatterjee, S., 1997. Coastal erosion and accretion at and around Digha in Midinipur District of West Bengal. Indian Journal of Geography and Environment. 2. Pp. 1-11.
19. Naidu, M.R. 1952. Report on a survey of fisheries of West Bengal. Government of Bengal. Dept. of Agriculture and industries, Bengal.
20. Oldham, R.D. 1893. A Manual of Geology of India, Calcutta.
21. Parulekar, A.H. & Verlencar, X.N., 1984. Status and prospects of fish farming in India. Proceedings of the Symposium on Coastal Aquaculture, Published by National Institute Oceanography, Goa, Vol. 3, pp. 732-737.
22. Paul, A.K., 2002. Coastal Geomorphology and Environment. ACB Publications. 575 pp.
23. Patnaik, K.C. & Mishra, P.M., 1988. Distribution of milk fish, Chanos chanos (Pisces: Chanidae) fry in Rushikulya Estuary. Mahasagar- Bulletin of National Institute of Oceanography, Vol. 21, pp. 239-243.
24. Pillay, T.V.R. & Ghosh, K.K., 1962. The bag net fishery of the Hooghly – Matlah estuarine system (West Bengal). Indian Journal of Fisheries, Vol. 9, pp. 71-99.
25. Qasim, S.Z., Sengupta, R. and Kureishy, T.W. 1988. Pollution of the sea around India. Proceedings of Indaian Academy of Science (Anim. Sci.). 97(2). Pp. 117-131.
26. Sanilkumar, V., Pathak, K. C., Pednekar, P., Raju, N. S. N., & Gowthaman, R. (2006). Coastal processes along the Indian coastline. *Current Science, 91*(4), 530–536.
27. Sarkar, S.K., B.N. Singh and A.Choudhury, 1986**.** The Ecology of copepods from Hooghly Estuary, West Bengal, India, Mahasagar. Bull. Nat. Inst. Oceanography. Vol.19 (2): pp. 103-112.
28. Sarkar, S. K., Bhattacharya, B. D., Bhattacharya, A., Chatterjee, M., Alam, A., Satpathy, K. K., et al. (2008). Occurrence, distribution and possible sources of organochlorine pesticide residues in tropical coastal environment of India: an overview. *Environment International, 34*, 1062–1071.
29. Salagrama, V. 2006. Trends in poverty and livelihoods in coastal fishing communities of Odisha State, India. FAO. ISBN 92-5-105566-1. 2006.
30. Shetty, H.P.C., S.B. Saha and B.B. Ghosh. 1961. Observations on the distribution and fluctuations of plankton in the Hooghly – Matlah estuarine system with notes on their relation to commercial fish landings. Indian J. Fish. 8: pp. 326-363.
31. Shetye, S.R. 2011. Indian estuaries: Dynamics, ecosystems, and threats, National Academy of Sciences, India. Vol. 34, No. 7 & 8, pp. 229-237.
32. Shetye, S.R; Kumar, M.D; Shankar, D (eds.), 2007. The Mandovi and Zuari Estuaries. ILP.pp 145. 2007.
33. Singh, B. and Choudhury, A. 1984. Occurrence of an enteropneust hermichordate in the Mangrove swamps of Sundarbans, India. Bull. Zool. Survey India. 6(1-3): pp. 1-4.
34. Subba Rao, N.V., A. Dey and S. Barua. 1983. Studies on the macro-fauna of Muriganga estuary, Sundarbans. Bull. Zool. Soc. India. Vol. 5: pp. 47-56.
35. UNEP. (1982). Pollution and marine environment in the Indian Ocean. UNEP regional seas Report and Studies. 13.
36. UNEP. 1985. Environmental problems of the marine and coastal areas of India. National Report UNEP Regional Seas Reports and Studies. No. 59.
37. Vijith, V, Sundar D, Shetye S.R. 2009. Time-dependence of salinity in monsoonal estuaries. Estuarine, Coastal and Shelf Science, 85: 601-608.