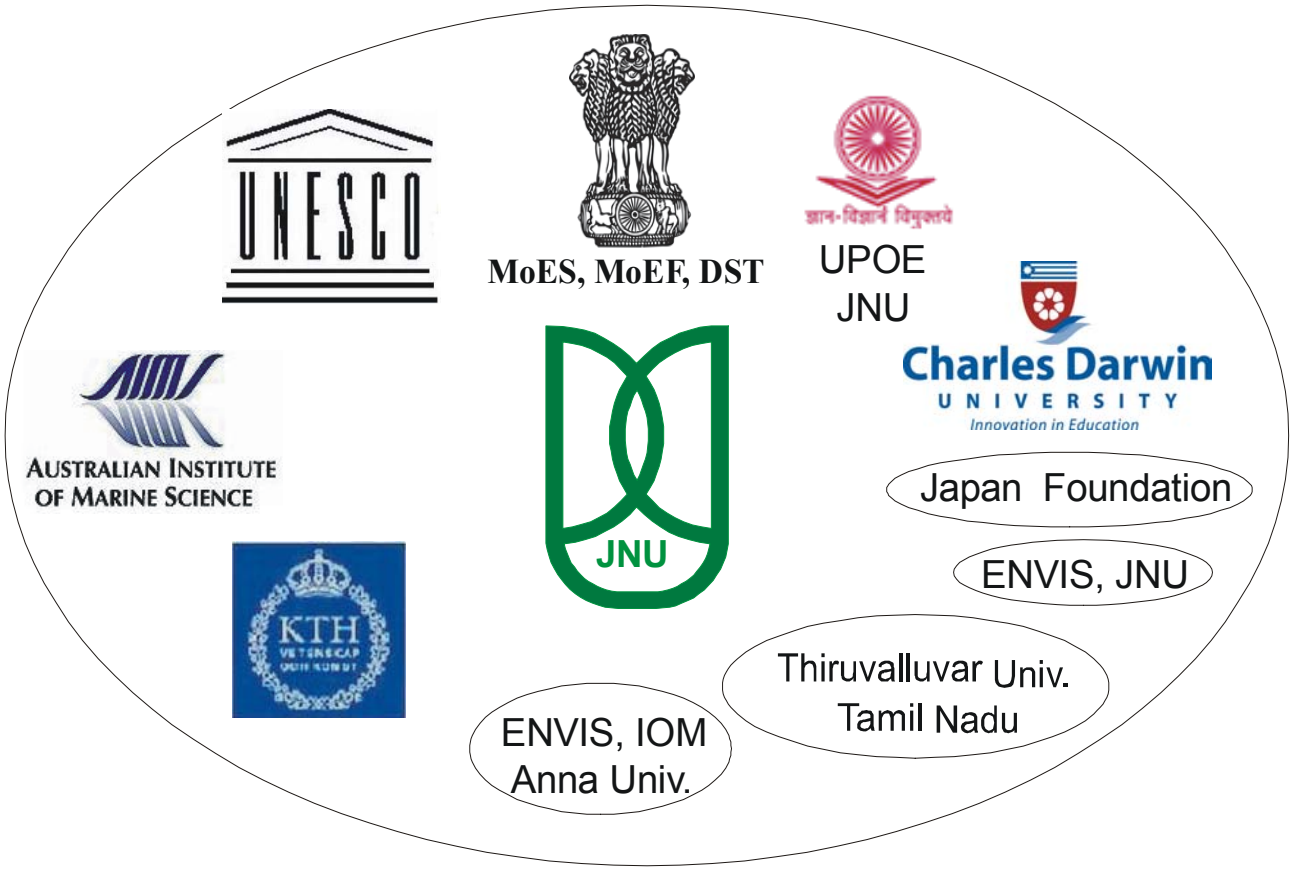
International Conference

COASTAL ZONE ENVIRONMENT AND SUSTAINABLE DEVELOPMENT
VULNERABILITY, ADAPTATION AND BEYOND

12–14 February, 2007

CZESD 2K7

School of Environmental Sciences
Jawaharlal Nehru University, New Delhi



Volume of Abstracts

and *souvenir*

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February, 2007

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SECRETARY

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D.O. No.DST/Secy/ 143 /2007

February 02, 2007

Dear Professor Ramanathan,

Thanks you for your invitation to the international Conference on " Coastal Zone Environment and sustainable Development – Vulnerability, Adaptation and Beyond" and Indo – Australian Scientific meet scheduled to be held on 12th to 15th February, at the school of Environmental Sciences, Jawaharlal Nehru University, New Delhi. I would have loved to participate in the meet and deliver a lecture. Since I have made several commitment already for these dates, it would be difficult to manage the time. It is a case of intention to deliver the lecture being denied by the realities of time pressure. There will always be another date and occasion.

Kindest Regards,

Professor A.L.Ramanathan
Organizing Secretary,
School of Environmental Sciences,
Jawaharlal Nehru University,
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Yours sincerely,

Ramasami

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ENVIRONMENT & FORESTS
GOVERNMENT OF INDIA
NEW DELHI - 110003

MESSAGE

I am happy to know that an International Conference on '**Coastal Zone Environment and Sustainable Development – Vulnerability, Adaptation and Beyond**' is being organised on 12th – 14th February, 2007 by the School of Environmental Sciences, Jawaharlal Nehru University, New Delhi.

The Conference has been planned to provide an opportunity to delegates from India and abroad to discuss various issues such as ecological aspects of coastal ecosystems, monitoring system for coastal zones, Tsunami impact on coastal groundwater, modelling and prediction of coastal environmental change, policy, legislation, protection and management of coastal resources.

On this happy occasion, I extend my best wishes to the Organisers, members and participants of Conference.

New Delhi

Dated : 5th February, 2007

(A. RAJA)

भारत के उप-राष्ट्रपति के विशेष कार्य अधिकारी
OFFICER ON SPECIAL DUTY
TO THE VICE-PRESIDENT OF INDIA
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TEL.: 23016422 / 23016344 FAX : 23012645

MESSAGE

Vice-President of India is glad to know that an International Conference on 'Coastal Zone Environment and Sustainable Development – Vulnerability, Adaptation and Beyond' is being organised during February 12-14, 2007 at the School of Environmental Sciences, Jawaharlal Nehru University, New Delhi.

Vice-President of India extends his good wishes to the organisers and wishes the Conference all success.

(Ashok Arya)

VICE-PRESIDENT
(Bhiran Singh Shekhawath)

New Delhi
7th February, 2007

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ORAL PRESENTATION

SESSION
ENVIRONMENTAL MONITORING
OF COASTAL ECOSYSTEM

INCREASED PEST INCIDENCES IN MAN-MADE MANGROVE PLANTATIONS IN COASTAL ZONE OF BANGLADESH

M.W. Baksha

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Abstract

Bangladesh faces recurrent cyclonic storms and tidal surges causing severe losses of lives and assets every year. To combat this problem a massive mangrove afforestation programme was initiated in 1966 to create a protective belt along the exposed south and south-eastern coastal zones of Bangladesh. The idea was conceived by the long-standing experience on the protective role played by the Sundarbans natural mangrove forest located in the south-western coastal region. It was also envisaged that the man-made mangrove plantations would reduce soil erosion and accelerate land stabilization and accretion through deposition of silt carried down by network of large rivers like Padma, Meghna and Jamuna and their numerous tributaries. So far, about 150,000 ha have been planted of which about 94% is covered with keora (*Sonneratia apetala* Buch.-Ham), mostly in monoculture. The species was selected mainly due to its fast growing habit and adaptability to newly accreted land. The species naturally grows in association with other species in the Sundarbans harbours a number of insects including the beehole borer (*Zeuzera conferta* Walker), defoliators {*Streblote siva* Lefebvre, *Trabala vishnou* Lefebvre, *Altica coerulea* (Olivier)}, sap sucker (*Psylla* sp.), and bark eater (*Indarbela* spp.), which seldom attain recognizable pest status in the Sundarbans. However, when keora was planted extensively in the vast coastal zone these insects emerged as serious pests causing severe damage both in plantations and nurseries. This paper reviews the pest problems, discusses the impact of keora monoculture in creating such problems and suggests management options to mitigate the problems.

THE RELATIVE LEVELS OF MERCURY AND SELENIUM IN THE SEAFOOD AND BLOOD OF STUDENTS FROM A WEST COASTAL TOWN OF SOUTH INDIA.

A. Sukumar

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Abstract

The coastal population is exposed to non-occupational element sources through eating seafood. Hence, in the present study mercury and selenium were estimated with quality assurance in the seafood and blood of students from Mahe, a west coastal town of South India to find status of exposure and relationship of Hg and Se interaction. The concentration of Hg was in increasing trend and that of Se within the normal ranges in the blood of students and the flesh of edible crab, shrimp, sea mussel, cuttle fish and eight economically important species of fish, when compared to the reported values. However, the values of Hg and Se may be considered as baseline levels useful for international comparison. The blood contents of both the elements were not significantly different between the boy and girl students, due to their narrow age limit (20 to 22 years) and similar food habit. As the levels of Hg and Se were correlated, it was elucidated that Se levels were lower and Hg levels were higher in the blood of students, but not in the seafood. Thus, a negative correlation discerned between the levels of two elements, indicates that the Se levels influence Hg levels in the blood of students leading to detoxification of Hg by Se.

NICKEL, LEAD, ZINC, COPPER AND CADMIUM IN SOFT TISSUE AND SHELLS OF MERETRIX SP. MUSSELS AND ASSOCIATED SEDIMENTS ALONG MUMBAI COAST.

A.F. Ashley[1], N. Swati[1], C. Rohini[1], D. Debjani[1], D. Chandrasekharam[2] and P. K. Saraswati[2].*

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Abstract

Industrial processing of metals, combustion of fossil fuels, smelting of nickel, lead and zinc are considered important sources of heavy metals in the coastal environment of Mumbai. Heavy metals (Ni, Cd, Zn, Cu and Pb) are potentially toxic to man and their concentrations in seafood must be continuously monitored as they form the main food chain of toxic metals into the human system. The common bivalve mussel, a source of food, is frequently used as an indicator marine organism to monitor such heavy metals in the coastal zone environment. Trace elements concentration in Meretrix sp. and sediments along the coast of Mumbai were investigated to understand the impact of industrial effluents on the marine organisms. Sample locations are shown in the figure. "A" in figure represents the location of mussels collected during this study and the numbers indicate the chemical characteristics of sediments analyzed and reported by earlier workers. Concentration of Cu, Zn, Ni and Pb from the soft tissues and hard shells in 40 Meretrix sp. were determined along with the associated sediments. The mussel samples were collected before the onset of SW monsoon of 2006. The Ni, Pb, Zn, Cu and Cd in the sediments from the four sites vary from 87-187, 20-62, 128 880, 90-400 and 1.9-3.8 ppm respectively. Our investigation shows that the shells of these mussels are able to scavenge a major part of the metals while the edible soft tissues recorded lower concentration. Thus the Ni, Pb, Zn and Cu in the shells vary from 1252-1290; 57-64, 1462-1632 and 3761-4157 ppm respectively. In the soft tissues the concentration of Ni, Zn, and Cu vary from 25-50, 41-61 and 13-21 ppm respectively. Except for Zn, partitioning of other metals between the soft tissue and hard shells is similar to that reported from other parts of the world. It is reported that the byssus of blue mussel (Mytilus edulis trossulus) concentrates metals relative to the shells. Accumulation of

metals by shells and byssus relative to the soft tissues appears to be environment specific. For example, the concentration of Zn in certain mussel (Mytilus edulis) from Great Britain appears to be at contrast from that observed in the present study.

PROCESSES CONTROLLING THE DISTRIBUTION OF SELECTED METALS IN THE SEDIMENT CORES FROM THE MUDFLATS OF MANDOVI ESTUARY, CENTRAL WEST COAST OF INDIA

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Abstract

The percentage of sediment components (Sand, silt, clay and total organic carbon) and concentrations of selected metals (Fe, Mn. Zn, Cu, Cr, and Co) were determined in two shallow cores from two different mudflats within the Mandovi estuary in order to understand their distribution and processes controlling their deposition.

Granulometric data showed the sediments of Core MR, which was collected from the mudflats located in the middle portion of main channel of estuary, is finer (Avg. mud 84.52 %) than the sediments of Core MS (Avg. mud 70.70%), which was collected from mudflat located near the mouth but from a creek of the estuary. Metal concentration profiles in both the cores are highly variable with depth and the average individual trace metal concentration in the core MR is relatively higher than the core MS. The metal concentration profiles in both the cores are quite similar indicating a common source and/or similar post depositional behaviors. All the metal profiles showed three distinct zones with a significant enrichment in the upper portion of the core except Zn, Cu, Cr in core MR. There is a significant correlation between trace metals (Zn, Cr, Cu, Co) and Fe & Mn in core MS indicating their adsorption on to Fe-Mn oxyhydroxides. Organic carbon content is higher in core MR than the Core MS and both the cores showed a decreasing trend towards the top. Interestingly there is no significant correlation between organic carbons with mud fraction in both the cores. Similarly total metal concentrations are also not showing any significant correlation with organic carbon and therefore there is little evidence to suggest that metals have been redistributed by the degradation of organic matter. The significant degree of correlation of trace metals with mud fraction especially in Core MS and to some extent with Fe and Mn in Core MR suggests association of Fe and Mn with finer fraction viz. mud. Probably organic carbon do as not play any role in the distribution of trace metals when supply of metals is higher through anthropogenic sources. Further, in such a condition trace metal distribution is largely seems to be controlled by Fe-Mn oxyhydroxides. The sediments of the cores, when plotted on the Ternary diagram proposed by Reineck and Siefert (1980) indicated that these sediments were deposited in the mud flats to mature mud flats environment.

ASSESSMENT OF MICROBIAL POLLUTION IN COASTAL WATERS OF THE LITTLE ANDAMAN ISLAND

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Abstract

Microorganisms distributed in the marine and brackish environments play an important role in the decomposition of organic matter and mineralization. Microbial water quality analysis has been given more importance in the marine pollution monitoring programmes as marine microbial pollution is mainly derived from land based sources. Considering the above importance the present study was carried out during January 2006 in eight different coastal stations of the Little Andaman Island to monitor the pathogenic bacteria. The present investigation found the presence of *Vibrio cholerae, V. parahaemolyticus, Shigella* sp*., Klebsiella* sp*., Salmonella typhimerium, S. paratyphi, Proteus vulgaris, Escherchia coli, Streptococcus faecalis* and *Pesudomonas aeruginosa* and their density varied from 14 to 78 x 10^2 CFU ml^{-1}, 7 to 53 x 10^2 CFU ml^{-1}, 3 to 36 x 10^2 CFU ml^{-1}, 7 to 32 x 10^2 CFUml^{-1}, 1 to 14 x 10^2 CFU ml^{-1}, 1 to 5 x10^3 CFUg^{-1}, 1 to 5 x 10^2 CFU ml^{-1}, 32 to 153 x 10^2 CFU ml^{-1}, 9 to 34 x 10^2 CFU ml^{-1} and 1 to 41 x 10^2 CFU ml^{-1} respectively. Among the pathogenic bacteria, *Vibrio* contributed more (23.0%), followed by *Pseudomonas* (20 %), *Escherchia* (17.0%) and *Streptococcus* (15 %). The present study indicates the microbial pollution in the coastal waters of the Little Andaman Island, which might have effects on human health.

COMPARATIVE INVESTIGATION ON PHYSICO-CHEMICAL PROPERTIES OF THE TWO DIFFERENT MARINE ECOSYSTEMS (CORAL REEF AND SEAGRASS) OF THE PALK BAY

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Abstract

Physico-chemical properties of the ambient marine environment will play a pivotal role in determining the type of ecosystem besides several other parameters like geomorphology, tidal amplitude and sediment composition. In the present study two different marine ecosystems viz. coral reef (Munaikkadu) and sea grass (Devipattinam) separated by a distance of 20 km in the Palk Bay region were investigated for their physico-chemical properties during 2002-2004. Ranges of the parameters studied are as follows: air temperature (27 - 35 ºC), surface water temperature (25.0 - 31.5 ºC), LEC (0.54 - 1.22 k), salinity (28.0 - 36.0 ‰), pH (7.0 - 8.2), DO (3.15 - 6.68 mll^{-1}), nitrate (0.25 - 7.3 µM), nitrite (0.03 - 2.91 µM), inorganic phosphate (0.12 - 4.1 µM), reactive silicate (0.6 - 7.4 µM) and POC (0.28 - 3.25 mg C l^{-1}). The results showed that, there is clear spatial variation at both the stations where as they exhibited more or less similar temporal variations in the physico-chemical characteristics of water.

DYNAMICS OF HEAVY METAL POLLUTION IN THE SEDIMENTS OF CHENNAI COAST, TAMIL NADU

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This paper presents data on seasonal variations of water quality parameters and heavy metals in the sediments of Chennai coast for 1997-1999. Variability in the physico-chemical parameters can be attributed to the dilution of coastal waters by direct runoff, human activities and organic load. The variations in water quality parameters in general suggest less significant spatial variations between different zones than seasonal changes. Water quality variables such as pH, Salinity and nutrients like nitrate, phosphate and silicate indicate very significant effects of seasonal influences on all the parameters studied. Spatial variations are highly significant only in the case of pH and salinity.

Phosphate and silicate concentrations and their availability were found to be higher in this coast than nitrates and high during pre and post-monsoon seasons. In the present study 5 heavy metals viz. Zn,Cd,Cu,Fe and Pb were quantified from the sediments of Chennai coastal areas and their concentration were dependent upon the seasonal variations. But, Pb registered the lowest concentration irrespective of seasonal variations. The concentrations of heavy metals in the revering zone and estuarine zone were found to be higher in the sediment samples, than Pb. The concentration of heavy metals in the riverine zone and estuarine zone were generally higher than in the near shore waters of Chennai coast. The average metal concentrations in the sediment samples especially of Fe, Cu, Cd and Zn were higher when compared that of Pb. Generally, Fe,Cu,Cd, and Zn concentrations were found to be higher in the sediment samples in the coastal sediments of Chennai than Pb. Therefore, it is understood from the present study the distribution of heavy metals showed the following trend: Fe>Cu>Cd>Zn>Pb.

BIOLOGICAL MONITORING OF TRACE METAL POLLUTION USING SEAWEEDS AS A TOOL

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Abstract

Elucidation of the pollution of aquatic areas by trace metals is theoretically possible by the analysis of water, sediments or a member of indigenous biota. Use of water analysis will be expensive, laborious and multiple sampling must be undertaken to eliminate variations in metal concentration with time, season, fresh water run off, current, wave and tides and other factors. B, the use of biological indicator organisions to define areas of trace metal pollution appears most attractive, as these organisms can concentrate metals from water and sediments, with an allowance of inexpensive and relatively simple analysis. This paper reports the level of Cu, Zn, Ni, Co and Cd in twenty species of marine algae collected from three intertidal sites along the Tamil Nadu coast of India viz. Chennai (Lat. 13^{o} 6'N; Long. 80^{o} 16'E), Nagapattinam (Lat. 10^{o} 46'N; Long. 79^{o} 51'E), and Tuticorin (Lat. 8^{o} 45'N; Long. 78^{o} 12'E). The levels of trace metals viz. Cu, Zn, Ni, Co and Cd were 189.50, 225.60, 98.00, 12.2 and 18.50 respectively in *Enteromorpha compressa* and 75.50. 157.50, 68.30, 88.30 and 2.25 in *Padina tetrastromatica* (mg g^{-1} for all metals) respectively. Further, these two species contribute more biomass and productivity than that of other species of seaweeds. Highly significant positive correlation was obtained between the concentrations of trace metals in seaweeds and water. Concentration factor (CFs) in seaweeds was higher in the case of all metals, and also concentration was higher in seaweed than water. *E. compressa* and *P. tetrastromatica* have effectively accumulated more amounts of trace metals as compared to other seaweeds. Hence, these two seaweeds can be used as biological monitors of trace metal pollution.

PHYSICO-CHEMICAL AND SEDIMENT CHARACTERISTICS OF THE DIFFERENT MARINE LOCATIONS OF THE GREAT NICOBAR ISLAND

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Abstract

Physico-chemical parameters of water and sediments play a key role in the respiration, calcification, photosynthesis, growth of the organisms in any aquatic ecosystem. These parameters also influence the diversity and density of varied groups of both adult and larval forms of the ecosystems. The study of sediments represents a useful tool for determining the actual state of the environmental condition and for understanding the origin and mechanism of the same. In this sense, the present investigation on the physico-chemical characteristics and sediment texture of the coastal waters and sediments of the Great Nicobar Island was made in 33 coastal stations during 2001-2003. Most of the physico-chemical parameters showed difference in their behaviour depending upon the location of the site and prevailing ecosystems. Various physico-chemical parameters are varied largely depending up the nature of the study location; air temperature (25-35 ^{o}C), surface water temperature (24-32^{0}C), transparency (2.25-22.93m), salinity (21-40‰), pH (6.6-8.1), DO (2.7-8.6 ml l^{-1}), phosphate (6.208 and 14.25 µM), silicate (27.48 – 39.96 µM), nitrate (3.66-14.93 µM), nitrite (0.021-1.591µM), total nitrogen (3.275-15.02µM) and TOC (0.926-8.824 mgC/g). Depending up on the prevailing ecosystem sediment composition also varied widely; sand (3.857%-97.29%), silt (1.036 - 94.34%) and clay (1.13-11.89%) and some of the stations were totally devoid of silt or clay fraction while one station recorded 100% of sand composition.

SESSION

HYDROGEOLOGICAL ASPECT OF COAST

GEOCHEMISTRY OF THERMAL WATERS OF THE KURIL ISLANDS (RUSSIA) AND THEIR INTERACTION WITH SURROUNDING FRESH AND SEAWATERS

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Abstract

Underground and surface waters of active volcanoes on islands are subjected to strong influence of volcanic activity on the one hand and seawaters on the other. The Kunashir Island (south of Kuril) with Mendeleev Volcano is example of this influence. Among the thermal waters of Mendeleev Volcano three main geochemical types can be distinguished: alkaline sodium-chloride, acid-sulfate and chloride-sulfate-bicarbonate waters. These waters have different values of pH, Eh, TDS, REE, ratios of stable isotopes and different origin. The geochemical zoning of these waters (from top to basement of volcano) is observed. On the fumaroles fields, predominantly acid sulfate waters occur, below in the basement of volcano sodium-chlorite waters are common. Chloride-sulfate-bicarbonate waters are located on the periphery of volcano. Seawaters interact only with sodium-chlorite waters. As evidence there is good correlation between chlorine and $\delta^{18}O$ for "Hot beach" area. This steam heated water uses for geothermal plant and if exploration is high the temperature drop down very fast because more seawater is involved. Acid sulfate waters are circulating in the depth of sixteen meters and discharge into the Kislaya (Acid) Creek. The Acid Creek (pH about 2.5) has very high contents of Fe, Al, Zn, Mn, Si and runs into Lesnaya River, biggest River of this Island. Everyday only Acid Creek delivers into the Lesnaya River about 706 kg of Si; 258 kg Fe; 190 kg Al, 90 kg Zn, and 42 kg Mn. Finally this material transports into Pacific Ocean. The sodium-chlorite-bicarbonate water forms as a result of dilution of sodium-chlorite alkaline waters by fresh underground waters. Thus, in volcanic islands we observe very complicated system of water's interaction.

USING STORMWATER IMPOUNDMENT AS AN ALTERNATIVE SOURCE OF WATER SUPPLY IN THE CALOOSAHATCHEE RIVER WATERSHED

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Abstract

Lower West Coast of Florida is an important part of the Florida's Everglades ecosystem since it contains the Caloosahatchee River that connects Lake Okeechobee to the Gulf. Excess runoff from the Caloosahatchee watershed results in high discharges to the estuary, which can potentially harm the estuarine ecosystem. The region is also increasingly facing water shortages due to urban development in the coastal areas. If excess runoff could be retained in the watershed, it can help reduce excess discharges to the estuary and increase water availability. One possible approach to retain water in the watershed is to use agricultural impoundments and use the stored water for irrigation in urban and/or agricultural areas. Three impoundments in the watershed were monitored to test this approach. Under current conditions, most of the water stored in the impoundment was lost within the first week of the dry season. The MIKE SHE/MIKE 11 integrated hydrologic model was used to evaluate structural and managerial alternatives to increase water retention volume and time in the impoundment. The alternatives include lining different parts of the impoundment and pumping water regularly from the surrounding ditch into the impoundment. Lining the entire impoundment could provide more than 10 weeks of additional irrigation during the dry period. Lining the embankment and the inner canal of the impoundment provided up to four weeks of additional irrigation. If stored water from impoundment could be traded, it can provide additional income source for agriculture which could help limit urban growth and reduce adverse impacts on the wetlands and estuarine ecosystems.

CREATION OF SYSTEM "DELTA-SEA" AS A BASIS OF ECOSYSTEM APPROACH TO THE MANAGEMENT OF LARGE ARAL SEA'S COASTAL ZONE

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Abstract

In the beginning of 1960s Aral Sea had area more than 64000km^3. In 1980s Aral Sea was divided on Large and Small Aral Seas (LAS and SAS). Now LAS was divided on 2 parts – Western and East Aral Seas (WAS and EAS). Area of SAS, WAS and EAS together makes less than 20000 km^3. After realization of necessary measures by Government of Kazakhstan, experts estimate a management of SAS and Syrdarya river delta as relatively satisfactory. EAS receives water from Amudarya river after satisfying the needs of delta, WAS receives water only in case when water is much and it overflows to EAS. Amudarya delta receives water not always in quantities sufficient for its steady existence.

Analysis of results some previous projects (NATO SFP 974357, INTAS/RFBR-1733, etc.) shows that the uniform opinion on ways for saving of WAS or EAS does not exist. It is necessary the decision on saving one of Seas (WAS or EAS) to accept. It is possible only under connection of Amudarya delta with one of named above Seas, and "Delta–Sea" ecosystem's creation. In this context, "Amudarya delta - WAS" ecosystem's creation is more expedient and preferable from the point of view of technical practicability, smaller expenses of financial assets and future efficiency.

The creation uniform ecosystem "Amudarya delta - WAS" will allow to solve a noble task of restoration of ecological stability in this region. If not to solve a problem of WAS preservation, management of Amudarya delta's ecosystem and WAS coastal zone will be unstable.

OCCURANCE OF MUDBANKS IN KERALA COAST, INDIA - INSIGHT FROM A RADON MONITORING STUDY

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Abstract

An in-situ radon monitoring study was conducted in coastal waters of mudbank region in Pallana, Haripad, Kerala, India for understanding the occurrence of mudbanks, a unique phenomenon in the Kerala coast. Natural ^{222}Rn (half life : 3.8 days), being a reliable tracer for identifying areas of groundwater discharges in sea, was used in the present study to assess the validity of some of the prevailing postulates on the occurrence of mudbanks. ^{222}Rn activities were continuously measured at various locations in and around the mudbank region, Vembanad lagoon and Pamba River using an in-situ radon monitoring system. Discrete water samples were collected from shallow and deep groundwaters in the neighbouring areas and analysed for ^{222}Rn. Other physical parameters like water temperature, electrical conductivity, pH and alkalinity were also measured in-situ. Results show that ^{222}Rn activities in the coastal waters of mudbank region are negligible compared to the suspected end members such as Vembanad lagoon, Pamba River and shallow and deep groundwaters. Also, the observed electrical conductivity in the mudbank region is same as those outside the mudbank and is similar to the mean seawater values indicating that there is no dilution of seawater because of any freshwater inputs. Hence, from the study, it appears that subsurface groundwater discharge or sub-terrainean (conduit flow) flow from the Vembanad lagoon may not be responsible for the sustenance of mudbank in Pallana coast.

SEA WATER INTRUSION AND DISASTERS: LIVELIHOOD RESILIENCE AND ADAPTATION BY COMMUNITIES IN SHAURASTRA COAST OF GUJARAT

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Abstract

Salinity is one of the most significant and widespread forms of groundwater pollution in coastal areas. Across Shaurastra Coast in Gujarat, vulnerability to climatic change and disasters is high. Floods and droughts are endemic and coastal regions are often devastated by extreme storm events, likely to be exacerbated by climate change and anticipated sea level rises. During high tide and monsoon floods, the mouth of the river is blocked and flooding becomes severe. From the study it was found that the loss to properties and lives, drinking water, electricity supply and livelihood are affected. People continue to face problems even after the floods and cyclones subside. Local communities have been coping and adapting to such disasters over years. The paper presents the adaptation by the coastal communities to the impacts of climate change, sea water intrusion and disaster associated with likely long-term climate change. It also focuses on risk reduction measures including sector-specific and cross-cutting responses. The lessons learnt by communities on adaptation and livelihood resilience have been used in disaster risk reduction and post-disaster recovery processes over a period of years in coastal region. In participation with stakeholders this if communicated to target audiences in a timely and usable manner, particularly those who are most vulnerable (gender, caste, economic class, age and physically challenged people) can reduce the risk due to sea water intrusion as well as disasters.

HYDROLOGY OF THE VEMBANAD WETLAND SYSTEM

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Abstract

The Vembanad wetland located in the central region of Kerala, in India has several functions and values including flood retention, pollution control, agriculture, fisheries, inland navigation, tourism etc. The wetland system includes the Vembanad Lake and the deltaic regions of five rivers draining to it. Out of the total 1100 km^2 area covered by the wetland, 790 km^2 is at or below the mean sea level. The wetland is characterized by groups of polders protected by earthen bunds and a land mass crisscrossed by waterways. High floods during monsoons overtop polder bunds resulting in crop loss and often leading to loss of life. Due to land reclamation and other developmental activities, flood proneness of the wetland has increased during the last three decades. Proper measures for management of the floods are essential to sustain agricultural production in the wetland. Results of a study on the hydrology of the wetland system are discussed in this paper.

The wetland region has a monsoon climate. Out of the average annual rainfall of 3200 mm, the southwest (June-August) and northeast (September-November) monsoons contribute about 60% and 30% of the rainfall respectively and the summer showers contribute the remaining 10%. Less rainfall is received in the wetland region compared to the highland regions of the river basins. Out of the total annual gauged flow of 13353 Mm^3 to the wetlands from the five river basins, 11934 Mm^3 (89.0%) occurs during the monsoon months and the remaining 1418 Mm^3 occur as low flow during six non-rainy months. Flow duration analysis for the river gauging stations indicates that for 50% of time, river flows to the wetland are negligible.

Analysis of the peak discharges of the extreme flood event in 1992 show that in the gauging stations of three river basins the flood peaks are attained almost at the same time. In the other two river basins, the peak flood occurred with a lag of one day compared to the first case. These results indicate that the flooding in the wetland area result from extensive storms covering the associated river basins. By flood frequency analysis, annual maximum discharges for the gauging stations in the five rivers and for the combined discharges are estimated for return periods up to 100 years. The extreme flood in 1992 has a return period of 10 years. Since the water level in the Vembanad lake is determined by the river flows and tidal conditions downstream, storage effects are important in the formation of extreme floods in the wetlands. In contrast, the flood storage capacity of the wetland is closely related to the land use pattern. Reservoirs in the upper river basins intercept only a small portion of the runoff, and therefore, their

effect on the floods is negligible. Under the existing land use conditions, scope for improving flood control through structural measures are limited and therefore an alternate solution is a combination of structural and non-structural measures including the control on land use.

IMPACT OF REDUCED FRESH WATER FLOW AND RIVER INTERLINKING ON ECOLOGY OF COASTAL ENVIRONMENT

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Abstract

Prudent and sustainable exploitation of nature's bounty ensures nourishment and flourishment of the human civilization as well as the well being of the living world and environment. River linking in the Indian subcontinent in a prudent and scientific manner will not only allow prevention of the colossal wastage of a vitally important natural resource, the often flood-causing excess amount of flowing surface water of rainy seasons, but also ensure supplying the water to drier areas and preserving it for use in drier seasons. River linking will come to the rescue of the flood-prone areas and the drought-prone areas simultaneously. Though linking of rivers may initially appear to be a costly proposition in ecological and economical terms, in the long run the net benefits coming from it will far outweigh these costs or losses, so much so that these would be counted later as essential investments. If the river linking, as we envisage it, is done and managed properly, it is going to be a potential boon for the entire Indian subcontinent.

Freshwater flow is the principal cause of physical variability in estuaries and a focus of conflict in estuaries where a substantial fraction of the freshwater is diverted. Variation in freshwater flow can have many effects: inundation of flood plains, increase loading and advective transport of materials and organisms, dilution or mobilization of contaminants, compression of the estuarine salinity field and density gradient, increase in stratification, and decrease in residence time for water while increasing it for some particles and biota.

SESSION

MANAGEMENT OF COASTAL ZONE

TECHNOLOGICAL SOLUTIONS FOR A SUSTAINABLE FUTURE

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Abstract

Our planet is heating up faster than we have ever known. We have degraded our key natural life-sustaining elements of land, air and water to the extent that there are increasing freshwater shortages, desertification and contamination of land, deterioration of urban air quality, and pollution in waterways (oceans, rivers, lakes, creeks, groundwater). To this, add the pressure of increasing global population that is projected to reach about 9 billion by 2050 and the continually higher per capita resource consumption rate reflecting "improved" standards of living. Future looks bleak. Life as we know it could be under threat. It is premised that we will have to move towards a green future or there will be no future.

Attaining a greener future requires substantial changes to priorities about resource utilization. Technologies that would alleviate the deteriorating trends and assist in attaining a greener future are needed. Resource efficiency technologies that save energy and materials and minimise emissions and waste can be significant money savers. City councils, local industry, households and community groups are embracing these technologies. Their implementation is facilitated by a growing number of sustainable technologies advisory and consulting services. These technologies addressing water management, waste treatment and recycling, resources and material consumption etc. are being developed at universities, research organizations (CSIRO), governments and industry.

This paper discusses some of the resource conservation technologies that can contribute towards a sustainable future. These relate to energy production, water management, transport, materials and waste management. Economics of sustainable technologies are also discussed.

STATE OF THE ART OF COASTAL ENVIRONMENT OF BANGLADESH FOR FUTURE RISKS

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Abstract

Coastal areas of Bangladesh comprises of the complex delta of Ganges-Bramaputra-Meghna (GBM) river system. Around 30% of the total population, which is approximately 150 million, lives in coastal areas. Due to this huge population pressure and over exploitation of natural resources, the environment of coastal region is constantly under severe threat where as storm surge, high tide and wave erosion cause disaster seasonally. Therefore, studies of saline water intrusion, degradation of water quality and vulnerability of species of ecosystem are important in coastal regions of Bangladesh. There have been few studies on them to find out necessary steps to overcome these. But assessment of future risks and practical recommendations are still very important to study.

This paper studies coastal environment by selecting some of the important coastal concerns (ICCs). The main focus of the paper is to identify vulnerability of several coastal environmental issues, preparation of a risk indicative table in order to propose a number of immediate to long term recommendations. The study has selected 11 (eleven) ICCs and these include morphological changes, climatic changes, fisheries, mangrove, forestry, salinity, marine and industrial waste, ecosystem and biodiversity, tourism, socio-economic condition and institutional framework. It has been carried out in the total coastal region of Bangladesh by dividing the same into three parts: the eastern region, the central region and the western region.

The eastern region is mainly comprised of sandy beaches, main port of Bangladesh, shipyards, navigation channels, industries and aqua cultural projects. The central region includes the mouth of the combined GBM rivers with heavy sediment input (2.4 billion tons per year), formation of new lands (locally named chars) and bank erosion and the western region is a stable region, mostly covered with mangrove forest where ecosystem is vulnerable and wild life is at stake. The study finds the vulnerable and potential ICCs, which can enhance ecosystem productivity and quality aspects of the environment.

STATUS, CONSERVATION AND MANAGEMENT OF CORAL REEFS IN GULF OF KACHCHH – INDIA

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Abstract

Coral reefs are one of the most diverse and productive ecosystem of the world. Bleaching due to global warming, Tsunami, excessive industrialization on coast, offshore drilling etc are the major threats to this unique ecosystem. In the recent years, corals have become subject of interest for majority of scientific community as they are the indicators of the marine environment. Gujarat has two of the three gulfs of the nation, one of which i.e Gulf of Kachchh has coral reefs along its southern coastline. Thus a total of 620.81 km^2 area along this coastline has been declared as Marine National Park and Sanctuary. The prime objective of the area is to protect two major ecosystems viz. mangroves and corals. The Coral reef of Gulf of Kachchh is one of the northern most reefs of the Asian continent. Tidal amplitude is also high in the region. The reef is also exposed to high turbidity and salinity, thus all 41 species of hard corals present are having high tolerance capacity towards environmental fluctuations. The paper deals in the status of coral reefs in the area, their conservation concerns and management issues. Field data has been collected through transect and quadrate method to obtain the qualitative and quantitative data. To enhance the work satellite data also has been used with remote sensing technology. The data has been collected over a span of 3 years to fulfill the objective of noting the status of corals and coral reefs in Gulf of Kachchh and planning a need based conservation and management strategy.

LOUISIANA COMPREHENSIVE COASTAL PROTECTION AND RESTORATION MASTER PLAN

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Abstract

The Louisiana Comprehensive Coastal Protection and Restoration Master Plan is a joint effort by federal, state, and local governments to address hurricane protection and coastal restoration issues. The purpose of this plan is to incorporate an inclusive long term coastal protection and hurricane defense plan while accommodating the coastal zone for numerous uses. The necessity of the plan was made evident by the unprecedented hurricane season of 2005. In addition to a phenomenal amount of damage, hurricanes Rita and Katrina also helped spotlight the vulnerability of the Louisiana coastline. The coastline is now facing a crisis which will determine not only the survival of a spectacular wildlife habitat but also several of the nation's industries and Louisiana's first line of defense against hurricanes and other storms.

The Louisiana Comprehensive Coastal Protection and Restoration Master Plan is designed based on a set of principles and criteria. The criteria serve as a guide to assess the human and environmental assets and risks in an organized un-biased manner. Through the use of existing data, the above mentioned principles and criteria, and evaluations based on future consequences to natural resources and other assets, distinct plans were developed. Problems such as subsidence, tidal exchange, salt-water intrusion, sediment disruption, storm surges and additional issues plaguing the Louisiana coast were given long term and short solutions. Modeling and consequent evaluations to judge the sustainability and practicality of the various resolutions are discussed.

ESTIMATION OF SALINE FRESH WATER INTERFACE STRUCTURE - AN IMPORTANT TOOL FOR FRESH WATER RESOURCE SYSTEMS DEVELOPMENT AND COASTAL ZONE MANAGEMENT

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Abstract

Almost all coastal aquifer systems in India and else where in the world have become targets for saline water intrusion processes. These processes are more pronounced in coastal deltaic areas when compared to inter deltaic regions. Saline water intrusion phenomenon is a complex processe and could be seen in a variety of combinations such as a) fresh water systems underlained by saline water aquifer systems with a hydraulic interface b) fresh water systems overlained by saline water aquifer systems and sometimes sandwitched between two saline water bodies with a geological interface (aquicludes and aquitards). The structural frame of saline - fresh water interface therefore becomes very important and basic for all developmental and management concerns.

A method of approach involving borehole geophysical logs (self potential and resistivity) is presented for Mahanadi – Baitarni – Brahmini – Subarnarekha river basins of Orissa coast. The method basically involves establishing a graphical relationship between Rw (true resistivity) and Rw_e (equivalent water resitivity) and develop standard graphical scatter diagrams between dissolved solids and other cations and anions for different depth levels. The salinity profiles obtained this way would help to evolve a saline fresh water interface structural map with clear cut subsurface geological, hydraulic and quality boundary conditions. A three dimensional saline - fresh water interface structure map for sub surface systems of Orissa coast is presented. This type of interface structural maps will serve as a important tool for a) estimation of fresh water resources b) magnitude of saline water intrusion processes and c) develop appropriate technologies for fresh water resource systems development and management strategies.

ENVIRONMENTAL ISSUES AND TOURIST'S PERCEPTION: THE GREAT BARRIER REEF –AUSTRALIA: CAIRNS REGION A CASE STUDY

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Abstract

The declining state of coral reef ecosystem has sparked concern by scientists, managers and government officials. The abundant biological diversity of the coral reef ecosystem, not only includes coral and the commercially important species associated with the reef but also tens of thousands of other plant and animal species. Thus, the status and trends of this ecosystem are not easily evaluated. Historically, most coral reef surveys have been limited to discrete reefs or species or have been time-limited (Rogers 1985; Dustin and Halas 1987; Porter and Meier 1992; Bythell et al. 1992; Ginsburg 1994). There is no doubt that Tourism is a smokeless industry and almost all nations are trying to develop their Tourism industry as best as they can. However, we have to recognize that tourism in itself is the major threat to the entire ecological and environmental system of any area.

In this zone out of 428 tourists including Port Dugulas and Green Island 260 were international tourists (77 from Cairns, 149 from Green Island and 34 from Port Douglas) and the remaining 90 tourists were made up from the Cairns area (12 local school children, 5 local laymen, 10 national tourists and 28 local farmers including Innisfail). Green Island (20 local school children, 20 local laymen, 32 national tourists) and Port Douglas no local school children, 2 local laymen, 8 national tourists and no local farmer). The study reveals that in the Cairns region, most tourists came from all over the world for snorkelling in order to see the coral reef. The majority of tourists in this region are from Japan, China, Korea, Taiwan and other Asian countries. Due to a poor understanding of the English language, they ignore all of the rules and regulations and seem to enjoy their carelessness in destroying the Great Barrier Reef marine ecosystem. This study reveals that in the region of Cairns not only the high level of construction is creating irretrievable devastation to the environment but also wrong farming practices are combining here to cause further threats to the ecological balance of the GBR. From the sky- rail near Cairns, one can see the massive clearing of trees and the over construction is taking place at a rapid rate. Combined with the intensive building construction which is going on at the foreshore of Cairns harbour, all of this construction will prove to have a devastating effect on the future ecology and environment of the GBR. The time has come to think together at a local, national

and international level to save not only the marine ecology of Australia but to protect the world's coral reefs which are degrading day by day at a very fast rate. The local community in different areas in the world can be a very useful instrument to create environmental awareness among their surrounding tourist in saving the marine ecology of the world.

The Queensland state in Australia is the main state where tourism industry has become the back bone of the state economy. The Cairns region along with the Great Barrier Reef is the main attraction center for the international tourists mainly Japanese tourists. In the Cairns region where the marine ecology is very strong and healthy, but due to different touristic activities the coral reefs are being degraded day by day. To understand the tourists perception about the environmental problems on the GBR, 428 tourist were surveyed and random sampling has been used at local, national and international level in which there is clear indication that the Cairns is the main attraction center for al tourists but tourists from Japan and china are the major one and due to their week English they ignore all the rules and regulation of the GBR and damage the coral reefs of their careless activities. The time has come where we all must think carefully at all levels including national and international to save the Great Barrier Reef for future generation.

MANGROVES & OTHER VEGETATION: ROLE ON COASTAL ZONE ENVIRONMENT

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Abstract

Mangroves and other coastal vegetation constitute the world's most productive coastal resources. Achieving sustainable management of these natural resources from destructive developmental activities and natural hazards is one of the main goals of coastal management. The important management issues- (i) coastal protection (ii) pollution abatement and (iii) sustainable livelihood-for which the mangroves and other vegetation which can offer solutions are discussed with data.

Coastal protection: A quick assessment study was undertaken after the 26th December 2004 tsunami in 18 coastal villages existing along the southeast coast of India, as a case study on the tsunami-mitigating effect of mangroves and other coastal vegetation on human lives. The mitigating effect of coastal vegetation to the wave attack depends on vegetation characteristics of coastal forest system. The protective role of vegetation depends on (i) giant wave characteristics such as wave height, wave period, depth of water *etc*. and (ii) coastal vegetation characteristics such as density, height, species composition, diameter of mangrove roots and trunks, elevation of habitats *etc.* The situation, where the height of dense mangrove forest (with more than 25 trees/10 sq. m) is higher than that of tsunami wave, can provide tsunami-mitigating effect. Plant species which are suitable to raise in between human inhabitation and sea for coastal protection, are suggested.

Pollution abatement: Two mangrove planted sites (2 and 5 years old) were compared with a control site (without any plantation) for levels of heavy metals and total organic carbon in mangrove sediments. Sediment samples were collected from the three sites at a monthly interval for a period of one year from January to December 2003. Standard methods were used to estimate levels of total organic carbon and heavy metals (Pb, Cd, Co, Ni, Fe, Mn & Cu) in the sediment samples. In general, the mangrove planted sites exhibited higher total organic carbon than the sites without any plantation. The levels of heavy metals are higher up to 64.1% in 5-year old planted site than those in control site.

Coastal fisheries & economy: Two locations of mangroves – (i) one is rich in extent and diversity of mangroves at Pichavaram and (ii) another one is poor in mangroves at Ariyankuppam - along the southeast coast of India were selected. Data

on the fish catch and income gained by fishermen were collected for two years l998-1999. The shellfish catch and income were 13-fold higher and the finfish catch and income was 2-fold higher in mangrove-rich waters than in mangrove-poor waters. The mangrove-rich waters provide 4-fold higher total catch and 6-fold higher total income than the mangrove-poor waters.

SUSTAINABILITY ASSESSMENT AS A TOOL OF COASTAL ZONE MANAGEMENT: A STUDY AT THE EAST COAST OF INDIA

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Abstract

Sustainability has become the most important aspect of present day developments. The coastal areas being ecologically sensitive zones with huge developmental and population pressure, therefore needs critical consideration of its sustainability before formulation of management plans.

In a contemporary study in the School of Oceanographic Studies, a methodology for sustainability assessment has been developed, which assigns definite sustainability values for ecosystems depending on the number of components and the threats on them. In this present study, at the Digha-Shankarpur area of the coastal West Bengal on the east coast of India, an overall sustainability value of (—) 0.296 was estimated using the aforesaid methodology. Subsequently, formulation of an integrated coastal zone management plan followed by sustainability assessment of the same area with projected changes through execution of the plan, showed significant improvements in the sustainability values. Even, the method facilitated prioritization of the managerial issues during the planning phase.

This paper, thus examines the importance and utility of sustainability assessment of any coastal area prior to formulation of a management plan, as the potentials of each of the management options could be analyzed and compared. It seems that the sustainability values may work as indicators in setting up management strategies for sustainable development of coastal zones.

MANAGING SALINE COASTAL ECOSYSTEM THROUGH COMMUNITY PARTICIPATION APPROACH: A CASE STUDY OF MANGROL TALUKA IN GUJARAT

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Abstract

Change in cropping pattern towards cash crops along with free electricity has raised the demand of water for agricultural purpose in the coastal region of Gujarat. As a result, the rate of withdrawal of ground water exceeded the rate of recharge. Over withdrawal of ground water has made water table lower. This lowering of water table has resulted in saline water intrusion due to reverse hydraulic gradient and capillary action in the coastal region. Further, geomorphologically the coastal region of Gujarat has emerged from submerged Miliolites. The region is thus made up of porous limestones in which water can percolate very easily. This has accelerated the process of seawater intrusion into ground water resources of the region.

Implementing regulatory and economic reforms to control ground water use is rather difficult for the state. In this situation, community based regulatory approach are the most appropriate approach. This paper presents a case study from the Mangrol taluka of Gujarat coastal region in which community based regulatory mechanism has facilitated local people to maintain their livelihood by using ground water in an efficient manner. The case study has looked into the community-based approach adopted by village level institutions. Two major strategies namely; use of drip irrigation and promoting horticultural crops, are studied in detail for their implications on ground water resources. The study has shown that community based strategies have drastically reduced withdrawal of ground water in the coastal villages of Mangrol Block in Gujarat.

INTEGRATING NATURAL AND SOCIO-ECONOMIC SCIENCE IN COASTAL MANAGEMENT

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Abstract

The future more sustainable management of coastal resources is an important policy goal for all governments of countries with coastlines. Coastal areas are under intense environmental change pressure with extensive feedback effects between the natural systems and the human systems. It could be argued that there is just one jointly determined and coevolving system that needs to be studied and managed. Understanding the interactions between the coastal zone and environmental change cannot be achieved by observational studies alone. Modelling of key environmental and socio-economic processes is a vital tool, required to buttress coastal management institutions and practice. Three overlapping procedural stages can be identified in the coastal resource assessment process. The scoping and auditing stage, implemented via a 'pressure-state impact- response' framework, details, among other thing, problems, system boundaries and value conflicts. The framework is itself based on a conceptual model, which lays stress on functional value diversity and the links between ecosystem processes, functions and outputs of goods and services, which are deemed 'valuable' by society. The two subsequent stages are integrated modelling, combining natural and social science methodologies, and evaluation of management options and related gains and losses. An overview of a research project which utilized the P-S-I-R framework and supporting concepts and methods is presented in the last section of the paper, together with some generic 'lessons' for interdisciplinary research.

VULNERABILITY OF INDIAN COASTAL ZONE

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Abstract

India has a long coastline with varying physical, ecological and socio-economic features. Like several other countries, Indian coast is also coming under pressure from a wide range of human activities and natural events. These lead to a varying vulnerability of the coast to degradation and devastation. The vulnerability of Indian coast is analysed in this paper to provide an overview of the internal and external pressures and therefore the need for having a coherent policy that addresses some of the concerns at least. It also attempts to discuss the policy and management options for addressing the same.

TRACKING ENVIRONMENTAL PROCESSES IN THE COASTAL ZONE FOR UNDERSTANDING AND PREDICTING OREGON COHO (ONCORHYNCHUS KISUTCH) MARINE SURVIVAL

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Abstract

To better understand and predict Oregon Coho (*Oncorhynchus kisutch*) marine survival, we developed a conceptual model of processes occurring during four sequential periods: (1) winter climate prior to smolt migration from freshwater to ocean, (2) spring transition from winter down welling to spring/summer upwelling, (3) the spring upwelling season and (4) winter ocean conditions near the end of the maturing Coho's first year at sea. We then parameterized a General Additive Model (GAM) with Oregon Production Index (OPI) coho smolt-to-adult survival estimates from 1970 to 2001 and environmental data representing processes occurring during each period (presort winter SST, spring transition date, spring sea level, and post-smolt winter SST). The model explained a high and significant proportion of the variation in Coho survival ($R^2 = 0.75$). The model forecast of 2002 adult survival rate ranged from 4 to 8%. Our forecast was higher than predictions based on the return of precocious males ('jacks'), and it won't be known until fall 2002 which forecast is most accurate. An advantage to our environmentally based predictive model is the potential for linkages with predictive climate models, which might allow for forecasts more than 1 year in advance. Relationships between the environmental variables in the GAM and others (such as the North Pacific Index and water column stratification) provided insight into the processes driving production in the Pacific Northwest coastal ocean. Thus, Coho may be a bellwether for the coastal environment and models such as ours may apply to populations of other species in this habitat.

SESSION
BIOOCHEMISTRY OF COASTAL ZONES

STATUS OF THE WORLD'S MANGROVE FORESTS

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Abstract

Mangroves, the only woody halophytes living at the confluence of land and sea, have been heavily used traditionally for food, timber, fuel and medicine, and presently occupy about 181 000 km[2] of tropical and subtropical coastline. Over the past 50 years, approximately one-third of the world's mangrove forests have been lost, but most data show very variable loss rates and there is considerable margin of error in most estimates. Mangroves are a valuable ecological and economic resource, being important nursery grounds and breeding sites for birds, fish, crustaceans, shellfish, reptiles and mammals; a renewable source of wood; accumulation sites for sediment, contaminants, carbon and nutrients; and offer protection against coastal erosion. The destruction of mangroves is usually positively related to human population density. Major reasons for destruction are urban development, aquaculture, mining and overexploitation for timber, fish, crustaceans and shellfish. Over the next 25 years, unrestricted clear felling, aquaculture, and overexploitation of fisheries will be the greatest threats, with lesser problems being alteration of hydrology, pollution and global warming. Loss of biodiversity is, and will continue to be, a severe problem as even pristine mangroves are species-poor compared with other tropical ecosystems. The future is not entirely bleak. The number of rehabilitation and restoration projects is increasing worldwide with some countries showing increases in mangrove area. The intensity of coastal aquaculture appears to have levelled off in some parts of the world. Some commercial projects and economic models indicate that mangroves can be used as a sustainable resource, especially for wood. The brightest note is that the rate of population growth is projected to slow during the next 50 years, with a gradual decline thereafter to the end of the century. Mangrove forests will continue to be exploited at current rates to 2025, unless they are seen as a valuable resource to be managed on a sustainable basis. After 2025, the future of mangroves will depend on technological and ecological advances in multi-species silviculture, genetics, and forestry modelling, but the greatest hope for their future is for a reduction in human population growth.

SPATIAL AND TEMPORAL VARIATIONS IN THE CHEMISTRY OF NETHRAVATI RIVER AND ITS IMPACT ON COASTAL ZONE ENVIRONMENT, SOUTHWEST COAST OF INDIA

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Abstract

A small west flowing river on the southwest coast of India, River Nethravati is chosen for this study. This river caters to the drinking water needs of major coastal city of Mangalore and its surroundings. Further, demands and pressure on this river is set to increase as several industries are being set up in this coastal zone under the SEZ programme on petrochemicals. Therefore this study will provide a baseline data on the physicochemical parameters, major ions concentrations and trace metals. Spatial and temporal variations in the chemical composition of river Nethravathi is carried out and the preliminary findings are reported. River has low TDS compared to other major river like Godavari, Ganga and Brahmaputra. The conductivity ranges from 14.1 to 91.9 us/cm indicating the presence of purely weathered granite-gneissic rocks in the catchment. Agricultural impact on the Nethravathi river is negligible because of the absence of phosphate and nitrates. Cl/Na ratio <1.15 showed that there is no enrichment of chloride ions in the river from anthropogenic sources. No significant spatial and temporal variations in pH were observed. pH value ranged from 6.6 to 7.1. The weakly acidic pH could be due to the river water-atmospheric CO_2 interaction. This also indicates the absence of carbonate rocks in the river catchments, as carbonate alkalinity was absent. Dissolved oxygen values ranged from 5.7 to 7.9 mg/ L indicating the well-oxidized, unpolluted nature of the river that is capable of self-purification.

MICROBIAL NUTRIENT MINERALIZATION PROCESSES IN THE PICHAVARAM MANGROVE ECOSYSTEM, INDIA

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Abstract

Mangroves are salt tolerant trees or shrubs that colonize sheltered marine shores and estuaries of tropical and subtropical regions. Mangroves are important ecosystems in the coastal hydrological cycle, regulating the amount of river-borne nutrients and other elements entering the coastal zone and also deliver various societal services to human beings. In tropical countries like India, the mangroves are heavily disturbed by human by cattle grazing, hypersalinity, and other human-induced impacts. In order to understand the impacts of human activities on the Pichavaram mangrove of south east coast of India, we measured the different microbial decomposition rates of soil organic matter (SOM) to determine if human impacts are altering biogeochemical activity at different locations. Rates of total carbon oxidation (T_{COX}) were higher in the undisturbed *A. marina* forest (199 mol C m^{-2} y^{-1}) than in the two impacted stands (43 and 79 mol C m^{-2} y^{-1}); rates of total carbon oxidation in the *R. apiculata* forest averaged 75 mol C m^{-2} y^{-1}. Sulphate reduction (21-319 mmol S m^{-2} d^{-1}) was the major decomposition pathway (65-85% of T_{COX}), except at the most disturbed forest (30% of T_{COX}). There was some indication of measurable iron and manganese reduction in the tree root zone. Rates of $\sum CO_2$ flux across the sediment-water interface were not an accurate measure of total microbial activity due to sharp zonation of dry, hypersaline surface soils overlying less saline, wetter soils. Rates of microbial activity were rapid and higher than other mangrove soils, reflecting high rates of primary production and organic matter retention and internal recycling in this mangrove ecosystem. These results explain that altered human activities disturbed microbial transformation rates which will lead to changes in plant-soil interactions in the mangrove ecosystem.

C-N-P FLUX TO THE BAY OF BENGAL FROM THE *BRAHMAPUTRA-GANGES* AND COASTAL ECOSYSTEM SUSTAINABILITY

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Abstract

Southwest monsoon driven high pulses of fluvial discharge resulting in climatic modulation of nutrient and organic matter fluxes to the Bay of Bengal is an event of significant relevance to the biogeochemistry of the Northern Indian Ocean. Impact of 95% of the two billion tons of annual sediment load (one of the highest in the world) on trace metal and nutrient biogeochemical cycles are important interactive forcing influencing coastal and deep sea ecosystems. The open sea connection to this sudden nutrient flux is of particular importance as time-series studies revealed particulate load fluctuations of an order of magnitude over two decades. Distribution of C-N-P and DO in the deep Indian Ocean suggests that the sediment flux serves as a major trace metal and nutrient source and oxygen sink. The nutrient element excess and oxygen deficiencies observed in the benthic mixed layer is consistent with diffusion along isopycnal surface with circumpolar deep water acting as a sink for C-N-P and source for dissolved oxygen. This unique aspect is likely to be result of very high rates of respiration and particle dissolution coupled with a high stability of the water column overlying the benthic mixed layer. Continental shelf areas including Indian coastal ecosystems could experience diverse impacts due to modified coupled C-N-P cycles in future. Its role in the evolution of marine food web of the Northern Indian Ocean and the nature and magnitude of the impact on the biogeochemical cycles is often critical.

SHORT- TERM UPTAKE STUDIES OF AMMONIUM AND UREA IN SOME MACROALGAL SPECIES FROM A CORAL ATOLL USING ^{15}N ISOTOPE MEASUREMENTS.

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Abstract

The short-term uptake rates of the reduced form of N (ammonium and urea) were examined by the measurements of incorporated ^{15}N in the macroalgal tissue. The five macroalgal species namely, *Ulva lactuca* Linnaeus (Cholorophyta), *Caulerpa sertulariodes* (Gmelin) Howe (Cholophyta), *Dictyota dichotoma* (Hudson) Lamouroux (Phaeophyta), *Padina tetrastomatica* Hauck (Phaeophyta) and *Soliera robusta* (Greville) Kylin (Rhodophyta) were collected from intertidal coastal waters of Kavaratti lagoon (10º32.325'N; 72º35.255'E) at Lakshadweep. Substrate saturable kinetics was observed in all the species for both the N compounds upto the concentration of 30M N. The maximum N uptake rates varied from species to species. The affinity for ammonium was higher than that for urea in all the species except for *D. dichotoma* with the affinity for ammonium twice lower than that for urea. The preference for ammonium and urea was shown by the algae in the order of *C. sertulariodes* > *S. robusta* > *U. lactuca* > *P. tetrastomatica* > *D. dichotoma* and *C. sertulariodes* > *P. tetrastomatica* > *D. dichotoma* > *U. lactuca* > *S. robusta* respectively. Thus these contrasting differences in the reduced N uptake rates between different species of algae indicate the ecological relevance of the algae in the N uptake rates, which could be dependent on the species of algae that compete successfully for ammonium and urea.

NUTRIENT DYNAMICS IN MANGROVE ECOSYSTEM: CASE STUDIES FROM EAST COAST OF INDIA.

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Abstract

Mangrove forests are an integral part of coastal wetlands in tropical regions of the world, including India. These coastal ecosystem acts as a shelter, feeding and breeding grounds for marine and terrestrial organisms. Many overseas studies have investigated the importance of mangrove habitats in sustaining coastal food chains. In India, however, we have covered major portions of mangroves in East coast of India, which includes Sundarban mangrove (West Bengal), Bhitarkanika mangrove (Orissa) and Pichavaram mangrove (Tamilnadu).

As a first step to investigate the detailed nutrient dynamics of mangrove ecosystem, we have quantified the nutrient concentrations in this ecosystem. Field studies involved the collection of surface -fresh and mangrove water (during low and high tides) and sediment samples at various sites within the mangroves. Chemical analyses were carried out to determine the concentration of C, N, P and Si macronutrients and micronutrients and their speciation.

During the past two to five years, we have measured seasonal changes in the nutrient fluxes within this region of the mangrove ecotone. Seasonal patterns of nutrient cycling, coincident with strong seasonality of fresh water inputs through their corresponding rivers. In depth studies of behavior of nutrients and their speciation in sediments were also carried out in order to have clear picture of the nutrient dynamic and the trophic nature in these mangrove ecosystems. Effect of natural disaster tsunami on the nutrient distribution in the mangrove ecosystem was also studied.

PHOSPHORUS SPECIATION STUDIES IN THE SEDIMENTS OF THE WESTERN CONTINENTAL SHELF OF INDIA

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Abstract

The surface sediments of the western continental shelf of India were studied for the different species of phosphorus using a five-step sequential extraction scheme. The total organic carbon content ant the texture analysis of the sediments were also done. The sampling was done during late summer monsoon (September - October, 2003) when the shelf experienced coastal upwelling and seasonal suboxia. Total phosphorus (TP) ranged from 0.015-0.723% and the maximum was observed at 13-17°N. The major phosphorus fractions were P_{org} (29% of TP), P_{auth} (31% of TP) and P_{detr} (30% of TP). A positive correlation was observed between TP and organic carbon. Most of the phosphorus fractions investigated were positively correlated with clay. Pauthi constituted 31 % of TP in the sediments of the western continental shelf, which is thought to be a characteristic feature of the coastal upwelling areas.

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PHOSPHORUS FRACTIONATION IN SEDIMENTS OF CORAL REEF REGION OF GULF OF MANNAR ISLANDS AND PALK BAY, SE COAST OF INDIA

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Abstract

The corals in Gulf of Mannar Biosphere Reserve and Palk Bay are a life supporting ecosystem for the local habitat. The surfacial sediment samples from Gulf of Mannar Islands and Palk Bay were subjected to Sequential extraction studies (SEDEX) with a purpose of assessing the biogeochemical behavior of phosphorus in the sediments of these islands. The sampling was done during post monsoon period (January- 2005), and (January-2006). The Gulf of Mannar contains twenty one islands but the islands near Rameshwaram were chosen for the study to perform a comparative study of islands in Gulf and corals in Palk Bay, which also boasts of high and healthy population of corals (even though it is not a restricted area as is the Gulf of Mannar Biosphere Reserve).

The concentration of Phosphorous did not reflect major variation in the single island samples but the same was not observed across various neighbouring islands and Palk Bay (with Palk Bay displaying a higher concentration of this limiting nutrient). The various phosphorus fractions which were dominant in these islands and Palk Bay, were exhibiting a similar trend as in the case of inter island phosphorus concentration (oxide bound phosphorus and organic phosphorus being dominant fractions in Palk Bay and adsorbed phosphorus in Kurusadai island).The study is an effort in the direction to understand the cycling of phosphorus in coral ecosystem (a reliable geochemical record reservoir).

SESSION
ECOLOGICAL ASPECTS OF COASTAL ZONE

EVALUATION OF BIOGEOCHEMICAL BEHAVIOR OF PHOSPHORUS IN SUNDARBAN MANGROVE ECOSYSTEM, INDIA WITH REFERENCE TO ANTHROPOGENIC STRESS

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Abstract

Sequential extraction studies (SEDEX) in sediments were carried out in order to assess the biogeochemical behavior of phosphorus in the inter-tidal sediments of the Sundarban ecosystem, West Bengal. Twenty four surface sediment samples and five surface water samples were collected from the island. The water samples were analyzed for dissolved Phosphorus and other physiochemical parameters viz. pH EC ORP. Influence of source (natural, diffuse and point) on Phosphorus fractionation in sediment was evaluated.

The dissolved phosphorus was in the range 1.0-3.2 mg/L along with high nitrate concentration in water samples is influenced by the anthropogenic factors.. In surface sediments, Available P and oxide bound P ranged from 10-44 µg/g and 71-267 µg/g respectively. Among phosphorus fractions, Organic and Detrital P fraction was the dominant one (95-410 and 89-376 µg/g). Available P was more in the areas with anthropogenic activities. Oxide bound P showed higher concentration in sampling location influenced by agricultural activities. Detritus P fraction was more dominant in places where dense mangrove areas. The adsorbed P fraction was more in places exposed to anthropogenic activity. Overall, the study reflected that vegetation type, succession and land use pattern is playing a significant role affect on the biogeochemical behavior of Phosphorus in this island ecosystem

PRISTINE MANGROVES FORESTS CAN BE A SIGNIFICANT SOURCE OF NUTRIENTS AND ORGANIC MATTER TO THE COASTAL OCEAN

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Abstract

To understand coastal biogeochemical cycles and food webs it is crucial to quantify the sources and dynamics of nutrients and dissolved organic matter (DOM). We investigated the impact of mangroves, the dominant intertidal vegetation of the tropics, on coastal nutrient and DOM inventories. Stable carbon-isotope and lignin analyses showed that mangroves are the main source of terrigenous DOM on the continental shelf off Northern Brazil. On a global scale, we estimate that mangroves account for >10% of the terrestrially-derived DOM transported to the ocean, while they cover only <0.1% of the continents' surface. Flux monitoring over an annual cycle revealed considerable outwelling also of inorganic nutrients (N, P, and Si compounds) from the pristine mangroves in Northern Brazil. Nutrient fluxes from the mangrove exceeded the riverine input by orders of magnitude. Tidal range and porewater concentrations were identified as driving forces behind coastal outwelling of nutrients and organic matter. Significant outwelling of inorganic nutrients probably occurs only from mangroves where the nutrient concentration in porewater exceeds the demands of the benthic community and trees, caused by positive sedimentation and high nitrogen fixation rates. Tidal range was identified as another driving force for outwelling. In macrotidal regions the exchange of porewater with tidal creeks and the coastal ocean is most efficient. I can be concluded that mangroves play a key role for the nutrient and organic matter cycles of coastal and marine ecosystems. In Northern Brazil mangroves are one of the driving forces for near-shore primary and secondary production, providing inorganic and organic nutrients to these environments.

ECOLOGY OF PICHAVARAM MANGROVES – A FORAMINIFERAL PERSPECTIVE

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Abstract

Mangroves are a characteristic feature of tropical and subtropical latitudes, while their temperature latitude counterparts are the salt marshes. Considerable attention has been given to the salt marshes in the U.K., U.S.A. and Canada and benthic foraminifers have been utilized for a variety of studies that include assessment of anthropogenic environmental problems, Holocene sea level changes, variations in microhabitats, taphonomic tiering etc. Although it is well known that foraminiferal assemblages from mangrove environments are typical, just as they are from estuaries, littoral zone, inner shelf etc, and the ecological aspects of mangroves in India from a foraminiferal perspective however, not been studied. Preliminary studies on recent foraminifera in 32 surface sediment samples from the Pichavaram mangroves, India, reveal the presence of a typically arenaceous, agglutinated foraminiferal assemblage dominated by *Miliammina fusca*, *Ammobaculites exiguus*, *Textularia earlandi* and *Trochammina inflata*. *Ammotium cassis*, *A. salsum*, *Haplophragmoides wilberti*, *Jadammina macrescens* and *Reophax* sp. comprise the other taxa of this group. The calcareous component of this assemblage is very poor, represented by *Ammonia beccarii*, *A. parkinsoniana*, *A. tepida* and *Quinqueloculina seminulum*, and few tests belonging to *Elphidium* spp. As the samples were collected in March 2003, this study provides valuable baseline data on the ecology of recent benthic foraminifers from mangrove sediments that could form the basis for further studies on important aspects such as paleoecology, taphonomic biasing and causative processes. It is also emphasized that the sampling strategy for foraminiferal studies in mangrove environments has to be modified in accordance with the reports of infaunal salt marsh species such as *Arenoparrellina mexicana* "living" at a depth of 30 cm.

WISE USE OF MANGROVE: APPLICATION OF ECOSYSTEM SERVICES IN ENHANCING ECOLOGICAL FOOTPRINT FOR SUSTAINABILITY OF HUMAN WELLBEING AND PARTICIPATORY ECO-RESTORATION OF DEGRADING MANGROVE FOREST OF INDIAN SUNDARBAN

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Abstract

Mangroves are inter-tidal tropical or subtropical ecosystems supporting unique forms of lives. The largest patch of mangrove forest of our country is Sunderban, situated at the extreme southern portion of the deltaic estuary of river Hugli & Matla at West Bengal which is the portion of the largest mangrove forest of the world. Due to availability of nutrients, solar radiation, rainfall & geographic position the discovered biodiversity status of Sunderban is globally highest. As the habitat is very unique and full of environmental stresses, the living components of this ecosystem are very unique regarding their morphological, anatomical, physiological and behavioral pattern. This unique ecosystem is facing severe degradation problem mainly due to increasing population pressure, unsustainable use of forest resources, conversion of forest to agricultural land, large scale netting of shrimp seeds, pollution and natural calamities. It is very much necessary to repair this damaged ecosystem and this can be best done by the participation of the local people. Local economy is dependent on this ecosystem, and as the ecosystem is degrading, it ultimately affecting the socio-economy of the entire region. The dwellers of this area traditionally using the biodiversity for the maintenance of their livelihood, treatment of different disease, recreations, rituals. If proper study can be done on the Traditional Ecological Knowledge (TEK) of the local people, biological resource of Sunderban will become potential for Bio-prospecting, economic upliftment and improvement for quality of life. For this purpose ecological and as well as economical dimensions of biodiversity are to be evaluated properly. But every biodiversity user should be aware of the sustenance of it. For Eco-restoration of mangrove ecosystem several steps had being taken in Sunderban like Ex and In Situ conservation, conservation through legislations, regeneration of mangrove forests, creation of alternative income sources for the local people to reduce pressure on natural resources, participatory forest management (25% of the earned forest revenues are distributed among forest dwelling people), awareness campaigning among the concerned people etc. Wise Use of

Mangrove emphasis on the human use of mangrove in such a way that it may yield the greatest continuous benefit to the present generations while marinating its natural properties and potential to meet the needs and aspirations of the future generation. In this aspect Mangrove Ecosystem Services like Provisioning services (Food, Shelter, Medicine, other bio-resources), Regulating services (Nutrient recycling, Water storage and retention, Hydrological balance, Climatic regulation, Disease control, Pollution reduction, Protection from natural calamities etc.), Cultural services (Amenity, Religion, Aesthetic, Ecotourism, Education and Research) can be utilized for enhancing the Ecological Footprint (i.e. the amount of productive land and water required by a population for producing all the resources the consume and take all the waste they produce) which will strengthen the sustainability of the well being of the poor people of that region.

DIVERSITY OF MANGROVE ALGAE IN SUNDERBANS: A POTENTIAL RESOURCE TO BE CONSERVED

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Abstract

Where the land meets the sea at the southern end of West Bengal, there is a stretch of impenetrable and elegant mangrove forest of great size and bio-diversity, known as Sunderban. Latitudinal and longitudinal extents are 21^0 31′ - $21^0$53' N and 88^0 37' – 89^0 09' E. The forest extends over an area of 4264 sq. Km in India and a greater portion in Bangladesh. It is a moist tropical seral forest nurturing a magnanimous diversity of flora and fauna along with a significant number of over 150 species of algae belonging to the groups of chlorophyta, rhodophyta, chrsophyta, phaeophyta and cyanophyta. The affluent mangroves here offer a paradise for algae with basically three distinct habitats: the open sea fostering mainly the free floating and the phytoplankton wealth of the region, the shallow water with tidal fluctuations by the edges, where the benthic forms are found attached to the substratum, the principal forms being *Catenella, Polysiphonia, Calloglossa, Dictyota, Rhizoclonium, Enteromorpha, Ulva, Lola* etc. The rich number of algae here not only plays the pivotal role of forming the primary producer group of organisms in the prevalent food-web balancing the entire ecosystem, but also offers unique potentiality for industrial applications in areas like food supplements, pharamaceuticals, enzyme and biotechnological applications with potency of tackling several environmental problems. This corroborates with our extensive study of nutrient composition, enzymatic analysis and stress metabolites panorama of eight predominant benthic algal forms for the last 4 years. The protein, carbohydrate and lipid content varied within the range of 14.34 to 35.27, 3.33 to 40.87, 2.61 to 7.13% of dry weight respectively. The other nutrient parameters like reducing sugar, free amino acid, proline and vitamin C showed an interspecific variation of 0.74 to 6.76, 35.85 to 386.66, 2.20 to 3.94 and 0.15 to 0.38 mgg^{-1}. On an average the biomass of the algae contained 0.37 to 2.45 and 0.09 to 1.77 mgg^{-1} chlorophyll a and chlorophyll b. Carotenoids were present in the range of 18.85 to 29.02 mgg^{-1}. However, the affluent ecosystem is now threatened by several anthropogenic stresses like coastal development, mariculture, commercial and residential constructions, deforestation for cultural purposes and pollution. To protect this fragile and highly productive ecosystem, we should immediately think of monitoring and restoration management from all dimensions.

THE IMPACT OF SHRIMP FARMING ON THE INDIAN COASTAL REGULATORY ZONE AND SUSTAINABLEE DEVELOPMENT

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Abstract

In the past two decades the development of shrimp aquaculture in India has been phenomenal. The rapid expansion in this industry was driven by the high profitability of shrimp farming and the ever growing market in the western world attracting a wide range of investors, ranging from individual farmers in the coastal regions who chose to convert paddy fields and surrounding mangroves to multinational companies resorting to large-scale intensive shrimp farming. The economic significance of the shrimp sector has been substantial both in terms of export earnings and employment. The total aquaculture shrimp production in India did more than triple from 30,000 tonnes in 1990 to 102,000 tonnes in 1999.Sea food exports alone have netted over 6,600 crores in 2005.And yet the development of shrimp aquaculture in India has been controversial causing considerable concern!

The author in her paper has sought to trace the impact of the CRZ notification on shrimp farming and understand the controversy shrouding the rapid growth in this industry. The irreparable environmental damage and danger to the surrounding areas, the hasty conversion of mangroves and paddy fields to shrimp farms and the negative social consequences of shrimp farming led to the filing of a landmark Public Interest Litigation (PIL) in 1996 by Shri S Jagannathan, Chairman, Tamil Nadu Gram Swaraj Movement, under Article 32 of the Constitution of India that culminated in a Supreme Court decision banning non-traditional shrimp aquaculture in India's coastal zone in 1996 besides directing the carving of domestic legislation on Aquaculture. The author also draws attention to the need for participatory processes in developing Coastal Management Legislation and in this regard has drawn on the findings of the Swaminathan Committee that submitted its report in February 2005, a month after the Indian Ocean tsunami. The author in her paper seeks to highlight how, sadly, time and again authorities have managed to subvert the decision of the Apex Court and advocates that the need of the hour is to engage in a cost benefit analysis of this industry taking into account environmental impact assessment and concludes her paper stressing on the requirement for the aquaculture industry to address development with a sense of social and environmental responsibility in both urban and rural coastal areas without compromising the traditional livelihood needs of coastal communities.

MICROBIAL RESOURCES OF THE MANGROVE AND VELLAR ESTUARY, SOUTH EAST COAST OF INDIA

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Abstract

The mangrove ecosystems are of great ecological and economical significance in coastal production, enrichment of water quality and in production of fishery resources. They consist of diversified macro-habitats such as core mangrove forests, litter forest floors, mudflats, adjacent coral reef and seagrass ecosystems and contiguous water bodies like rivers, bays, inter-tidal creeks and channels and backwaters. Mangrove ecosystems are rich in microbial flora. Fertility of the mangrove waters results from the microbial decomposition of organic matter and recycling of nutrients. In the present study an attempt was made to find out the microbial resources of Vellar estuary (11°29'N and 79°46'E), southeast coast of India and the adjacent mangroves during four seasons- summer, pre-monsoon, monsoon and post-monsoon in 2004. Mangrove area showed more microbial population than that of estuarine sediments. Higher microbial population was found during monsoon season and less population during summer so also the generic composition of heterotrophic bacteria and actinomycetes. In the mangrove area, THB and actinomycetes population ranged from $6.5x10^7$ - $2.3x10^5$ CFU g^{-1} and $5.4x10^4$ - $2.6x10^2$ CFU g^{-1} respectively. In the estuarine sediments, THB ranged from $3.8x10^6$ – $4.3x10^4$ CFU g^{-1} and $7.1x10^3$ – $6.3x10^3$ CFUg^{-1}. Hence in the mangrove area both the leaf litter production and the microbial abundance are interrelated and are responsible for the overall production.

EVALUATION OF HABITAT HETEROGENEITY, RESOURCE EXPLOITATION AND FUNCTIONAL RESOURCE UNITS IN MUNDEL DIVISION, NW COAST OF SRI LANKA: A NOVEL APPROACH OF COASTAL ZONE MANAGEMENT.

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Abstract

Mundel administrative division (244 km^2) located bordering the 28 km stretch on the northwest coast in the dry zone of Sri Lanka (79º 44-54'E and 7º 45-59'N), with a population density of 350 individuals km^{-2} is rich in heterogeneous coastal habitats such as hyper-saline lagoons, barriers, beaches and reefs, dune sand, mud flats, salterns, fringe mangroves and corridor canals. This coastal locality has been subjected to a variety of unwarranted human interventions including intensive shrimp farming, ground water driven agriculture exploitation of dune sand. A multidisciplinary study was conducted to identify habitat heterogeneity and functional resource units, to determine the impact of human interventions on natural habitats and also to formulate a community based investment plan for rehabilitation of already degraded coastal habitats and sustainable utilization of functional resource units.

Corridor canal has been degraded beyond the threshold with respect to eutrophication as a result of enrichment by effluent discharged from shrimp ponds. Seasonal hydrography of Mundel Lake (lagoon) has altered to a certain extent by changes of inward and outward fluxes and decline in freshwater input via seasonal rivers and seepage. Although most of the fringe mangroves have disappeared with associated roosting migratory birds, marine fish production remain unchanged over the time. 28 km marine stretch, hyper-saline Mundel Lake and the sand dune extended along the entire beach stretch were identified as three major functional resource units associated with livelihood. An investment plan highlighted the importance of establishment indigenous and eco-friendly post-harvest techniques, community based re-plantation of mangroves and reclamation of abandoned shrimp ponds and corridor canal as the priority areas to achieve sustainable livelihood.

DYNAMICS OF PLANKTON DIVERSITY IN THE CHENNAI COAST, TAMIL NADU

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Abstract

This study described the diversity, abundance and percentage composition of both zoo and phytoplankton status at Chennai coast, during 1997-1999. Totally 21 sampling locations were fixed in the Chennai Coast covering large spectrum of different habitats. A variety of Zooplankton taxa numbering 28 were identified from four major groups, viz Cladocera, Copepoda, Ostracoda and Rotifera. Among these four groups Copepoda was the dominant group of micro zooplankton represented by 16 species under 3 sub groups, Calanoida, Cylopoida and Harpacticoida. Next to Copepoda, Rotifera was represented by 8 species and then Ostracoda and Cladocera are represented by a single species of *Daphnia*. Phytoplankton plays a vital role in food chain as they are consumed by primary and secondary consumers. In the phytoplankton Bacillariophyceae comprising 21 species, followed by 12 species of Chlorophyceae and 3 species of Cyanopyceae were recorded.

STATUS OF THE WORLD'S MANGROVE FORESTS

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Abstract

Mangroves, the only woody halophytes living at the confluence of land and sea, have been heavily used traditionally for food, timber, fuel and medicine, and presently occupy about 181,000 km [2] of tropical and subtropical coastline. Over the past 50 years, approximately one-third of the world's mangrove forests have been lost, but most data show very variable loss rates and there is considerable margin of error in most estimates. Mangroves are a valuable ecological and economic resource, being important nursery grounds and breeding sites for birds, fish, crustaceans, shellfish, reptiles and mammals; a renewable source of wood; accumulation sites for sediment, contaminants, carbon and nutrients; and offer protection against coastal erosion. The destruction of mangroves is usually positively related to human population density. Major reasons for destruction are urban development, aquaculture, mining and overexploitation for timber, fish, crustaceans and shellfish. Over the next 25 years, unrestricted clear felling, aquaculture, and overexploitation of fisheries will be the greatest threats, with lesser problems being alteration of hydrology, pollution and global warming. Loss of biodiversity is, and will continue to be, a severe problem as even pristine mangroves are species-poor compared with other tropical ecosystems. The future is not entirely bleak. The number of rehabilitation and restoration projects is increasing worldwide with some countries showing increases in mangrove area. The intensity of coastal aquaculture appears to have levelled off in some parts of the world. Some commercial projects and economic models indicate that mangroves can be used as a sustainable resource, especially for wood. The brightest note is that the rate of population growth is projected to slow during the next 50 years, with a gradual decline thereafter to the end of the century. Mangrove forests will continue to be exploited at current rates to 2025, unless they are seen as a valuable resource to be managed on a sustainable basis. After 2025, the future of mangroves will depend on technological and ecological advances in multi-species silviculture, genetics, and forestry modelling, but the greatest hope for their future is for a reduction in human population growth.

BIODIVERSITY AND BIOTECHNOLOGY – AN AQUATIC PERSPECTIVE.

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Abstract

This presentation looks at the relationship between biodiversity and biotechnology within the context of aquatic species and the environments they inhabit. Initially, and, following the UN Convention on Biological Diversity broadly based definition of biotechnology, the benefits and drawbacks of aquaculture are explored especially as they relate to coastal environments and especially its impact on biodiversity at different levels. The key issue here is that an increasing diversity of aquaculture species are being domesticated and improved through genetic enhancement and increasing translocated within and between countries. Despite the benefits of domesticated fish in terms of increased production, there are risks associated with conservation of biodiversity when the introduced strains/species escape in natural waters. Also in the context of aquaculture, the contribution, both positive and negative, of the role of genetic manipulations and associated technologies are discussed focusing on environmental issues.

A second focus of this presentation is an examination of how biotechnologies utilize or depend upon biodiversity emphasing activities such as bio-discover and bio-prospecting and conversely how biotechnologies, especially genetic technologies can contribute to the understanding and the preservation of biodiversity. A major issue here that will be explored is the dramatic decline in taxonomic expertise and its consequences for identifying, describing and monitoring biodiversity and whether or not the combined use of molecular genetics and bioinformatic data bases (DNA barcoding) is a realistic solution. Lastly the related issue of the increasing number of cryptic aquatic species that are being discovered and the impacts of invasive species and how biotechnologies may be used for their control with is discussed.

EXCHANGE OF GREENHOUSE GASES AND ITS IMPACT AT THE LAND–OCEAN BOUNDARY CONDITION OF SUNDARBANS MANGROVES, NE COAST OF BAY OF BENGAL, INDIA.

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Abstract

The Sundarbans Mangroves eco-region the world's largest mangrove ecosystem extends across southern Bangladesh and India's West Bengal State in the land ocean boundaries of Bay of Bengal. The Indian Sundarbans Mangrove forest located at the estuarine system of the River Ganges, NE coast of Bay of Bengal. The total area of the Indian part of the Sundarbans forest, lying within the latitude between 21°13'-22°40' North and longitude 88°05'-89°06' East, is about 4,262 sq km, of which 2,125 sq km is occupied by mangrove forest across 56 islands. Diurnal and seasonal variations in carbon dioxide and methane fluxes between Sundarbans mangrove biosphere and atmosphere were measured at one of these islands namely Lothian Island using micrometeorological method during 1998–2000. This environment acted as a net source for carbon dioxide and methane. The mixing ratios of methane were found to vary between 1.42 and 2:07 ppmv; and that of carbon dioxide, between 324.3 and 528:7 ppmv during the study period. The biosphere–atmosphere flux of carbon dioxide ranged between -3:29 and 34:4 mg m^{-2} s^{-1}; and that of methane, between -4:53 and 8:88 mg m^{-2} s^{-1}: The overall annual estimate of carbon dioxide and methane fluxes from this ecosystem to atmosphere were estimated to be 694 Tg yr^{-1} and 184 Gg yr^{-} respectively. Considerable variations in mixing ratios of carbon dioxide and methane at the NE coast of Bay of Bengal were observed due to the seasonal variations of their fluxes from the biosphere to the atmosphere. The composition was inferred by fitting model prediction to measurements.

SESSION
REMOTE SENSING AND GIS APPLICATION

THE USE OF INFORMATION TECHNOLOGY APPLICATION FOR FISHERIES MANAGEMENT IN LAO PDR : GEOGRAPHICAL INFORMATION SYSTEMS IN PRACTICES

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Abstract

There is little information available on application of GIS to inland fisheries. Most research of this type has been conducted in marine environments. Most indigenous knowledge, such as fish habitats, fish species, gear use and environmental change is descriptive. In order to use and link this qualitative information with scientific knowledge, it needs to be converted to digital data. GIS serves as a tool to store local knowledge and to visualise and scientific knowledge in the form of maps, which are user-friendly and can be easily understood by all.

The advantage of GIS is that it can store, retrieve, display, link and analyse data and export this data into digital maps in ArcGIS, which other software often has a limited function to deal with. Spatial data in GIS databases is associated with attributes that can be easily updated and incorporated with other datasets.

The results show that when scientific and indigenous knowledge are both stored digitally in GIS databases, a variety of analysis can be done. Multiple layers or visualising functions in ArcGIS are an example of ways in which indigenous and scientific knowledge can be combined in GIS. Maps of deep pools and important fishing grounds gathered using GPS and indigenous knowledge provide base maps of aquatic resources in the study area. The attribute table associated with the map links characteristics of each point, including fishing gear and species found in each pool as well as Fisheries Conservation Areas. This information is useful for management and planning purposes.

INVENTORY OF LANDFORM AND SHORELINE CHANGES, THIRUVANANTHAPURAM COAST, SOUTHWESTERN INDIA – A REMOTE SENSING APPROACH

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Abstract

The coastal zone (CZ), an important, complex, dynamic and delicate environment, harbours sensitive ecosystems such as mangroves, tidal flats, breeding grounds, and beaches with high productivity. Higher population density and consequent stress on renewable and non-renewable resources, release of industrial effluents and raw or treated municipal sewage and siting of industries and large spurts in recreational infrastructure are also markers of the state of CZ.

An environmentally sound coastal zone management (CZM) program heavily leans on a sound archival data base or collection of sets of precise and comprehensive baseline-data on shoreline and coastal landforms and their past changes as well as the state-of-the-art. Admittedly, shoreline is the most rapidly changing landform of the CZ. Geomorphic processes continue to modify the shoreline and elements of adjacent coastal landforms. Therefore, a precise demarcation of shoreline is very much important for planning and conservation measures.

Our report here is based on a study of the coastal tract of Thiruvananthapuram district (shore-line-length = 70.0km; area = 361.25 km^2), marking the southern limit of Kerala state, in the southwest coast of India. Data sets on landforms and shoreline changes within the 500m landward of the shoreline have been identified and gathered from LISS-IV imageries (of IRS/P6 and IKONOS satellites) for analysis in a GIS platform.

Major landforms like beaches, coastal plains, laterite mounds (or hills or hillocks), paleochannels, flood plains, beach ridges, beach cliffs, estuaries and lagoons have been rigorously examined and enumerated. With the exception of rocky promontories, a narrow strip of modern-sandy-beach is noticed along the shoreline. Parallel beach ridges have been noticed at the southern, central and northern sectors of the study area. Well-developed backshore cliffs (as at Varkala in the north) and cliff-lines (as at Karichal in the south) are also recognized. One most remarkable aspect of the morphology is the presence of estuaries and lagoons in the coastal land. The process of formation of coastal landforms, indelibly depict the evolutionary history of this coastal tract.

Based on the analysis of data pertaining to short- (1989-2004) and long-term (1967-2004/05) shoreline changes, it has been inferred that the coastal land under scrutiny, demonstrates very significant variations in terms of the intensity of erosion and/or accretion. As a result, it has been possible to segment coastal into different sectors or types. For e.g. in the southern sector (L= 12 km; south of Chowara) beaches are in an accretionary mode, whereas, the Chowara-Vizhinjam-Kovalam (L=8.0 km) sector is characteristically stable, perhaps due to the crystalline nature of cliff or promontory-forming-rocks, which could withstand monsoon-wave-energy and also block the littoral drift.

Though, sector between Kovalam and Vettukad (L= ~25km) falling further north, is an eroding one, while the one between Vettukad to Mudalapozhi (L= 4km) is undergoing accretion. Yet another northerly lying sector lies to the north of Mudalapozhi harbour (= 18.0 km) as an erosion sector.

Thus the geological makeup of the coastal tracts has a direct bearing on the intensity of erosion or accumulation and hence on the stability of the coastal land. Both natural and anthropogenic factors do influence and modify the shoreline and landform. In addition to the wave and wave-induced processes, the anthropogenic factors like breakwaters and steep reduction of river-delivered-sediment are other causes of erosion

STATUS REPORT ON INDIAN FISHERIES AND ROLE OF REMOTE SENSING

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Abstract

An array of production systems available today, aquaculture provides a mechanism to increase protein consumption in the third world countries. On the other hand, increasing population and fast dwindling land resources all over the world are causing concern and a need is felt to exploit marine resources. Most of the Island and Coastal nations have large dependency on ocean resources, primarily on seafood. Fish provide a vital source of food for hundreds of millions of people worldwide. Fish is inexpensive source of protein for both the rural and urban poor. Overall, the marine catch accounts for 16% of global animal protein consumption. In general, people in developing countries relay on fish as a part of their daily diets much more heavily than those residing in developed countries. For example, fish accounts for roughly 29% of the total animal protein in the diet of Asian population, but only 7% for North Americans. In terms of annual consumption of fish per person, the global average annual consumption is 12 Kg., per person. The average consumption of fish per person in industrial nations is roughly three times that of developing countries. The use of fish as a source of food rose from nearly 40 million tons in 1970 to 72 million tons in 1993. In case of population, it is most important factor for the change in total demand for a period from 1970 to 1993. According to Food and Agricultural Organization (FAO), at the current rates of world population growth, the total world supply of fish as a food from all sources (marine, freshwater and aquaculture) would have to grow from roughly 85 million tons in 1994 to nearly 100 million tons by 2010 to maintain today's per capita fish supplies. The International Centre for Living Aquatic Resources Management (ICLARM) conducted a study on "Global food scenario in 2020" and concluded that exploitation of Marine Living Resources on urgent basis is needed to avoid major food crisis.

In the present report, an attempt has been made to review the status both the inland and marine fisheries in India and also to the study the usefulness of the satellite based remote sensing data for better management of the Indian fishery resources. Some of the studies carried out in this direction have been presented and the results are discussed in detail. India has vast potential for fish resources both from inland and marine environment. The Indian fisheries sector, which produced only 0.6 million tones of fish 50 years ago, now produces nearly 6.0 million tones. Indian inland

fisheries production it self contributed 45.4% of the total fish production. Inland production including farming is now catching up with production from the marine sector and is likely to overtake marine capture fisheries in the next millennium. Inland production includes catches from rivers, upland lakes, peninsular tanks, reservoirs and oxbow lakes. The major states contributing are West Bengal (33%), Andhra Pradesh (9.09%), Bihar (8.71%), Assam (6.92%) Uttar Pradesh (6.49%), Orissa (6.01%), Tamil Nadu (4.82%), Madhya Pradesh (4.07%), Karnataka (3.89%) and Maharashtra (3.4%). In the inland fisheries, the fresh water aquaculture and brackish water aquaculture are considered to be the most important ones. Economics is the most heavily weighted factor in any of the aquaculture ventures. Hence, a holistic approach to coastal aquaculture development is needed for restoring and conserving the ecological and economic integrity of the India's coastal zone resources. Today the nation is pushing ahead with a 'blue revolution' by increasing its fish production rapidly in small ponds and water bodies. Recently, 'Potumarru', a small village in Kalidindi mandal of Krishna district in the state of Andhra Pradesh, India, figured in national headlines through its 'blue revolution'. A case study focusing on the delineation and estimation of the areal extent of pond aquaculture in these three mandals viz; Kaikalur, Kalidindi, and Mandavalli in Krishna district of Andhra Pradesh state, India, where pond aquaculture is found to be maximum, with the help of high-resolution data from Landsat and IRS (Indian Remote Sensing Satellite) satellites have been carried. The study also dealt with socio-economic benefits of the pond aquaculture in these three mandals. The high-resolution data from satellites are found to be highly useful in mapping, monitoring and providing direct information on land use patterns for proper management of the coastal environment.

India has a very long coast line of about 7500 kilometre, spread in 9 maritime states comprising 3100 fishing villages with 1588 fish landing centres. The law of the sea entitles every maritime state an Exclusive Economic Zone (EEZ) of 200 nautical miles from the coast. As per EEZ definition, India acquired a total area of about 2.02 million sq. Km. India has an excusive continental shelf of about 448,000 sq. kms. including western, eastern and shelves around Islands. The western shelf is broader with an area of 310,000 sq. kms. compared to the eastern shelf of 90,000 sq. kms. Nearly 2.38 lakh fishing vessels are in operation as on date in these 9 maritime states with 3.2 million fishermen depending on fishing industry. India harvests only 40% of the total landings from the Indian Ocean countries. Indian fish landings are only 2.5% of the world production (85.0 million tones). However, significant improvement has been witnessed in the fish landings in almost all the maritime states during past decade. Marine fisheries are fast emerging sector with significant growth potential in India and play a vital role in the National income. Based on the fishing craft statistics in maritime state (including both the Islands) 1,52,570 traditional crafts, 6,171 Motorized traditional crafts and 34,571 mechanized crafts are in active fishing

operations all over the country as on 31 March 1996. The marine fish landings attained the peak of about 2.40 million tons during 1996, and are all time record during the last four and half decades.

Fishermen are always concerned trying to obtain in making the best catches for the amount of time spent in search of productive fishing areas. Towards this, it has become necessary for the fishermen to utilize available technologies and scientific knowledge. Modern fishermen require timely, reliable and accurate information on meteorological and oceanographic parameters, such as ocean colour, sea surface temperatures, winds, waves, circulation, etc. Satellite ocean remote sensing provides such information to aid fishery research and management. The use of satellite remote sensing in Oceanography expanded considerably in 1970s and satellite with dedicated oceanographic sensors was first launched in 1978. Hence, the era of space technology brought new perspective in remote sensing for fisheries. Several researchers have made use of Advanced Very High Resolution Radiometer (AVHRR) thermal infrared data from the NOAA Satellite series to aid fishing industry. The potential fishing zone forecast information from NOAA_AVHRR thermal infrared data has been made available to the fishing industry in India too since late 1991 on an experimental basis and was made operational from late 1992. This programme, has been initiated at NRSA under DOD's National MARSIS Programme. Some of the salient results of this programme are presented in this paper.

The SST information derived using NOAA-AVHRR data is being used to locate the thermal boundaries, upwelling areas and Oceanic eddies, where the maximum pelagic fish populations are found to occur. This information is being disseminated to the fishermen residing all along the Indian Coast. The usefulness of this information has been studied based on the feedback provided by the fishermen. The results indicated that on an average the Catch Per Unit Effort (CPUE) is more than double along the thermal boundaries in comparison to the catch obtained from other areas. The feedback on the utilisation of potential fishing zone information revealed that they are highly useful and aid to the fishermen in saving the fuel and search time for productive areas for fishing.

ANALYSIS OF SPATIAL AND TEMPORAL CHANGES ALONG MUMBAI COAST USING REMOTE SENSING AND GIS

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Abstract

The aquatic biodiversity, the most threatened of all extant biodiversity on earth needs the utmost and urgent conservation action plan. The coastal biodiversity is even more threatened with the tremendous human pressures and compounded further by the looming climate change. Remote sensing and GIS tools proved beneficial in providing a detailed scenario on past and present land use / land cover patterns. The availability of past satellite imagery helps in identifying the global changes that occur over a period of time either by natural or artificial anthropogenic factors. Many researchers worked on the mangroves along Mumbai coast and concluded that there is decrease in mangrove vegetation. In contrast ,our analyses on mangrove vegetation along Mumbai coast using three satellite imageries *viz*., 1992 (TM), 2001 (ETM) and 2005 (LISS IV) data showed considerable increase in mangroves, mudflats and coast area. The study mainly emphasized on tracking the changes in mangrove vegetation along the west thane creek. Satellite data was classified by hybrid approach of unsupervised and supervised techniques along with visual interpretation into various land use / land cover themes. Results showed that there was increase along the coast line comparatively between 1992 to 2005 with a significant increase in mangroves, mud flat areas and sandy beach. A variety of inter transformation of various classes were observed between 1992, 2001 and 2005, showing the influence of anthropogenic activities in the study area. The increase in dense mangrove areas along with mud flats is appreciable since these sites act as repository for the fauna diversity and should be preserved. It is concluded that mangrove monitoring programme involving the civic society and various stakeholders is established sooner than later.

ROLE OF INFORMATION COMMUNICATION TECHNOLOGIES IN COASTAL ZONE MANAGEMENT

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Abstract

Cyclones are one of the major disasters, that have been occurring world over since time immemorial and India is no exception. Such natural disasters are inevitable and the nation comes across innumerable losses in terms of lives, income and property in aftermath of disasters. Adding on to it, the recent tsunami (26 December 2004) seriously disrupted the functioning of the coastal zones causing devasting impact on human life, economy, natural resources and environment.

Coastal zone management begins with information and its appropriate dissemination to various communities present in the coastal zone. In this context, the advancements in Information Communication Technologies plays a vital role in providing inputs for coastal zone management. The interoperability of various communication systems including internet, mobile phones, e-mail, radio and television is reaching out rapidly to all people specially the fishing communities present in the coastal areas, since they are the worst affected by natural disasters like cyclones and tsunami.

The paper will primarily focus on the emerging role of ICTs for coastal zone management resulting in its sustainable development. It majorily highlights on the development that meets the needs of the present without compromising the ability and opportunity of the future generation to meet their own needs. From the review of various literatures, under different conditions and contexts, and also with the help of a few case studies, it is revealed that the integration of different ICTs can be effectively used for coastal zone management.

SESSION
TSUNAMI IMPACT ON COASTAL ECOSYSTEM

PRELIMINARY INVESTIGATION ON THE SUITABILITY OF *CASUARINA* PLANTATIONS ON SANDY SHORES AS BIOSHIELDS AGAINST TSUNAMI

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Abstract

Casuarina is widely used for plantations on sandy shores in many countries due to their timber or wood quality and higher growth performance on sandy beaches. The role of plantations as a shield for winds and salt spray is also appreciated. Reports on negative effects of *Casuarina* plantations are rather less and therefore planting *Casuarina* on coastal sands are continuing.

The tsunami strike of 26 December 2004, hit *Casuarina* plantations also of the affected countries. As a part of our post tsunami observations in Sri Lanka, one of the most severely affected countries, the impact of the killer tsunami on *Casuarina* plantations was assessed. Casuarina plantations on a 500m wide coastal stretch from Kalutara (west coast) to Batticaloa (east coast) that cover about two third of the severely affected coastline of Sri Lanka were visited three times at 14 days, 44 days and 134 days after the tsunami and observations made. Their damages, growth stage of trees and distance to the sea, were recorded during the first visit. The recovery status of affected plants was noted during the 2nd and 3rd visits. During the first visit as well as another visit after one year from the tsunami, the under growth and elevation of the land of some selected *Casuarina* plantations on sandy shores were compared with those of adjacent areas of the shore where there were no *Casuarina* plantations.

Observations showed that *Casuarina* plants with the height less than the run up height of tsunami waves were damaged but recovered later. Some larger trees located very near to the high water mark of the sea, were uprooted. Undergrowth was weak and the elevation of the land was low in *Casuarina* plantations compared to adjacent shores without *Casuarina* plants. Photographic evidences clearly showed that *Casuarina* plants on sand dunes were unable to keep the higher elevation of the land probably due to the lack of dune forming species in the undergrowth implying that sand dunes without *Casuarina* could be a better shield against tsunami waves .

When all these observations are taken into consideration, the suitability of *Casuarina* plantations on sandy shores and coastal sand dunes as bioshields is questionable. Apparently the level of knowledge and understanding of the functions of *Casuarina*, particularly in coastal plantations, is still insufficient and multidisciplinary research is needed to fill that void.

ARE ALL THE MANGROVES EQUALLY IMPORTANT IN MITIGATING THE IMPACT OF TSUNAMI?

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Abstract

Among the series of economic and ecological importance of mangrove ecosystems, the protective role of mangrove forests against a wide range of water-related impacts - not only tsunamis but also cyclones, sea-level rise, and daily tidal action – was well documented, during the last few decades. In contrast, the anthropogenic pressure on mangrove ecosystems was increasing throughout the world. However, the tsunami strike of 26 December 2004, raised this importance of mangroves overnight, leading to an acceleration of mangrove replanting, particularly in tsunami affected countries. Although many reports have well highlighted the protective role of mangroves with respect to the tsunami, most of them were anecdotes and not based on proper scientific surveys.

This study aimed to investigate the resistance shown by mangrove forests in Sri Lanka against the post Christmas tsunami in 2004. Almost all the mangrove forests located within the first 500m coastal belt of western, southern, and eastern coasts of Sri Lanka (i.e. the coastline from Kalutara to Batticaloa that cover about two third of the tsunami affected coastline of Sri Lanka,) were visited three times, i.e. 14 days, 44 days and 134 days, after the tsunami. Dominant or co-dominant species in each mangrove stand and their damage level were noted at the first visit. The thickness of the mangrove belt and damages to the area beyond the mangrove belt were also noted. The attention during the second and third visits was mainly paid on the recovery status of damaged species/stands.

Results revealed that the resistance of mangroves to tsunami appeared to depend on:

(a) the type of mangrove forest
(b) the species composition
(c) the maturity or growth stage and
(d) the level of ecological degradation

of the relevant mangrove forest. The highest resistance was shown in mature fringe forests dominated by ‘major mangrove’ species, whilst the lowest resistance was noted in mangrove forests with ‘cryptic ecological degradation. It remains almost certain that mangrove stands with a considerable thickness can form a positive physical buffer which can mitigate the impact of tsunami.

ROLE OF SAND DUNES AND MANGROVES IN THE MITIGATION OF COASTAL HAZARDS WITH REFERENCE TO DECEMBER 26, 2004 TSUNAMI

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Abstract

Natural barriers or bio-shields such as mangroves, and sand dunes have protected the ecosystem, life and living during a tsunami better than areas that were left unprotected and environmentally degraded. Tsunami occurred on December 26th 2004, though was a natural hazard is an example for its destructive variations on land and the apathy of humans toward protecting nature. The funneling effect of the tsunami was more prone in areas where coastal sensitive areas were encroached and destructed by anthropogenic activities. The pockets and patches along the coastline of India, where mangroves and sand dunes exist were less vulnerable to the destruction activity of tsunami and the areas without these natural barriers were severely affected. It was exemplified from certain areas where they acted as the best safeguards from coastal hazards while protecting the coastal ecosystems from erosional activities, either climatic or anthropogenic. In this context, this paper studies the importance of mangroves and sand dunes in the mitigation strategies of a coastal hazard and emphasizes the need to protect them in a sustainable way.

IMPACT OF TSUNAMI ON GROUNDWATER QUALITY IN KALPAKKAM COAST, SOUTHERN INDIA

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Abstract

Tsunami of M-9 had caused great destruction along the Tamil Nadu coast. Tsunami waves entered in land up to 0.2 – 1 km and damaged most of the coastal regions in Tami Nadu. The Kalpakkam coast of Kancheepuram District, Tamil Nadu, was also seriously affected due to the recent tsunami. The present work was carried out with the objective of studying the effect of tsunami in the coastal aquifer of the Kalpakkam region, Tamil Nadu. Geologically the area has two distinct formation namely, Charnockite and recent alluvium. Groundwater occurs in the alluvial formations. Twenty groundwater samples were collected once in a month after tsunami and analyzed for major and minor ions by using standard methods. During tsunami seawater has inundated up to 500m inland in the Kalpakkam coast. This results in percolation of seawater into coastal freshwater aquifer. There has been a slow decline in the EC of groundwater up to the month of July 2005 in the inundated zone. In the months of August and September, EC of groundwater has raised in the inundated zone due to rainfall in this area. The recharge of fresh water through the unsaturated zone resulted in washing of the salts deposited due to the evaporation of seawater that entered during tsunami in the unsaturated zone. Such a trend is observed in all the wells located in inundated zone. The EC of groundwater increased beyond the post tsunami condition in the inundated zone. The finite element computer code FEFLOW (Modular 3-d finite element flow and transport) was used to simulate the groundwater flow and movement of chloride transport after the tsunami. The model has been was run with initial condition of June 2004. The model was run to know the time required for complete flushing of saltwater from the tsunami affected area. The model results show that a few more monsoons may be required for complete flushing of tsunami induced salinity from this aquifer.

BIOSHIELDS AND ECOLOGICAL RESTORATION IN TSUNAMI AFFECTED AREAS IN INDIA

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Abstract

Following the tsunami in the year 2004, there has been considerable interest in activities concerning "Bioshields". Bioshields are coastal vegetation structures (both natural and planted) that are expected to contribute to protection of the coast from storms, cyclones and even tsunamis to varying extents. In India, these mainly comprise of mangroves and Casuarina plantations. There is an ongoing debate about the effectiveness of these bioshields with respect to the tsunami both within the state, and scientific and local communities. In spite of the heated debate, there have been several post-tsunami initiatives that have established and promoted plantations as bioshields in India. Both government and non-governmental bodies have contributed significantly in this regard. Various international bodies are either involved directly or fund bioshields in India. In this context, we have attempted to collate information on the work done on bioshields and the flaws therein from an ecological perspective. In this paper, we present a brief overview of a state Forest Department's post-tsunami initiatives as a representative of a governmental organisation and present details of NGO efforts on bioshields. In conclusion, we propose long-term monitoring of these "restored sites" or shelterbelts to evaluate their sustainability in the long run.

TSUNAMI PROVOKED RECENT CHANGES IN CORAL REEF COMMUNITIES OF ANDAMAN AND NICOBAR ISLANDS, INDIA

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Abstract

The earthquake and *tsunami* on 26 December 2004 had resulted in major uplifts and subsidence of coral reefs in Andaman and Nicobar Islands. Due to uplift, almost all reef flats of about 4000 ha areas were exposed and dead on the western side of northern group of Islands. However, the corals in reef slopes were not been affected much and the live coral percentage are 55-60%. In contrast, the coral reefs of South Andaman are in pristine condition except Jolly Buoy and Redskin Islands. New recruitment of corals is coming up in reef flats of rest of the Islands due to the subsidence of landmass by 1-2 m. About 3000 ha reef flats of Nicobar Islands heavily damaged by sand deposition except the northeast side. The reef slope in southern side of Camorta Island was not been affected by the tsunami. About 45 species of live corals are present with the dominance of *Millipora* and *Heliopora* corals. In Trinket Island, the reefs were worst affected and only *Acropora palifera*, *Pocillopora eydouxi* coral colonies and 11 species of fishes found. The coral reef resilience, biodiversity and disturbances are discussed in the paper in detail.

STUDY ON THE TSUNAMIGENIC SEDIMENTS IN CERTAIN PARTS OF CENTRAL TAMILNADU, EAST COAST OF INDIA

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Abstract

On 26th December 2004, a massive earthquake occurred in NW of Sumatra in the seismically active zone close to Sunda Trench at a water depth of about 1300m with an epicenter located at a shallow depth of 10km below the ocean floor. The earthquake triggered tsunami waves in the northeast of Indian Ocean at 6.29 IST. These waves travelled in the open Ocean of Bay of Bengal and hit along the Tamilnadu coast, India at around 8.45 IST with a wave height of 3 to 10m. An attempt has been made to decipher the sediment characteristics and geomorphic changes along the coasts in Kodiakarai, Point Calimere and Vedharanyam regions. At Point Calimere a large tidal flat extending up to 3 km inland is observed. Two prominent sand dunes with a height varying from 2- to 4 m are observed along the coast. The mud flats are extending upto 500m from the shore between Vedharanyam and Point Calimere. Point Calimere coast is a prominent cuspate foreland. The inundation of water was upto 1.5 km in these regions. Widespread thin sheets of very fine sediments were observed in the inland upto 200 to 300m from the shore. Two or three layers of marine clay are prominent below the tsunami sediments. The size of the tsunamigenic sediments are medium to coarse than the normal tidal sedimentation. The tidal sediments are fine grained, massive without lamination.

DEC. 26, 2004 TSUNAMI IMPACT ON COASTAL WETLANDS BETWEEN VELLAR AND COLEROON RIVERS, TAMIL NADU

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Abstract

Tsunami seldom occurs in the subcontinent. However, the Dec 26, 2004 tsunami made a severe impact on the coastal ecosystem resulting in heavy loss of human life, livestocks, household properties, coastal structures, coastal habitats and geomorphic set up. The coastal segment between Vellar and Coleroon encompasses typical wetlands such as intertidal sand and mudflats, mangroves, salt marshes, which are intervened by shallow lagoons. The coastal segment of the study area was inundated by the tsunami wave with a wave height of 4m and up to a distance of 2km inland. As the coastal stretch of study area is cut by four major inlets and with low barrier beaches associated with low foredunes, the tsunami waves easily crossed these geomorphic components.

One of the primary effects of tsunami is the breeching of the long barrier beaches and dunes complexes and transportation and deposition of these sediments in the hinterland environments such as estuarine inlets, inter tidal sand and mud flats, mangroves and salt marshes. Because of the large tsunami wave the tidal inlets were widened and deepened by leveling the estuarine mouth bars built during the fair weather season. Because of large sedimentation the inlets were made shallow by tsunami deposits. In the Vellar Estuary the core samples reveal that the thickness of sand layer over the estuarine clay bed is slightly thick near the estuarine mouth and getting thinner near Marine Biology station of the Annamalai University located nearly 1.5km west of the estuary. The thickness of the sand unit varies from 10-40cm. Below the sand unit, pre tsunami sediments are primarily clayey nature. The surficial tsunamigenic sand unit consists of up to 90% sand while the remaining are silt and clay. The tsunamigenic sediments is medium to fine sand categories resembling that of the modern beach and dune sediments. On the other hand the pre tsunami estuarine sediments consist primarily of sandy mud near the mouth of the estuary while muddy sediment in the middle and upper reaches of the estuary.

Similarly the MGR island, located south of the Vellar estuary, with about 100 settlements has under gone maximum havoc in this stretch. The southern extension of

the dune system (600m long, 2–3m height and width varying from 20-40m) between MGR island and northern bank of the Mulukkuthurai tidal inlet was totally eroded and brought to level of the present beach. The eroded sediments were transported and deposited in the Mulukkuthurai lagoon and over the intertidal areas between the lagoon and the barrier. Similarly the northern extension of the MGR island about 800m of the barrier had under gone severe erosion. Near the Colerron estuary a large extent of the intertidal area have been coverd with tsunamigenic sediments with depth varying from 20-50cm. Based on the thickness of the large number of short core sample collected from Vellar estuary, Mulukkuthurai tidal inlet, inter tidal areas, the total volume of tsunamigenic sediment deposited over the wetlands were calculated. Because of considerable sedimentation the mud flats at places were converted into sand flats and vice versa. At places because of large sedimentation and tsunami inundation considerable intertidal fauna and flora have been subjected to either severe stress or partly perished. So also the different zonations are now in a complex pattern without any clear cut demarcations. The intertidal areas at many places were cut by channels.

THE USE OF GEOGRAPHIC INFORMATION SYSTEMS FOR COASTAL ZONE MANAGEMENT

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Abstract

Determining the accurate length of the coastline is important for such coastal zone management applications as shoreline classification, erosion, biological resources, habitat assessment, and for the planning and response to natural (e.g. storm surges) and manmade disasters (e.g. oil spills).

The increasing use of spatial data and GIS (geographic information systems) by organizations and researchers is a valuable tool for coastal zone management. The effectiveness of the results obtained by using a GIS is dependent upon the quality of the data that goes into these systems. This data is known as spatial data, since each geographic feature in the database has its own geographic coordinates such as longitude and latitude. Another important aspect of spatial data is that of scale. As with a map, spatial data contains geographic information that is limited to the scale of the database. For example, a 1:100,000 scale map does not show as much detail as a 1:50,000 scale map because it displays an area that is four times smaller. The reduction of detail on maps is known as map generalization. Map generalization not only limits the amount of information that can be shown on a map, but it can also limit the accuracy of a map. The same is true of spatial data. Spatial data is simply map data in a digital format.

CHARACTERIZATION OF GROUNDWATER IN THE TSUNAMI AFFECTED COASTAL AREAS OF TAMILNADU – A CASE STUDY

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Abstract

The event of tsunami has caused distress to humanity and natural environment. Assessment of damage done to natural system has to be approached scientifically. One such was the Tsunami event occurred on December 26, 2004. The event has proved to have extended serious damages to different segments of the environment. A study was conducted to bring out the impact of tsunami on the shallow ground water, from Pumpuhar to Portnova using geochemical and geophysical methods. The geochemical study reveals that there has been significant physical mixing happened in January followed by precipitation of salts in March and complete leaching and dissolution of these precipitated salts in post monsoon i.e August. In total maximum amount of impact of tsunami water inundation was observed in the month of August after the monsoon. The geophysical study reveals subsequent reduction in the apparent Resistivity of the formations. This event of tsunami has invaded (inundation) waters inland and stayed stagnated in the topographic lows, in the near shore regions. Maximum invasion has occurred along the fluvial distributary channels. Tsunami inundation is accelerated by the bathymetry to certain extent where the southern part has a gentle bathymetry compared to the north.

IMPACT OF TSUNAMI ON MICROBIAL QUALITY OF WATER AND SEDIMENTS AND PHYSICO-CHEMICAL PARAMETERS OF THE COASTAL WATERS OF CHENNAI , BAY OF BENGAL, INDIA

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Abstract

Present work was carried out in the Chennai coastal waters (Tamilnadu), India at Kasimedu, Marina beach and Besant Nagar for studying the physico-chemical parameters of water and the microbial characteristics of the sediments and water, since these three areas were severely affected by tsunami on 26th December, 2004. Physio-Chemical parameters of water of three study areas were studied and compared. The sampling stations showed variations which could be due to various features of environmental factors such as organic and inorganic loads, pollution discharges and sediments deposited in and around the coastal region. Of the ten pathogenic microbial flora detected in the water and sediment samples, only *E.coli* and C*lostridium perfringens* were found to be present in the water and sediment samples, respectively. As far as the impact of tsunami is concerned, much changes have been noticed in the water and sediment qualities, after one month of tsunami.

IMPACT OF TSUNAMI ON AGRICULTURAL LANDS IN CUDDALORE AREA (TAMILNADU, SOUTHEAST COAST OF INDIA

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Abstract

Cuddalore is the head quarters of South Arcot District in Tamil Nadu. It has 51 fishing villages with 55.5 km coastal area. After Tsunami, all fishing activities came down drastically and around 603 peoples were killed. The disaster affected the agriculture lands of five villages around Cuddalore.We have surveyed the affected area and studied the damages caused by the Tsunami. The saline water with sediments were deposited on the lands directly and also through the estuaries namely Penniyar, Gadilam and Paravanar. Therefore, there was a severe damage to the crops like groundnut, rice, sugarcane etc. Many trees were vanished due to salt-water intrusion. About 180 acres of land was desalinated with manual removal of topsoil and applications of gypsum were done by NGO's from Rome and UK with cost of 50 lakhs rupees. After the monsoon the nature of the soil was recovered completely. The paper discuss the impact of Tsunami on agricultural lands and the recovery management at Cuddalore area.

GROUNDWATER QUALITY ASSESSMENT OF A TSUNAMI AFFECTED COASTAL AQUIFER IN SOUTHERN SRI LANKA

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Abstract

Study area is the tsunami affected Weligama coastal area (latitudes and longitudes of $80^0$22', $5^0$97), which situated in the Southern region of Republic of Sri Lanka. Ninety affected and non affected shallow dug wells sunk through permeable sandy and calcareous sandy Quaternary aquifer overlying the Precrembrian metamorphic hard rock were selected along a 8 km Weligama coastal strip and in the main river basin of the area, Polwattumodara Ganga. Continuous monitoring was done from May 2005 to December 2006 and Groundwater levels, Electrical conductivity (EC) and Total dissolved solids (TDS) were measured. The results helped to prepare EC, TDS and groundwater distribution maps of the area using the GIS packages MAPINFOR and ARC VIEW. According to the shallow depth (3-5 m) and small diameter (0.5- 1.5 m) classes, sea water intrusion to the aquifer through the inundation of wells may cause little damage.

According to the landscape of the area, three types of favorable saline intrusion aquifer systems were identified in the study area and all the aquifer systems were affected due to tsunami wave. In-between coastal strip and Polwattumodara Ganga area were completely flooded by sea water and EC levels in the aquifers are still not changed during the past two years after the tsunami (values are around 3000 μsiemens/ cm). It could be concluded that the flooded saline water have disturbed the freshwater/saltwater equilibrium in the coastal aquifer. But in the elevated areas affected coastal aquifer EC values are slightly rectified due to in-land groundwater recharge and atmospheric precipitation.

ASSESSMENT OF HEAVY METALS CONTAMINATION IN TSUNAMIGENIC SEDIMENTS OF PICHAVARAM MANGROVES, SOUTHEAST COAST OF INDIA

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Abstract

26 December 2004 Tsunami deposited sediments in the Pichavaram Mangrove Ecosystem, east coast of India resulting in the geo-physical changes. Samples (ten surface sediments and three cores) were collected within 30 days of the event. Cd, Cu, Cr, Pb, and Ni, showed higher concentration in tsunamigenic sediments where as in case of Fe, Zn, and Mn, as there was less variation or decrease as compared to earlier reported values. The sediments were extremely contaminated with respect to Cd and they show moderate to strong contamination with respect to Cr, Pb and Ni. Serious environmental hazard exists in that region because, due to gentle morphology, there is a risk of migration of these heavy metals in the food web due to various biogeochemical processes.

IMPACT OF THE TSUNAMI ON THE EAST COAST OF SRI LANKA.

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Abstract

The Tsunami that struck Sri Lanka on the 26th of December 2004 resulted in more than 35,000 human deaths and the destruction of 100,000 houses, rendered an estimated 850,000 homeless, and damaged most of the socio-economic infrastructure along almost two-thirds of the island's littoral. The disruption of coastal ecosystems in its wake included the spread of a cover of rubble and other debris over the shoreline, the salinisation of freshwater wetlands including shallow dug-wells which serve as the main source of water for domestic consumption, and the extensive losses of fauna in ways that have had both short-term as well as long-term consequences.

In the Tsunami episode, as in other sudden natural convulsions such as cyclones, floods, landslides and earthquakes, it is the poorest segments of the population that were most adversely affected. For instance, those whose livelihood depends on fishing and, hence, live along the coastal fringe are estimated to have accounted for more than two-thirds of the total death-toll. The greater vulnerability of the poor has been due to causes such as their residential agglomerations and their economic assets such as fishing boats being confined to relatively unsafe locations, the abysmally low physical quality of their dwellings and, above all, to the fact that they possess hardly any reserve strength for unaided recovery.

There was wide spatial diversity in the pattern of Tsunami damage, with twelve out of the twenty five Administrative Districts of the country suffering the brunt of that damage (Figure 1). The worst hit was the eastern coastal zone, comprising the three districts of Ampara, Batticaloa and Trincomalee. The micro-spatial variation in the intensity of the losses – a product of a wide variety of factors such as the diversities associated with the off-shore sea-depth, morphology of the coast line, the configuration of the coast in relation to the on-coming Tsunami waves, the nature of the protective vegetation cover available and the density of population – in some of the more severely affected districts was even greater in magnitude as the inter-district variation. For instance in districts such as Trincomalee, Batticaloa, Ampara, Hambantota, Matara and Galle, while the devastation was almost total over certain stretches of the littoral, reaching as far to the interior as one-thousand meters or more, the effects of the Tsunami was scarcely evident in adjacent localities in the very same areas.

SESSION
COASTAL GROUND WATER

ASSESSING THE IMPACT OF GROUNDWATER SALINITY INCREASE CAUSED BY THE 2004 INDIAN OCEAN TSUNAMI WAVE – CASE STUDY IN TAMIL NADU, INDIA

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Abstract

The December 26th, 2004 tsunami caused severe damage on coastal areas around the Indian Ocean. In India, a total of 2 260 km of the coastline was affected by the tsunami. The state of Tamil Nadu was the most severely hit area in India in terms of people affected. A case study of the salinity impact on the coastal aquifer between the city Cuddalore and Parangippettai in Cuddalore region was carried out in February 2006. The study area has unprotected coastline and flat topography, which allowed the tsunami waters to inundate as far as 2 km inland. Saline water was infiltrated through the permeable sandy soil and contaminated the uppermost aquifer, which is the main source of drinking water in the study area. The flooded open wells in the area also allowed the polluted sea water to enter the aquifer. A major ion analysis showed a clear ongoing impact of the tsunami in the wells within the inundation zone, with chloride concentrations exceeding 1200 mg/l in some locations, compared with concentrations less than 200 mg/l outside the tsunami inundation zone. A rapid deterioration of the water quality after the tsunami was also reported by the inhabitants of the coastal villages. Removal of the salt water is not an option in these wells, as fresh water exists as a shallow lense over salt water, and extensive pumping would cause salt water upconing and mixing. Fresh water flushing is therefore the major remediation measure, and it can be estimated that several monsoon cycles are needed to flush the salt water from the aquifer. Growing and unregulated groundwater exploitation can however pose a further threat to the coastal aquifers in Cuddalore, and if no measures are taken to protect the fresh water resources in the area, the salinisation of the shallow aquifers might become irreversible. The case study clearly shows an urgent need for further research of the freshwater-saltwater dynamics in the coastal aquifers in Cuddalore region.

HIGH-FLOODING INDUCED EFFECTS ON REGIONAL GROUNDWATER CONTAMINATION AND IMPLICATION OF PATHWAYS TO COASTAL ZONE OF INDUSTRIAL MEGA SITES OF GERMANY

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Abstract

The exceptional high flooding event of the River Mulde in August 2002 led to an unexpected filling of open-pit lignite mining lakes, within two days. Due to this exceptional situation, the groundwater table in the vicinity of the lake shoreline rose several meters in the area of Bitterfeld (Eastern Germany). This region has been affected by a large-scale contaminated aquifer caused by the former chemical industry complex Bitterfeld / Wolfen for the last 100 years. Due to the rising groundwater level, the regional hydraulic situation and the groundwater flow direction changed entirely within the modelled area of 65 km^2, as proven by hydraulic modelling results. The predominant channel-filled structures in the subsurface evidently affect the groundwater flow direction indicated by the modelled path lines. The resulting pathways of the contaminants can be used for the identification of exposure routes related to areas of high ecological sensitivity. This highly monitored and modelled regional example gives implications to the dynamic processes of contaminant path way interaction in coastal zones and shoreline environments.

The monitoring of highly soluble groundwater contaminants (e.g. Benzene, TCE, cis-1,2 DCE), close to the flooding event, show irregular patterns of increasing as well as decreasing concentration values of related groundwater contaminants. Until the present, no consistent regional pattern can be recorded in the shift of the distribution of the concentration induced by the flooding event. Local differences in the concentration values are obviously more related to small scale variations within the Quaternary aquifer in terms of hydraulic conductivity and higher residual concentration of the contaminated matrix sediments. The temporal effects of concentration values can be traced back, by most of the organic compounds, to distinct observation wells within the monitored time span at the starting point before flooding.

LUMPED MODEL APPROACH FOR GROUNDWATER BALANCE STUDIES IN COASTAL AQUIFERS OF SOUTHERN PART OF CHENNAI METROPOLITAN AREA, TAMIL NADU, INDIA

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Abstract

The phenomenal increase in population of Chennai city has resulted in water demand in excess of regular source of water supply. In order to meet the deficit the private entrepreneurs have resorted to marketing of water by mining water. The phenomenon of seawater ingress in the coastal aquifers in Minjur in north has diverted the entrepreneurs to exploit the coastal aquifers in the southern part of Chennai Metropolitan Area (CMA) and there is lots of apprehension about the fate of the coastal aquifers in the southern part of CMA in the coming years.

The technique of conventional hydrogeological techniques coupled with isotope techniques have been used for conceptualisation of aquifer framework of the study area. On the basis of these studies, it has been inferred that the aquifer system can be considered as two layered system, viz., top sandy unconfined aquifer underlain by weathered and fractured chanockites under unconfined to confined condition. The interconnection between the two aquifers varies from limited to complete interconnection. The precipitation is the major source of recharge to top sandy aquifer and the second layer gets recharge as vertical leakage and also as horizontal flow across the boundary. Lumped model approach was used to determine various recharge and discharge components for monsoon and non monsoon season for both the layers separately. The different components so estimated also have been validated taking into consideration of the parameters values available in the literature.

In the layer 1 during non-monsoon period, there is a change in storage of –3.960998 M.Cu.m, while during Monsoon period the change in storage is of the order of 2.554059 M.Cu.m. During the period of July 2000 to May 2001, there is a change of –1.40693 M.Cu.m; there by indicating the discharge components are more than the recharge components.

In the layer 2 during non-monsoon period, there is a change in storage of -0.045686 M.Cu.m, while during Monsoon period the change in storage is of the order of 0.015149 M.Cu.m. During the period from July 2000 to May 2001, there is a change of –0.03054 M.Cu.m; there by indicating the discharge components are higher than the recharge components.

In both the layers, the change in storage is negative there by indicating that the recharge components do not sufficiently compensate the discharge components. This would result in the further decline of water level over the years unless groundwater development is regulated and measures for augmentation of groundwater recharge are undertaken.

THE COMPOSITION OF GROUND WATERS OF MURAVIOV-AMURSKY PENINSULA, PRIMORYE, RUSSIA

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Abstract

The Muraviov—Amursky peninsula is a middle mountain area (up to 400m). The rocks of peninsula are presented by Permian granite and basalts as well as Triassic sediments. Water table is located at a depth from less than 1 m to more than 20 m and changes depending on season and atmospheric precipitation (mean annual precipitation 1000 - 1200 mm). Vladivostok city with population about 700 thousand peoples is located on the southern part of Peninsula. Some wells are used for private water supply. Values of pH vary from 5.2 to 7.5 depending on location and season. Because the mineralization of waters is low, the concentrations of microelements including the toxics is low too. For example, Cr concentrations are 0.1-12.6 ppb, Ni 0.14-10.7, Cu 1.2-12.1, Zn 1.0->2000, Ga 0.9-19, As 0.04-1.4, Se 0.08-4.6, Rb 0.07-3.7, Sr 1.4-825, Cd до 0.4, Cs 0.002-0.046, Ba 9-235, Hg 0.3-0.4, Tl 0-0.05; Pb <0.1, Th <0.2, U <0.1 ppb. Thus, the ground water chemistry of the Muraviov-Amursky peninsula is satisfactory as per Russian water quality standard. Only in some samples were found elevated concentration of Zn which is mostly due to local contamination of water.

SPATIAL VARIATION OF SOME GROUNDWATER QUALITY PARAMETERS IN A HIGHLY VULNERABLE COASTAL AQUIFER IN THE WEST COAST OF SRI LANKA: A HYDRO CHEMICAL AND GEOPHYSICAL APPROACH

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Abstract

Kalpitiya peninsula on the western coastal belt of Sri Lanka is an intensive agricultural land where shallow groundwater is extensively exploited from highly productive unconfined coastal sand aquifers. Extraction of groundwater and heavy usage of agro chemicals in the peninsula have lead to many environmental problems.

Observations were made at the agricultural and domestic dug wells of the area in order to make an assessment on the depth to ground water table and shallow subsurface geological formations. On-site water quality measurements were taken using electronic chemical loggers for determination of Electrical Conductivity (EC), Ammonia, Nitrate and Chloride of the water. These parameters were used to prepare water quality maps of the area depicting safe and vulnerable areas.

Continuous Vertical Electrical Sounding (CVES) profiles (each with 400 m long) were carried out at nine representative locations to demarcate (a) the saline water freshwater interface, (b) lateral and vertical extent of the fresh water lenses. Measured data of the profiles were processed into two dimensional resistivity images depicting the subsurface resistivity distribution of the formations resulting from the variations of the salinity of groundwater.

The findings of the study revealed that fresh groundwater occurs as a shallow lens/layer floating on an underlying brackish/saline water body which extends beyond the studied depth (approximately 50m). Thickness of the shallow fresh water layer varies from place to place from less than one meter to more than 12 m under favorable conditions. Up-coning of saline water due to excessive pumping of groundwater is also evident at some locations. This problem however, appears to be confined to those locations rather than being an area wise problem. Shallow groundwater has low to moderate salinity in most parts of the area. Pollution of groundwater due to agricultural activities and improper waste disposal practices is evident from high Nitrate and Ammonia in groundwater of a very large part of the area.

Based on the present study, it was possible to identify and demarcate three potential areas with adequate quantity and good quality groundwater to cater to the proposed new settlements. One of these three areas is more desirable in view of the technical, social and logistic aspects involved in community water supply programs.

HYDROCHEMISTRY OF THE KERALA COASTAL AQUIFERS

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Abstract

The Kerala coast hosts sediments of Pleistocene, Holocene and Tertiary age. They are more extensive than the short present day rivers emerging in the Western Ghats would create as the Indian peninsula has tilted over to the east.

The Tertiary sediments contain three units more or less separated from each other, the Warkali, the Quilon and the Vaikom beds. There is a sequence of water qualities from SE to NW from a Ca-HCO_3, via a Na-HCO_3 to a brackish Na-Cl water. This infers flushing of a former saline aquifer. Dating has shown that it is a fossil pattern dating back to the early Holocene, about 20-30 ka B.P. The groundwater flow is likely to be directed by faults running from SE to NW.

The groundwater in the Tertiary beds is reduced with often elevated iron concentrations. The ferrous iron is in equilibrium with siderite. The groundwater is also approaching the solubility of vivianite. The groundwater is also equilibrated with calcium carbonate, in the Warkali beds with aragonite and in the Quilon and Vaikom beds with calcite. Iodide concentrations are elevated in the Vaikom groundwater up to 180 □g/l and there is excess iodide in relation to the sea water ratio of iodide to chloride. The sea water is depleted in iodide through uptake of iodide which is released when these organisms are buried in sediments. The groundwater chemistry is similar to that found in the Bengal delta and also in the Mekong delta. Like in the Mekong delta the saline-fresh water interface may be offshore. However, arsenic is not found in levels above the permissible limit in India, 50 □g/l. Possibly the bulk of the arsenic has been flushed out of the aquifers during the past. The drawdown in many wells is below the sea water level which should warrant close monitoring to detect any sea water intrusion.

REGIONAL GROUNDWATER DYNAMICS AND HYDROCHEMICAL EVOLUTION IN THE COASTAL AREAS OF WESTERN BENGAL BASIN, INDIA

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Abstract

The coastal areas of the western Bengal basin consist of the modern deltaic areas of the districts of North and South 24 Parganas of West Bengal, India. The area consists of an active delta front of ~150 km through a linear width of 70 km, dissected by several tidal channels. The regional groundwater dynamics in the area is controlled by the interaction of the subsurface groundwater discharge (SGD) from the western Bengal delta into the Bay of Bengal (BoB), inflow from the BoB and the stream levels of the major tidal rivers. Flow modeling results show that natural SGD through the multi-layered aquifers (up to a depth of 300 m below MSL) was 5.7×10^6 m^3/y, which has decreased by ~6% since 1970s, due to extensive groundwater exploitation. As a result, the inflow from the BoB has increased by about 98% to a present volume of 5.37×10^3 m^3/y.

Interaction with intruded seawater and resident connate water from paleo-BoB has largely modified the hydrochemistry of the groundwater, evolving the Ca-HCO_3 water to Na-Cl through the pathways of Na-Ca-HCO_3 and Ca-Na-HCO_3-Cl, with increase of Na+K relative to Ca+Mg and rapid decrease of Si. The $\delta^{18}O$ values have also enriched from about –5‰ to –0.5‰. Geochemical modeling suggests siderite dissolution as a result of this evolution, along with possibilities of pyrite precipitation, in general. Si mostly acted as non-conservative solute along reaction paths with seawater mixing suggesting influence of silicate cycling.

STATUS OF GROUNDWATER ARSENIC IN GANGETIC DELTA OF WEST BENGAL: A CASE STUDY.

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Abstract

In recent decades groundwater arsenic contamination posses a major threat in Gangetic delta region of West Bengal (India) and thus occupy as one of the major arsenic affected hotspot region of the world. There are a number of reports accumulated over the years in this region which undoubtedly states the people are at severe risk of chronic arsenic poisoning. In this region over 95% people depends on groundwater for drinking, cooking and also for crop irrigation during dry months. Considering these facts a micro level study was carried out to study the state of arsenic in groundwater and soil of the crop fields. The study confined in two distinct blocks of Nadia and North 24-Pargana districts of West Bengal. The study reveals the fact that in Haringhata block of Nadia district, the average arsenic concentration in groundwater is 126µg/L (maximum of 870µg/L). Out of 220 samples analyzed, 42.72% water samples have arsenic level above 10µg/L (WHO safe limit) and 19.09% water samples have above 50µg/L arsenic (ISI permissible limit). The arsenic contamination primarily found in the boreholes within the depth range of 15–60 meters and 121–150 meters. In contrary the Habra block-II of North 24-Pargana district the average arsenic concentration is 116µg/L (maximum of 1752µg/L). Out of 156 samples analyzed 93.58% samples contain above 10µg/L arsenic and 50% of water samples contain above 50µg/L of arsenic. In both the cases highest concentration of arsenic reported to be existed in shallow borehole i.e. 15 to 30 meters range. In Habra-II block also the arsenic concentration found in two distinct depth range i.e. 15-30 meters and 136–150 meters. The surface soil of the irrigated crop field also analyzed in both the blocks particularly after crop harvesting during Rainy season. A total of 30 and 18 samples were analyzed in Haringhata and Habra-II blocks respectively. The average arsenic concentration in surface soil is 7.74 µg/g (maximum 25.47µg/g) and in Habra block-II is 27.07 µg/g (maximum 85.34µg/g) of arsenic.

GROUNDWATER VULNERABILITY AND ITS MANAGEMENT FOR SUSTAINABLE DEVELOPMENT IN THE NELLORE COAST, A.P., INDIA

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Abstract

Unplanned exploitation of groundwater resources in the coastal region may result into the increased salinity of groundwater making unfit for drinking purpose. Anthropogenic activities further complicate the dimensionality of groundwater contamination, and thus warrant appropriate management plans for sustainable development of groundwater resources in the coastal region. The study carried out in this paper examines the vulnerability of the Nellore coastal zone of Andhra Pradesh, India, and a number of management options are evolved for sustainable development of groundwater resources in this coastal zone. A systematic monitoring and interpretation of various groundwater quality parameters was carried out to assess the vulnerability of the coastal groundwater. The groundwater level in the study area varies from 9.5 to 19 m. Results reveal that the various groundwater quality parameters vary significantly in the study area. Results show that pH varies from 7.2 - 8.4, TDS 639 to 9300 mg/L, total hardness 175 to 2990 mg/L, calcium 143 to 1190 mg/L, magnesium 12 to 437 mg/L, fluoride 0.2 to 1.0 mg/L, chloride 183 to 4220 mg/L. The groundwater quality characterizes a variety of past and present land-uses. The appropriate groundwater management should consider prevailing and anticipated future anthropogenic activities, master land use plan and the potential of unsaturated zone media to convey water and pollutants to the aquifer. Assessment of potential recharge ability of aquifer can provide a qualitative ecological tool towards its potential vulnerability and effectively facilitate in evolving sustainable groundwater management plans. The study draws significance owing to its location, water demand and available fresh water supply for various purposes in this region.

HYDROCHEMICAL CHARACTERISATION OF THE COASTAL AQUIFER BETWEEN KOLLAMCODE AND KANYAKUMARI, TAMIL NADU, INDIA

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Abstract

Based on the seasonal sampling from thirty five coastal wells during 2005-06 the quality variation in terms of non-ionic and dissolved constituents as well as cations and anions is reported. In general, the groundwater samples showed higher concentrations for conductivity, salinity, chloride, hardness, calcium, sodium and potassium. The major anions like nitrate, nitrite and sulphate were within the limit prescribed by WHO, where as phosphate concentration was above the limit, probably due to fertilizer application. The dominant hydrochemical facies reflected in Piper trilinear diagram were Na-K and Cl-SO_4 -HCO_3. Samples from the coastal fringe zone seldom represent fresh groundwater. Landward shift of freshwater-saltwater interface is observed throughout the coastal zone but at varying intensities during summer. The study also indicated Base Exchange phenomenon that causes increased brackishness of groundwater. Gibb's plot suggests that major ion chemistry of groundwater in the region is controlled by rock weathering. Carbonate weathering is the dominant hydrochemical process compared to silicate weathering as suggested by scatter plots. The general lower values of SO_4^- /Cl^- ratio is an indication of predominant sulphate reduction in the groundwater. We assume that the interface zone that extends upto 200-250m from the shoreline has to be carefully exploited

STATUS OF ARSENIC IN GROUNDWATER IN PONDICHERRY REGION

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Abstract

Pondicherry is one of the regions in India that depends solely on groundwater for all needs. The area is covered by Quaternary, Tertiary and Mesozoic sediments of marine origin with Archean basement rocks. The excessive mining of groundwater, intense agricultural practices, industrial growth and geological environment have prompted to study the status of arsenic in groundwater in Pondicherry region.

The arsenic is one of the most dangerous inorganic pollutants for the environment and human beings due to its high toxicity. The wide spread high concentration generally results from natural processes, although anthropogenic causes increase concentration locally. An attempt has been made in the present work to study the concentration, spatial variations and source of arsenic in groundwater. Totally fifty four groundwater samples were collected covering the entire study area and analysed for arsenic concentration using atomic absorption Spectrometer. Also, eleven sediment samples were collected from two bore holes representing all aquifers and conducted XRD analysis to identify the presence of arsenic bearing minerals in aquifer materials.

It was observed that the concentration of arsenic vary from zero to 99 µg/l with an average of 25.08 µg/l and it is wide spread. About 53% of water samples have arsenic in higher concentrations than the provisional guideline value of 10 µg/l prescribed by World Health Organization. The presence of arsenic rich Pyrite and arsenic bearing minerals such as Realgar, Arsenolite, Claudetite , Enargite, Proustite and Scorodite in aquifer and their continuous interaction with pore water has led to higher concentrations of arsenic in groundwater.

$^{18}O/^{16}O$ RATIOS OF GROUNDWATER IN GODAVARI DELTA, ANDHRA PRADESH

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Abstract

In hydrogeological investigations generally ratios of $^{2}H/^{1}H$ and $^{18}O/^{16}O$ are used to infer interactions between surfacewater and groundwater with regard to movement between shallow and deep groundwaters, identification of rainfall recharge, identification of recharge sources and saline water intrusion. The isotope ratios of hydrogen and oxygen of precipitation are controlled by temperature and amount of rainfall distance from coast, altitude etc. Due to evaporation the ratios of $^{18}O/^{16}O$ gets enriched in the water phase. A few groundwater samples in Central Godavari Delta along the coast in Andhra Pradesh has been analyzed the ratios of $^{18}O/^{16}O$ for assessing the enrichment for ascertaining nature of salinity in the area. Hydrochemistry of the waters also confirms the enrichment ratios determined in the area. Repeat measurements were carried out to confirm the persistence of the ratios.

THE EFFECTS OF COASTAL AQUACULTURE AND OTHER LAND USE PRACTICES ON THE QUALITY OF GROUND WATER RESOURCES AND THEIR SUITABILITY FOR DIFFERENT USES IN KALPITIYA PENINSULA, SRI LANKA.

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Abstract

During the past two decade coastal shrimp culture has rapidly expanded in Kalpitiya Peninsula in North-western Sri Lanka. The Peninsula is bordered by the Indian Ocean and Kalpitiya Lagoon and connected with the mainland by a narrow strip of land. Since there are no sources of surface runoff, ground water is the only source of water for drinking, agriculture and aquaculture (to maintain salinity) purposes and therefore considered as the most precious resource in the area. The shrimp culture causes salt-water intrusion and farm water can be leached to the aquifer, causing salinisation of ground water. There is also a possibility of ground water contamination resulting from heavy use of agrochemicals.

The present study was conducted with the objectives of finding out the effects of coastal aquaculture on the quality of highly utilised ground water resources and to evaluate the suitability of water for drinking, agricultural and aquaculture purposes in the peninsula.

The water samples from representative tube wells and dug wells were collected and analysed for twelve important physicochemical parameters. The results were compared with the quality guidelines for each use. The pH and dissolved oxygen in wells used for shrimp farming were not within acceptable ranges. Except for ammonia, other parameters in the wells used for drinking were suitable for the purpose. Electrical conductivity and chloride levels were generally elevated especially in agricultural wells.

The findings of the present study are useful for planning for conservation and management of ground water resources in Kalpitiya Peninsula.

ASSESSMENT OF GROUNDWATER CONDITIONS IN METTUPALAYAM INDUSTRIAL ESTATE AND ENVIRONS, PONDICHERRY

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Abstract

The Mettupalaym Industrial Estate (IE), established during 1979 in the fringes of Pondicherry State. Chemical, paper and metal industries generate effluents and are being discharged on ground. The effluents have found their way into the groundwater regime and started migrating along the groundwater flow path. Muttarapalayam well field, the main source of drinking water supply to Pondicherry since 1870 is located in the downstream side of IE. There is likelihood of contaminant migration from the Industrial estate reaching the well field. The groundwater study investigated the status of groundwater contamination around IE and Muttarpalyam well field.

The water quality data corroborates very well with the inferences derived from geophysical investigations with a few exceptions due to some inconsistencies observed in the quality data. The high concentration of TDS and Sulphates in effluents during November 2000 clearly indicates discharge of stored effluents from factory premises with surface runoff in the effluent channels during rainy season. Sulphates in groundwater are quite high along the northern boundary of the Industrial Estate close to the channel and increased in general towards East. Background Sulphate concentration in Cuddalore formations around Pondicherry generally varies between 30-60 mg/l and TDS varies from 100–150 mg/l from outcrop to discharge areas. TDS concentration of the Cuddalore aquifer in the outcrop region (Mettupalayam Industrial Estate) does not show much variation as compared to the aquifers in the same formation at greater depth.

In general, the TDS concentration of groundwater is higher on the northern periphery of the Industrial Estate. It shows a reduction from West to East. The prominent contaminant sources identified are: waste dumps near Electricity Department Quarters and the wells inside Quarters where some of the industries might have injected chemicals; the effluent channels originating from some industries. These effluents contain appreciable quantities of Sulphates. The seepage from the effluent channel could act as a diffuse source of contamination resulting in groundwater contamination in the industrial area. The Cuddalore formations are

known to have a high permeability, which may facilitate easy infiltration and transport of the contaminants.

Based on the results of geophysical investigations, hydrogeological data and water quality analyses, a groundwater flow and mass transport model of the Mettupalayam Industrial Estate and its environs covering Muttarapalayam well field has been constrcted using visual MODFLOW software. The flow model has been calibrated using water level data of March 1998. The mass transport model has also been calibrated using Sulphate concentration as contaminant during that time. Sulphate concentration at the source locations vary from 400 mg/l near M/s Magna Chemicals and M/s Guru Papers to 500 mg/l around Electricity Department Quarters and reduces gradually to 200 mg/l near Well No. PWD 1. Sulphate concentrations have been computed in the Mass transport model for 5, 10, 15, 20 and 40 years since 1979. The computed values are matching closely at all the observation wells. Sulphate contaminant plume in general extends towards the Muttarapalayam well field from the Mettupalayam IE. The contaminant plume has migrated to about 200-250 m during 10 year period (from 1989 to 1999) towards the Muttarapalayam well field with an average groundwater velocity of about 30 m/year. The contaminant plume emerging from the IE is elongated in NS direction because of over-exploitation of groundwater from Muttarapalayam well field in the South.

Significantly the pumping levels in the well field at Muttarapalayam is less than -18 m (amsl) which is drawing most of groundwater from thick Cuddalore formations in the East. Further, Sulphate contamination in groundwater from the Mettupalayam Industrial Estate is very limited due to over exploitation from the water supply wells within the IE. These wells draw most of the groundwater from the eastern part. It suggested that 10-12 additional observation wells may be drilled in the contaminant plume migration path piercing the entire thickness of Cuddalore formation for continuous monitoring of the water level and water quality in the Industrial Estate and its environs. The water level and quality monitoring should be carried out systematically and regularly once in every two months. The water quality monitoring should include the effluent samples also. In the future monitoring programs, the pumping wells in the Muttarapalayam well field must be included. To arrest the further migration of contaminants towards the Muttarapalayam well field, a few wells should be drilled along the Southern boundary of Industrial Estate for abstraction and treatment of the contaminated groundwater for industrial use. This may help contain further spreading of contaminant plume towards the Muttarapalayam well field. Close monitoring of the water quality particularly for Sulphates in the Muttarapalayam well field may be warranted once in two months to check the entry of contaminants, if any in the drinking water supply.

AQUIFER VULNERABILITY ASSESSMENT USING THE DRASTIC MODEL IN LANDFILL SITES – AN APPROACH TO MANAGE AQUIFERS INCLUDING COASTAL CITY AQUIFERS OF INDIA

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Abstract

Okhala landfill is located in South-East Delhi the capital city of India. The major source of drinking water is groundwater. The study reveals Groundwater is inherently susceptible to contamination from anthropogenic activities and remediation is very difficult and expensive. Prevention of contamination is hence critical in effective groundwater management. In this paper an attempt has been made to assess aquifer vulnerability at the Okhala solid waste landfill. This disposal site is placed at the most important aquifer in southeast Delhi. The leachate infiltrates to groundwater and degrades the quality of the groundwater. The area is strongly vulnerable to pollution due to the presence of agricultural activity (northwest area of landfill), the solid waste disposal site and industries. Increasing groundwater demand makes the protection of the aquifer from pollution crucial. Physical and hydrogeological characteristics make the aquifer susceptible to pollution. The vulnerability of groundwater to contamination in the study area was quantified using the DRASTIC model. The DRASTIC model uses the following seven parameters: depth to water, recharge, aquifer media, soil media, topography, impact on vadose zone and hydraulic conductivity. The water level data were measured in the observation wells within the disposal site. The recharge is derived based on precipitation, land use and soil characteristics. The aquifer media was obtained from a geological map of the area. The topography is obtained from the Survey of India. The impact on the vadose zone is defined by the soil permeability and depth to water. The hydraulic conductivity was obtained from the field pumping tests. The calculated DRASTIC index number indicates a high pollution potential for the study area.

NUMERICAL MODELING FOR ASSESSING THE CONTAMINATION HAZARD FOR DEEP AQUIFERS IN COASTAL AREAS CAUSED BY THEIR EXPLOITATION

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Abstract

Contamination of the shallow coastal aquifers and the increasing water demand of the coastal zones caused by expanding populations and industries increase the groundwater exploitation from deeper, not yet contaminated aquifers. In contrast to this development, the deeper aquifers are insufficiently considered and consequently few information exists on them.

At many sites of the world, this increasing exploitation of deeper aquifers occurs within the superficial highly contaminated urban areas. This exploitation causes often a difference in the hydraulic potential between the shallow and the exploited deep aquifer. Hence contaminated shallow waters may flow into deeper aquifers e.g. by windows in clay layers, or along anthropogenic hydraulic connections (abandoned dilapidated perforations, purely insulated perforations).

To estimate potential influences of the groundwater exploitation from deeper aquifers, numerical simulations were conducted. In three model series, the hydraulic permeabilities and thicknesses of two or three layers and the presence and distribution of additional clay layers and lentils were varied. All simulations were executed with and without groundwater exploitation from the deeper aquifer. The results were compared to determine the impact of the exploitation on the groundwater flow field, the water balances for the different layers and the spatial distribution of the groundwater ages within the aquifer system. It was investigated under which geometric aquifer configurations the impact is greatest and for which configurations the influence may be neglected. The potentially related increase of contamination of the deep aquifer from the contaminated uppermost aquifer was thereby of special interest.

AN APPROACH TO MANAGE GROUNDWATER AQUIFERS INCLUDING COASTAL CITY AQUIFER OF INDIA

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Abstract

Groundwater is most precious commodity, should be preserved for future generation. The coastal city of India has an increasing need for water as the result of rapid industrialization and population growth and further sea water intrusion in groundwater aquifer deteriorate the availability of fresh water for utilization in industrial and other domestic purposes. Excessive withdrawals from wells have lowered water levels; caused salt water intrusion; shortage of potable and other water; and land subsidence. Keeping in view the increasing thrust on groundwater resources and the present scenario of availability vis-à-vis demand there is needed to re-orient our approach to groundwater management. The Annual replenishable Groundwater Resources in India is estimated as 432 BCM. Keeping in provision for domestic, industrial uses and natural loss to the system, the available Groundwater Recourse for irrigation is 361BCM. The Groundwater draft is around 150 BCM, which is 42 % of the total annual recharge. This study suggested number of scientific method for sustainable use and management of groundwater aquifers for coastal city. The scientific major is based on preliminary study in few costal city of different states like Orrisa, Tamilnadu, Kerala , Andhra Pradesh, Maharastra and Gujarat and further modeling approach was used to minimize the sea water intrusion in coastal aquifer of India. The major scientific approach are modeling (protect from sea water intrusion), rainwater harvesting, water conservation and recycle of available domestic water for fruits/flower/vegetable. Using of domestic water for agriculture purpose also helps in recharge of groundwater in that specific area of coastal city. The study also suggest sound engineering planning for sustainable water usage, including the drilling of wells, rates of water withdrawal, and eventually artificial recharge of the aquifer. It will carry out research activities with the participation of 3 communities who will be the immediate beneficiaries in this region. Research results will be applied to improve the water supply for other communities in the country and other Asian cities which have similar geological, hydrogeological, and geotechnical settings and water problems

SESSION
CLIMATE CHANGE AND COASTAL ECOSYSTEM

THE NEED FOR INTEGRATING HIGH RESOLUTION HYDROLOGY-HYDRODYNAMIC MODEL FOR DECISION SUPPORT SYSTEMS AND MANAGEMENT OF COASTAL ZONES AND ESTUARIES, UNDER CHANGING CLIMATE FORCING.

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Abstract

Gone are the days of analyzing hydrology and hydrodynamics of the interconnected system of watershed(s) and estuary as separate domain/system. With all the major concerns of the present and future – sea level changes, changes in costal regions, watershed runoff, floods, etc. - it is necessary to integrate both the major systems and establish a model capable for realistic Decision Support Systems and management purposes.

The model is built for tropical estuaries and is tested for the Vembanad Lake System (VLS) in Kerala, South India - a complex system of seven catchments draining into the lake, which meets the sea at the Cochin Estuary. A GIS-based hydrological model - local runoff estimated using observed precipitation, evapotranspiration and estimated infiltration - used to investigate the impact of climate and land-use changes showed that during the recent years the mean annual runoff was highly variable over the downstream part of the basin, which affects the estuarine processes.

The hydrology model coupled with a high resolution 2D depth-averaged hydrodynamic model of the lake-estuary system, solved using Finite Element Method, is based on tidal, hydrologic, wind and coriolis forcing. The integrated model is designed to examine detailed physical and environmental characteristics. The model, coupled to a Chemical Engineering Module, can capture temporal and spatial variability of ecological processes.

The integrated modeling approach is a challenge in determining the realistic boundary conditions, matching with the appropriate initial conditions. High resolution topography and bathymetry is necessary to achieve accurate dispersion predictions in these systems.

SEASONAL VARIATION IN METHANE EFFLUX FROM A TROPICAL RICE FIELD OF COASTAL ORISSA

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Abstract

Methane (CH_4), an important greenhouse gas, plays a key role in the tropospheric and stratospheric chemistry. Tropical rice fields are considered as one of the most important anthropogenic sources of CH_4. Rice, a moderately salt-tolerant crop, is widely grown in the salt-affected coastal areas of India, Bangladesh, Myanmar, Thailand, Vietnam, Malaysia and Indonesia. In a field experiment at Ersama, a fishing hamlet of coastal Orissa ravaged by the super cyclone of 1999, impact of organic and inorganic N management on CH_4 efflux was studied in a flooded field in the wet and dry seasons of 2002-2003. Cumulative CH_4 efflux varied from 157.56 to 368.92 kg $CH_4.ha^{-1}$ during the wet season and 16.75 to 96.56 kg $CH_4.ha^{-1}$ during the dry season. Lower CH_4 emission during the dry season was attributed to increased soil salinity that went up from 0.76 $dS.m^{-1}$ during the wet season to as high as 2.87 $dS.m^{-1}$ during the dry season. Grain and straw yields of rice were significantly higher in the dry season with significant residual impact of organic amendments. Studies reveal that judicious management of resources can produce economical yield of rice with low CH_4 emission in the marginal lands of coastal saline areas.

EFFECT OF CLIMATE CHANGE ON THE MANGAL DISPOSITION OF THE SUNDARBAN COAST OF W.BENGAL

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Abstract

The easterly tilt of Bengal basin due to neo-tectonic movement changed the main flow of Ganges through the river Padma of Bangladesh .Owing to lack of upstream fresh water flow the monsoon freshets accumulate at the estuary mouth over salt wedge in Sundarban. Global climate change coupled with this easterly subsidence caused an annual rate of sea-level rise of 3.14mm/y at Sagar point and the rate of rise increases east wards towards Bangladesh.

The rise in sea level is causing upstream extension of salt wedge which during driest period extends up to Diamond harbour (30 Kms from estuarine mouth). Coupled with this an accelerated geomorphic action by the surge of surf goes undeterred. These two factors caused a shallow marine condition in southern Sundarban coast and resulted in the migration (dancing state of existence) of plant communities in the inner, outer and mid-estuaries of Indian Sunderbans. The typical outer estuarine communities feature at inner estuary or mid estuary and vice-versa. Thus when *Avicennia marina* has to appear at the narrow creeks of midestuary, it shows abnormal adaptations throwing stilt roots to protect against high current velocity. Similarly *Excoecaria* plants on the foreshore have to develop perforated burrs to augment their breathing being a plant without pneumatopohore. Abnormal mangal adaptations and a topsey turby mangal disposition have thus resulted basically from a combined effect of Neo-tectonic movement and Global warming.

SEASONAL DYNAMICS OF CH_4 AND N_2O EMISSION FLUX FROM MANGROVE SEDIMENTS OF EASTERN ORISSA

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Abstract

Methane (CH_4) and nitrous oxide (N_2O) are potential greenhouse gases with impact on destruction of stratospheric ozone as well as a source of tropospheric ozone. Coastal areas have been recognized as major marine contributor to the atmospheric flux of CH_4 and especially N_2O. Mangrove forests occupy a significant fraction of the tropical land/seas interface and receive high inputs of organic C from the forest detritus and large-scale loading of terrestrial N from the anthropogenic activities in the intensely habituated hinterland. Experimental *in situ* determination of emission fluxes of CH_4 and N_2O from the mangrove forests/sediments of Bhitarkanika National Park (North-eastern Orissa) exhibited large-scale spatial and temporal variations. Emission fluxes yielded rates between 0.09 to 3.23 mg $CH_4.m^{-2}.h^{-1}$ and 0.19 to 253.78 ng $N_2O.m^{-2}.h^{-1}$. CH_4 and N_2O emission fluxes varied greatly depending upon the season and was lowest during the pre-monsoon and followed the order of monsoon > post-monsoon > pre-monsoon. CH_4 and N_2O yields varied depending upon both the magnitude and chemical nature of the sediment C and N sources and microbial activity that was in turn affected by the salinity. Results indicate that mangroves constitute a significant and hitherto unrecognized source of greenhouse gases to the global GHG budget.

ARE COASTAL SYSTEMS A SOURCE OF GREENHOUSE GASES?

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Abstract

The inventories of sources and sinks of atmospheric CO_2 in the coastal oceans is currently recognized as essential for better knowledge of the global carbon cycle. The current understanding in the coastal systems is that temperate open continental shelves are net heterotrophic while near-shore system influenced by anthropogenic and/or terrestrial organic carbon inputs in particular temperate coastal systems are net heterotrophic. A climatological approach is not possible at present to evaluate sinks and sources of CO_2 in the coastal oceans due to strong temporal and spatial heterogeneity of coastal environments and relative paucity of data.

In our study, the atmospheric fluxes of CO_2, CH_4 and N_2O were monitored from diverse coastal systems with varying anthropogenic inputs (viz., mangroves, coral reefs, coastal lagoons, estuaries and in the open ocean) in mainland India and in the Andaman Islands. This is the most exhaustive study conducted in India using both static and floating chambers. We studied both sediment-water fluxes and air-sea gas fluxes to determine the rates of trace gas emission from these systems. We adopted an upscaling approach to assess the relative importance and potential impact of near-shore systems on the overall budget of trace gases. Our results indicate a net source for CO_2, CH_4 and N_2O from these tropical coastal wetlands in comparison to the temperate regions, where they are net sinks

CLIMATIC CHANGE AND SEA LEVEL RISE

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Abstract

Sea level change during the Quaternary is primarily a consequence of the cyclic growth and decay of ice sheets, resulting in a complex spatial and temporal pattern. . Regional analyses indicate that the earth-response function is depth dependent as well as spatially variable observations of glacially induced sea level changes also provide information on the response of the mantle to surface loading on time scales of 10^3 to 10^5 years rising mean sea level, it is proposed, is a significant indicator of global climate change. The principal factors that can have contributed to the observed increases of global mean sea level in recent decades are thermal expansion of the oceans and the discharge of polar ice sheets. Calculations indicate that thermal expansion cannot be the sole factor responsible for the observed rise in sea level over the last 40 years; significant discharges of polar ice must also be occurring. Global warming, due in some degree presumably to increasing atmospheric carbon dioxide, has been opposed by the extraction of heat necessary to melt the discharged ice. During the past 40 years more than 50,000 cubic kilometers of ice has been discharged and has melted, reducing the surface warming that might otherwise have occurred by as much as a factor of 2. The transfer of mass from the polar regions to a thin spherical shell covering all the oceans should have increased the earth's moment of inertia and correspondingly reduced the speed of rotation. This accounts for about three quarters of the observed fractional reduction in the earth's angular velocity since 1940. Monitoring of global mean sea level, ocean surface temperatures, and the earth's speed of rotation should be complemented by monitoring of the polar ice sheets, as is now possible by satellite altimetry. All parts of the puzzle need to be examined in order that a consistent picture emerges. Sea level change during the Quaternary is primarily a consequence of the cyclic growth and decay of ice sheets, resulting in a complex spatial and temporal pattern.

Two global coupled climate models show that even if the concentrations of greenhouse gases in the atmosphere had been stabilized in the year 2000, we are already committed to further global warming of about another half degree and an additional 320% sea level rise caused by thermal expansion by the end of the 21st century. Observations of this variability provide constraints on the timing, rates, and magnitudes of the changes in ice mass during a glacial cycle, as well as more limited information on the distribution of ice between the major ice sheets at any time.

Comprehensive models of sea level change enable the migration of coastlines to be predicted during glacial cycles, including the anthropologically important period from about 60,000 to 20,000 years ago.

CLIMATE RESILIENT COASTAL ZONE DEVELOPMENT IN BANGLADESH:PARTICIPATORY GOVERNANCE FOR COMMON RESOURCES MANAGEMENT

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Abstract

Fragile coastal zone exposed to recurrent natural disasters further aggravated with climate change impacts calls for science based resource generation and its management through participatory governance of common coastal resources. This paper is aimed at introducing an innovative concept of climate resilient coastal resource development with application of scientific and indigenous knowledge through a eco-specific participatory governance of resource management. In order to set the congenial environment for resource generation activities of coastal farmers, it has been recommended to combat poverty alleviation through the formation of numerous resource user groups by type of occupation and type of resource harvesting nature as well as management. The paper focuses on a paradigm shift from income generating activity to resource generating activity by creating and enhancing natural resource base through participatory management approach. "Seed Production Areas" (SPA) by bio-climatic zones have been established throughout coastal belts as a model for participatory governance of common resource use. Technological achievements demonstrated by suitable species selection adaptable to inundation type and extent in coastal habitats. In this context ten mangrove species adaptable in response to natural disasters including climate change impact were selected. Several techniques are developed for eco-friendly maintenance of coastal embankments such as palm techniques from detached germ tubes, low cost erosion control and differential saline tolerant mainland species composed of both plants, trees and grasses. All these consolidated technical initiatives are found to be proven security against climate change impact as well as unique source of resource generating activities for sustainable livelihood of the communities. It has been shown that the users will be benefited from using improved seeds of SPA attaining 24.1 to 66.5 % gain in eastern zone, 33.7 to 121.2 % gain in central and 26.4 to 57.8 % gain in western coastal belt. What is urgently needed is to involve the respective farmers group in the systematic process of management and further exploration of resources through replication of these pilot demonstrations.

EXCHANGE OF GREENHOUSE GASES AND ITS IMPACT AT THE LAND–OCEAN BOUNDARY CONDITION OF SUNDARBANS MANGROVES, NE COAST OF BAY OF BENGAL, INDIA.

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Abstract

The Sundarbans Mangroves eco-region is the world's largest mangrove ecosystem extends across southern Bangladesh and India's West Bengal State in the land ocean boundaries of Bay of Bengal. The Indian Sundarbans Mangrove forest located at the estuarine system of the River Ganges, NE coast of Bay of Bengal. The total area of the Indian part of the Sundarbans forest, lying within the latitude between 21°13'-22°40' North and longitude 88°05'-89°06' East, is about 4,262 sq km, of which 2,125 sq km is occupied by mangrove forest across 56 islands. Diurnal and seasonal variations in carbon dioxide and methane fluxes between Sundarbans mangrove biosphere and atmosphere were measured at one of these islands namely Lothian Island using micrometeorological method during 1998–2000. This environment acted as a net source for carbon dioxide and methane. The mixing ratios of methane were found to vary between 1.42 and 2:07 ppmv; and that of carbon dioxide, between 324.3 and 528:7 ppmv during the study period. The biosphere–atmosphere flux of carbon dioxide ranged between -3:29 and 34:4 mg m^{-2} s^{-1}; and that of methane, between -4:53 and 8:88 mg m^{-2} s^{-1}: The overall annual estimate of carbon dioxide and methane fluxes from this ecosystem to atmosphere were estimated to be 694 Tg yr^{-1} and 184 Gg yr^{-1};respectively. Considerable variations in mixing ratios of carbon dioxide and methane at the NE coast of Bay of Bengal were observed due to the seasonal variations of their fluxes from the biosphere to the atmosphere. The composition was inferred by fitting model prediction to measurements.

IMPACT OF TSUNAMI ON GROUND WATER IN COASTAL AQUIFER SYSTEM OF NORTHERN COASTAL DISTRICTS – TAMILNADU

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Abstract

The impact of the Tsunami on the coastal aquifer system and the ground water quality changes in the drinking water sources is another area which has to be assessed for providing protected water supply to the affected coastal rural and urban population. The present paper deals with the ground water quality in coastal aquifer system of 7 northern coastal districts which were severely affected by tsunami. In order to achieve the above objective 384 (shallow and deep wells / bore wells) monitoring wells have been identified in a grid pattern and ground water level and water quality samples have been collected for three seasons viz. August-05, October-05, December-05, February-06 and April-06. The analysis of the results has been compared with the pre-tsunami ground water quality data. The interpretation of results reveal that the flooded sea water during tsunami receded and saline water remains in pools (natural and man made depressions) and increased the duration of infiltration and there by saline water mixes with fresh ground water. The rainfall occurred during the north east monsoon of 2005 has recharged the fresh water and gradually the quality of the coastal aquifer system of the northern coastal districts is being restored.

POSTER PRESENTATIONS

A REVIEW OF THE LEGISLATIVE FRAMEWORK FOR CONTROLLING POLLUTION IN COSTAL INDIA

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Abstract

The Indian coastal stretch is made up of diverse ecosystems - sand dunes, beaches, wetlands, mangroves, estuaries, backwater lagoons and coral reefs. Settlements of traditional people, especially fisher folk, are concentrated in these areas, as they mainly depend on coastal areas and seas for their occupation. Equally diverse are the development activities impacting these ecosystems. Tourism, industrial activity, infrastructure, aquaculture, sand mining, construction of sea walls & rapid urbanization pose serious threats to the health of these ecosystems and to lives and livelihoods of coastal communities. The coastal zone is also threatened with problems of erosion, deposition flooding, destruction of mangroves, silting of estuaries.

Laws and regulations are a major tool in protecting the environment. To put those laws into effect, government agencies create and enforce regulations. The Indian constitution is amongst the few in the world that contains specific provisions on environment protection. The Central Board for the Prevention and Control of Water Pollution spearheads the effort at systematically tackling pollution problems in the country. The basic tasks before the Board are: assessment and control of air pollution; assessment and control of coastal pollution; development of professional expertise and trained manpower; development of cost-effective technologies for air and water pollution control; and strengthening the institutional R&D support for pollution monitoring. The legislative framework for controlling marine pollution is provided by the Territorial Waters, Continental Shelf, Exclusive economic Zone and Other Maritime Zones Act of 1976.Development along coastal stretches is severely restricted under a regime comprising the Coastal Regulation Zone (CRZ) notification of 1991. This paper gives a detailed account of the legislative framework for controlling marine pollution in coastal lands of India.

THERMAL POLLUTION IN COASTAL WATERS

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Abstract

Many ecosystems resulting from man's various activities in the world become inherently unstable. This means that wise management of the environment is an increasing imperative if catastrophe is to be avoided. Among the natural systems, Ocean plays important role in many spheres such as resource development, human health, biodiversity, climate and economic development. Though various anthropogenic activities can cause adverse effects on marine environment, thermal pollution implies unique problems. Thermal pollution in natural water bodies is caused by external influences that result in higher temperatures and further consequences. The effects of temperature changes in the aquatic environment may affect organisms directly or indirectly by means of ecological perturbations because of the synergistic effects of a number of parameters. This could cause internal functional and physiological aberrations and other critical activities like destruction of coral reefs and other sensitive sedentary species.

Recent advances in studying biochemical and cellular-level responses to thermal stress have facilitated a new exploration of the role of climate and climate changes in driving inter tidal community and population ecology. Biophysical methodologies are required to be used to investigate the relationship between the highly intricate pattern of thermal stress with the interaction of climate and the dynamics of inter tidal community. It is also reported that the water temperature and fecal indicator bacteria (FIB) co vary in coastal ecosystem. Another important area to be studied in future is the epidemiological investigations in our coastal waters in relation to temperature increase. In this paper, an attempt is made to outline some future plan of studies.

ARSENIC ABSORBANCE BY TWO CYANOBACTERIAL SPECIES, ISOLATED FROM SURROUNDINGS OF TOKYO BAY, JAPAN

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Abstract

Arsenic (As) is an extremely toxic metalloid that adversely affects human health. There are many countries in the world including Bangladesh, China, India (West Bengal), and United States of America, where arsenic in drinking water has been detected at concentrations greater than the WHO's guideline value (0.01mg/L) and/or the prevailing national standard and also adverse health effects have been documented. In West Bengal (India) and Bangladesh, the impact of arsenic extends from immediate health effect to extensive social and economical hardship that effects especially the poor. There are a variety of methods currently available for removal of arsenic from contaminated water. Some studies reported preliminary success in using packets of chemicals for household treatment, but there are no proven technologies for the removal of arsenic at water collection points such as wells, hand-pumps and springs (WHO 2001). Biological methods are gaining momentum because of their potential in providing a cost-effective technology for remediation. One emerging technology that has received more attention in recent years is the development of bio-sorbents with high affinity and specificity. Two cyanobacterial organisms were isolated from freshwater canals around Tokyo Bay and were tested for removal of arsenic from drinking water in both fresh and dried condition. The preliminary result elucidated that both the test organisms can be useful to remove arsenic from drinking water in a natural condition such as watershed/reservoir without applying any chemicals.

IMPACTS OF ANTHROPOLOGICAL ACTIVITIES ON MARINE PHYTOPLANKTON AT THE COASTAL AREA OF ALANG SHIP BREAKING YARD, ALANG, INDIA

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Abstract

Indiscriminate exploitation of nature by man has disturbed the delicate ecological equilibrium between living and non-living components of the environment as a whole. One of the most serious problems confronting the modern world today is the problem of ship breaking activities. Ship breaking activities add the heavy metal pollutants in the coastal areas of the respective yards, as ships bottom are painted with toxic paint to prevent algae and sessile marine animals from fouling the body and haul. The withdrawal of active participation of countries like Taiwan and Korea in the ship-breaking industry has indeed helped India to emerge as the leader in this industry during the past several years. In India, there are several ship-breaking sites, but the Alang area, is the main center of the ship-breaking activity and account for around 90% of the ship-breaking in the country. Alang ship breaking yard, the largest ship-breaking yard in the world was established at Alang (Lat 21°18'to 21°22' N and Long 70°15' to 72° 10' E) during 1982 on the west coast of Gulf of Cambay, India. Ships from all over the world come here for scrapping**.** Even though, it is a potential source of raw materials for re-rollers and as a result of which import of ships for breaking is accelerating for meeting the demand of re-cycled steel in the southern zone of Asia, the ship scrapping activity causes a considerable coastal marine pollution in the surrounding areas. The eight heavy metals (Fe, Mn, Cd, Co, Cu, Zn, Ni and Pb) were estimated from seawater (both in dissolved as well as particulate form) and sediment, and total petroleum hydrocarbons were also estimated from the coastal region of Alang ship breaking yard. Effect of anthropological activities at the coastal area of the Alang ship breaking yard on marine phytoplankton were studied in *in situ* condition.

CONTAMINANT TRANSPORT MODEL OF THREE INDUSTRIAL SITES OF VISAKHAPATNAM CITY

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Abstract

Industries are safe to set up away from residential localities so that environmentally no pollution problems could arise. Visakhapatnam is one of the rapidly developing cities in Asia. Since 1970s various heavy industries like Hindustan Zinc, Coromandal Fertilizers limited, HPCL, Hindustan Polymers and nearly 50 major industries are being developed.

There was a simultaneous development in urbanization of Visakhapatnam city, which caused development of residential localities in the close vicinity of industrial localities since 1970s.

The TDS (mg/l) values in the groundwater wells of residential areas located in the close vicinity of industrial sites have risen to hazardous levels. Various investigators have monitored the groundwater quality of residential areas at various periods which concluded the increase in the levels of TDS (mg/l) due to the migration of industrial effluents.

Here an attempt has been made to monthly monitor the groundwater quality of residential areas of three industrial sites (Hindustan Zinc, Coromandal Fertilizers and HPCL) for 2005 and 2006 years. Taking in to account the previous TDS (1500mg/l) values and the present TDS values (>3000mg/l), Contaminant Transport Model was applied through Visual MODFLOW system. The Plume Dispersion was predicted upto the year of 2025.

ENVIRONMENTAL IMPACTS OF OUT FALL DRAINS ON SOIL OF BADIN AREA, SINDH, PAKISTAN

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Abstract

A mega project, Left Bank Outfall Drain (LBOD), was designed to drain saline and surface water, storm runoff, and municipal wastewater from three districts (i.e., Nawabshah, Sanghar, and Mirpur Khas) of Sindh province. The Project intended to improve irrigation and drainage conditions for an area of about 516,500 hectares in the southeastern Sindh. It comprises 2.5 million hectares catchments of the left bank of Indus River. Spinal drain is its central feature, which connects the drainage network to the sea through a Tidal Link. The Spinal drain collects surplus drainage and distributes it through a weir to other two branch drains, the Kadhan Pateji Outfall Drain (KPOD) and the Dhoro Puran Outfall Drain (DPOD). DPOD drains the effluents in Lake Shakoor, while the KPOD drains into the sea through 26 miles long canal. The heavy rains and high tides cause backflow in the LBOD, which causes environmental effects on the cropping land and drinking water in the area. Representative soil samples of the area were analyzed for heavy and trace metals and the results were compared with international standards. The data indicate that the concentration of, Zn (upto 543 ppm), Ni (upto 64 ppm), Cr (upto 69 ppm) and Co (upto 49 ppm) in the soils of Badin area is exceeding the limits as proposed for the environmentally safe agricultural soils. However, Cu and Pb are in the permissible limits. It is, therefore, recommended that appropriate measures should be taken for the proper management of the LBOD, and environmental rehabilitation of soils in the lower Sindh, Pakistan.

ENVIRONMENTAL IMPACT OF LBOD ON COASTAL AREAS OF SINDH, PAKISTAN

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Abstract

Pakistan coast is about 700 Km out of which Sindh has 215 km long coast, delta covering almost 85 percent of the total coastal belt of Sindh. The rest of the coastline (15%) in the northwest constitutes the western coast of Karachi. The mega project, Left Bank Outfall Drain (LBOD), was designed to drain saline and surface water, storm runoff, and municipal wastewater from three districts (i.e., Nawabshah, Sanghar, and Mirpur Khas) of Sindh province. The Project intended to improve irrigation and drainage conditions for an area of about 516,500 hectares in the southeastern Sindh. It comprises 2.5 million hectares catchments of the left bank of Indus river. Spinal drain is its central feature, which connects the drainage network to the sea through a Tidal Link. The Spinal drain collects surplus drainage and distributes it through a weir to other two branch drains, the Kadhan Pateji Outfall Drain (KPOD) and the Dhoro Puran Outfall Drain (DPOD). DPOD drains the effluents in lake Shakoor, while the KPOD drains into the sea through a 42 Km long canal. The problem of sea intrusion and LBOD has affected the coastal land: settlement as well agricultural of the lower Sindh. While the heavy rains and high tides cause backflow in the LBOD, which causes environmental effects on the cropping land and drinking water in the area. Representative soil samples of the area were analyzed for heavy and trace metals and the results were compared with international standards. The data indicate that the concentration of Zn (upto 543 ppm), Ni (upto 64 ppm), Cr (upto 69 ppm) and Co (upto 49 ppm) in the soils of Badin area is exceeding the limits proposed for the environmentally safe agricultural soils. However, Cu and Pb are in the permissible limits. It is, therefore, recommended that appropriate measures should be taken for the proper management of the LBOD, and environmental rehabilitation of soils in the lower Sindh, Pakistan.

WATER QUALITY AND MANAGEMENT PROBLEMS FROM THE SOUTHERN-WEST COAST OF INDIA

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Abstract

The groundwater quality is controlled by factors starting from the seeding of cloud, composition of rain, effect of weathering on the surfacial hydrological processes as well as interactions in the subsurface horizon. Anthropogenic activities like sewage disposal, dumping of solid wastes can substantially modify the chemistry of groundwater. This problem is serious along the coastal sectors, particularly in the densely populated and urbanized regions. Industrial expansion has also a bearing on the quality of groundwater, especially in discharging the effluents. The restricted circulation and cycling of near-shore contaminated water has an impact on coastal groundwater quality.

Coastal aquifers are thin veins of shallow fresh waters below the seawater. Overexploitation of this thin zone causes seawater intrusion which is alarming in the coastal zone. Though the west coast of India receives seasonally high rainfall (200-400 cm/yr mainly received during the south-west monsoon from June-September), this may not be sufficient enough to feed rivers and replenish groundwater.

Groundwater acidification is another impact of human induced activity on the earth's environment. This problem is becoming a serious issue in the developing countries particularly located in the southern and southeastern Asia. Harmful algal growth along the coastal regions suggests either improper/poorly treated effluent/sewage discharge to the coastal zone and in river water. All these issues will be discussed.

THE OCEAN PART OF COASTAL ZONE: GOOD PRACTICES FOR SUSTAINABLE DEVELOPMENT

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Abstract

Coastal Zone Management (CZM) often focuses on the land part together with means of overcoming the awful influences from the marine environment. However, in the broader perspective of the coastal zone (CZ), the ocean part too plays a very crucial role in modifying and regulating the set up of any region. A general lack in strong policy oriented planning and management is time and again found in the offing when attempting to regulate and manage our precious coastal oceans and the adjacent land. By drawing our concern to the sustainable development of the ocean part of CZM, an attempt is made to explore the possibilities and venues for good practice for this vital part of the globe.

Notably, as a sensitive ecological unit, the geo-physical-chemical entity of the coastal waters play an important function in control of life sustaining systems and overall biodiversity – this underlying concept appears to be the focus for our start to negotiate the current practices and future growth. The age old marine navigable routes, well flourishing meadows of fishing grounds, wealth in terms of oil, coral and minerals and practices like sea sand mining, dredging and numerous defence installations mingled with traditional practices– these are coupled with our aspirations to develop the ocean part of the CZ as well with the landward section of any such neighbourhood. A synthesis on this subject is presented while considering the CZM practices, globally, but pin-pointing the coastal ocean part of the Indian CZ.

Currently, CZM in India appears to be in transition in light of the review and recommendations proposed by relevant committee(s) and the very recent environment policy document. An appropriate opportunity now exists to introduce the significance of the ocean part of the CZ with relevant suggestions on good practices to ensure sustainable development. On a policy framework, this includes points for the fullest consideration of any CZM authority, national or regionally established; propositions to follow a common policy to regulate and to ensure that proper and appropriate actions are contemplated within the ocean part of any CZ under renewed or modified regulations.

DEVELOPMENT OF THE SYSTEM OF INFORMATION SUPPORT OF ACCEPTANCE OF INTERSTATE AGREEMENTS ON USE OF WATER-POWER RESOURCES OF THE RIVERS OF CENTRAL ASIA (EXAMPLE OF SYR-DARYA RIVER BASIN)

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Abstract

Now there is a sharp necessity of data-ware for making the decisions in the field of management of water-power resources (WPR) of Central Asia region, especially Syr-Darya river basin, which is the most developed, regulated by water-storage reservoir and the most intense. In the basin covering 4 states, problems of WPR use and regulation are urgent. Gathering and generalization of multilateral information is necessary to support of management of water consumption in a zone of formation of basin drain on the whole observation network with use of the data of remote sounding of the Earth (RS). An effective mechanism for solving the given problem will be realization of opportunity of reception of exact and operative information using modern networking technologies.

The network I&R database, which concept is based on minimization of cost of means of control due to maximal use of information resources of the departmental monitoring systems integrated in the uniform network and data RS, is created. The system includes the organizations-owners of databases of ground monitoring, nature managers and administrative parts.

SUSTAINABLE MANGROVES MANAGEMENT (SMM) IN INDONESIA: A VIEW FROM A MANGROVE ECOLOGIST FOR EVALUATING POLICIES AND INSTITUTIONAL ARRANGEMENTS AT DIFFERENT LEVELS RELATING TO USE OF MANGROVE FORESTS

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Abstract

Mangrove forests and adjacent marine habitats in Indonesia are potentially the sites of extreme resource conflicts. An increasing proportion of the changes under pressures on mangroves in Indonesia are strongly affected by human activities, both physically and biologically. Additionally, lacks of professional management are likely to cause changes of mangrove resources. To assess anthropogenic impacts in coastal zone in Indonesia, pattern of local inhabitants and natural coastal changes need to be known and longer-term trends need to be separated from short-term variability. Socio-economic studies of coastal inhabitants during the last 10 years are a good basis for estimating longer-term trends human activities in the coastal zone and for assessing mangrove ecosystem responses to human pressures. A sustainable management plan for mangrove forest (SMM) also needs public awareness, public participation, public relations and support system. Integrated Coastal Zone Management (ICZM) is needed as a system to reduce the adverse impact of a major population increase in the coastal zone. The good condition of mangroves is very important for the socio-economic development of coastal villages in Indonesia and having a sustainable impact for fishery productivity in the adjacent waters nearby.

AGRICULTURAL EDUCATION FOR SUSTAINABLE DEVELOPMENT: TODAY'S NEED, TOMORROW'S BULLION

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Abstract

Agricultural education for sustainable development in the third millennium is not only an option, but also is an essential and sensitive process. Nowadays, majority of the countries, especially the Third World countries, face environmental problems. Also every damage to natural resources and environment influence on food security. In this connection,, agricultural education institutions can play an important role by creation of modern technologies to conserve natural resources and environment. We can say that agricultural education for sustainable development is safe investment and is today's need and tomorrow's bullion, because education in general and agricultural education in particular is essential and important for sustainable development from three aspects: food security, social constancy and support from environment for present and future generations. The methodology of this paper is descriptive-analytical and the main purpose is to investigate and determine the role of agricultural education in conservation and improvement of environment in the context of sustainable development. Using systematic approach, revision in structure and programs of agricultural education institutions in order to achieve sustainable development, integrating modern and indigenous knowledge in order to conservation programs of environment, attention to environmental problems and finally education of agricultural instructors are the most important results of this paper.

TOURISM IN THE COASTAL REGIONS: A CASE STUDY OF THE KENYA COAST

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Abstract

Tourism is one of the important service industries in Kenya, leading in foreign exchange earnings in the form of invisible exports. It is Kenya's second largest source of foreign exchange earnings after horticulture. Agriculture, traditionally the country's main source of foreign exchange has been declining leaving an economic gap, which is now being slowly occupied by tourism. Each year, tourists travel to the coast of Kenya especially during the chilling winters in Europe and America. Some tourists also come from Asia particularly Japan, Korea, India and China. Tourism sector has attracted over 1.5 million external tourists in Kenya in 2006. Domestic tourism is also being encouraged so that people from other parts of Kenya also visit coastal tourist sites for leisure especially during the low season and holidays.

This paper will examine the major tourist attractions along the coast of Kenya and their status. Features to be examined include the beaches, lagoons, the sea sports; the variety of fauna particularly wildlife in the national parks and game reserves; the wide variety of flora such as mangrove forests and coconuts among others; the wide range of cultural and historical sites, some of which have been excavated recently.

The paper will also discuss the benefits of the tourist industry to the local coastal inhabitants and the country as a whole. The positive effects such as role of tourism in economic development and negative aspects of the industry will be scrutinized such as sex tourism and environmental degradation in the coastal areas. The last part of the paper will deal with recommendations or way forward towards improving the tourist industry in Kenya's coast. This would make the industry beneficial to the local people as well as the country of Kenya.

ENVIRONMENTAL VULNERABILITY OF AN EMERGING METROPOLIS: CASE STUDY OF MUMBAI- A COASTAL METROPOLIS CITY, INDIA

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Abstract

Rapid urbanization leading to environmental degradation has become an issue of primary concern in developing nations like India. Indian metropolitan cities like Mumbai, Chennai and Kolkata are amongst the largest in the world and are located on fragile ecosystems and have serious environmental and ecological consequences. This was reflected in the 2005 floods in Mumbai. There was significant loss of life and property and the city came to a halt. If viewed closely one can see that inappropriate habitat planning, negligence of seismic safety measures, outdated drainage systems, large scale land reclamation etc has marred the environment and has made local natural systems vulnerable.

The research paper identifies the ecological impacts of intensive urban land use practices in rapidly growing Indian cities by getting a deeper insight into the pattern of development and earths natural environment systems prevailing in the area. The research paper focuses on the case of Mumbai. Since the last decade Mumbai is emerging as an important financial centre and the policy makers dream to make Mumbai a global city by 2020. City development plans, large infrastructure development projects have been planned to make the vision of global city a reality. But the heavy downpour on 26th July 2005 brought the city to a grinding halt and exposed the vulnerability of the great metropolis which is a result of conflict of human intervention and natural environment. The result of the study is expected to contribute towards understanding and planning sustainable habitats in ecologically sensitive areas.

TOURISM DEVELOPMENT STRATEGY FOR TSUNAMI AFFECTED ANDAMAN AND NICOBAR ISLANDS

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Abstract

On Dec. 26, 2004 a gigantic undersea earthquake, which struck just north of Simeulue Island of the Western Coast of Sumatra in Indonesia and measuring 8.9 on Richter scale, generated Tsunami waves having speed more than 600 miles/hour. The deadly force of Tsunami waves struck the coast of Indonesia, Bangladesh, India, Sri Lanka, Maldives and others. More than 2 lakh people were dead, 142,000 were missing and 1,986,000 displaced. Apart from loss of life huge impact is also visible on other elements like impact on environment, infrastructure, economic activities like fisheries and Tourism. In India the most affected parts are Coastal Region and Andaman Nicobar Islands. In this region many beaches and tourist spots are located and worst hit. Andaman and Nicobar Islands is a group of 572 Tropical Islands in the Bay of Bengal, about 1255 km. from Kolkata and 1190 km. from Chennai and are formed by a sub marine mountain range. The Islands are located between the latitudes of 6^o N to 14^o N and 92^o E to 94^oE longitudes. Out of the total 572 islands, only 36 are inhabited. The Andaman & Nicobar Islands are a Naturalist's heaven. It has a unique culture where all religions, languages, ethnic groups live in total peace and harmony. Adventure tourism like Trekking, Camping, Snorkelling, Scuba Diving, and Water Sports are the real attractions. Important tourist spots in Andaman and Nicobar Islands include Jolly Buoy Island, Havelock Island, Ross Island, Chatham Island, Viper Island, Corbyn's Cove Tourism Complex, Cellular Jail, Naval Marine Museum, Indira Point. 60% population of Andaman and Nicobar Island is dependent on tourism and related activities. It is a natural tourist paradise. Tourism industry presently shares about 2.03% in the total turnover of the Union Territory. Tsunami Disaster has taken heavy toll on the tourism industry, Great Nicobar and Car Nicobar were the worst hit, about Rs. 375 crores loss was caused to tourism industries in Andaman Islands. Drop in tourists flow also damaged the small and medium industries related to tourism, loss is about Rs.100 crores. Fear of more Tsunamis as strong aftershocks are continuing.

In order to set up the life normal and to rejuvenate the tourism development, need of the hour is a comprehensive restoration strategy. Strategy is suggested keeping in mind unique eco-systems, their carrying capacity, balanced utilization of natural

resources, national security and socio-economic conditions. It includes immediate, short term and long term suggestions. These three will helps in achieving the goals of tourism policy for the Islands. Immediate level may include facility of landing international flights at Port Blair, relaxation in Coastal Regulation Zone, opening more Islands for tourism, promotion of eco-friendly tourism, Organization of more Festivals etc. The short term level may be construction of eco-friendly semi-permanent Jetties at popular destinations, Popularize Andaman as a destination for Business Meetings or Conferences etc., introduce Insurance Cover to tourist, deployment of life guards at all Beaches, conduct a Survey to assess the status of tourism sector. Long term level may include integrated development of Nicobar Group of Islands, Multi Entry/Exit Points instead of one at various places, Inter-Island Sea plane services etc.

STATUS OF BONELLIA WITH REFERENCE TO CORAL REEF HABITAT IN GULF OF KACHCHH – GUJARAT

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Abstract

Bonellia or popularly tongue worm belongs to the minor phyla Echiura. The phylum is represented by 150 species throughout the world all of which are marine (Stephen and Edwards, 1972) and of them 5 are recorded from Indian coast (ZSI, 2004). Mainly feeding on sediments on coral reef, they play an important ecological role of controlling sedimentation at micro level on coral reefs. The worm is also an area of interest due to its typical characteristic of environmental sex determination. This species mainly inhabit coral reefs especially dominant with lobbed corals like *Porites lutea.* One species *Acanthobonellia pirotanensis* (Jose, 1964) has been reported from Gulf of Kachchh and was believed to be endemic to the famous Pirotan Island only. However GEER Foundation has recorded this animal at three reefs in Gulf of Kachchh viz. Goose, Kalubhar and Chank. Out of which Goose is a submerged reef and is in northeast direction to Sikka jetty, where as Chank reef is one of the largest reef and is situated near the mouth of the Gulf. The distance between Pirotan and Chank is approximately 30 nautical miles. Water current is thought to be the reason for this kind of distribution range expansion. In Gulf of Kachchh it is used as bait to catch larger fish and birds. Special attention should be given to this species mainly for two reasons, as it is believed to be endemic to the coral reefs in Gulf of Kachchh and it is a sediment eater.

ENVIRONMENTAL IMPACT OF TOURISM IN COASTAL AREAS OF INDIA

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Abstract

There is a complex relationship between tourism and the environment. Given its scale and global extent, it is inevitable that tourism has important environmental impacts. These impacts are related to resource consumption and the pollution and waste generated by tourism activities. Main adverse impacts of tourism on the environment are connected to pressure on natural resources, harm to wildlife and habitats (with associated loss of biological diversity), the generation of pollution and wastes. The main types of pollution in coastal waters resulting from tourism include sediments, sewage, solid waste, nutrients, synthetic organic chemicals, oil and pathogens. These result in eutrophication and deteriorating water quality, which have adverse effects on coastal ecosystems. The possible contribution of tourism to conservation is one of the reasons explaining the current interest given to the development of nature tourism. However, for sustainable tourism, there is a need to better understand not only the benefits but also the impact of tourism in the form of environmental pollution. The present paper is an attempt to study the distribution of tourist resorts along the Indian coasts and to see the widespread impact of tourism in costal areas of India.

A THREAT OF BIO-TERRORISM: IN SOUTH EAST ASIAN COASTAL REGION

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Abstract

India is among the most vulnerable countries that run the risk of facing threats of bio-terrorism especially on the coastal zone which are vulnerable to the intrusion of terrorist organisations from neighbouring countries.. A lot of R&D and groundwork has to be planned and carried out speedily, for the vulnerable countries to offer even a semblance of fight against bio-terrorism. In the current absence of awareness and preparedness, we need to examine what the developed world has been doing to face bio-terrorism. A *bioterrorism attack* is the deliberate release of viruses, bacteria, or other germs (Agents) used to cause illness or death in animals, or plants.These agents are typically found in nature, but it is possible that they could be changed to increase their ability to cause disease, make them resistant to current medicines, or to increase their ability to be spread into the environment. Biological agents can be spread through the air, water, or food .

GEOCHEMICAL CHARACTERISTIC OF VEERANAM LAKE, TAMILNADU, INDIA: CONSTRAINS ON WEATHERING AND ANTHROPOGENIC IMPACT

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Abstract

The area of study Veeranam lake falls in between the longitudes 79°35'N and 79°45'N and between latitudes 11°l5’E and 11°45’E. Proper planning and sustainable usage of the ground water is essential in the study area due to its location in coastal belt of Tamilnadu. 45 bore wells were drilled from Sethiathope to Kadambuliyur to augment water supply to Chennai city where water level has reached negative gradient in certain locations like Panruti and Vadalur. A major extraction of the groundwater is also taking place in the Western part of the proposed study area for the lignite mining in Neyveli. Since, there is a larger frequency of complete dependence on a very limited source; it assumes really a very high value, which in turn requires an efficient planning and proper management of this coastal aquifer. An attempt has been made in the study area to access the water quality by collecting both groundwater and surface water samples. The groundwater in the study area is colorless and odorless in nature. The ground water in the study area is moderately alkaline to strongly alkaline. Chloride and Sulphate was higher indicating anthropogenic impact. The order of dominance of cations was as flows Na>Ca>Mg>K. Gibbs plot for groundwater indicate evaporation dominance and surface water indicate weathering dominance. From statistical analysis chemical weathering and leaching of secondary salt formation and anthropogenic sources are the major contributor for ions in both groundwater and surface water. In general both rock weathering and anthropogenic impact due to the intensive agricultural practices controls the water chemistry of both surface and groundwater quality in the study area. Ionic concentration was higher in groundwater when compared with surface water due to residence time of groundwater water with adjoining aquifer materials.

GIS AND PROBABILISTIC MODELING FOR GROUNDWATER POLLUTION HAZARD PREDICTION – METHODOLOGY AND CASE STUDIES.

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Abstract

Assessment and prediction of natural hazard events are inherent with uncertainties, which can never be eliminated, but can be reduced – (1) by objectively 'extracting' (GIS) the empirical associations directly from the data and (2) by using iterative statistical (probabilistic) methods. These predictions are more realistic and, as such are more reliable, because they are based on the 'observed' relationships within the area under investigation, rather than on some generalized relationships that may not be strictly applicable to the area.

Although we have been employing a number of probabilistic methods (e.g. Logistic, Discriminant, etc.) depending on the type of data and result needed, the recently developed "Weights of Evidence" (WOM) method is particularly suitable for GIS analysis. This method consists of the following main modules : (1) Data Integration and Manipulation, (2) Spatial mapping of all Unique Conditions of association between variables, (3) Estimation of Weights for variables, (4) Estimation of Prior Probabilities for all variables and Joint Probabilities for the Unique Conditions, (5) Estimation of Posterior Probabilities for hazard, (6) Statistical testing of Weights and Posterior Probabilities, (6) Final map of hazard probabilities, and (7) Sensitivity analysis and validation.

We have been applying these methodologies in Canada , Japan, Columbia, India and Kuwait. Two case studies - fluorine hazard in groundwater in semiarid region near Hyderabad, India and oil pollution hazard in groundwater in Kuwait, will be presented.

SPATIAL SCALE IN COASTAL ZONE MANAGEMENT : CURRENT APPROACHES, CHALLENGES AND POSSIBILITIES

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Abstract

Coastal zone management is expected to deal with land use and access while integrating concerns about environmental sustainability, aesthetic values and the linkages between the local coastal system and larger scale biological and physical systems. These concerns involve physical systems and social interests operating on diverse spatial scales. Traditionally, coastal zone management has focused on the integration of interest sectors through local level using physical planning supported by property rights instruments. Mediation of interests has also taken place on the local level. However, large-scale environmental processes cannot be addressed on a strictly local level. This means there is a need to bridge scales both in terms of the relevant physical and biological processes and in terms of the institutions responsible for management decisions and their implementation. In this paper we review some of the accepted approaches to cross-scale integration and conclude that management with a strong focus on spatially based management instruments supported by property rights often offers purely technical solutions that are ineffective in addressing problems that are basically political. Effective coastal zone management requires conflict management and the identification of solutions that are at least minimally acceptable to most of the relevant interests. The fact that these interests operate on many different scales further complicates the institutional problem. Two case studies are presented that illustrate this dilemma. The 'state of the art' optimal solution is a framework of nested institutions with representative decision-making characterized by transparency and effective accountability. We conclude by proposing that such systems can be made more effective by the creation of a new kind of management professional who systems can be made more effective by the creation of a new kind of management professional who can move between scales, identifying and communicating issues, facilitating compromises, and enabling effective accountability. We offer an initial outline of the skill set such a professional would possess.

AGRICHEMICAL CONTAMINATION OF COASTAL GROUNDWATER

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Abstract

Agriculture is an important part of the economy and cultural heritage of any country. Although the number of farmers has declined universally over the last fifty years, food and fiber still accounts for a large percentage of the gross national product of any country. Because of the scientific and technological advancements occurring, most farms have become more automated, specialized, productive and increasingly dependent on off-farm inputs. Among these commercial fertilizers and pesticides have been widely used to save time and labor. However, along with an increasing demand for food, environmental concerns about agrichemicals, especially pesticides are also on the rise. These concerns revolve around long-term hazards to the consuming population, the wildlife and to the environment, especially coastal groundwater where maximum agricultural lands are found especially in Asian Countries.

The paper aims at reviewing the possible status of agrichemical contamination of coastal groundwater in Southeast Asia followed by means of rectifying the problem. Whether the widespread occurrence of agrichemicals in groundwater implies chronic mismanagement of these substances or reflects the consequences of normal, label specified field use is not clear, nor is the full extent of the problem known. However, the paper concludes that agrichemical contamination can best be reduced through agricultural approaches which maybe diversified in its application principles but can be identified fundamentally through four generic strategies.

HYDROCHEMICAL EVOLUTION OF GROUNDWATER ALONG THE COASTAL TRACT OF SOUTH ORISSA, EAST COAST OF INDIA

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Abstract

For over a decade, the hydrochemical investigation of groundwater was carried out all along the coastal tract of south Orissa to assess the quality and evolution of groundwater in this region. Results indicate that the groundwater of this region is highly enriched in Ca, Mg, Na, Cl, and HCO_3 ions with high salinity. While the land areas are found to be rich in Ca and HCO_3 ions, the coastal areas are rich in Mg, Na and Cl ions. Salt-water intrusion was found to have contributed to the high salinity of this water mass near the coast. This fact is supported by higher values of Mg^{++}/Ca^{++} and Cl^{-}/HCO_3^{-}. Over-exploitation of groundwater may be the cause for saline water intrusion. At some locations the concentration of Na, Cl and Mg are present at a level much above the World Health Organisation (WHO) standards for drinking water and the water was found to be not suitable for drinking. On the basis of hydrochemical study, five groundwater types have been delineated. They are Ca $(HCO_3)_2$, Mg $(HCO_3)_2$, Na (HCO_3), $CaCl_2$ and NaCl types. As the salinity increases, the groundwaters are found evolving more towards NaCl type. Moreover, strong positive correlation was found between Mg and Mg^{++}/Ca^{++}, and between Cl and Cl^{-}/HCO_3^{-}.

GROUND WATER FLUXES TO INTER-TIDAL REGIONS AND ITS IMPACTS ON COASTAL PRIMARY PRODUCTION.

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Abstract

In constructing water budget and mass flux estimations for coastal regions, submarine ground water discharge is often overlooked. The ground water discharge influences coastal chemistry through supply of nutrients and trace metals. A boosting of coastal primary productivity in regions of subterraneous ground water discharges to Arabian Sea was recently identified. The long-term (decadal) trend of chlorophyll showed a "greening" of the near-shore waters with 3 times greater chlorophyll-a than the peak reported values. These ground water fluxes depend on factors such as: climatic (Monsoon) variability, which controls the fresh water discharge into backwaters providing the necessary force to overcome the frictional resistance of the coastal porous lime shell beds, human factors (land use mosaic, socio economic and sanitary conditions) and tidal factor which controls the hydraulic difference between sea and brackish water. Significant quantity of ground water flow occurs during the monsoon months when water level in the backwater is high and the sea level remains at its annual low. The possibility of heavy rains and flash floods are high with climate variability. Such critical conditions can occur during other seasons and also at similar locations. So far, the coastal nutrient enrichments, primary productivity boosting and a slow change in biodiversity were identified at few coastal pockets. Any noticeable change of the current oligotrophic nature of the coastal region may contribute the removal of atmospheric carbon through photosynthesis, planktonic grazing and sinking.

IMPACT OF COASTAL GROUNDWATER IN GADILAM LOWER SUB BASIN OF CUDDALORE DISTRICT, TAMILNADU, INDIA.

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Abstract

The growing needs for drinking, irrigation and industrial water call for the protection of groundwater quality especially in the coastal tracts such as Cuddalore region. Estimation of quality of groundwater in these aquifers is of prime importance in the assessment, development and utilization of groundwater resources and their protection against pollution and depletion. The Gadilam river basin in Tamilnadu is characterized by different geological formations, and groundwater is the major source for domestic, agriculture and other water-related activities. Geochemical signatures of groundwater were used to identify the chemical processes that control hydrogeochemistry. Chemical parameters of groundwater such as p^H,EC,TDS,Na^+,K^+,Ca^+,Mg^+,Cl^-,HCO_3^-,SO_4^-,PO_4 and H_4SiO_4 were determined. Interpretation of hydrogeochemical data suggests that secondary leaching, saline water intrusion and anthropogenic impact are the major processes in the study area.

CLIMATE CHANGE AND COASTAL ZONE RULES AND REGUALTIONS- NOW AND THEN (THE INDIAN SCENARIO)

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Abstract

India has a coastline of more than 6000 kilometers, which comprise of beaches, wetlands, mangroves, estuaries, backwater lagoons coral reefs and human settlements that are vulnerable to the climate change and its consequences. In India, the Coastal Regulation Zone Norms were framed in 1991 to regulate human activities within 500 metres from the coast at high tide. The land between the Low Tide Line (LTL) and the HTL was designated as the Coastal Regulation Zone. It imposed restrictions on the setting up and expansion of industries, operations or processes etc. in the said Coastal Regulation Zone (CRZ). These regulations were enacted based on the scenario prevailing at that time and were amended 20 times, each time diluting its provisions even further. However after more than a decade and half with the drastic changes in the climatic patterns, need is to have more stringent guidelines and awareness system. The 26th December 2005 tsunami has already opened the eyes of authorities and given the realization for better conservation of coastal resources and fragile ecosystem which are very sensitive to any change in the present state of climate.

In July 2004 the MoEF constituted the Swaminathan Committee and it has already submitted the report in 2005. It recommended a shift from 'regulation' to 'management', i.e., from 'Coastal Regulation Zones (CRZ-I to IV)' to 'Coastal Management Zones' (CMZ I to IV). It also recognizes that coastal protection and conservation should be guided by 'techno-economic efficiency, precautionary approach, 'polluter pays' principle and 'public participation'. There is no mention of livelihood security, safeguarding customary and traditional rights, access and resource use, protection or regulation of development in the coastal zone. There are various lacunae in this draft recommendation, as this report doesn't include very important issues like dealing with disasters like Tsunami, sea level rise and combating serious consequences because of changing climatic pattern. While drafting any such guidelines, ministry should include coastal communities, fisher folk organizations as well as other stakeholders including State Governments, coastal Panchayats, and relevant Government departments and the scientific community. Present need is to have more practical and accessible coastal plan which will serve holistic purpose to conserve precious natural ecosystem, biodiversity and more important human life from any imminent disasters like Tsunami.

NATURAL HAZARDS AND SEA LEVEL RISE ADAPTATION POLICY: THE COASTAL ZONE OF THE AMAZON REGION, BRAZIL

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Abstract

Studies carried out in the low-lying coastal zone of the State of Pará in the Amazon region of Brazil, have recorded, in the last 25 years, extensive evidence of the impact of natural flooding and erosion. Global climatic changes and relative sea-level rise impacts, together with the effects of disordered urban and economic development are factors that will be able to raise this record of negative events. Therefore, this work aims to describe and evaluate the performance of the natural hazards adaptation strategies and measures (*No action, Protection, Accomodation and Retreat*) already employed in the coastal zone of the NE of the State of Pará (16,000 Km^2, 600,000 inhabitants). Among the accommodation policy, the land use legal framework, and the brazilian disaster relief and insurance program are studied. Field data, time series of remote sensing images, planned and autochtonous community activities and national and local legislations were analyzed, focusing on adjustement of management policies to changing environmental scenarios due to a climate change/relative sea level rise. The results of the evaluation process are analyzed. Despite the reduced success of some of these policies and measures, their future use in the region and other alternatives of adaptation still incipiently implemented are discussed in order to provide policy advisers and decision-makers with information to support coastal zone management.

NATURE OF ORGANIC MATTER AND FLUX IN GODAVARI ESTUARY

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Abstract

Many studies indicate an enrichment of organic material and trace metals and few of these investigations establish the nature of any organic-metal association, which may exist. The reports, which indicate that humic acids exert an influence on the metal geochemistry of certain metals, are of increasing interest. Information on the geochemical aspects of major and minor elements in the Bay of Bengal, in general, and the Godavari estuary in particular, is limited and confined only to few reports.

A study on the geochemistry of trace metals is of great importance in several ways. Knowledge of their distribution provides information not only about specific chemical processes in which they are involved but also about the formation and diagenesis of major solid phases in which they become incorporated by biological and anthropogenic processes. It has become increasingly evident in recent years that biogenous processes in surface layers play an important role in removing trace elements from seawater and transporting them to the sediments. Trace elements in coastal environments are derived from three major sources (i) the bordering watershed, (ii) the offshore marine environment, and (iii) industrial and/or urban effluents. The site of deposition, however, is controlled by physical and chemical processes, which are controlled by climate and vary seasonally. To understand their distribution and seasonal variations, sediment samples were collected once in each of the following seasons (i) Monsoon (September): (ii) Post monsoon (December) and; (iii) Pre monsoon (May), and then they were subjected to analysis for trace elements (Cu, Ni, Zn, Cd and Pb) and some major elements (Fe and Mn). Data on the concentration levels of these elements are presented in this study.

Since it is well known that the estuarine ecosystem is more influenced by the biologically available metal fractions than the total amount of metal present in the sediment, the biologically available fraction of metals was also analysed in addition to the total amount of metal present. The analytical procedures used were the dilute acid (0.5N HCl) treatment for determining biologically available fractions of the total trace elements and the concentrated HNO_3 and HF dissolution for determination of the total concentration of the elements.

Results of analyses for organic carbon, Kjeldahl nitrogen and humic acid are presented in this study on a dry weight basis. From the determination of ash weight the percentage of weight lost on ignition was determined. Organic carbon concentration 3.63%, at the mouth of the sea 20.17 ‰ at high concentrations of organic carbon occurred between the estuarine regions. A similar pattern was found for the humic acid concentrations. Results of analyses for this group of compounds ranged from 1.05 %, at mouth of the sea, to 4.68%, at estuarine regions 4.55%. Information on organic carbon is important as it plays a significant role in geochemical cycles of major and minor elements. It is often a good index of the depositional environment, cycling of nutrients and chemical activities of marine organisms.

Relatively high organic carbon was observed during premonsoon/ monsoon compared to post monsoon seasons. This can be attributed to higher productivity due to upwelling in the former and land runoff due to excessive rainfall in the later seasons. The factors that influence that accumulation and preservation of organic carbon in the marine sediments include (i) the abundant supply of organic matter to the environment of deposition through the overlying water column, (ii) the rate of deposition of organic matter which, in turn, depends upon temperature, plankton productivity, wave energy and oceanic mixing, (iii) availability of DO at the sediment-water interface, and (iv) the texture of the sediments. The large amounts of N at mid of the estuarine region are associated with the general accumulation of organic matter in this area, as suggested by the organic carbon and humic acid results.

CONFLICTS OF COASTAL ZONE REGULATION POLICIES: AN INDIAN CONTEXT

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Abstract

The term coastal zone means the coastal water, wetland and shore land strongly influenced by marine waters. In other word, this is the area of interaction between land and sea, which is influenced by both terrestrial and marine environment. The coastal zone includes the area between high and low tide line, up to 10 nautical miles toward the sea from high tide line and up to 20 km. from high tide line towards land side. Coastal Zone is always on the forefront of civilization and has been by far the most exploited geomorphical unit of earth. Its easy access and resourcefulness have always attracted human activities, but its complexity in understanding has led to misuse and abuse.

This paper describes the conflicts of coastal zone regulation policies with reference to India. Coastal Regulation Zone (CRZ) notification was issued by the Ministry of Environment and Forest of Government of India in February 1991 as a part of the Environmental Protection Act of 1986 to protect the coast from eroding and to preserve its natural resources. It was unnoticed or rather ignored till 1994. The CRZ is battle between a long-term resources management and short-term economic gains. The tourism played a major role in destruction of coastal environment and led to a concentration of resorts and undesirable pressures on coastal strips. Impact assessments were not carried out to assess its impact on socio-economic life of the coastal population. The major areas suffered from a wide variety of environmental as well as socio-economic problems due to unplanned and non-integrated sectoral developmental activities over the years. There is need of site-specific management skills to prevent diverse coastal environment.

STUDY OF FLORAL BIOLOGY AND POLLINATION BEHAVIOR OF A MANGROVE SPECIES NAMELY AEGICERAS CORNICULATUM AT MARINE NATIONAL PARK, GULF OF KUTCH, GUJARAT

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Abstract

Though widely distributed in the subcontinent, *Aegiceras corniculatum* has restricted distribution in GOK, which is one of the important mangrove areas of India. There has been a lack of information on pollination biology of the species with respect to its biological cycle in GOK. We therefore studied the floral and pollination biology of *Aegiceras corniculatum* by examining various aspects of reproductive phases such as duration of reproductive phase, flower and fruit production, duration and pattern of anthesis and anther dehiscence, visitation pattern of pollinators etc. The study is sponsored by the Ministry of Environment and Forests, Government of India.

The species is reported to have seasonal reproductive and vegetative phases. Reproductive phase has been reported to start from the beginning of October and prolong up to April end; however, we observed temporal variations with reference to initiation and completion of reproductive phase at different locations in Marine National Park, Gulf of Kutch, Gujarat. The initiation and development of inflorescences starts from October and continue up to mid December while blossoming starts from December end and prolong up to mid March. The plants show gregarious flowering and fruiting. The flowers white in color are produced on axillary, umbel inflorescences. The flowers are fragrant, complete, actinomorphic, pentamerous, and pedicellate. A single inflorescence holds 16.1±4.2 (SD) buds in an inflorescence. Diurnal and nocturnal both anthesis has been reported in this species, which starts from the peripheral flowers of an inflorescence. During initial anthesis in an inflorescence the anther dehiscence does not occur simultaneously with anthesis. However in last few cases the process of anthesis and anther dehiscence go almost simultaneously. The anther dehisced by longitudinal slit, which start at the apex of anther lobes and it takes 3.9±1.4 (SD) hrs to complete. A single flower produces about 2.32±0.69 laks of pollen. Some other aspects of pollination such as pollen load, ratio of pollen and ovule production have also been studied. The pollen dehiscence and stigma receptivity match temporally. It was experimentally examined by manually self

–pollinating the flowers. However, the bright white color and floral nactaries attract diurnal and nocturnal visitors. During observation of diurnal visitors it was found that the majority of visitors belong to Lepidoptera and Hymenoptera. Birds mostly visit during late evening 15:30-18:00 Hrs.

The information on above-mentioned aspects is crucial for understanding the reproductive behavior of the species and may help its in-situ conservation programme. It is also important for improving restoration efforts.

RINES AND SALTPAN BITTERNS OF COASTAL INDIA – A POSSIBLE SOURCE OF POTASH

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Abstract

Potash is of strategic importance for the Indian agriculture sector and its substantial annual requirement is entirely met through imports, which is envisaged to be of the order of 3.0 million tonnes by the end of X^{th} plan in 2007 .The sub-surface brine available in parts of coastal Gujarat is an important source of potassium alongwith other valuable elements . The bittern, leftover liquor in the evaporating salt pans, after extraction of calcium and sodium salts gets enriched in potassites (the salts of potassium and magnesium) and is an important source of potassium salts, bromine and magnesium salts.

Sea water is an inexhaustible and major source of potassium salts. Fortunately, India is blessed with a sea coast of about 7500 line Km and at many places, specially along Gujarat coast, large quantities of sub-soil concentrated brines are available. Besides, after recovery of common salt, the salt pan bittern gets concentrated in the potassites from which potash is presently being not extracted. India produces more than 10 million tonnes of common salt annually from sea water in the coastal areas. It has already been established that for every 100 tonnes of common salt production, 2.75 tonnes of potassium schoenite can be recovered from bittern. Besides, 0.8 tonnes of magnesium chloride and 2.9 tonnes of magnesium sulphate will be available as by-product. Thus, potentially our country can recover annually 0.275 million tonnes(275,000 tonnes) of potassium schoenite containing 18-20% KCl from the bitterns of salt pans.

Gujarat has remained the largest producer of salt in the country. Out of total Indian salt production of 15.50 million tonnes, Gujarat had a dominant share of 73% in common salt production in 2000, followed by Tamil Nadu(13%) , Rajasthan (9%), while remaining 5% was from the other states. The Gujarat state contributing the maximum share of salt production mainly from seawater and sub-soil brines, is the most important state with the potential to produce potash salts

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