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## Lake2010:Wetlands, Biodiversity and Climate Change 22<sup>nd</sup>-24<sup>th</sup> December 2010

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**Venue: Satish Dhawan Auditorium, Indian Institute of Science, Bangalore**

Organised by:

Energy & Wetlands Research Group, Centre for Ecological Sciences (CES),  
Centre for *infrastructure*, Sustainable Transportation and Urban Planning (CiSTUP), IISc  
Centre for Sustainable Technologies (CST), Indian Institute of Science  
Karnataka State Council for Science and Technology (KSCST), Bangalore  
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Symposium focusing on lakes popularly known as “**Lake symposium**” was initiated by the Energy & Wetlands Research Group at Centre for Ecological Sciences, Indian Institute of Science, Bangalore in the year 1998. Lake 2010 is the 7<sup>th</sup> Biennial Lake Conference focussed on “**Wetlands, Biodiversity and Climate Change**” commemorating the International Year of Biodiversity. The United Nations has declared **year 2010** as the **International Year of Biodiversity** and the symposium provided a unique opportunity to increase understanding of the vital role that biodiversity plays in sustaining life on Earth. There is growing evidence that the biological diversity is being severely threatened by rapid climate change. Also, hydrological changes could be dominant effect of climate change, as snow melt increases, as evaporation rates increases and as droughts, storms and floods intensifies. Conservation of natural resources through sustainable ecosystem management and development is the key to our secured future. Formulation and implementation of action plan that best conserve the aquatic resources requires an understanding of issues, concerns and threats to water resources are identified, and cause and effect relationships.

LAKE 2010 provided a platform for interaction among the researchers, policy makers, academicians and NGO’s and has addressed issues related to wetlands and biodiversity in the era of climate change. There were 97 oral presentations and 48 poster presentations in this symposium covering 13 different sub-themes. Participants from all over the country and abroad

came forward to present their research findings. The three day symposium proved to be an appropriate venue for raising the critical water issues and bring forth the severity of the problems faced by the water bodies. The beginning of the symposium was marked by the key note lectures from experts highlighting the issues of biodiversity, ecology and hydrology. Dr. T. V. Ramachandra of Energy and Wetlands Research Group, Centre for Ecological Sciences, IISc asserted the poorly maintained condition of the Bangalore water bodies and emphasized that if immediate remedial measures are not taken, the water crisis could be more severe. He also pointed out of the poor environmental literacy level (3.5% environment literates) and opined that the ecological awareness among the civilians in Bangalore is very low and hence, more literacy and awareness programmes are needed to ensure the protection and sustainable maintenance of the water bodies. He also pressed the need for developing more water bodies and increasing the water table for quenching the thirst of Bangalore. Dr. M. D. Subhash Chandran highlighted the importance of the Gondwana relics and emphasized on the conservation of the primeval forests of Uttara Kannada district. He also warned that if these relics are not conserved, the entire peninsular India including Bangalore will be in dire straits. The members of the Energy and Wetlands Research Group at CES highlighted the researches carried out by the group which spread across different themes like biodiversity, ecology, hydrology, climate change, remote sensing, etc. Rishabh Jain presented Solar Hotspots in India and showed the areas in the country having good solar potential.

Lake 2010 provided a unique opportunity to increase understanding of the vital role that biodiversity plays in sustaining life on the earth. Three parallel sessions were arranged on the second day wherein the participants from across the country shared their research knowledge. The issues pertaining to the water quality status, documentation of biotic resources and sustainable management of water bodies like lakes, rivers and estuaries were highlighted in the sessions conducted at Satish Dhawan auditorium. The need for biomonitoring the water bodies, studying the pollution levels and its effects on the aquatic biota and application of remedial steps like phytoremediation were also brought out effectively. The first session at Centre for Sustainable Technologies (astra) was dedicated to the sacred groves which support a large number of endemic biodiversity and plays a key role in the ecosystem. The emphasis was laid on the ecosystem services of the sacred groves, its importance as an abode of relic species and developing conservation strategies for its sustainable management. The subsequent sessions witnessed the presentations pertaining to documentation of terrestrial and aquatic biodiversity and its importance, understanding the impacts of climate change on biodiversity and its adaptations, developing strategies for conservation (ex situ and in situ), restoration and management of ecosystems and also understanding the impacts of urbanization on the

ecosystems. The first session at Centre for *infrastructure*, Sustainable Transportation and Urban Planning (CiSTUP) pointed out the importance and usefulness of Geoinformatics in monitoring the ecosystems and developing conservation strategies for their sustainable management. The following session dealt with the problems caused by unplanned disposal of solid wastes in the city and the steps to deal with it. The competition for the undergraduate research presentations was also held which provided a boost for the young researchers to come up with innovative ideas and work on them.

On the third day, Dr. Sankara Rao emphasised the role of plants, especially trees, in the urban areas as they act as carbon sinks and help in reducing the pollution levels. Next session entitled 'My Village Biodiversity' drew wide attention and appreciation by the audience. The students from Uttara Kannada district presented their respective village biodiversity based on their observations. The school students from Bangalore gave impressive presentations on 'Ecology, Biodiversity and Environment'. A competition for the school teachers of Bangalore and Uttara Kannada was also arranged. The key recommendations of Lake 2010 forum are:

#### **1. Documentation of biodiversity:**

- The biodiversity of every water body should form part of the School, College, People's Biodiversity Registers (SBR, CBR, PBR).
- The local Biodiversity Management Committees (BMC) should be given necessary financial support and scientific assistance in documentation of diversity.
- The presence of endemic, rare, endangered or threatened species and economically important ones should be highlighted.
- Habitat destruction is very critical problem faced by the biotic species and hence, the habitat conservation is very essential for sustainable management of species diversity.
- A locally implementable conservation plan has to be prepared for such species.
- New metrics are needed to be developed for identifying and prioritizing conservation areas.
- All kinds of introduction of Exotic species and Quarantine measures be done in consultation with the concerned Authorities and the data bank
- There is an urgent need for creating a 'Data Bank' through inventorisation and mapping of the aquatic biota.

- Identify water bodies of biodiversity importance and declare them as wetland conservation reserves (WCR)
- There is also a need to document the biodiversity of the cryptogamous plants like pteridophytes, bryophytes, lichens and fungi and develop conservation strategies for them.
- Mangroves are key players in the coastal ecosystems and hence, their conservation also should be focussed upon.
- The taxonomy and systematic biology should be integrated with new developments and more opportunities are needed to be generated for the systematic biology in the country.
- The documentation and inventorisations of flora and fauna of different biologically rich zones needs to be encouraged.
- It is also essential to facilitate the use of information technology for organizing the taxonomic data and also support the biodiversity portals to engage the local people for collating the highly dispersed and vast biodiversity information.
- The biodiversity should also be linked with the environmental parameters to understand the ecology of the important species.
- The metal toxicity studies in the natural environments are also essential to analyse its effects on the biodiversity and hence, minimise the same.
- Conservation of ecosystem is essential for conserving the genetic diversity of the wild plants. This would be more effective than maintaining gene banks or germplasm conservatories.

## **2. Combating Climate Change:**

- The laws regarding pollution problems already exist but they need to be implemented effectively.
- Emphasis should shift from the fossil fuel based sources of energy to renewable sources of energy.
- In-depth research should be carried out on popularising the first, second and third generation bio-fuels.
- Renewable energy potential assessment should be prioritised in the regional level.
- Climate change is a global phenomena and it also needs studies at local level.
- We should also focus on increasing the green cover especially in the urban areas which would help in carbon sequestration.

- Awareness campaigns are needed to involve different sectors of societies for combating the climate change issues.

### 3. **Protection and maintaining sacredness of Sacred groves –**

- The sacredness and the faith associated with the sacred groves needs to be understood and preserved.
- The sacredness of the groves should also be taken into account by the researchers while studying the groves.
- Cryptogams also form an important and integral part of the sacred groves and hence, they should also be documented and conserved.
- Many faunal groups of the sacred groves are not studied and taken into account because of the lack of expertise. Hence, this aspect should also be looked into.
- Awareness among the people also needs to be generated for successful community participation in the conservation efforts for the sacred groves.
- Sacred groves have been integral part of traditional watershed protection systems. Ponds, lakes, springs, streams and rivers associated with the sacred groves were integral to the landscape management systems of traditional societies of especially Indian highlands. Most of these groves lost their significance due to merger of them with the state reserved forests or due to cultural changes. There still exist thousands of sacred groves along the Indian countryside. If these groves are recognized, ecologically restored and brought under appropriate management mechanisms in collaboration with local communities, a fresh revival can happen of the water bodies associated with them.

### 4. **Valuation of the ecosystem goods and services:** Goods and services provided by the individual ecosystems and the respective species to be documented, evaluated through participatory approach and be made part of the Biodiversity Registers (PBR: People's Biodiversity Registers, SBR: School Biodiversity Registers). If in any case the traditional fishing rights of the local fishermen are adversely affected by waterbodies conservation or by declaring it as a bird sanctuary, etc they should be adequately compensated.

- Ecological values of lands and water within the catchment / watershed shall be internalised into economic analysis and not taken for granted. Pressure groups shall play as watchdogs in preventing industrial and toxic and persistent pollutants by agencies and polluters.

5. **Carrying capacity studies for all macro cities:** Unplanned concentrated urbanisation in many cities has telling impacts on local ecology and biodiversity, evident from decline of water bodies, vegetation, enhanced pollution levels (land, water and air), traffic bottlenecks, lack of appropriate infrastructure, etc. There is a need to adopt holistic approaches in regional planning considering all components (ecology, economic, social aspects). In this regard, this forum recommends carrying capacity studies before implementing any major projects in rapidly urbanizing macro cities such as Greater Bangalore, etc.
6. **Demarcation of the boundary of water bodies:** The existing regulations pertaining to boundary demarcations within different states need to be reviewed according to updated norms and based on geomorphology and other scientific aspects pertaining to individual water bodies. Maximum Water Level mark should form the boundary line of the water body. In addition, a specified width, based on historical records/ survey records etc. may be considered for marking a buffer zone around the water body. In case such records are not available, the buffer zones may be marked afresh considering the flood plain level and also maximum water levels. The width of the buffer zone should be set considering the geomorphology of the water body, the original legal boundaries, etc. The buffer zone should be treated as inviolable in the long term interests of the water body and its biodiversity.
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  - The width of the buffer zone should be set considering the geomorphology of the water body, the original legal boundaries, etc.
  - The buffer zone should be treated as inviolable in the long term interests of the water body and its biodiversity.
  - Declare and maintain floodplains and valley zones of lakes as no activity regions
  - Remove all encroachments – free flood plains, valley zones, storm water drains, etc. of encroachments of any kind.

- Ban conversion of lake, lake bed for any other purposes.
- Urban wetlands, mostly lakes to be regulated from any type of encroachments and pollutants (sewage, effluents) letting into the waterbody.
- Regulate the activity which interferes with the normal run-off and related ecological processes – in the buffer zone (200 m from lake boundary / flood plains is to be considered as buffer zone)

7. **Mapping of water-bodies:** The mapping of water bodies should also include smaller wetlands, particularly hill streams, *Myristica* swamps of the Western Ghats, springs etc. The neglect of these hydrological systems could cause considerable impoverishment of water flow in the river systems as well as turn out to be threats to rare kinds of biodiversity. As most of the streams originate in forest areas they come under the legal authority of the forest departments. At the same time the waters of many of these streams are being diverted for private uses. This causes diminished water flow especially in the non Himalayan Rivers during the summer months. A judicious water sharing mechanism has to be worked out at the local level taking into account also the broader national interest as well as conservation of dependent biodiversity. The mapping of these smaller water-bodies, along with their catchments needs to be conducted involving also the local Biodiversity Management Committees. The jurisdictional agreements on the water usage and watershed protection need to be arrived at on a case to case basis involving all the stakeholders.

- Spatial Extent of Water bodies
- Spatial extent of its catchment (watershed/basin)
- Demarcate Flood plains
- Demarcate buffer zone – with a list of regulated activities
- Land cover in the catchment
- Ensure at least 33% of land cover is covered with natural vegetation (to ensure the lake perennial)
- Identify the natural areas in the catchment
- Biodiversity inventory – capture entire food chain
- The jurisdictional agreements on the water usage and watershed protection need to be arrived at on a case to case basis involving all the stakeholders.
- Develop a comprehensive database (spatial with attribute information)
- Identify and demarcate the region around the lake where all activities are to be prohibited (Flood plain)

- The biodiversity of every water body should form part of the Biodiversity Registers (BR).
- The local Biodiversity Management Committees (BMC) should be given necessary financial support and scientific assistance in documentation of diversity.
- The presence of endemic, rare, endangered or threatened species and economically important ones should be highlighted.
- A locally implementable conservation plan has to be prepared for such species.

8. **Holistic and Integrated Approaches** – Conservation and Management : Integration of the activities with the common jurisdiction boundaries of Government para-statal Agencies for effective implementation of activities related to management, restoration, sustainable utilization and conservation. This necessitates:

- Common Jurisdictional boundary for all para-statal agencies
- To minimise the confusion of ownership – assign the ownership of all natural resources (lakes, forests, etc.) to a single agency – Lake Protection and Management Authority (or Karnataka Forest Department). This agency shall be responsible for protection, development and sustainable management of water bodies).
- Custodian shall manage natural resources - let that agency have autonomous status with all regulatory powers to protect, develop and manage water bodies.
- All wetlands to be considered as common property resources and hence custodians should carefully deal with these ensuring security.
- Management and maintenance of lakes to be decentralised involving stakeholders, local bodies, institutions and community participation without any commercialization or commoditization of lakes.
- Integrated aquatic ecosystem management needs to be implemented to ensure sustainability, which requires proper study, sound understanding and effective management of water systems and their internal relations.
- The aquatic systems should be managed as part of the broader environment and in relation to socio-economic demands and potentials, acknowledging the political and cultural context.
- Wetlands lying within the protected area of National Parks and Wildlife Sanctuaries shall be regulated under the Wildlife Protection Act, 1972.

Wetlands lying within the notified forest areas shall be regulated by the Indian Forest Act, 1927 and the Forest Conservation Act, 1980; and the relevant provisions of the Environment (Protection) Act, 1986. The Wetlands outside protected or notified forest areas shall be regulated by the relevant provisions of the Environment (Protection) Act, 1986.

- Immediate implementation of the regulatory framework for conservation of wetlands by the Ministry of Environment and Forests, GOI.
- Formulation and implementation of the National wetlands policy both at state and at national levels.
- Socio-economic studies & land use planning in & around the lakes can help in providing ecological basis for improving the quality of lakes.
- Prohibit activities such as conversion of wetlands for non-wetland purposes, dumping of solid wastes, direct discharge of untreated sewage, hunting of wild fauna, reclamation of wetlands.
- Maintain Catchment Integrity to ensure lakes are perennial and maintain at least 33% land cover should be under natural Vegetation.
- Plant native species of vegetation in each lake catchment.
- Create new water bodies considering the topography of each locality.
- Establish laboratory facility to monitor physical, chemical and biological integrity of lakes.
- Maintain physical integrity - Free storm water drains of any encroachments. Establish interconnectivity among water bodies to minimise flooding in certain pockets . The process of urbanization and neglect caused disruption of linkages between water bodies such as ancient lake systems of many cities. Wherever such disruptions have taken place alternative arrangements should be provided to establish the lost linkages.
- Encroachment of lake beds by unauthorized /authorized agencies must be immediately stopped. Evict all unauthorized occupation in the lake beds as well as valley zones.
- Any clearances of riparian vegetation (along side lakes) and buffer zone vegetation (around lakes) have to be prohibited
- Penalise polluters dumping solid waste in the lake bed.
- Implement polluter pays principle for polluters letting liquid waste in to the lake either directly or through storm water drains.

- Lake privatised recently to be taken over and handed over to locals immediately thus restoring the traditional access to these lakes by the stakeholders.
- Restore surviving lakes in urban areas strengthening their catchment area and allowing sloping shorelines for fulfilling their ecological function.
- Alteration of topography in lake / river catchments should be banned.
- Appropriate cropping pattern, water harvesting, urban development, water usage, and waste generation data shall be utilized and projected for design period for arriving at preventive, curative and maintenance of aquatic ecosystem restoration action plan (AERAP).
- Desilting of lakes for removal of toxic sediment, to control nuisance macrophytes; further silting in the catchment be checked by suitable afforestation of catchment areas and the provision of silt traps in the storm water drains.
- Maintaining the sediment regime under which the aquatic ecosystems evolve including maintenance, conservation of spatial and temporal connectivity within and between watersheds.
- Conversion of land around the lakes particularly in the valley zones and storm water drains for any kind of development must be totally banned.
- Flora in the catchment area should be preserved & additional afforestation programmes undertaken.
- Check the overgrowth of aquatic weeds like *Eichhornia*, *Azolla*, *Alternanthera* etc. through manual operations.
- Aquatic plants greatly aid in retarding the eutrophication of aquatic bodies; they are the sinks for nutrients & thereby play a significant role in absorption & release of heavy metals. They also serve as food and nesting material for many wetland birds. Therefore, knowledge of the ecological role of aquatic species is necessary for lake preservation.
- Adopt biomanipulation (Silver carp and Catla– surface phytoplankton feeders, Rohu – Column zooplankton feeder Gambusia and Guppies – larvivorous fishes for mosquito control), aeration, shoreline restoration (with the native vegetation) in the management of lakes.
- Environmental awareness programmes can greatly help in the protection of the water bodies.

§ Government Agencies, Academies, Institutions and NGO's must co-ordinate grass-root level implementation of policies and activities related to conservation

of lakes and wetlands (both Inland and Coastal), their sustainable utilization, restoration and development including human health. There is also a need for management and conservation of aquatic biota including their health aspects. Traditional knowledge and practices have to be explored as remedial measures. Cost-intensive restoration measures should be the last resort after evaluating all the cost-effective measures of conservation and management of the wetlands.

- § A National Committee be constituted consisting of Experts, Representatives of Stakeholders (researchers, industrialists, agriculturists, fishermen, etc.) and Line Agencies, in addition to the existing Committee(s), if any, in order to evolve policies and strategies for reclamation, development, sustainable utilization and restoration of the wetlands and socio-economic development of the local people.
- § At regional level, Lake Protection and Management Authority (LPMA) with autonomy, corpus funds from plan allocations of state and center and responsibility and accountability for avoiding excessive cost and time over runs. LPMA shall have stakeholders-representatives from central and state and local body authorities, NGO's and eminent people and experts shall be constituted
- § Generous funds shall be made available for such developmental works through the National Committee, as mentioned above. Local stakeholders be suggested to generate modest funds for immediate developmental needs in the aquatic systems in their localities.
- § Provisions be made for adoption of lakes and wetlands by the NGO's and Self-help groups for their conservation, management, sustainable utilization and restoration.
- § Aquatic ecosystem restoration works taken up by any agency, Govt. or NGO's should have 10% of restoration costs (per annum) spent or set off for creating awareness , research and monitoring compulsorily in future.
- § Public education and outreach should be components of aquatic ecosystem restoration. Lake associations and citizen monitoring groups have proved helpful in educating the general public. Effort should be made to ensure that such groups have accurate information about the causes of lake degradation and various restoration methods.

6. **Preparation of management plans for individual water bodies:** Most large water bodies have unique individual characteristics. Therefore it is necessary to prepare separate management plans for individual water bodies.

- Greater role and participation of women in management and sustainable utilisation of resources of aquatic ecosystems.
  - Impact of pesticide or fertilisers on wetlands in the catchment areas to be checked.
  - Regulate illegal sand and clay mining around the wetlands.
7. **Implementation of sanitation facilities:** It was noted with grave concern that the water bodies in most of India are badly polluted with sewage, coliform bacteria and various other pathogens. This involves:
- Preserving the purity of waters and safeguarding the biodiversity and productivity, dumping of waste has to be prohibited;
  - In addition to this, all the settlements alongside the water body should be provided with sanitation facilities so as not to impinge in anyway the pristine quality of water.
8. **Management of polluted lakes:** This programme needs priority attention. This involves:
- Implementation of bioremediation method for detoxification of polluted water bodies.
  - The highly and irremediably polluted water bodies may be fenced off to prevent fishing, cattle grazing and washing, bathing and collection of edible or medicinal plants to prevent health hazards.
  - Warning boards should be displayed around such water bodies.
  - Collection of any biomaterials from such water bodies should be prohibited.
  - Based on the concept of polluter pays, a mechanism be evolved to set up efficient effluent treatment plants [ETP], individual or collective, to reduce the pollution load. Polluting industries be levied Environmental Cess, which can be utilised for conservation measures by the competent authorities. A `waste audit' must be made compulsory for all the industries and other agencies.
9. **Restoration of lakes:** The goals for restoration of aquatic ecosystems need to be realistic and should be based on the concept of expected conditions for individual eco-regions. Further development of project selection and evaluation technology based on eco-region definitions and description should be encouraged and supported by the national and state government agencies.
- Ecosystem approach in aquatic ecosystem restoration endeavour considering catchment land use plan as of pre-project status and optimal land use plan shall

first be prepared for short term (10 years and 30 years) and long term periods keeping in view developmental pressure over time span.

- Research and development is needed in several areas of applied limnology, and this programme should take an experimental approach which emphasizes manipulation of whole ecosystems.
- Appropriate technologies for point and non-point sources of pollution and *in situ* measures for lake restoration shall be compatible to local ethos and site condition as well as objectives of Aquatic Ecosystem Restoration Action Plan (AERAP).
- Traditional knowledge and practices have to be explored as remedial measures. Cost-intensive restoration measures should be the last resort after evaluating all the cost-effective measures of conservation and management of ecosystems.
- Public needs to be better informed about the rationale, goal and methods of ecosystem conservation and restoration. In addition, the need was realized for scientist and researchers with the broad training needed for aquatic ecosystem restoration, management and conservation.
- Improved techniques for littoral zone and aquatic microphytes management need to be developed. Research should go beyond the removal of nuisance microphytes to address the restoration of native species that are essential for waterfowl and fish habitat. Basic research is necessary to improve the understanding of fundamental limnological processes in littoral zones and the interactions between littoral and pelagic zones of lakes.
- Biomanipulation (food web management) has great potential for low-cost and long-term management of lakes, and research in this emerging field must be stimulated.
- Innovative and low-cost approaches to contaminant clean up in lakes need to be developed.
- The relations between loadings of stress-causing substances and responses of lakes need to be understood more precisely. Research should be undertaken to improve predictions of trophic state and nutrient loading relationships.
- Improved assessment programmes are needed to determine the severity and extent of damage in lakes and wetlands and a change in status over time. Innovative basic research is required to improve the science of assessment and monitoring. There is a great need for cost effective, reliable indicators of ecosystems function, including those that would reflect long-term change and response to stress. Research on indicators should include traditional community and

ecosystem measurements, paleoecological trend assessments and remote sensing. Effective assessment and monitoring programme would involve network of local schools, colleges and universities.

- Procedures such as food web manipulation, introduction of phytophagous, insects and fish lining, and reintroduction of native species show promise for effective and long-lasting results when used alone or in combination with other restoration measures. Further research and development needs to be undertaken on these aspects.
  - Paleolimnological approaches should be used to infer the past trophic history of lakes and wetlands and to decide whether these systems should be restored. Paleolimnological approaches could also be used to infer whether a lake has been restored to its predisturbance condition.
9. **Regulation of boating:** Operation of motorized boats should not be permitted within lakes of less than 50 ha. In larger lakes the number of such boats should be limited to restricted area and carrying capacity of the water body. In any case boating during the periods of breeding and congregations of birds should be banned.
  10. **Protection of riparian and buffer zone vegetation:** Any clearances of riparian vegetation (alongside rivers) and buffer zone vegetation (around lakes) have to be prohibited.
  11. **Restoration of linkages between water bodies:** The process of urbanization and neglect caused disruption of linkages between water bodies such as ancient lake systems of many cities. Wherever such disruptions have taken place alternative arrangements should be provided to establish the lost linkages.
  12. **Rainwater harvesting:** Intensive and comprehensive implementation of rain water harvesting techniques can reduce taxation of water bodies and also minimize electricity requirements. The country needs in principle a holistic rainwater harvesting policy aimed at directing water literally from “roof-tops to lakes” after catering to the domestic needs.
  13. **Adopt Inter-disciplinary Approach:** Aquatic ecosystem conservation and management requires collaborated research involving natural, social, and inter-disciplinary study aimed at understanding various components, such as monitoring of water quality, socio-economic dependency, biodiversity and other activities, as an indispensable tool for

formulating long term conservation strategies. This requires multidisciplinary-trained professionals who can spread the understanding of ecosystem's importance at local schools, colleges, and research institutions by initiating educational programmes aimed at rising the levels of public awareness of aquatic ecosystems' restoration, goals and methods. Actively participating schools and colleges in the vicinity of the water bodies may value the opportunity to provide hands-on environmental education, which could entail setting up of laboratory facilities at the site. Regular monitoring of water bodies (with permanent laboratory facilities) would provide vital inputs for conservation and management.

- Funding is needed for both undergraduate and graduate programmes in aquatic ecosystem conservation and restorations. Training programmes should cross traditional disciplinary boundaries such as those between basic and applied ecology: water quality management and fisheries or wildlife management: among lakes, streams, rivers, coastal and wetland ecology.
- Aquatic sanctuaries be created and tanks of religious places be declared as heritage centers for *in situ* conservation.

#### 14. **Waste management:**

- Awareness among people regarding proper waste disposal strategies should be carried out.
- Segregation of waste at the source will help in effective waste management.
- Economic importance of waste
- Proper collection and transportation facilities are to be provided for avoiding illegal dumping of waste materials.
- Emphasis is also to be laid on development of new techniques for treating decomposable wastes.

15. **Environment Education:** It was felt among the participants that public needs to be better informed about the rationale, goal and methods of ecosystem conservation and restoration. In addition, the need was realized for scientist and researchers with the broad training needed for aquatic ecosystem restoration, management and conservation. Public education and outreach should include all components of ecosystem restoration. Lake associations and citizen monitoring groups have proved helpful in educating the general public. Effort should be made to ensure that such groups have accurate information about the causes of lake degradation and various restoration methods. Funding is needed for both undergraduate and graduate programmes in ecosystem conservation and

restorations. Training programmes should cross traditional disciplinary boundaries such as those between basic and applied ecology: water quality management and fisheries or wildlife management: among lakes, streams, rivers, coastal and wetland ecology. In this regard the brainstorming session proposes:

- Environmental education program should be more proactive, field oriented and experiential (with real time examples) for effective learning.
- Environmental education should be made mandatory at all levels as a compulsory subject – schools, colleges, universities, professional courses, teachers and teacher educators at the teachers’ training institutes (C P Ed, B P Ed, B Ed, D Ed)

These recommendations after deliberation in Lake 2010 were handed over on 24<sup>th</sup> Dec 2010 evening to The Chairman, Western Ghats Task Force and the Member Secretary, Karnataka Biodiversity Board with a request to initiate appropriate actions for implementation of suggestions.