THE ENVIRONMENT MANAGEMENT

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SIES Indian Institute of Environment Management
RISE WITH EDUCATION

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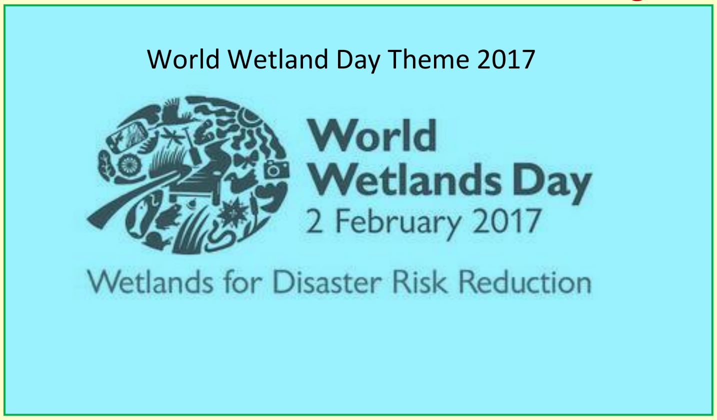
Current Issue - Wetlands: Conservation and Management



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From Director's Desk

Wetlands are the most dynamic, diverse and productive ecosystem on the earth. Wetlands are estimated to occupy nearly 6.4% of the earth's surface and in India their density is about 4.63 % of total geographical area. They form a transitional zone between water and land due to that they are rich in nutrients and biodiversity. Wetlands act as a sponge along terrestrial areas by absorbing and storing excess rain water and helping in controlling the natural hazards like floods and drought. In coastal areas wetlands act as a buffer against disasters and support the biodiversity by providing ecosystem services viz. food, shelter, energy etc. This precious ecosystem is under constant threat due to the vagaries of population growth, rapid economic development, urbanization and over exploitation of resources. The degradation of wetlands is expected to cause increased flooding, changes in water property, reduction in species diversity and ultimately their decline from that area. The Ramsar Convention (1971) was a significant step towards the conservation of wetlands that ensured the protection of wetlands through international cooperation and intergovernmental treaty. Recently in COP 12 Fourth Ramsar Strategic Plan for 2016- 2024 was approved that lays out a new vision under convention mission with four overall goals and 19 targets.

For sustainable management of wetlands it is desirable to assess their potential, identify potential threats from natural and anthropogenic hazards and implement appropriate technologies for their management with focus on regional requirements. We are releasing current issue of newsletter on the theme 'Wetlands: Conservation and Management' with focus on the potential of wetlands in water security, ecosystem services; issues related to pollution; conservation and management aspect for propagating information on different aspects of wetlands and its sustainable management..

Dr. Seema Mishra

Conserving wetlands for reducing the impact of natural hazards

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Wetlands are very important for human survival. They are vital because they provide environmental, social as well as economic benefits. As per the report of UNISDR (United Nations Office for Disaster Risk Reduction) wetlands form a barrier against hazards such as floods, drought or cyclones, making their protection a key link in the disaster risk reduction chain. They not only help in reducing the risk associated with disaster but are also helpful in mitigating the impact of climate change. A report of Ramsar has indicated that there are five wetlands that can help us in coping up with extreme weather events. They are:

1. Mangroves,
2. Coral reefs,
3. Rivers and flood plains,
4. Inland deltas
5. Peatlands

A mangrove is a low lying tree or shrub that grows in coastal saline water. They play a key role in mitigating the impact during extreme weather events. They are useful in stabilizing coastlines. Mangroves reduce the height and energy of wind passing through them. The dense mangrove forest canopies reduce wind speeds.

Coral reefs are underwater ecosystems housing several marine species. Coral reefs also act as offshore wave barriers.

Floodplains have enormous capacity to store water. Lateral movement of stream and enlargement of meander curve create wide floodplain thereby storing water long enough and reducing flood damage.

Inland deltas are ecologically important because they provide coastline defense and are home to many species. Due to this diversity they have been selected as a wetland of international significance under the Ramsar Convention.

Peatlands globally represent a major store of soil carbon and sink for carbon dioxide. Peatlands can reduce millions of tons of CO_2 and helps in mitigating impact of climate change.

However various developmental activities have led to degradation of wetland habitat. Therefore, it is important to conserve wetlands. Detailed inventory of wetlands is important for wetland protection. This inventory can help in minimizing the impacts to wetlands and identifying priority wetlands to be conserved.

GIS play an effective role for wetland conservation and management as it helps in integrating spatial as well as non spatial characteristics of wetlands diversity. GIS based system using early warning and forecasting can help policy makers and decision makers to deal with disaster in a better way. In this way it in helps in maintaining healthy wetlands as well as in restoring degraded ones.

Conservation of wetlands for ensuring regional water security

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Water is one of the fundamental elements of the universe from which early life originated millions of years ago on earth. Every life on the earth is primarily dependent on water which hosts innumerable aquatic species from single cell creatures to gigantic blue whales. As the evolution of human took place, civilized human settled down on the fertile river banks. In other words, river banks are the motherhood for civilized human and most of the civilization around the world. These river or lake banks gave water for drinking and also for cropping along with mineral rich soil. Civilized men knew the importance of water and respected these water bodies. Advantages of traditional water harvesting structures are:

- Water made to stand for a period so as to allow infiltration / percolation and recharging of groundwater aquifers to sustain good water levels in the surrounding wells;
- a saturated sub soil/top soil, enhances the green cover in the surroundings;
- green cover in the catchment reduces soil erosion and hence sedimentation of rivers; and
- mitigation of instances of frequent floods and runoff.

Deterioration of traditional water harvesting practices in other parts of burgeoning Bangalore has resulted in the inequity in water distribution and growing water scarcity, which has escalated water conflicts during the 20th century. Irresponsible management of natural resources is evident from (i) sustained inflow of untreated sewage and industrial effluents; (ii) dumping of solid waste (with 70% being organic); (iii) transport of untreated wastewater in storm water drains (water drains are essentially arteries of a landscape carrying water), etc.

Bangalore being located on the ridge, forms three watersheds as precipitation flows as runoff in three directions along the valleys (Figure 1) - Koramangala Challaghatta Valley (K&C Valley), Hebbal Valley (H Valley) and the Vrishabhavati Valley (V Valley). Under the administrative boundary of Bruhat Bengaluru, K&C valley is the largest encompassing an area of 255 square kilometers, followed by Hebbal valley with an area of 207 square kilometers and Vrishabhavati valley with an area of 165 square kilometers. Both K&C valley and Hebbal valley joins at Nagondanahalli village (BBMP Ward 94 – Hagadur) which further flow to Dakshina Pinakini River, where as Vrishabhavati valley joins Arkavathi river which is a tributary of river Cauvery.

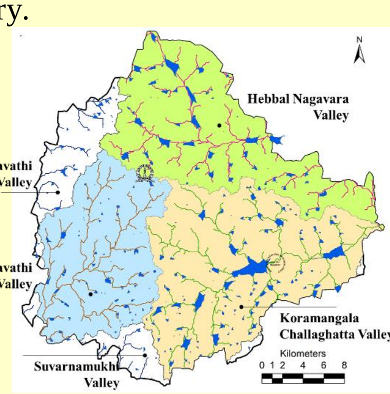

Figure 1: River and wetlands – Drainage Network along the Major valleys

Number of wetlands in Bangalore has reduced from nearly 285 (spatial extent of Bangalore: 161 sq.km. in early seventies) to 194 (spatial extent of Bangalore: 741 sq.km. in 2006). Unplanned rapid urbanisation during late nineties, witnessed large-scale unrealistic, uncontrolled developmental activities in the neighborhood of wetlands.

Land use analysis in Bangalore City shows 1005% increase in urban (built-up) area between 1973 and 2016 i.e., from 8.0% (in 1973) to 77% (in 2016). Land use prediction using Agent Based Model showed that built up area would increase to 93.3% by 2020, and the landscape is almost at the verge of saturation.

Average annual rainfall in Bangalore is 787 mm with 75% dependability and return period of 5 years. Catchment wise water yield analysis indicates that about 49.5% (7.32 TMC) in the Vrishabhavathi valley (including Arkavathi and Suvarnamukhi), followed by 35.2% (5.2 TMC) in Koramangala Challaghatta valley and 15.3% (4.2 TMC) in Hebbal Valley and the total annual water yield is about **14.80 TMC.** Domestic demand of water (at 150 lpcd) is 20.05 TMC per year (1573 MLD). This means about 73% of Bangalore's water demand can be met by efficient harvesting of rain water. Quantification of sewage generated shows that about 16.04 TMC (1258 MLD) of sewage is generated in the city. Sewage treatment with complete removal of nutrients and chemical contaminants by adopting decentralized treatment plants similar to the success model (secondary treatment plant integrated with constructed wetlands and algae pond) at Jakkur lake. In addition to this, water available with efficient rainwater harvesting is about 14.8 TMC. This means that total of 30.85 TMC of water is available annually to cater the demand of 20.05 TMC, provided the city administration opts for decentralized optimal water management through (i) rainwater harvesting by rejuvenating lakes. The best option to harvest rain water is through interconnected lake systems, (ii) treatment of sewage generated in households in each locality (opting the model at Jakkur lake – STP (Sewage Treatment Plant) integrated with constructed wetlands and algal pond; (iii) conservation of water by plugging the pilferages (due to faulty distribution system); (iv) ensuring water supply 24x7 and (v) ensuring all sections of the society get equal quantity and quality of water. Rejuvenating lakes in the region helps in retaining the rain water. Treating sewage and options to recycle and reuse would minimize the demand for water from outside the region. The analysis illustrates that the city has at least 30 TMC (Bangalore city) of water, which is higher than the existing demand (20.08 TMC, at 150 lpcd and 2016 population), if the city adopts 5R's (Retain, Rejuvenate, Recycle, Reuse, Retain and Responsible citizens). In order to enhance the water retaining capability in the catchment, it is essential to harvest rain water and undertake large scale watershed programme (soil and water conservation). Lakes are the optimal means of rainwater harvesting at community level. This entails:

(i) Reestablishing interconnectivity among lakes needs to remove all encroachments without any consideration, as the water security of a region is vital than the vested interests, who have unauthorisedly occupied without respecting future generation's food and water security. This would also reduce the frequency of floods and consequent damage to life and property,

(ii) removal of all encroachments of lakes and lake bed,

(iii) rejuvenation and regular maintenance of water bodies - this involves desilting of lakes to (a) enhance the storage capacity to retain rainwater, (b) increase the recharge potential – will improve groundwater table, (c) ensure recharging without any contamination,

(iv) allowing only treated sewage (removal of chemical and biological contaminants) through adoption of integrated wetlands ecosystem (Jakkur lake model),

(v) creation of wetlands with native vegetation and regular harvesting of macrophytes; food and fodder, which supports local people's livelihood, and

(vi) maintaining at least 33% green cover with native vegetation (grass, trees, shrubs)in the catchment and planting riparian vegetation in the buffer region. This would help infiltration of water and retain this water.

SIES IIEM DEDICATED TO ENVIRONMENT MANAGEMENT THROUGH R & D AND OUTREACH ACTIVITIES

ABOUT SIES IIEM

- SIES IIEM was established in 1999. It has been contributing in the fields of R&D activities and Academics in the areas of Environment Management and Biotechnology.

- IIEM is recognized by Department of Scientific and Industrial Research for research activities and has successfully completed various research projects with funding from DST, BRNS, DBT, ICMR, MOEFCC, MMREIS and several other agencies.

- IIEM also conducts consultancy services, organizing seminars, workshop and providing community service through research and creating awareness.




INFRASTRUCTURE AND FACILITIES

State of Art Facilities to conduct R & D and consultancy in the areas of Environmental Science and Management. Laboratories are equipped with the advanced equipments (HPLC, AAS, GC, HVS etc.)

CONSULTANCY SERVICES

GREEN MANAGEMENT

Environmental Monitoring and Analysis

- Water, Soil, Air, Waste
- Eco-toxicity studies

Conservation of Resources and Biodiversity

- Eco restoration of Resources
- Biodiversity mapping and indexing

Waste Management

- Wastewater management for zero discharge
- Solid waste management
- Industrial sludge management
- E- waste management

Expertise in:

- Advanced oxidation processes
- Aerobic and anaerobic processes
- Bio- and phyto- remediation

EIA and Sustainability Solutions for Mitigation of Climate Change Vulnerability

GIS based Environmental Planning and Management

- Natural resource mapping
- Groundwater recharge study
- Site selection
- Database management

GREEN COMMUNICATION

Providing CSR Solutions for Environment and Society

- Environmental Education
- Training and Awareness programme
- Water audit and energy audit
- Carbon footprint mapping
- Capacity building
- R&D proposals and report writing
- Events – workshops, seminars and conferences

Areas of Research	Specific Areas
1. Total Water Management	1. Purification of drinking water by using low cost techniques. 2. Management of nitrite contaminated wastewater 3. Textile wastewater management. 4. Phytoremediation. 5. Oil spill management by biosurfactants. 6. Management of brine generated from water purification technologies. 7. Assessment and management of marine pollution
2. Solid Waste Management	1. Management of industrial waste. 2. Management of MSW and other solid wastes. 3. Management of agro- residue.
3. Applied Biotechnology	1. Utilization of biofertilizers and biopesticides in soil fertility management and agriculture. 2. Exploitation of beneficial microorganisms in remediation of heavy metals, oil pollution etc.
3. Management of Natural Resources	1. Pollution monitoring and management 2. Ecorestoration. 3. Studies on Climate Change. 4. Biodiversity Studies. 5. GIS & Remote Sensing

MAJOR FUNDING AGENCIES

- Ministry of Environment Forest and Climate Change
- Department of Science and Technology
- Department of Biotechnology
- Board of Research in Nuclear Sciences
- Indian Council of Medical Research
- Mumbai- Metropolitan Region- Environment Improvement Society

OUTREACH ACTIVITIES

Dr. Rajeev Pratap Singh

Wetlands of India: threats, restoration and management strategies

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Introduction of Indian wetlands:

India has wide range of wetlands habitats. The entire area covered by wetlands in India is about 58,286,000 ha i.e. 18.4% (Trivedy and Trivedy 2015). As per latest report of National Wetland Atlas, the total numbers of natural wetlands in the nation are 55,862. Under Ramsar convention, India's 119 wetlands are identified as of conservation importance as they are significant waterfowl habitats. Around 0.4 % of area is under protection to total number of natural wetlands of the country. Wetlands perform many important roles in the ecosystems because of their exclusive interaction between physical, biological and chemical components of the ecosystem. These functions include aquifer recharge and discharge, water storage, checks flood and erosion, storm protection, shoreline stabilization and stabilization of weather conditions (de Voogt et al. 2000).

Potential threats to Wetland:

Wetland habitats are the most threatened habitation of the earth that is facing severe anthropogenic pressures. Rapidly expanding developmental projects, changes in land cover and land use pattern, grazing and unsustainable fishing along with improper utilization of watersheds have consequently lead to significant losses of wetlands. These stresses have caused a substantial decline of wetland habitat which had led to pollution and hydrological perturbation. Problems pertaining to India are basically due to its ever-increasing population which directs to serious consequences. 16% of the planet's population resides in India and yet occupies only 2.42% of the earth's surface, of which 74% of the human population is rural in nature and is resource dependent (Prasad et al. 2002). With the passage of time, the figures of natural wetlands of India are decreasing. Losses in wetlands refer to loss in function or physical loss in spatial extent. Lee et al. 1996 reported that the degradation of 1 Km^2 of wetlands in India will be having a higher effect than the degradation of same wetlands in less population density areas of plentiful wetlands. Hence, for sustainable food production and potable water availability, healthy wetlands habitats are important for India.

Wetland management and Restoration strategies:

Management program for wetlands generally includes actions that protect, manipulate, restore that emphasizes on quality by promoting their sustainable usage (Walter et. al. 1996). Restoration projects requires intense monitoring and improved co-operation among different ministries concerned with soil, water, agriculture, environment, natives, research groups along with policy makers. Restoration of wetland can be achieved by integrated efforts through monitoring, planning and execution, that requires efficient expertise. Management strategies entail protection of wetland habitat by means of water quality standards adopted for wetlands so as to support the normal functioning of wetlands. Whereas, wetlands in urban areas provide life support system for aquatic organisms, flood control, and act as pollution sink. A strong database on type of wetlands, hydrological, morphological, biodiversity and socio-economic issues are to be generated in this context. Environmental awareness programs must be conducted to correct the non-point source pollution problems and create buffer zones so as to limit the anthropogenic activities around the degraded habitat. This also entails interdisciplinary trained professionals who have developed the understanding of wetlands and their importance of sustaining ecosystems.

Action plan:

Preservation of wetlands in India is regulated by a number of policies and legislative measures (Parikh & Datye 2003). Some of these are - Maritime Zone of India (Regulation and fishing by foreign vessels) Act – 1980, Forest (Conservation act) – 1980, Environmental (Protection) Act – 1986, Coastal Zone Regulation Notification - 1991, Wildlife (Protection) Amendment Act – 1991, National Conservation Strategy and Policy Statement on Environment and Development – 1992, National Policy and Macro Level Action Strategy on Biodiversity-1999 and many more are added to the list. India is an also signatory to the Ramsar Convention on Wetlands and the Convention of Biological Diversity.

To implement these policies, a strategic action plan is required that involves collaborated research involving environmental, social and economic study. This will eventually direct to long term conservation strategy plans in order to restore degraded habitats. Active participation of students, researches and NGO's in the vicinity of the wetland will provide an opportunity for hands on practice on environmental education that will lead to setting up of laboratories by regulatory bodies for continuous monitoring.

Conclusions:

For continuous and sustained food production along with water availability in India; good, healthy and physical shapes of wetlands are essential. Also, wetlands are essential for prolonged existence of India's diverse flora and fauna as many of the endemic species are dependent on wetland.

Figure 1. Degradation of wetlands in India

Table 1: Top five Ramsar site in India in terms of area

S. NO.	NAME OF RAMSAR SITE IN INDIA	LOCATION	AREA (Km^2)
1.	Vembanad-Kol Wetland	Kerala	1512.5
2.	Chilika Lake	Orissa	1165
3.	Kolleru Lake	Andhra Pradesh	901
4.	Bhitarkanika Mangroves	Orissa	650
5.	Ashtamudi Wetland	Kerala	614

Wetland restoration: an emerging issue and management in changing climate

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In the report, *Restoration of Aquatic Ecosystem (*1992), the National Research Council defined restoration as the "return of an ecosystem to a close approximation of its condition prior to disturbance." The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to former or degraded wetland known as wetland restoration. Wetlands cover almost 6% of the world's land surface and contain about 12% of the global carbon pool, playing an important role in the global carbon cycle. The major wetland systems are the Sundarban (Bangladesh and India), Mekong river delta (Vietnam), and southern Ontario (Canada), where the effects of climate change are evolving in different ways.

Wetlands provide significant social, economic and environmental benefits. Wetlands are associated with several activities like water storage, groundwater recharge, storm protection, flood mitigation, shoreline stabilization, erosion control, and retention of carbon, nutrients, sediments and pollutants. Wetlands can also produce services that have a significant economic value such as clean fresh water, fisheries, timber, peat, wildlife resources and tourism opportunities. The loss and degradation of wetlands is driven by several factors, i.e., climatic and non climatic. Presently increased demand for agricultural land to fulfill the food need associated with population growth continues to be a significant cause of wetland loss in some parts of the globe.

Global climate change is identified as a major threat to the survival of species and integrity of ecosystems. Wetland systems are susceptible to changes in quantity and quality of their water supply, and it is assumed that climate change will have a dominant impact on wetlands through alterations in hydrological regimes with large climatic variability. In the era of global climate change, wetlands are considered one of the biggest unknowns of the near future regarding element dynamics and matter fluxes. Climate change is perceived as a risk to species survival and the diversity of natural systems both aquatic as well as terrestrial globally.

Researchers are looking at the ecological and hydrological impacts resulting from climatic events. Climatic events and variability will make present and future efforts more complex to restore the wetlands. The restoration strategies for different wetland systems are different, i.e., floodplains, mangroves, sea grasses, salt marshes, arctic wetlands, peat lands, freshwater marshes and forests are very diverse habitats, with different stressors and hence require different management and restoration techniques.

Hence, proper and successful long term restoration and management of these wetland systems will hinge on how we choose to respond to the effects of global climate change. Though, researches should take care of restoration practices and should take climate change into account when implementing restoration processes as part of a climate change adaptation and mitigation strategies. There are some strategies or recommendations for the restoration of wetland in changing climatic and other situations:

1. **Reduction of non climatic factors:** The reduction of non climatic factors (human induced activities) that affecting the wetlands which can enhance the resilience of natural habitats and living beings in changing climate.

2. **Protect coastal wetlands:** This strategy imposed in the case of sea level rising and that can be ameliorated with acquisition of inland buffer zones to provide an opportunity for habitats and wildlife to migrate inland. Setback lines for coastal development can be effective at establishing zones for natural coastal migration based on projected sea level rise.

3. **Ecological monitoring:** It is based on long term identification of ecosystem changes and provides judgment to the potential ecological consequences of the change, and help in decision making to determine how management practices should be implemented. Monitoring can also be helpful in providing baseline for ecosystem conditions and undesirable changes.

4. **Training, education and awareness programs:** Design such training and courses for researchers as well as students to understand, design and implement wetland restoration and management process on a large scale in vulnerable areas.

5. **Prevention of invasive species:** Rapidly changing climates and habitats may increase opportunities for invasive species to spread because of their adaptability in changing environment. Invasive species control efforts will be essential, including extensive monitoring and targeted control to preclude larger impacts.

6. **Involvement of institutions:** Conduct an integrated medium and long range planning that incorporates climate change and variability. This planning should also apply to institutions, NGOs and governmental organizations.

7. **Understand the nature:** Researchers should understand the nature of climatic and ecological changes that are likely to occur regionally in order to properly design wetland management and restoration plans.

Report of the International Conference on Environment Management and Sustainability (ICEMS 2017)

The international conference on 'Environment Management and Sustainability' was organized from 4th to 6th January 2017 with sponsorship from Science and Engineering Research Board, GoI and Maharashtra Pollution Control Board. The event was co- sponsored by Council for Scientific and Industrial Research, Defence Research and Development Organization and Jawaharlal Nehru Port Trust. The deliberations were divided into seven sessions and were conducted in parallel during the three days of the conference. Seven key note lectures were delivered during different sessions. Fifty one technical presentations including invited lectures were given during the conference. Fifty presentations were made in the poster format. Total participation in the conference was 140 including 112 registered delegates. In inaugural session Dr. P.K. Tewari, Distinguished Scientist and Associate Director (Retd.), Chemical Engineering Group, BARC was the Chief Guest of the conference. Presently he is Raja Ramanna Fellow and Professor, Homi Bhabha National Institute, Mumbai. Shri. Rajendra Singh, Chairman, Tarun Bharat Sangh was the Guest of Honour.

Mr. S.Ganesh Hon. Secretary, SIES felicitating Chief Guest Dr. P. K.Tewari,

Mr. M.V. Ramnarayan, Hon. Treasurer, SIES felicitating Guest of Honour, Shri. Rajendra Singh

A panel discussion on the topic 'Environment Management, Sustainability and Way Forward: Role of Multisectoral Partnership was also conducted during the event. In Valedictory session the guest of honour was Dr. Y. B. Sontakke, Joint Director, MPCB. The conference addressed wide ranging issues related to environment management and climate change. Problems of our country are unique and they should be addressed in unique way. Imitation of the western solutions may not be effective. Novel solutions are emerging indigenously in a big way, for example, in the field of waste biomass conversion and radioactive waste disposal. Discretion should be exercised between excessive greed and technology growth for environment management in a sustainable manner.

Organizing Committee

Mr. S.V.Viswanathan, Joint Hon. Secretary, SIES addressing the gathering

पर्यावरण संतुलन काळाची गरज

नेरूळ, ता. ४ (बातमीदार) : पर्यावरण ही नैसर्गिक साधनसंपत्ती आहे. तिच्याकडे मिळकतीचे साधन म्हणून न बघता तिचे संवर्धन करण्याची गरज आहे. पर्यावरणात होणाऱ्या बदलामुळे निसर्गात अचानक बदल होत आहेत. म्हणून पर्यावरण संतुलासाठी सर्वांनी गांभीर्याने विचार केला पाहिजे, असे मत जलतज्ज्ञ राजेंद्र सिंह यांनी येथे व्यक्त केले.

राजेंद्र सिंह

एसआयईएस महाविद्यालयात पर्यावरणावर आधारित आंतरराष्ट्रीय परिषदेचे आज उद्घाटन करण्यात आले. बीआरसीचे डॉ. पी. के. तिवारी, एसआयईएसच्या संचालक सीमा मिश्रा आदी या वेळी उपस्थित होते. पर्यावरणाचे संतुलन राखण्याची जबाबदारी सरकारबरोबरच नागरिकांचीही आहे. त्यामुळे त्यांनी स्वतःपासून सुरुवात करायला हवी, असे बीआरसीचे डॉ. तिवारी यांनी सांगितले. या परिषदेत हवा, ध्वनी व पाणी प्रदूषण, ग्लोबल वॉर्मिंग, घनकचरा व्यवस्थापन यावर चर्चा होईल.

Release of Souvenir

Constructed wetlands and their benefits for varied eco-systems

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Constructed wetlands for used generally for waste-water treatment and are mostly created in transitional areas between land and water. These use the boundaries between wetlands and uplands or at deep water ponds. Their eco-systems are complex integrated systems consisting of water plants, animals, microorganisms and the environment. These wetlands are very reliable, self-adjusting systems, capable of dealing with the pollutants and follow the pattern of structured natural wetlands. Their function greatly increases the likelihood of successfully constructing a treatment-wetland.

These wetlands comprise of broad range of wet environments, having marshes, bogs, swamps, meadows, tidal wetlands, floodplains, riparian wetlands along stream channels and deep ponds. They are either natural or constructed by human intervention at wastewater flows and are specially made in stream flows. Also provide many uses to mention a few, are- improvement of quality of water- physical, chemical and micro-biological in nature, storage in times of excess rain-flows and flood situations, in agri-farms they also do cycling of nutrients and others beneficial for plant growth, aiding in marine and wild life, birds and avians as bird- watchings are also aided. These wetlands also provide ideal locations for recreation for boating, photography. One can pursue exploration, education, research and landscape enhancement.

These processes are planned and designed basins containing elements of in flow-water, a substrate with soil and vascular plant life that feeds from it. All these are appropriately used to make the engineered wetlands. A composite and desired eco-systems is created with beneficial communities of microbes and aquatic invertebrates that which develops naturally in them. It is observed that all these components of the wetlands are sustained if proper care is given for its operation and maintenance practices. As the time passes, the components grow in a cascading effect which multiplies all species adequately.

Water flows and the wetlands are formed naturally due to the flow gradient and the quantum of flows are governed by the slopes. All these hydrological conditions create wetlands with depths and mounts, the typical behavior of the litho logy governs the permeability and evapo-transpiration character of the substrates. The next factor in the wetland system is the type of vegetation prevailing in providing flow paths and the network of stems, leaves, roots and rhizomes duly supported by energies from wind and sun.

In the design stage of a constructed wetland, due regard is given to all the factors of the site’s substrate having soil, sand, gravel, rock, organic matter i.e. carbon, compost and others. Sediments and litter which are by products around the roots/ rhizomes gather in the eco-system. This phenomenon assists in filtering the water as it flows with lower velocities, this in turn causes higher productivity of vegetation.

The plants provide phyto-remediation of the waste-water having the vascular plant life that grow on surface. In a water saturated substrate, atmospheric gases including sewage gas in its pore spaces is replaced with water and the microbial metabolism consumes the available oxygen. When water becomes anoxic, devoid of oxygen , the plant life above due to photosynthesis in the presence of sunlight creates the required oxygen and this process gets balanced and continues. The non vascular-algae variety remaining submerged in water also play an important part in remedying water. Photosynthesis by algae sp. increases the dissolved oxygen content of the pond water.

Another characteristic behavior of wetlands is regulated by the metabolism of micro-organisms- bacteria, yeasts, fungi, protozoa and algae, remaining in desired proportion. All these provide a major sink for organic carbon and many nutrients. These microbial activities transform a great number of organic and inorganic substances into innocuous or insoluble substances, altering the reduction/ oxidation – redox conditions of the substrate. The processing capacity is desirably simulated in recycling of nutrients. However caution is exercised to ensure that wetlands are not effected by toxic substances such as pesticides, heavy metals, chemicals.

Constructed wetlands provide habitat for rich diversity of invertebrates and vertebrates. Invertebrate animals, such as insects and worms, contribute to the treatment process by consuming organic matter. Although invertebrates provide improvement of water, they attract a variety of amphibians, turtles, birds, and mammals. All these attract water-birds viz. water fowl, teal, ducks, with roosting and nesting grounds.

Holistically there is abundant bio diversity and inventory of environmental assets gets enhanced, progressively. These processes have been used mainly for treatment and management of waste water but they also offer intangible benefits by increasing the aesthetics by enhancing the landscape of the project site. The remedial mechanisms have tanks, filters, plants, water-body and can be built with curving shapes, that follow natural contours of the site. The process are cost-effective and technically feasible with low day to day expenses. The technology used being low-tech can easily be maintained and the process can adjust to flow fluctuations. The processed water at the outlet is easily taken for reuse and recycled.

This type of process is termed as Dewats System- Decentralised Wastewater Treatment System. The only drawback with these Dewats Systems is that it requires larger land areas than normal systems. But where larger land is available, it becomes a viable option with a very good sustainability level. There are mainly two types of constructed wetlands, one has surface flow and another having subsurface. Hybrid systems are also possible with both surface and subsurface flows. Conventional treatment technologies can also be combined with Dewats.

Given below, details of a Dewats System in operation since 2003, in an effluent colony at Delhi

Dewats Plant- WWT - Vasant Vihar drain, New Delhi

Project Concept:

Urban waste water in open drain sourced for bio-remediation.
Processed / treated water re- used in parks and lawns easing the water shortage situation with other benefits.

Project Design:

Waste water inflow/ outflow quantity : 45/40 KL per day
Parameters quality inflow/ outflow BOD : 300/ < 30 ppm

Project Data:

Cost of all elements- mid 2003: Rs. 8.0 Lakhs-excluding land costs.
Present cost- Jan 2017 : Rs. 30 Lakhs --- // --
Process used- DEWATS, Anaerobic tanks, filters- stones, Plants.

Prospects feasible: Both for smaller and larger flows at local-level. Can be applied for large river and canal flows.


Dr. Pragati Pramanik

Ecosystem services from wetlands

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Wetlands are unique, biologically diverse and productive ecosystems with their rich natural resources for plant life, animals and wetland agriculture. It is a transition of terrestrial and aquatic habitats. Ramsar Convention (1997) defined wetlands as the areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing; fresh, brackish, or salty, including areas of marine water the depth of which at low tide does not exceed six meters. A single wetland may provide multiple types of ecosystem services depending on the type, location, condition and uses. Accordingly, MA (2005) identified four types of ecosystem services *viz*, provisioning services, regulating services, cultural services and supporting services. These services are derived from the ecosystem functions performed by wetlands. According to Costanza*et al*.(1997), the wetland all over the world occupying only 6.5% of the earth's surface area and contributes about 14.7% of the world's ecosystem service values with a global average value of $6,000 per acre.

The goods and services provided by the wetland ecosystem have been listed in table 1. All these services mentioned in table 1 improve water security, including security from natural hazards and climate change adaptation and mitigation. Not all wetlands provide all of the services every time. Value of wetland ecosystems is often underestimated. Globally, they provide services entirely free of cost valuing trillions of US dollars every year which is a notable contribution to human health and well-being of the society. However, the United Nations Millennium Ecosystem Assessment recognizes the enormous global economic importance of wetlands, valued at up to US$15trillion dollars in 1997. The goods and services provided by Jagdishpur reservoir, Nepal have been evaluated by Baral et al., 2016 (table 2).

Growing understanding of the economic benefits of wetlands has resulted in significant expenditure in some countries on wetland restoration and rehabilitation of lost or degraded hydrological and biological functions of wetlands. World Wetlands Day (WWD) is celebrated every year on 2 February to raise awareness about the value of wetlands for humanity and the planet. This day marks the date of adoption of the Convention on Wetlands on 2 February 1971, in the Iranian city Ramsar. By protecting the services, the judicious use of water and wetlands is very important for enabling sustainable social and economic development and improving social cohesion and economic stability.


Wetlands for water bird

Table 1: Ecosystem Services Provided by or Derived from Wetlands (MA, 2005)

Ecosystem Services	Examples
I. *Provisioning*	
Food, Fresh water, Fiber and fuel, Biochemical, Genetic materials	Production of fish, wild game, fruits and grains. Storage and retention of water for domestic, industrial and agricultural uses. Production of logs, fuel wood, peat, fodder. Extraction of medicines and other materials from biota. Genes for resistance to plant pathogens, ornamental species, andso on.
II. *Regulating*	
Climate regulation, Water regulation (hydrological flows), Water purification and waste treatment, Erosion regulation, Pollination, Natural hazard regulation	Source and sink for greenhouse gases; influence temperature,precipitation, and other climatic processes. Groundwater recharge/discharge, Retention, recovery, and removal of excess nutrients and otherpollutants, Retention of soils and sediments, Habitat for pollinators, Flood control, storm protection.
III. *Cultural*	
Spiritual and inspirational, Recreational, Aesthetic, Educational	Source of inspiration; many religions attach spiritual and religiousvalues to aspects of wetland ecosystems, Opportunities for recreational activities, Many people find beauty or aesthetic value in aspects of wetlandecosystems. Opportunities for formal and informal education and training.
IV. *Supporting*	
Soil formation, Nutrient cycling	Sediment retention and accumulation of organic matter, Storage, recycling, processing, and acquisition of nutrients.

Table 2: Total economic value of goods and services of Jagadishpur Reservoir catchment area, Nepal (Adapted from Baral et al., 2016)

Good & service	Value (NRs)
Wetland goods	16,915,165
Tourism	9,076,950
Carbon	1,047,848
Biodiversity	11,200,000
Irrigation	1,821,000

Workshop
on
Plastics and its Management for Environment Conservation

Organized by

SIES RISE WITH EDUCATION — Indian Institute of Environment Management

Ministry of Environment, Forest & Climate Change

Sponsored by and jointly organized by

Plastics are integral part of our life. However, due to mismanagement of plastic waste it is becoming environmental hazard. To address the issues of pollution from plastic waste, training programmes in 4 different schools of Mumbai and Navi Mumbai were conducted as a part of our consultancy project. Further to the training programme, workshop on "Plastics and its Management for Environment Conservation" was organized on 10th January 2017 to discuss about the measures that can be taken to manage plastic waste and to share significant observations that were made during the training programme.

For workshop various stakeholders were involved from Industry, Plastic manufacturing Association, Recycling association, formal and informal sector, students and teachers. There were lectures from 4 invited speakers in this half day workshop followed by felicitation of students who actively participated and contributed in the training programme.

S.N.	Resource Person	Topic
1	**Mr. T.K.Bandopadhyay** Technical Director ICPE	Importance of plastics in our day to day life and measures to manage plastic waste.
2	**Mr. Haren Sanghavi,** President All India Plastic Manufacturers' Association	Management of Plastic waste in Plastic Manufacturing Units
3	**Dr. P. A. Mahanwar** Institute of Chemical Technology, Matunga (East)	Plastic Waste Management by Recycling
4	**Ms. Kalpana Andhare** Stree Mukti Sanghatana (SMS), Mumbai	Involvement of informal sector in plastic waste management

Students awarded with certificate and medal in the workshop for their active participation

Ms. Kalpana Andhara, Mr. T.K.Banopadhyay and Mr. Haren Sanghvi (L to R)

Dr. Saumya Singh felicitating Mr. T.K.Bandopadhyay, Technical Director, ICPE

Impact of water pollution on wetland ecosystems

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The transitional areas between upland and water are often composed of "wet" soils that are known as wetlands. In their natural state, wetlands provide habitat and food sources for hundreds of plant and animal species. But, the quality of wetlands disturbed due to some direct or indirect impacts.

Types of Wetland Impacts

- Direct impacts result from disturbances that occur within the wetland. Common direct impacts to wetlands include filling, grading, removal of vegetation, building construction and changes in water levels and drainage patterns.
- Indirect impacts include influx of surface water and sediments, fragmentation of a wetland from a contiguous wetland complex, loss of recharge area, or changes in local drainage patterns.
- Cumulative impacts are those impacts resulting from combined direct and indirect impacts to the wetland over time.
- Human Impacts caused significant changes in the function and quality of many wetlands by different activities which can have lasting effects on wetland ecosystems include stream channelization, dam construction, discharge of industrial wastes and municipal sewage (point source pollution) and runoff urban and agricultural areas (non-point source pollution). These changes have resulted from alteration of the physical, chemical and biological components of wetland ecosystems.

Sources of water pollution: water pollution have mainly two sources which effects the chemistry and quality of water flowing through wetlands.

I. **Point sources**: Any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack and municipal industrial sites.
II. **Non-point sources:** Describe pollution from agricultural lands and urban runoff; add materials to ground water and surface water that upset the balance of wetland water chemistry and the biogeochemical cycling of materials in wetland ecosystems.

Pollution in wetlands is a growing concern, affecting drinking water sources and biological diversity. So, I will briefly discuss about the water pollution impacts on wetlands.

1. Metal toxicity: Drainage and run-off from fertilized crops and pesticides used in industry introduce nitrogen and phosphorous nutrients and other toxins like mercury to water sources and bio accumulate in estuarine wetlands, causing deformities, cancers, and death in aquatic animals and their terrestrial predators.
2. Eutrophication: Wastewater and storm water can alter the ecology of a wetland ecosystem if high nutrient levels cause extended eutrophication that can lead to algal blooms in estuaries which deplete dissolved oxygen, leading to mortality of benthic organisms. Excess algae can shade underwater sea grasses (part of the coastal wetland ecosystem),

preventing photosynthesis and resulting in sea grass death.

3. Immobilization: Iron and magnesium, in particular, may reach toxic concentrations, immobilize available phosphorous, and coat roots with iron oxide, preventing nutrient uptake.

By knowing the adverse impacts of water pollution in wetland there is need to conserve the wetlands in India and other countries in context, a policy document should support a set of immediate programmes comprising:

- Identification and classification of all wetlands and water bodies
- Delineation of catchment areas as the basis of analysis and activities for large wetlands
- Reduction in non-point source (agro-chemical) pollution
- Establishment of water quality standards of wetlands and water bodies
- Development of policy and legal framework
- Dissemination of information and awareness generation
- Seeking funds for natural resource conservation as a part of development agenda.

Mangrove wetlands: conservation and management

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Mangrove an important ecosystem, are densely vegetated wetlands at the intertidal zones of estuaries, backwaters, deltas, creeks, lagoons marshes and mudflats of tropical and subtropical latitudes. Mangroves possess a range of features which make them uniquely adapted to stressful environment. Due to peculiar environmental conditions such as high humidity and temperature mangroves have a rich biodiversity of bacteria and fungi. Microbial activity in mangrove plants has been observed throughout the world, which varies from site to site. They occupy several million hectares of coastal area worldwide and distributed in over 112 countries and territories comprising a total area of about 1,81,000 km^2 in over one fourth of the world's coastline. In India it accounts for about 5% of the world's mangrove vegetation and are spread over an area of 4,461 km^2 along the coastal states/ union territories of the country, which is 0.14% of the country's total geographic area.

Importance of Mangrove Wetlands

Mangroves act as a natural barrier to shoreline erosion, and in fact stabilize fine sediments. They also maintain water quality by extracting nutrients from potentially eutrophic situations and by increasing the limited availability of saline and anaerobic sediments to sequester or detoxify pollutants. They have a special role in protecting human life and property of people during natural disasters such as storm surges, coastal erosion, and tsunamis, while providing environmental services and timber resources to people. Wood of mangrove trees has high tannin content and calorific value that makes them good fuelwood species. Also, they are extensively used in construction purpose. The leaves of mangrove trees are used for making roof thatches and mats for floor. Exploitation of mangroves for tannin, dye and medicine is well known. Harvest and sale of mangrove forest products viz. wood, leaf, bark, fruits, honey etc. is an important income supplement to rural, marginalized communities around coastal areas. In order to maintain the supply of mangrove products it is very important to manage resources.

Causes of Degradation of Mangrove Wetlands

Degradation of mangroves is a global phenomenon. Global changes such as an increased sea level may affect mangroves. Natural disasters like tsunami weaken the mangrove vegetation and make them prone to pests and diseases. Problem of deforestation is compounded by growing human populations in many coastal areas. More important is human alterations created by conversion of mangroves to mariculture, agriculture and residential areas as well as forestry uses. The insect herbivory, propagule predation by crabs, barnacle fouling etc. also degrade the mangrove forest. Effluents from industries, sewage and oil spillage further degrade the soil of mangroves and make them less productive. The author has conducted extensive monitoring of mangrove forest sediments for pollution in the areas in the vicinity of industries. It was observed that the level of Pb, Ni and Cd were above permissible limit in the areas near oil refineries, discharge of industrial effluents and brick kiln site, respectively. The decline in mangrove cover is resulting into submergence of land areas by sea water and less protection against natural calamities. In particular, the Indian

Ocean Tsunami disaster of December, 2004, which killed thousands of people and damaged livelihood and coastal resources in 14 Asian and African countries, highlighted the need to restore mangroves for sustainable coastal management.

Eco restoration of Mangrove Wetlands

Mangrove restoration is increasingly practiced in most part of the world for their protection, conservation and utilization. Mangrove restoration is desired for not only their conservation in original pristine state but also for the sustainable management of ecosystem. Restoration of mangroves is often considered a way to minimize ecological and economic losses incurred from their decline. For the rehabilitation of mangrove following objectives are desired-

***Afforestation of degraded sites*:**

Mangrove silviculture is practiced widely for improving the degraded coastal sites with the objective of wood production, shoreline protection, aquaculture, social enrichment etc. Mangrove afforestation was proved to be very effective in the restoration of mangrove plantations due to intensive efforts. However, the productivity of mangrove plantation was found to decline despite of scientific efforts. Nursery and planting techniques vary considerably among mangrove species. Reforestation of mangrove forests through natural regeneration is relatively inexpensive and maintenance is less labour intensive. But for degraded sites natural regeneration was not found to be very useful. Assisted regeneration is expensive but it may be useful for sites with insufficient natural regeneration. Macro- propagation of mangroves was reported to be beneficial for the direct transplanting. Selection of site specific plant species is also very important for good survival and growth.

***Ecological management of degraded coastal areas*:** For effective rehabilitation, it is very important to identify the reasons of previous degradation. The knowledge of ecology of individual mangrove species is necessary for successful seedling management. The ecology of mangrove wetlands is influenced by number of macro-level physical forces. Among them, the quantity and periodicity of fresh water flow plays a significant role in determining the species diversity, biomass and forest structure. Further, invasion of exotic plant species in mangrove forest is rising that also needed to be identified. Sediment and rhizosphere microorganisms are the major biological components that contribute to the productivity of mangroves. Plant growth promoting rhizobacteria (PGPR) could be beneficial in this regard; they are well known to promote growth and production of plants by acting as biofertilizers and biopesticides. The density of beneficial microorganisms viz. AM fungi was observed to be the highest in the polluted areas by the author.

***Government- public partnership for the management of mangroves*:**
Due to the unusual environment of mangrove between dry land and shallow marine and brackish water the planning and management of becomes very complex because of competing and overlapping interest in mangrove lands. For the management of mangroves the awareness generation is needed at all levels from decision makers in government, to community leaders and educational institutions. Long term success in mangrove restoration can be achieved by the level of support and involvement of local communities and local government.

Conclusion
Mangrove forests are under intense stress due to anthropogenic and natural causes. It is very important to identify the intensity of degradation for planning and management of mangrove wetlands. The participation of researchers, government stakeholders and local people is desirable for ensuring effective management.

Wetland ecosystem conservation management policy in India

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Introduction

Wetlands are the transitional zones between permanently aquatic and dry terrestrial ecosystems. A wide variety of wetlands like marshes, swamps, open water bodies, mangroves and tidal flats and salt marshes etc. exists in our country. Wetlands are considered life support systems and provide a wide range of services critical to human development and well-being. They help recharge aquifers, support local food production, function as habitat for indigenous and migratory birds and are effective in flood and erosion control besides being a major source of national and international ecotourism. Wetlands also play a major role in treating and detoxifying variety of waste products as well as physical buffering of climate change impacts. Globally, 1.5 - 3 billion people depend on wetlands as a source of drinking water as well as for food and livelihood security. The significance of linkages between wetlands and human development can be most explicitly experienced within Asia whose major civilizations have evolved in the river valleys and wetlands.

Wetlands in India:

India has a varied terrain and climate that supports a rich diversity of inland and coastal wetland habitats including Keoladeo National Park (Bharatpur, Rajasthan), which supports a large population of migratory birds every winter; Chilika (Orissa), the largest brackish water lake in India; and Wular (Jammu and Kashmir), one of the largest freshwater lakes in Asia playing a key role in hydrographic system of Kashmir. Wetlands constitute 18.4% of the country's area of which 70% are under paddy cultivation.

Key Threats:

Despite their immense use to human well-being, wetlands are the most threatened and rapidly degrading ecosystems globally. The biotic and abiotic threats are varied and include:

- Habitat destruction and encroachments through drainage and landfill
- Over-exploitation of fish resources
- Discharge of waste water and industrial effluents
- Uncontrolled siltation and weed infestation
- Ill-effects of fertilizers and pesticides
- Other such anthropogenic pressures.

Policy Support

Until the early part of 2000, the policy support for wetland conservation in India was virtually non-existent. The action on wetland management was primarily influenced by the international commitments made under Ramsar Convention and indirectly through array of other policy measures, such as, National Conservation Strategy and Policy Statement on Environment and Development, 1992; Coastal Zone Regulation Notification, 1991; National Policy and Macro level Action Strategy on Biodiversity, 1999; and National Water Policy, 2002. As a signatory to Ramsar Convention on Wetlands and recognizing the importance of protecting such water bodies, the Government of India identified two sites, i.e. Chilika lake (Orissa) and Keoladeo National Park (Rajasthan), as Ramsar Wetlands of International Importance in 1981. Thereafter in 1985–1986, National Wetland Conservation Programme (NWCP) was launched in close collaboration with concerned State Governments. Initially, only designated Ramsar Sites were identified for conservation and management under the Programme . Several measures were taken to arrest further degradation and shrinkage of the identified water bodies due to encroachment, siltation, weed infestation, catchment erosion, agricultural run-off carrying pesticides and fertilizers, and wastewater discharge. Subsequently in 1993, National Lake Conservation Plan (NLCP) was carved out of NWCP to focus on lakes particularly those located in urban and peri-urban areas which are subjected to anthropogenic pressures.

Initially, only 10 lakes were identified for conservation and management under the plan. There is also a National River Conservation Plan (NRCP), operational since 1995, with an objective to improve the water quality of the major Indian rivers through the implementation of pollution abatement works,to the level of designated best use.

The new draft National Water Policy, 2012 which is cleared recently by the National Water Resources Council also recognizes the need for conservation of river corridors and water bodies (including wetlands) in a scientifically planned manner. Further, the policy emphasizes that the environmental needs of aquatic eco-system, wetlands and embanked flood plains should be recognized and taken into consideration while planning for water resources conservation (Ministry of Water Resources, 2012). Over the years, number of designated Ramsar Sites has increased to 26 (Ramsar Convention on Wetlands, 2012), number of rivers under NRCP has increased to 39 and number of wetlands covered by the NWCP and NLCP has increased to 115 and 61 respectively. However these initiatives proved to be too little considering the extent of ecologically sensitive wetland ecosystems in the country Lately,the National Environmental Policy 2006 recognized the importance of wetlands in providing numerous ecological services. The policy, for the first time, accepted that there is no formal system of wetland regulation in the country outside the international commitments made in respect of Ramsar sites and thus there is a need of legally enforceable regulatory mechanism for identified valuable wetlands, to prevent their degradation and enhance their conservation.

Reader's Corner

International Conference on Environment Management and Sustainability (ICEMS 2017)- 4th to 6th January 2017

Please accept my congratulation for a highly successful event organised by your team.

(Mukesh Khare, C. E, Ph.D (UK), Fellow, Wessex Institute of Great Britain, Fellow, Institution of Engineers (India), Honorary Patron, Planet Earth Institute, London. Professor of Environmental Engineering, Civil Engineering Department, IIT Delhi, New Delhi - 110016, India)

I would like to thank you and your SIES conference team for arranging the International Conference very nicely. I can say this conference was very successful. Very well organized session and great speakers. My heartiest thanks for Inviting us as Speaker of this great event.

(Ashwani Kumar (M.Phil., Ph.D.), Assistant Professor, Metagenomics and Secretomics Research Laboratory, Department of Botany, School of Biological Sciences, Dr. H.S. Gour Central University, Sagar, M.P. INDIA)

Workshop on "Plastics and its Management for Environment Conservation" – 10th January 2017

I am really privileged to present my thoughts and interact with your group. Hope we can work together as we are also working with All Plastics Recyclers Association for "Awareness of Plastics usage and disposal ". Thanks once again for inviting me for the function.

(Dr. Prakash A. Mahanwar, Professor and Ex. Head, Department of Polymer and Surface Engineering, Institute Of Chemical Technology (ICT), N.M. Parekh Marg, Matunga, Mumbai (INDIA),

Ongoing R & D projects in SIES Indian Institute of Environment Management

Development of Electrochemical Oxidation Methods for Treatment of Organic Radioactive Wastes (Sponsored by BRNS, DAE)

Organic wastes arise in different industries including nuclear industry. Incineration is a traditional method for volume reduction and management of organic wastes. With the growing environmental concerns associated with incineration process, more eco-friendly alternatives are emerging. One such is mediated electrochemical oxidation process. The present project aims to develop electrochemical process for management of waste organic ion exchange resins and organic solvents employed in nuclear industry. The process occurs in water medium at near ambient conditions of temperature and pressure and converts organic materials into carbon dioxide, water etc. The process has the potential to address the issue of hazardous organic solid and liquid wastes which are difficult to incinerate.

Addressing Drinking water Issues in Slums in Greater Mumbai and its mapping using GIS (Sponsored by NRDMS, DST)

In urban India, people living in slums are facing drinking water problems. An adequate supply of safe drinking water is a basic human need. More than 60% of the Mumbai city lives in slum communities. The present project aims at mapping and monitoring of drinking water quality in selected slums in Greater Mumbai. Since water quality is spatially variable in nature, therefore GIS will be used for mapping and analysis. Areas of poor water quality will be identified. Suitable low cost water purification technologies will be recommended accordingly. Dissemination of knowledge on the need for better management of urban water resources involving stakeholders like government departments, research and educational institution, NGOs, and local people will also be done.

Training Programme Scheduled during 2017- 2018 at SIES Indian Institute of Environment Management

Sr. No.	Topics of the training programme	Tentative schedule					
		April - July		August - October		November - January	
1.	Internal Auditor Training for Environment Management Systems (ISO 14001:2015)						
2.	Instrumentation techniques in Environmental Pollution Monitoring						
3.	Corporate Social Responsibility Strategy and Reporting						
4.	Internal Auditor Training for Occupational Health and Safety (ISO 18001: 2015)						
5.	Environmental Law and Policy						
6.	Training programme for CETP Plant Operators						
7.	Green technologies in waste water management						

For further details contact on 022 61196454/55/56/57/60 or e mail id.: iiemoffice@sies.edu.in. Fee concession will be given on group registrations.

Nutrient cycling in wetlands ecosystems

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Wetlands have the potential to reduce nutrients from inflow water by sorption to minerals and sediments, sedimentation and burial, vegetation uptake, biogeochemical transformations including denitrification, and microbial degradation.

To better understand these mechanisms, it is important to understand the phosphorus and nitrogen cycle in wetlands ecosystem.

Phosphorus

Phosphorus is an essential element for all living organisms. Plants must have phosphorus for growth and maturation. There are four different pools of phosphorus: one that is available to plants (dissolved inorganic phosphorus) and three that are not immediately available to plants (organic dissolved phosphorus, particulate organic phosphorus, and particulate inorganic phosphorus). Phosphorus enters a wetland as dissolved and particulate phosphorus. Depending on the form of phosphorus a variety of physical, chemical, and biological processes will occur resulting in a wetland acting as a sink, source, or transformer. Adsorption, desorption, precipitation, weathering, mineralization, immobilization, sedimentation, and diffusion of phosphorus to the overlying water column determine the amount of phosphorus that may be retained in a wetland. Long-term removal of phosphorus from a given ecosystem can only occur when vegetation is harvested or when sediment bound phosphorus is removed from the system (Figure 1).

Nitrogen

Nitrogen enters wetlands in organic and inorganic forms. Three main processes responsible for nitrogen retention and removal in a wetland are denitrification, sedimentation, and uptake by vegetation. Nitrogen has a gaseous cycle and therefore can be permanently removed from soil and water column in a treatment wetland through denitrification. Through nitrification, ammonia is converted into ammonium which is then converted into nitrate (NO^{3-}) and nitrite (NO^{2-}) by microbes in the water column and aerobic zone. Denitrification is the process where anaerobic bacteria produce nitrogen gas (N_2) or nitrous oxide (N_2O) using end-products of nitrification. N_2 and N_2O gas are released into the atmosphere, thus removing it from the wetland. Between 70% and 90% of nitrogen may be removed from a wetland through denitrification. The amount of available carbon impacts the amount of nitrogen reduced in a wetland, since the microbes needed for the nitrogen cycle depend on carbon. Ammonium plus nitrite may also be converted to nitrogen gas through a process known as anaerobic ammonium oxidation (anammox); however, more research is needed to fully understand the role anammox has in the nitrogen cycle in treatment wetlands (Figure 2).

Conclusion

Wetlands are dynamic and heterogeneous systems; there are no two wetlands that will behave identically, in terms of nutrient reduction, due to the numerous factors that influence this function.

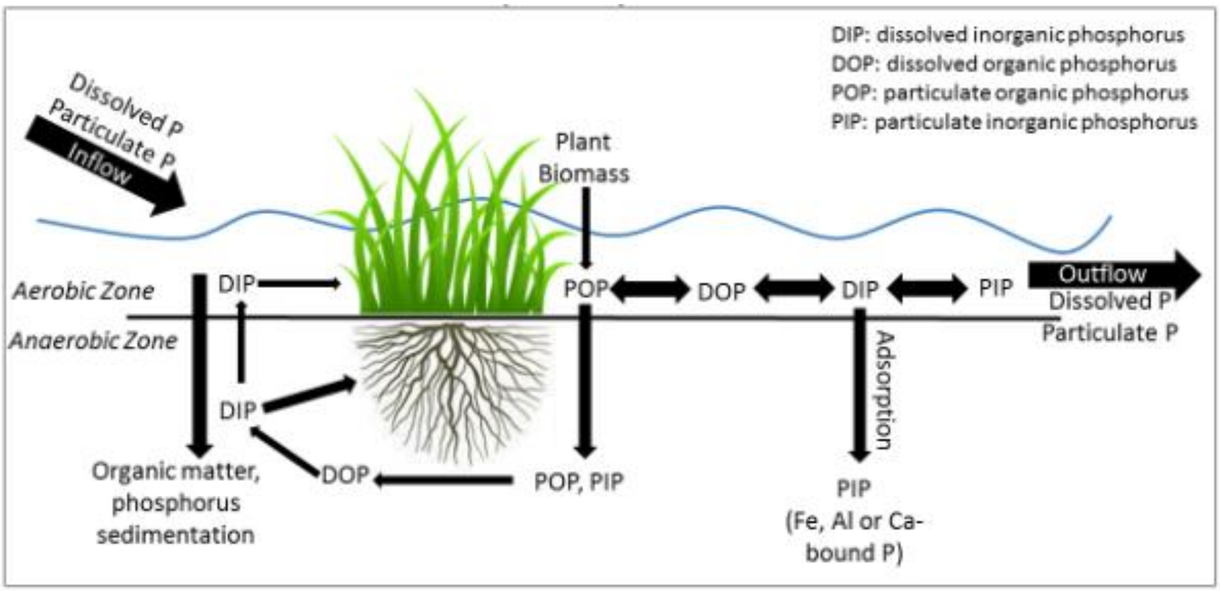

Figure 1: Phosphorus cycle of soluble and particulate phosphorus

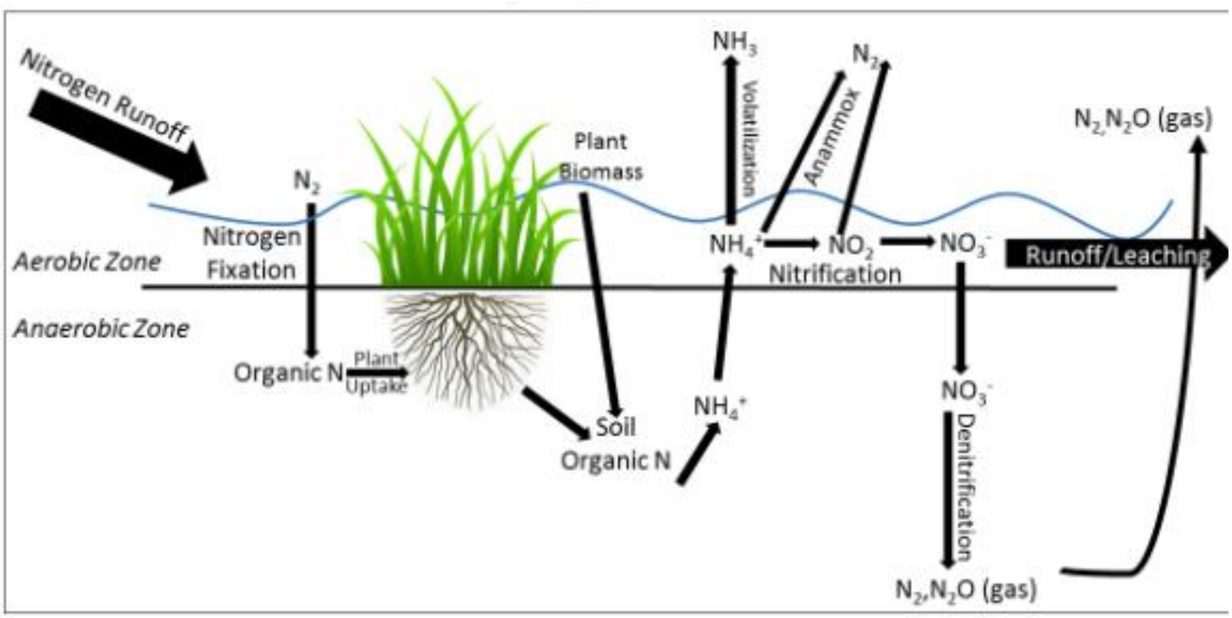

Figure 2: Nitrogen cycle in wetlands Source

Transformations of nitrogen in wetland ecosystems system

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Introduction

To meet the demand for rice *(Oryza sativa* L.), the world's annual rice production must increase to 556 million tons by 2000 and to 758 million tons by 2020. Of the world's riceland, more than 80% is grown to wetland rice. About 50% of this, and 75% of total rice production are obtained from irrigated wetland rice. This increase in rice production is only possible if soil, water, nutrients and other production inputs are used more efficiently in the future. Nitrogen is the nutrient most limiting rice production worldwide and it accounts for about 67% of the total amount of fertilizers applied to this crop.

Despite this impressive growth in world production and use, research over the past 20 to 30 years has shown that crop utilisation of N fertilizers are generally inefficient, with less than 40% of the N applied normally used by the crop. In the past two decades, a major research effort to devise efficient management practices and modified forms of urea to improve the level of efficiency has been advocated. Basic N transformation processes to improve N fertilizer use efficiency in wetland rice were studied. It is important to understand how wetland (lowland) soils differ from dryland (upland) soils in order to fully understand N transformation processes in wetland rice soil ecosystems.

In Asia, a wetland rice soil is a soil in a bunded area that is prepared by tillage such as plowing, followed by puddling for transplanted or broadcast-seeded rice culture. The area may be rainfed or irrigated, or a combination of both. The characteristic soil moisture regime varies from near saturation to submergence (flooding) resulting in several centimeters of standing floodwater for most of the crop growth period. Understanding the N transformation processes would greatly facilitate regulating N losses from wetland rice soils and increase the availability of N. Based on this understanding of N transformation processes, alternative management agendas can be developed to minimize fertilizer and soil N losses and increase efficiency of this important nutrient element in these ecosystems.

Nitrogen dynamics in wetland soils

Ammonium N is the dominant form of mineral N in wetland rice soils, existing in three major fractions:

- Ammonium in soil solution
- Ammonium in exchange sites
- Ammonium in non-exchangeable form
- Ammonium N in soil solution and at exchange sites is readily available to the rice crop, whereas reports on the availability of non-exchangeable NH_4-N are conflicting

Relation between initial NH_4^+ on N uptake

Initial NH_4^+ content in the analyzed soils ranged from 12 to 62 kg N ha $^{-1}$.The relations were substantially improved when the N uptake of the crop was plotted against fertilizer NH_4^+ initial exchangeable soil NH_4^+ Field experiments at three sites in major rice growing areas in the Philippines showed that NH^+ fertilizer application was clearly reflected by an increase of exchangeable and nonexchangeable soil NH^+, while N uptake resulted in a decrease of both NH + fractions. In one wetland soil (Maligaya silty clay loam) containing montmorillonite/ vermiculite as principle clay minerals (Typic Pellustert), significant increases in exchangeable NH +, however, occurred only in the fertilized plots.

Exchangeable NH + decreased continually with crop growth, reaching the lowest level at 60 days after transplanting IR36 rice. This decrease was reflected by an increased N uptake by rice, particularly with fertilized N treatments. From these studies, the same authors concluded that the exchangeable NH_4^+ and in some soils the non-exchangeable NH_4^+ are the most important soil N fractions easily available to wetland rice.

Effects of green manure and urea in nitrogen dynamics

Mineralization and immobilization processes occur simultaneously in wetland soils and depend on soil properties and environmental factors. Mineralization of organic N (native or added organic N sources) is the most important process in the N nutrition of wetland rice. Nitrification processes, however, are inhibited under reduced soil conditions. Thus, mineralization stops at NH_4^+ Temperature, soil moisture regime, soil pH, organic matter content, C/N ratio, amount and kind of organic residues or organic matter added are major environmental factors that affect mineralization/immobilization turnover of N in the soil-plant system.

Ammonia volatilization loss

Ammonia volatilization is a major loss mechanism that affects the efficiency of urea and other N fertilizers in irrigated wetland rice. The magnitude of ammonia loss depends on wind speed, temperature, rainfall, ammoniacal-N (NH_4^+ + NH3) concentration, pH and cation exchange capacity. In wetland rice fields in Asia, the floodwater ammoniacal-N concentrations following N application, high temperatures common in the tropics, and elevated floodwater pH resulting from algal photosynthetic activity create a favorable environment for NH3 loss. Aqueous NH_3 content in floodwater increases almost linearly with increasing temperature, which results in nearly a fourfold increase in the range from 10 to 40 °C. In field systems, floodwater pH displays a diurnal pattern seemingly synchronized with cycles of photosynthesis and not respiration or the addition or the depletion and additions of CO_2 to floodwater.

Denitrification loss

Nitrification in oxidized soil zones and floodwater converts the ammoniacal N formed by ammonification and hydrolysis of urea into NO_3-N. This NO_3-N can thereafter move into reduced soil zones where it is readily denitrifed to dinitrogen (N_2) and nitrous oxide (N_2O). Although denitrification in wetland rice soils has been the subject of laboratory investigation, quantification of denitrification losses in wetland rice soil systems has been hindered by the lack of viable methodology for direct measurement.

Conclusions

Green manure incomoration in wetland rice fields reduced N losses from mineral N source due to resulting lower floodwater pH and lower partial pressure of N~ (pNH3) than that of urea applied alone. At present, the integrated use of green manure and mineral N is receiving much attention in the hope of meeting farmers' desire to reduce cost of production as well as ecological considerations such as increased methane production which contribute to global climate change. Other promising alternative practices for increasing fertilizer N efficiency include improved timing and application methods, particularly through better incorporation of basal N fertilizer without standing water, deep placement, and use of coated fertilizers.

Wetlands: values and conservation strategy

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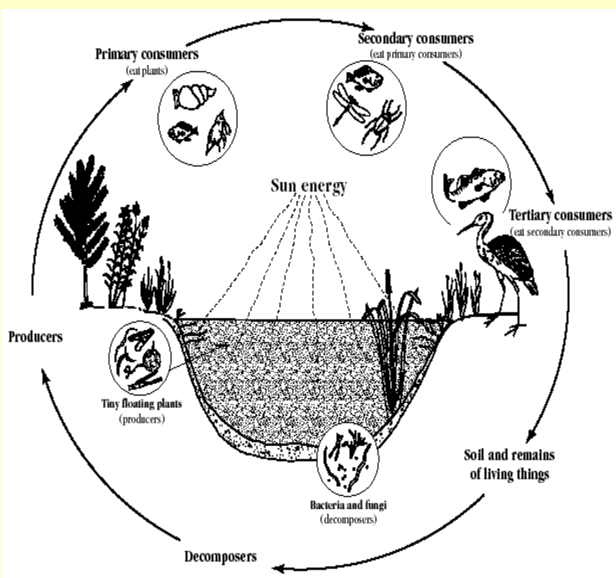
Wetlands are transition zones where the flow of water, the cycling of nutrients, and the energy of the sun meet to produce a unique ecosystem characterized by hydrology, soils, and vegetation. It plays a vital role in climate change adaptation and mitigation. Wetlands act like sponges by holding flood waters and keeping rivers at normal levels

Wetlands filter and purify water as it flows through the wetland system. Provide habitat for several plants and animals. Wetlands also regulate and maintain the planet's air and water cycles including the levels of oxygen, nitrogen, sulphur, methane and carbon-dioxide.



Wetland loss has been occurring for thousands of years. Lowland rice cultivation began in SE Asia about 6,500 years ago. Much of the 40 million hectares of rice cultivation in the central plains of India must have been developed at the expense of natural wetlands.

ISRO had in 2011 prepared a national wetlands atlas on the basis of satellite image and 201503 wetlands were mapped. Total wetland area estimated is 15.26 Mha, which is around 4.63 per cent of the geographic area of the country. Area under inland wetlands is 10.56 Mha and area under coastal wetlands is 4.14 Mha

Tropical wetlands are part of climate change strategy

Tropical wetlands are well distributed in REDD+ countries. The REDD+ accredited countries had showed less carbon emissions compare to without REDD. The mangrove forests globally cover 13.8 Mha. But over the past half century it declined by 30–50%. So, carbon emissions had increased 0.2-1.2 billion t C/y. In SE Asia the peat lands were also reduced i.e. from 35-40 Mha in 1990 to 25-30 Mha in 2002. Wetlands (mangroves, peat lands, swampy areas etc.) could store large amount of carbon below the ground **(Fig. 1)**

Conservation strategy

- Wetland protection must be included into local watershed planning process to restrict dredging, filling, clearing, and paving. Land acquisition of ecologically sensitive areas by local governing body also provides full control of the land.
- Proper land use planning technique which transfers developmental activities from environmentally sensitive areas to non-sensitive areas.
- Establishment of vegetative buffer (depends on buffer width) provides numerous benefits. Widths of

vegetative buffer 50 -100 feet are recommended to protect wetland water quality, while widths of 100 to 300 feet or more are for important wildlife functions.

- During the constructional process, land is cleared and graded often resulting in soil compaction and destruction of natural drainage ways. Communities can minimize these impacts by avoiding constructional activity in the sensitive areas, developing the site using the existing terrain, using the natural topography and vegetated waterways to convey runoff to pervious areas for infiltration.
- Perimeter control practices include sediment traps and basins, dikes, earthen berms, and silt fences (**Fig. 2**) These devices must be installed along the boundary of any required wetland buffer. Although most effective means of stabilization is to establish a vigorous grass cover to prevent erosion.
- Strom water management (like reduce runoff through design, capture and treat runoff etc.) must be followed.
- Several voluntary activities like trash removal, invasive plant removal (e.g., buckthorn, purple loosestrife), native buffer planting, water quality monitoring, wetland data collection and monitoring and community education are also fruitful. Effective wetlands conservation will not be achieved without public participation.

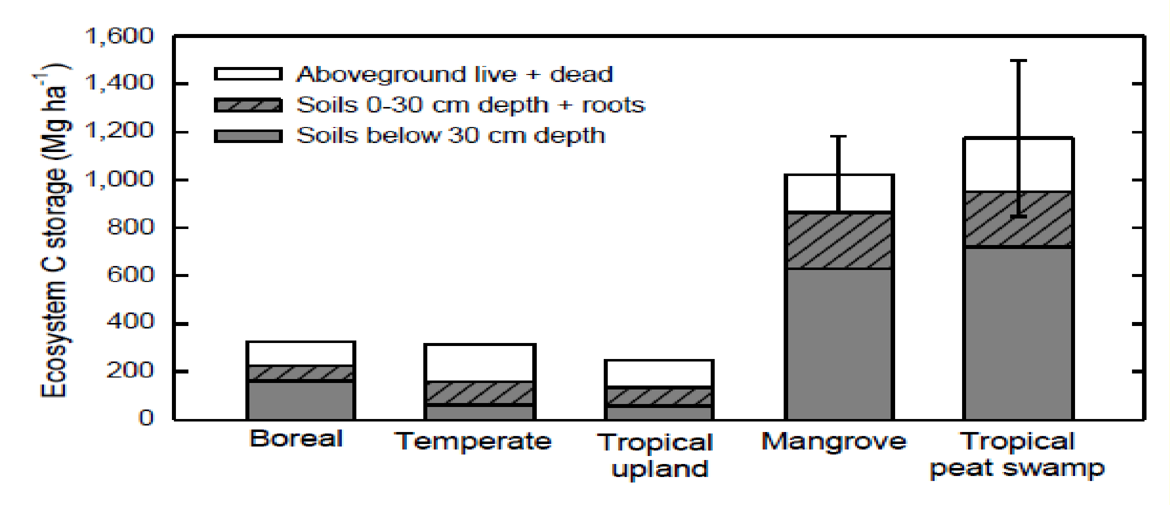


Figure. 1 Large below ground stock of carbon by mangroves

Figure. 2 Perimeter control practices

INDUSTRIAL VISIT
organized
for
Post Graduate Diploma in Environmental Pollution Control Technology (PGDEPCT)
and
Post Graduate Diploma in Sustainable Environment Management (PGDSEM)

MUMBAI WASTE MANAGEMENT LTD.

The visit was organized on 18th February 2016 as a part of academic curriculum of the courses PG Diploma in Sustainable Environment Management and PG Diploma course in Environmental Pollution Control Technology. Mumbai Waste Management Limited is certified for ISO 9001:2008, ISO 140001:2004 and OHSAS 18001:2007.

The purpose of visit was to gain practical knowledge of the various processes involved in waste management and fill the industry academia gap. MWML is equipped with a Hi Tech laboratory enabling comprehensive analysis of solid waste, water and waste water. It is well equipped with all sophisticated instruments required for the analysis prescribed by governing authorities. The laboratory monitors periodically the ground water, surface water, air, noise, soil and stack emissions within its premises. MWML is certified for a Quality management system as per ISO 9001:2008, Environment Management System as per ISO 14001:2004 and Occupational Health and Safety Management System as per OHSAS 18001:2007 standard.

Faculty members and students during the site visit at Mumbai Waste Management Limited

TALOJA CETP CO-OP. SOCIETY LTD.

The Taloja Industrial area (TIA) is situated adjacent to Navi-Mumbai and Panvel. Taloja CETP Co-operative Society Ltd. has cluster of 977 Member Industries. These units are mainly involved in manufacturing of viz. chemicals, Bulk drugs, drug Intermediates, Fertilizers, Glass, Petrochemicals, Pigments, Dyes and Intermediates, Specialty chemicals, Engineering and Textile, Food and Fish processing. The visit was organized to learn practical knowledge of the various processes involved in effluent treatment. The CETP initially was conceptualized for Small Scale Industries considering their space, financial and technical constraints of effluent treatment. Later on the large and medium scale industries were made the part of CETP due to common effluent collection and disposal line and considering their treated effluent as a dilutant of effluent to make the treatment scheme feasible.

Faculty members and students during the site visit at Taloja CETP

National Seminar on "WETLANDS FOR FUTURE SECURITY"

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The inaugural function of **National Seminar on 'Wetlands for Future Security'** and Wetland & Biodiversity Aptitude Test organised jointly by Dr. Ambedkar College, Deekshabhoomi, Nagpur and Social Forestry Department Nagpur Govt. of Maharashtra State & In association with Vanrai Foundation, Nagpur at New Auditorium, Deekshabhoomi, Nagpur. The program received a great attention of teachers, researchers, students and representatives of different NGOs as the words of Shri. Rajendra Singh, The Waterman of India, Raman Magsaysay Award recipient appealed all to conserve water bodies for securing everyone's existence on the earth. His speech was an emotional appeal to the young minds who are at the forefront of academics and global welfare. The inaugural function was presided over by Pujya Bhadant Arya Nagarjun Surei Sasai, President of Param Poojya Dr. Babasaheb Ambedkar Smarak Samitee, Deekshabhoomi, Nagpur.

Present on the dais were Shri. Rajendra Singh, The Waterman of India, W. I. Yatbon, Chief Conservator of Forests, Government of Maharashtra; Shri Kishor Mishrikotkar, Deputy Director, Social Forestry, Government of Maharashtra; Dr. S. V. Kameshwara Rao, Scientist-G, & GM, RRSC-NRCS-ISRO, Nagpur; Dr. Mrs. Alka Chaturvedi, Convenor Indian Science Congress Association Nagpur Chapter, Dr. Ram Gavande-Vanarai Nagpur; Dr. K. M. P. Singh-OCW, Nagpur; Shri Vilasji Gajghate & Shri Vijaykumar Chikateji-Members of Smarak Samiti; Dr. P. C. Pawar (Principal); Dr. Mrs. K. M. Reddy (Director, College Development); Prof. Subhash Somkuwar, Organising Secretary and Dr. Arun Joseph, Registrar.

Jaltarang –

An effort to create a rippling effect on wetland related awareness

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In the course of development and urbanization, wetlands are completely neglected and abused, thus, losing their resource potential. Wetlands and especially freshwater bodies offer the key to the alarming situations of acute water shortages, and it is essential to take into account the available resources and conserve them. Designating certain area as an IBA (Important Bird Area), having no development policy, reservations and keeping a strict vigilance needs to be in place on priority. In a view to raise awareness regarding the same, The Energy Resources Institute's (TERI's) WRC (Western Regional Centre), has been celebrating World Wetlands Day (WWD) under the title *'**Jaltarang**'* for the last ten consecutive years to deliberate on the current status, issues, views and policies pertaining to the preservation and restoration of fresh water resources. There is severe dearth of knowledge, resources and awareness on the concept of Wetlands across all strata of the society. Hence, TERI devised programs innovative and customized programs to reach out to diverse stakeholder groups like government officials, environmentalists, educational institutions, corporates, citizens and students; such as nature trails and guided tours, Shramadan activities, brain storming sessions and so on. This year, an interactive session and nature trail was organized to celebrate *Jaltarang 2017* for youth, college students and citizens. The focus of the session was the importance of wetlands in reducing the impact of disasters and helping prevent them, keeping in mind the theme for WWD 2017, Wetlands for Disaster Risk Reduction. This was followed by a nature trail in which 39 avi-fauna species, including several important migratory ones were recorded.It is high time that we all start moving towards this collectively and constructively which is only possible through public participation for the conservation of these unique entities. Jaltarang is a humble effort of trying to reach out to various stakeholders with the aspiration to create a rippling effect in spreading awareness for the protection of wetlands.

Picture 1: A few of the birds spotted (In the picture; Common Teals)

Picture 2: Participants during the nature trail

Environment in News Headlines

Red sea mangroves fight back in the face of global decline

Mangroves are the ecosystems with the highest capacity to absorb and bury CO_2 from the atmosphere into the sediment via photosynthesis. Mangroves also play a key role in protecting coastal communities in the face of natural disasters, such as hurricanes and tsunamis. Red Sea mangrove coverage has actually increased by 12% since 1972. Remote sensing has been used to analyse satellite images and map the temporal and spatial prevalence of mangroves around the coasts of the Red Sea over the past four decades. Along the coasts of Yemen and Africa, overgrazing by camels and logging have affected mangrove cover. These losses have been partially compensated for with large-scale plantation projects. A rehabilitation project in Yanbu, Saudi Arabia saw mangrove cover increase by around 50-fold from 1975 to 2013.

Source: The Conversation, February 28, 2017

With climate change, shrubs and trees expand northwards in the Subarctic

Shrubs expand in the tundra in northern Scandinavia. And it is known that fixation of nitrogen from the air is in the tundra to a high degree performed by cyanobacteria associated with mosses. Also enhanced nitrogen fixation stimulates plant growth. New research shows that as taller shrubs expand into the tundra, nutrients in their leaf litter will either promote or reduce the nitrogen fixation, depending upon which shrub species that will dominate.

Source: ScienceDaily, March 15, 2017

Empty reservoirs, dry rivers, thirsty cities – and our water reserves are running out

Some of the most stressed aquifers are in the world's driest regions such as Asia, up to 88% of which is water-stressed. South Asia accounts for half the groundwater used globally, but the continent's aquifers – many of which were formed millennia ago when areas like northern China had a more humid climate – are no longer being replenished regularly by rainfall. Boreholes are getting deeper and water tables are falling. The first step towards remedying this situation is to establish how much groundwater is left and how it is being used. Nasa's Gravity Recovery and Climate Experiment satellite provides information on changes in the Earth's gravity due to fluctuating water volumes.

Source: The Guardian, March 27, 2017

Arabian sea is suffocating due to toxic algal bloom, and it is going to get worse

Scientists are of the opinion that these microscopic organisms are thriving in new conditions brought about by climate change. It's not the first time that algae bloom has appeared in the Arabian Sea, but the bloom now stretches from the shores of Oman on the west to India and Pakistan on the east. The build-up of green slime is an ominous sign for the local ecosystem as it triggers release of ammonia, causing sea stench and poisoning nearby marine life. This bloom isn't regularly seen until the past decade. Now, they are not only forming twice a year in the Arabian Sea, but its extent is also growing.

Source: Down to Earth, March 30, 2017

Forthcoming Events

- World Environment Day Celebration on 5th June 2017.
- Training programme for certification of internal auditor for ISO 14001:2015 and ISO 18001

Articles, photos etc. are invited for next issue (April - June 2017) of 'The Environment Management' on the theme 'Green technologies in pollution control and management'

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