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RESEARCH ARTICLE

Assessment of Water quality in terms of physico – chemical parameters of East Godavari mangrove ecosystem (Coringa Wildlife Sanctuary) East Godavari, Andhra Pradesh, India.

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Abstract

A study was conducted on physico-chemical parameters of water from the estuary region in Coringa Wildlife Sanctuary. Physico-chemical parameters play an important role in the structuring the fish species and other aquatic organisms in mangrove swamp, estuaries and coastal areas. The baseline study was carried out for two successive years that is from January 2015 to December 2016 respectively. Monthly water samples were collected and 10 water parameters were analyzed. Data on temperature and pH were obtained from the field using mercury-in-glass thermometer and portable pH pen. Dissolved Oxygen, Salinity, Alkalinity, Hardness, Calcium and Magnesium were analyzed by using the standard protocols. Temperature varied between 33.8-26; pH, 8.5-7.15; salinity 24-0; dissolved oxygen 7.8-4; Ammonia 1.2 - 0.05; alkalinity, 340-80; Nitrite 1 – 0.01; Hardness 3500-110;Calcium 250-80; Magnesium 450-180. The water parameters favored the growth of the aquatic organisms. However, due to the ever increasing discharge of the effluents from the industries, municipality drainages and the aqua culture ponds contribute to the pollution of the estuarine ecosystems. This study is baseline data towards future ecological study, conservation and management of the resources in the East Godavari estuarine ecosystem.

Introduction:-

Water quality is defined in terms of the chemical, physical and biological contents of water. The water quality of rivers and lakes changes with the seasons and geographic areas, even when there is no pollution present. Water quality guidelines provide basic scientific information about water quality parameters and ecologically relevant toxicological threshold values to protect specific water uses. Important physical and chemical parameters that majorly influencing the aquatic environment are temperature, pH, salinity, dissolved oxygen ,Ammonia, Nitrite, Alkalinity Hardness, Calcium and Magnesium. These parameters are the limiting factors for the survival of aquatic organisms (flora and fauna) of the particular water bodies. Poor water qualities may be caused by low water flow, municipal effluents and industrial discharges (Chitmanat and Traichaiyaporn, 2010). Water temperature is probably the most important environmental variable. Temperature is also a limiting factor in the aquatic environment Odum

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(1971) and Boyd (1979). The salt concentration directly affects the salinity which impacts circulation with estuaries and coastal regions can derive from or be strongly influenced by the density variation associated with salinity.
Mangrove vegetation is considered to be highly productive tropical ecosystems (Clough, 1992). The mangrove forests are the important source of carbon and nutrients to the adjacent lagoonal and coastal systems (Odum and Heald, 1972, 1975; Twilley, 1988; Wattayakorn et al., 1990; Robertson et al. 1992).

The Godavari Mangroves are located in Godavari Estuary of East Godavari District, Andhra Pradesh. Total area under Godavari mangroves is 33,263.32 ha. and is the second largest mangrove patch along the east coast of India. This area also supports a wide range of other flora and fauna that include 35 species of mangrove and associated species, 277 benthic organisms, 609 Fin Fish species, 269 bird species, 26 species of Reptiles and 18 species of terrestrial mammals. Coringa Wildlife Sanctuary comprises of 34creeks, canals including the Coringa and Godavari rivers.

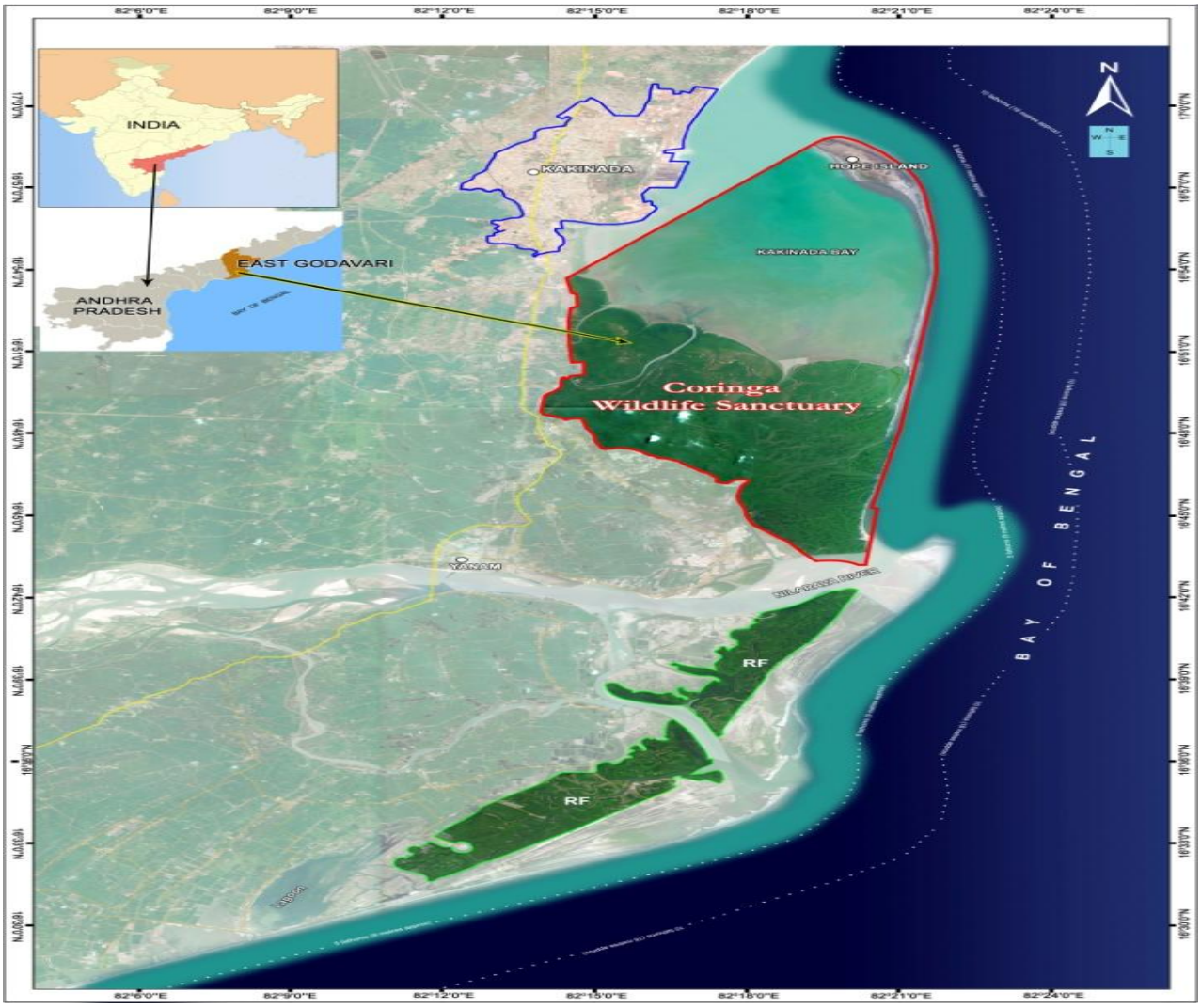
Due to rapid development of Kakinada port and erection of large scale industries changed urbanization of the Kakinada town, the mangrove fringed Coringa became a victim due to drastic urbanization and intensive commercial aquaculture practices. These factors have been identified as possible attributes towards a steady increase in eutrophication of waters in this area (Murthy, 1997). Although Coringa mangroves declared as Wildlife Sanctuary since 1972, this rich but fragile ecosystem has undergone serious alterations largely induced by human activities. Most of the mangrove areas are being converted for aquaculture culture areas. It is therefore necessary to understand the possible role of mangroves in ecosystem functioning. Selvam et al. (1992) studied the diurnal variation in physical – chemical properties and primary production in the interconnected marine, mangrove and freshwater biotopes of Kakinada coast, Andhra Pradesh. Bhaskara Rao et al.(1992) studied the mangrove environment and its sediment characters in Godavari estuary, east coast of India. Tripathy et al. (2001) studied the Water quality assessment of Gautami Godavari mangrove estuarine ecosystem of Andhra Pradesh, India.

Materials And Methods:-

Study Area:-

'Coringa Wildlife Sanctuary' is located between 16°44' to 16° 53' N and 082° 14' to 082° 22' E and at the confluence of the river Godavari with the Bay of Bengal in the East Godavari District of Andhra Pradesh. The sanctuary is a part of the Godavari Estuary and has extensive mangrove cover. The total area is 235.7 sq.km. The average temperature of the region is 17°C to 40°C. Average Rainfall is greater than 1,000 mm. The Northern part of sanctuary is covered by the back waters of the Kakinada Bay and covers an area of about 100 sq. km.

Map -1:- Study area Godavari mangroves (Coringa Wildlife Sanctuary)



Due to seasonal distribution of rainfall, East Godavari estuary ecosystem experiences seasonal flooding which introduces a lot of detritus and pollutants from the land. The estuary region presently serves as a major drainage channel receiving domestic wastes as well as industrial effluents from the industrial area of Kakinada.

Activity in the field:-

Water samples were collected to study the physico-chemical parameters of the estuary region of the Coringa Wildlife Sanctuary, these samples were collected from both surface and bottom of the creek. Usually water samples water samples were collected between 6 AM to 10 AM, samples were collected from two different points between January 2015 to December 2015 and January 2016 to December 2016.

Water parameters like pH and salinity were analyzed at the sampling station by using portable pH pen and digital salinometer. The water was collected by dipping cans 50-60 cm beneath the water surfaces. Fixation of the DO samples were done immediately after the sample collection in the DO bottles with the Wrinklers A and Wrinklers B reagent. The sample bottles were filled fully with water from each sample station, labelled and stored on ice for transport to the laboratory for water quality analysis. Samples collected in the 500ml plastic bottles and DO bottles were analyzed for general parameters *viz*., pH, Dissolved Oxygen, Salinity, Alkinity, Hardness, Calcium and Magnesium using the standard protocols and calibrated methods.

Results and Discussions:-

The results were primarily influenced by seasonal variations and inflow of the Godavari and Coringa river influencing the water quality parameters. The results were tabularize in (Table -1).

In the present study atmospheric temperature ranges from 26^0 C to 33.8^0C. Minimum recorded in the month of December and February 2015 and maximum in the month of May 2015 and 2016. The temperature is important factor which considerably fluctuated during study period. Lower temperature in the above months due to cloudy sky and rainfall brought down the temperature to the minimum.

The Hydrogen ion concentration or pH is one of the important proxy of water quality conditions, since pH of water is easily changed by chemical pollution. It is one of the vital environmental characteristics decides the survival, metabolism, physiology and growth of aquatic organisms. The pH is influenced by acidity of the bottom sediment and biological activities. High pH may result from high rate of photosynthesis by dense phytoplankton blooms. pH higher than 7 but lower than 8.5 according to (Abowei 2010) is ideal for biological productivity, but pH at <4 is detrimental to aquatic life. pH may be affected by total alkalinity and acidity, run off from surrounding rocks and water discharges. Ramanathan et al. (2005) recommended optimum range of pH 6.8-8.7 for maximum growth and production of shrimp and carp. The Hydrogen ion concentration has been recorded to be maximum of 8.5 to 7.15 minimum during the two years of study. Hence, the pH is at the permissible limit for the favorable growth of the aquatic fauna in this region.

Salinity is a dynamic indicator of the nature of the exchange system. It determines distribution of organisms in aquatic environments. The salinity of the water within the estuary tells us how much fresh water has mixed with sea water. Oxygen solubility decreases slightly as salinity increases, but oxygen solubility decreases more as temperature goes up regardless of salinity. Alkalinity of a water body is a measure of its capacity to neutralize acids to a designated pH (APHA, 1980 and Edokpayi, 2005.) In the present study the lower salinity was recorded during the month of October 2016(0 ppm), The zero level of the salinity was because of the inflow of the Godavari River during the monsoon season. and higher salinity was recorded in the month of March 2016 (24ppm), the result was corroborated with the (Muduli Bipra Prasanna et al., 2010) When river water mixes with seawater, a large number of physical and chemical processes take place, which may influence of water quality.

Dissolved oxygen (DO) affects the solubility of and availability of nutrients. Dissolved Oxygen is essential for the survival of fish and other aquatic life and is an important indicator of pollution and/or eutrophication in rivers. The solubility of oxygen in river waters depends mainly on the water temperature and salinity. Its low levels can result in damages to oxidation state of substances from the oxidized to the reduced form thereby increasing the levels of toxic metabolites. In the present study Dissolved oxygen ranges in between 4 to 7.8 ppm. The highest (7.8 ppm) D.O recorded in the month of July 2016 and lowest (4ppm) D.O recorded in the month of April 2016 and September 2105.

Ammonia acts as indicator of the pollution from excessive usage of ammonia especially from fertilizers. Ammonia is the initial product of the decomposition of nitrogenous organic wastes and respiration. Ammonia concentration in waters must not exceed the recommended limit because it is very dangerous and can harm an aquatic life in the river water. High concentrations of ammonia causes an increase in pH and ammonia concentration in the blood of the fish which can damage the gills, the red blood cells, affect osmoregulation, reduce the oxygen-carrying capacity of blood and increase the oxygen demand of tissues (Lawson, 1995). Present study confirms the maximum level of 1.2 ppm and the lowest 0.05 ppm and the mean for the two successive years was 0.47782.

Alkalinity is a measure of the capacity of unfiltered water to neutralize acid. In almost all natural waters alkalinity is produced by the dissolved carbon dioxide species, bicarbonate and carbonate.

Alkalinity is the water's ability to resist changes in pH and is a measure of the total concentration of bases including carbonates, bicarbonates, hydroxides, phosphates and borates, dissolved calcium, magnesium, and other compounds in the water. According to Moyle (1946) the range of total alkalinity as 0.0 - 20.0 ppm for low production, 20.0 - 40.0 ppm- low to medium, 40.0 - 90.0 ppm- medium to high production and above 90.0 ppm productive of the aquatic organisms especially fish fauna. Hence, the present study determines the good alkalinity levels in the study for the good environment for the growth of fishes.

Nitrite is an intermediate product of the aerobic nitrification bacterial process, produced by the autotrophic *Nitrosomonas* bacteria combining oxygen and ammonia. The ideal and normal measurement of nitrite is zero in any aquatic system. Stone and Thomforde (2004) suggested that the desirable range 0-1 mg L-1 NO_2 and acceptable range less than 4 mg L-1 NO_2. The results shows that the Nitrite rate from 1 ppm. and 0.01 ppm and most of the months was recorded to be nil thus the study area has permissible limit for the survival of the aquatic organisms.

Hardness is the measure of alkaline earth elements such as calcium and magnesium in an aquatic body along with other ions such as aluminium, iron, manganese, strontium, zinc, and hydrogen ions. Hardness was recorded maximum 3500ppm during September 2015 and minimum 110 ppm during October 2016 from the study area.

Calcium salts and Calcium ions are the most commonly occurring salts in Nature. They can come from natural or manmade. The concentration of calcium in water samples detected in between the range of 250-80 ppm with mean level of 155.24 ppm. It can be attributed to Hydro-chemical processes and also by anthropogenic sources like domestic wastes. Mean value of Magnesium was found to be 352.205 ppm and showed between the range of 450-180ppm, which may be attributed to basaltic inflows due to natural process in the study area, sea water influx, Aqua culture waste water and industrial waste waters.

Table : 1 Physico-Chemical Water Parameters of the Godavari estuary during 2015-2016

Months	Temp(^{0}c)	pH	Sal (ppm)	DO (ppm)	NH_3 (ppm)	NO_2 (ppm)	Alk (ppm)	Hrd ppm	Ca (ppm)	Mg (ppm)
Jan-15	27	7.15	1	4.5	1	NIL	110	150	200	410
Jan-16	28	7.5	20	5	0.8	NIL	80	1500	120	300
Feb-15	26	7.7	15	7	0.1	NIL	250	890	110	390
Feb-16	29.2	7.9	12	4.9	0.4	0.01	170	750	130	450
Mar-15	27	8.4	7.5	6.2	0.2	0.9	190	567	250	450
Mar-16	27.3	8.3	24	5	0.8	NIL	340	2900	140	300
Apr-15	28	7.38	12	5	0.6	NIL	120	780	130	380
Apr-16	31	8.3	6	4	0.8	1	160	290	120	300
May-15	33.5	7.9	22	4.7	NIL	0.08	150	3100	150	300
May-16	33.8	7.4	16	6.7	0.4	NIL	190	2400	80	210
Jun-15	29	7.8	5	5	0.4	0.03	120	750	160	300
Jun-16	27.3	7.8	12	6	NIL	NIL	200	1800	140	300
Jul-15	27	7.9	6	6.2	0.05	NIL	220	900	80	210
Jul-16	32.1	7.2	5	7.8	0.1	0.02	120	750	90	180
Aug-15	28	7.3	23	5.8	1.2	0.4	180	3450	90	180
Aug-16	32	8.1	12	6.8	0.2	NIL	140	1800	150	300
Sept-15	27	8.3	23	4	0.5	0.03	200	3500	150	300
Sept-16	27.3	8.5	23	4.9	NIL	0.01	140	3200	140	300
Oct-15	31	8.4	18	5.8	0.9	NIL	250	2700	130	380
Oct-16	33.6	8.3	0	6	NIL	NIL	300	110	140	280
Nov-15	28	8.1	7	5.9	NIL	0.3	140	1050	140	300
Nov-16	31.2	7.51	23	7	1.2	NIL	120	3400	120	300
Dec-15	26	8.3	18	5.4	NIL	NIL	300	2800	140	300
Dec-16	27.3	8.5	23	7.2	NIL	0.01	140	3500	160	390
Average	29.06	7.91	13.89	5.7	0.56	0.25	180.41	1793.20	135.83	312.91
Max	33.8	8.5	24	7.8	1.2	1	340	3500	250	450
Min	26	7.15	0	4	0.05	0.01	80	110	80	180
Mean	32.76	8.89	15.47	6.42	0.47	0.16	205.43	2018.34	155.24	352.20

*ppm = parts per million

It is perceived that the chemical run off from aquaculture may also contribute to the pollution of the estuarine ecosystems. The discharge of these effluents into the environment poses a threat to the coastal ecosystem and it is natural resources (Chua et al. 1989) and cause eutrophication of receiving water such as lakes and rivers (Cripps and Bergheim,2000). A study by Rangarao et al. (2003) indicates that pollutants are not flushed out completely due to the existing water circulation pattern and tend to accumulate in the southern part of the bay where mangroves are located. A small percentage (9%) of the fishermen of the Godavari mangroves attributes aquaculture effluents as the main cause of declining harvests (Dahdouh- Guebas et al. 2006). Untreated waste water loaded with uneaten feed

and fish faeces may contribute to nutrient pollution to the creeks which are near to the fish ponds. Industrialization, municipality drainage discharges, discharge of untreated water from the aqua culture ponds which were adjacent to the creeks and canals of the Coringa Wildlife Sanctuary contribute the estuary ecosystem. And when quantities of nitrogen wastes such as ammonia and nitrite are greater than creek waters can assimilate, water quality can deteriorate to a level that is toxic to aquatic organisms.

Recommendations:-

Proper disposal of industrial wastes, agricultural runoff, and the municipal waters while outlet in to the marine waters. Industrial sectors, governmental authorities and aqua cultural farmers have to take responsibility to ensure that chemical use in view of environmental quality and human health as well.

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References:-

1. **Abowei, J.F.N. (2010):** Salinity, dissolved oxygen, pH and surface water temperature conditions in Nkoro River, Niger Delta, Nigeria. Adv. J. Food Sci. Technol., 2(1): 16-21.
2. **American Public Health Association (APHA), (1980):** Water Pollution Method for the Examination of Water and Wastewater. 18 th ed., Washington D.C., pp: 1437.
3. **Bhaskara Rao, V., Narasimha Nao, G. M., Sarma, G. V. S. and Krishna Rao, B. (1992):** Mangrove and its sediment characters in Godavari estuary, east Coast of India. *Indian Journal Marine Science* 21: pp 64-66.
4. **Boyd, C.E. (1979):** Water Quality in Warm Water Fish Ponds. University, Press, Alabama, USA, pp: 59.
5. **Chitmanat, C. and Traichaiyaporn, S. (2010):** Spatial and temporal variations of physical- chemical water quality and some heavy metals in water, sediments and fish of the Mae Kuang River, Northern Thailand. International Journal of Agriculture and Biology, 12(6) : 816-820. ISSN; 1560-8530.
6. **Chua, T.E., Paw J. and Guarin F. (1989):** "The Environmental Impact of Aquaculture and the Effects of Pollution on Coastal Aquaculture Development in Asia," Marine Pollution Bulletin, Vol. 20, No. 7, pp. 335-343.
7. **Clough, B. F. (1992):** Primary productivity and growth of mangrove forests, In: *Tropical mangrove ecosystems*; (eds) Robertson A I and Alongi D M, American Geophysical Union, Washington, D.C., Pp. 225-249.
8. **Cripps, S.J, Bergheim, A. (2000):** Solids management and removal for intensive land-based aquaculture production systems. Aquacultre Eng 22: 33−56
9. **Dahdouh-Guebas, F., Vrancken, D., Ravishankar, T., Koedam, N., (2006):** Short term mangrove browsing by feral water buffaloes: conflict between natural resources, wildlife and subsistence interests? Environ. Conserv. 34, 157– 163.
10. **Edokpayi, C.A. (2005):** Variation of chemical constituents of a brackish water prawn habitat in southern Nigeria. Acta SATECH, 2(1): 11-18.
11. **Lawson, T. B. (1995):** indices of lake productivity, Transactions of the American Fisheries Society, 76, pp 322-334.
12. **Muduli Bipra Prasanna, Panda Chitta Ranjan. (2010):** Physico chemical properties of water collected from Dhamra Estuary. *International Journal of Environmental Sciences*, 3, 2010.
13. **Murthy, N.V.S.S. (1997):** Hydrography. In: "An assessment of the ecological importance of Mangroves in Kakinada area, Andhra Pradesh, India", Final report European Community INCO-DC Project: 16-25.
14. **Odum, E.P. (1971):** Fundamentals of Ecology. 3rd Edn., W.B. Saunders. Philadelphia, pp: 574.
15. **Odum, W. E. and Heald, E. J. (1972):** Trophic analysis of an estuarine mangrove community; *Bull. Mar. Sci.* 22 671-738.
16. **Odum, W. E. and Heald, E. J. (1975):** The detritus based food web of an estuarine mangrove community,In: *Estuarine Research*; (ed.) Cronin L E, Academic Press, New York, Pp. 265-286.

17. **Ramanathan, N., Padmavathy, P., Francis, T., Athithian, S. and Selvaranjitham, N. (2005):** Manual on polyculture of tiger shrimp and carps in freshwater. Tamil Nadu Veterinary and Animal Sciences University, Fisheries College and Research Institute, Thothukudi, pp: 1-161.
18. **Ranga Rao, V., Reddy, B. S. R., Raman, A. V. & Ramana Murthy, M. V. (2003):** Oceanographic features of the Bay-mangrove waterways of Coringa, East coast of India. *Proc. AP Akad. Sc.*, 7 (2): 135-142.
19. **Robertson A I., Alongi, D. M. and Boto, K. G. (1992):** Food chains and carbon fluxes In: *Tropical mangrove ecosystems* (eds) Robertson A I and Alongi D M, American Geophysical Union, Washington, D.C., Pp. 293-326.
20. **Selvam, V., Azariah, J. and Azariah, H. (1992):** Diurnal variation in physical – chemical properties and primary production in the interconnected marine, mangrove and freshwater biotopes of Kakinada coast, Andhra Pradesh, India. Hydrobiologia, 247: pp 181-186.
21. **Stone, N. M. and Thomforde H. K. (2004):** Understanding Your Fish Pond Water Analysis Report. Cooperative Extension Program, University of Arkansas at Pine Bluff Aquaculture / Fisheries.
22. **Tripathy. S. C., Ray, A. K., Patra, S. and Sarma, V. V. (2005):** Water quality assessment of Gautami-Godavari mangrove estuarine ecosystem of Andhra Pradesh, India during September 2001 *Journal of Earth System. Science.* 114, No. 2, April 2005, pp. 185-190.
23. **Twilley, R. R. (1988):** Coupling of mangroves to the productivity of estuarine and coastal waters, In: *Coastal-Offshore Ecosystem Interactions*; (ed.)Jansson B O, Germany: Springer-Verlag, Pp. 155-180.
24. **Wattayakorn, G., Wolanski, E. and Kjerfve, B. (1990):** Mixing, trapping and outwelling in the Klong Ngao mangrove swamp, Thailand; *Estuar. Coast. Shelf Sci.* 31 667-688.