

Restoration of Polluted Lakes - A new approach

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ABSTRACT

Lakes are the important water resources which support millions of people, but due to rapid urbanization and industrialization, many thousands of lakes adjacent to urban center has already been closed. The remaining lakes are most useful for holding domestic waste water and dumping of solid wastes.

After the severe crisis facing in water supply, local bodies, irrigation departments, state and central governments and other NGO's are showing keen interest on cleaning lakes and restoring the existing remaining water bodies. It is pathetic to see that even at this stage the action plan proposed to restore the polluted lakes involves only structural oriented activities and not concerned with ecological components like flora and fauna and environmental aspects.

The structural components like desilting strengthening sluice and weir repairs are plays critical role in the action plan. The action plan does not address the waste water, solid wastes, public awareness, training etc. since the civil engineers involving in the restoration programme do not have any idea about basic environmental and ecological issues and the need of remedial measures for keeping the lakes pollution free.

This article insists the need of change of attitude in lakes conservation concepts. In the lakes restoration plan the causes, impacts due to pollution are to be studied. Some time the change of land use pattern also paves ways for encroachments. Before arriving any action plan, for polluted lakes, all the social and environmental issues shall be listed and also the holistic approach is to be adopted for preparing the DPR.

Basis for the scientific way of improving lakes is arrived based on the eco system approach for which the communities involved in the preparation of DPR have to develop their skill in environmental, ecological and social aspects. Since our lands and areas are divided into specific eco system such as forest, pond, river eco systems. Each eco system has its own advantages in supporting the environment and people. Without knowing these facts about the pond eco system, restoration of lakes with respect to structural component will not solve the problems. Here a new approach is needed in preparing the DPR for the restoration of polluted lakes.

Keywords Urbanization - Industrialization – Domestic Waste Water – Solid Waste – Ecological Components – Flora and fauna – Encroachments – River Eco system.

INTRODUCTION

Lakes are life supporting system of the society. Some of the lakes have water only during rainy season called as rain fed tanks and some other lakes have water throughout year called as system tank. Lake pollution is a common scenario due to rapid urbanization and industrialization. So the water quality of lakes become unfit for the purposes assigned. Lake restoration is being practiced for past several years by central and state governance and local bodies. Even many NGO (Non Governmental Organization) and private firms are also involving in the restoration programme of polluted lakes. Some popular lakes in India viz Katchrali lake, Ooty Lake, Kodaikanal lake, and Hussain sagar lakes restoration programme have been implemented in the past years. But the water quality of few lakes has again polluted due to mixing of waste water and the amounts invested become waste due to unscientific approaches.

The restoration of polluted lake is easy in the rain fed tanks and seasonal lakes. It is very tough in the system tanks and perennial lakes. From the past experience, it has been observed that the restoration action plan consists of desilting of lakes and strengthening of weirs and bunds. Many action plans do not talk about the discharge of waste water and dumping of solid waste. So the polluted or degraded lakes have not been rejuvenated completely except in one or two lakes. So, the present restoration approach adopted to restore the lakes has to be changed because of highly complicated pollution problems. Before going to deal the new approach, how the present approach become constraint in the restoration plan can be seen in detail. So this is a concept paper prepared based on the various experiences from field of Tamilnadu and south India lakes which could be suitable for world.

GENERAL FUNCTION OF LAKES

Conventional Functions

Whether it is a big lake or small lake, shallow or deep lake, seasonal or perennial lakes the lakes are generally useful for the following purposes.

1. Substitute the drinking water
2. Substitute the ground water recharging.
3. Useful for cultivation
4. Useful for domestic activities
5. Useful for aquaculture activities
6. Useful for water theme centered tourism
7. Influence and Maintain the local climate
8. Influence local precipitation.
9. Attracts migratory birds and native birds.
10. Act as an efficient flood control system.
11. Solve the water scarcity issues in summer.
12. Enrich the floral and faunal communities

New Functions

In addition to the conventional uses mentioned above, today these tanks and lakes are also more useful for the following purposes

1. Act as sink of modern society
2. Useful for encroachments for all kind of buildings
3. Act as a dumping yard of the city
4. Fulfill the city's space scarcity

The modern society treat the lakes water spread area and the supply channels as sink and dumping yard of the society.

Degradation of lakes

More and more people migrate from rural area to urban area for their better livelihood. Though the statistics says that 65% people are still living in rural area, the migration rate is very fast. In Tamilnadu the urban population already crossed 40% which is higher than any other state in India. Urbanization demands more water resources as well as more household materials for easy and luxury life. The people, who cannot afford cost for land and house for their homes, generally occupy the banks, bunds and even in water spread area of the urban lakes. Some time the government itself encroached for hospitals, school buildings and housing board flats in the name of providing development schemes. More over the city's development did not concentrated on land use pattern. Unplanned growth of the city created public civic problems and untreated domestic water entry is a common scenario in all major Municipalities and corporations. The urban lakes are polluted more than the rural lakes. Many thousands of lakes have already been disappeared due to urbanization and the remaining lakes are polluted with waste water and solid wastes. The remaining lakes shall be conserved for the future generation is

the need of the hour. Pollution prevention and restoration of polluted lakes are the essential components of lake development programme.

Causes of degradation

The lakes are degraded due to various activities. The major causes of degradation are listed below:

1. Encroachments (unauthorized by private agency)
2. Change of land use pattern (authorized by Government agency)
3. Dumping of all kind of solid wastes
4. Discharge of untreated municipal sewages
5. Discharge of untreated industrial waste water
6. Siltation in water spread area
7. Poor maintenance of the lakes
8. Hiring of Consultants concept
9. Poor city master plan
10. Lack of awareness on water bodies, Environment and Nature
11. Crazy ornamental consumerism

The above mentioned causes play crucial role in the degradation of lakes. The social and livelihood issues are influencing the activities. The change of life styles, change of occupation, ornamental consumerism, material driven life styles are the major causes of the degradation. Let us see how the each activity affects the lake's eco system. Without analyzing these causes and impacts, one cannot prepare a successful detailed project report for the restoration plan for the polluted lakes.

Encroachments

Encroachments are very common scenario near urban lakes. Poor people encroaches the bunds; slope of banks, water spread area, foreshore area for their houses. They construct houses with tiled sheds thatched huts, temporary and semi permanent structures. Rich people and companies are also encroaching the water bodies for their business purposes since the land value is more in urban area. Farmers are occupying the fore shore area for cultivation purposes when there is no water in the lake. These are the unauthorized encroachments done by the people as per their capacity. The main supply channels of the lakes are severely encroached in all cities; because it is the public property and no one question them. The surplus channels are also closed in many areas. The impacts can be seen in rainy season as flooding in all low lying area, streets and Roads even for a light rain. The waste water discharge into the supply channels lead to pollution of lakes unanimously. After closing or encroaching the lakes, people cry for the water supply in dry season and summer. They demonstrate struggles in front of government office demanding for their water supply. The Tamilnadu Government has realized the

need of protecting the water bodies and so enacted an act recently stating severe punishment on encroachers of water bodies belong to Public Works Department. It is a pioneer act stating severe punishment for encroachments and helps the field engineers for encroachment removal action programme.

Change of land use pattern

Whether for school building, hospitals, housing scheme, court buildings, power stations and for any other government office buildings construction, the lakes were encroached by changing the land use pattern. This kind of encroachments is called as authorized encroachment. The government or local bodies can make resolution and make order for constructing buildings in water bodies and in the banks. In Tamilnadu during 1960, we had 40000 lakes and during 2000, the figure reduced to 30000 lakes. This can also be seen from the agriculture statistics. During 1960, the cultivation through lake water was around 44% of the total area. But during 2000 this figure reduces to 23% shows the reduction in lakes and agriculture area. In Tamilnadu more than Ten thousand lakes were closed for development activities due to lack of awareness and mismanagement.

Once upon the lakes were utilized mainly for irrigations and aquaculture. When urbanization takes place irrigation lands have been converted into other uses. So people and government also thought that the lakes are no more useful for irrigation. Since irrigation lands are not available and simply they swallow the lakes with change of land use pattern. They miserably failed to understand the other functions of the lakes apart from cultivation. They failed to see the lakes as unique eco system. They calculated the lakes value with respect to cultivation alone and simply forget the other uses such as aquaculture, ground water recharging, climate control system and flood control systems etc. This experience give us a lessons that lakes are a part of eco systems have multiple direct and in direct functions. If this is realized by the administrators, the action plan shall include all steps to restore the 'biotic' components in addition to 'a biotic' component.

Dumping of solid wastes

Urbanization tends to produce more solid wastes than rural area. The solid wastes produced in the city are used to dump in the low lying area, streams, and supply channels and in the lakes for two purposes. One is that the authorities do not know the scientific waste disposal plan since they wanted to solve the solid waste problem. Second is if they dump and level the low lying area this could be useful for other construction activities.

So legally and illegally the local bodies, public, merchants, builders, contractors, industrialists dump their solid wastes into the water spread area and banks of the lakes for the easy disposal. This habit continues still in all urban lakes. Because of solid wastes the water quality is affected due to lea chat effect even the Ground water quality in and around the lakes are also affected. After few years of dumping, the periphery of the lakes is slowly closed for any building activities. So the Detailed Project Report of restoration of polluted lakes shall include the disposal management of municipal solid wastes. With out addressing the solid waste management plan restoration of polluted lakes could not be implemented successfully.

Discharge of municipal waste water

The waste water produced from municipalities and corporation; ultimately find its ways to low lying area such as canals, drains and lakes. The untreated and semi treated waste water discharged into the lakes is the only simple solution could be offered by the local administration. For the implementation of sewage treatment plant, many conventional treatment plants are available such as aerated lagoons, oxidation ponds which need more land for the treatment. The other methods viz, Activated Sludge Process (ASP), Trickling filter (TF), Rotating Biological Contactor (RBC), Rotating Biological Reactor (RBR), Ion Exchange and Electrolysis needs more mechanical and electrical equipment which increases the maintenance cost especially the skilled labour and electricity charges. In growing urban area it is very difficult to get more land area for the conventional methods and hard to meet out the expenditure for the maintenance charges.

So the local bodies simply sent the waste water into the lakes found easy for all purposes. Even in the well developed corporations, in the outer periphery developing area, where they do not have UGD (underground drainage) system, they discharge the waste water into low lying area. The waste water contains high amount of nitrates, phosphorous which act as nutrients for water weeds. So unanimously all the urban lakes have water hyacinth and other weeds over the surface area. The manual removal of water hyacinth cannot solve the problems and all lakes lead to eutrophication condition. Many local bodies, NGOs are removing the water weeds manually or mechanically and within three months the weeds come as evader. So the DPR shall include the sustainable waterweed management plan so that the growth of water weeds could be stopped. In many NLCP (National Lake Conservation Lake Project) programme the Environmental part is delayed or ignored so that weeds have grown again in the water bodies.

Discharge of industrial waste water

Urbanization, other sides paves ways for industrialization. Industrialization helps the society for better employment, increase of standard of livings, and fulfills the house hold goods need to the society. It also parallelly generates the waste streams, solid wastes and gaseous. The industries like tannery, textile, paper, pulp, sago and pharmaceutical, sugar and chemical industries consume more water for their process and generate waste water. These industries till date do not have effective full-fledged waste water treatment plant. The semi treatment plant or partial treatment plant provided in the treatment system for sake of business do not solve the purposes. The waste water contains with huge quantity of chemicals, dyes, salts and other organic material mixed in the lake water which deteriorated the quality of water. The treatment technologies adopted in ETP (Effluent Treatment Plant) and CETP (Common Effluent Treatment Plant) do not meet the standards required because of more complicated issues. That's why nowadays high court and supreme courts are intervening in the issues and directing the concerned authorities for zero discharge concept by changing the technology.

The so called proud able technologies adopted in the ETP and CETP solved only a few parameters. For example in Tannery and Textile industries, the ETP and CETP can reduce the colour and reduce the BOD, COD and TSS to certain extent but did not solve the TDS (Total Dissolved Solids) issues. Even after spending crores of rupees for CETP and ETP the partial approach adopted in the treatment system made the urban lakes into severe pollution. One form of waste has been converted into other form. The liquid waste has been converted into solid wastes during the treatment process and disposal of solid waste become big menace to the society. So without addressing the industrial waste water issues, lakes could not be restored. In many lakes untreated and semi treated waste water found mixing and the restoration programme shall have mitigation plan for the management of industrial waste water.

SILTATION IN LAKES

Catchment management programme

Siltation is the natural phenomenon. The soil erosion takes place in the catchment area silt up in the water spread area which reduce the water holding capacity of the lakes. But dumping of solid wastes including construction debris, agriculture wastes and municipal wastes are found along the banks of the lakes more than the natural silt.

So the rain water from the upper tanks, surplus to down stream side as waste. So growing more vegetation in agriculture field nary by banks can prevent soil erosion. The dumping of solid wastes in catchment area also leads to silting in supply

channel. So if necessary desilting could be done occasionally to increase the capacity.

When the farmers used the lakes for irrigation purposes, they desilted the lakes during summer season and used the enriched soil for their lands. When change of utility shifted or irrigation activities reduced, silt removal become problem. Moreover the urban silt contains with plastic bags, water bottles, glasses and many non decomposable materials, the silt totally unfit for agriculture lands and so the farmers rejected the urban lakes silts. So without planning for the urban solid wastes management and the proper catchment management programme the restoration programme of polluted lakes will not become success.

Poor maintenance of the lakes

During 1960 and 1970s, the lakes were used for irrigation purposes. So during summer the authorities, taken steps along with farmers to repair the sluices and strengthen the bunds. When agriculture uses are reduced, the maintenance budget also reduced. To increase the productivity through cultivation, the periodical maintenance expenditure was incurred. When the utility scope changed as urban area, the maintenance budget either stopped or reduced, which increased the damage of the structures such as bunds, weirs, sluices and inlet and outlet channels.

They have seen the lakes as productivity component when agriculture took place. When the ayacut changed into urbanization they thought that lake area is waste. Irrigation is one of the activities; one can see the benefit directly. The other uses of the lakes such as the ground water recharging, aqua culture, influence on local participation and climate control and helpful to aquatic organisms and birds might be invisible could be easily linked with the productivity. In short the flora and funna status of the lakes towards the productivity is not measured and realized. So the budget for the regular maintenance of the lakes have been considerably reduced or stopped. The B.C. ratio calculation does not permit the authorities to allot the needed amount for its regular maintenance increases the damage of physical components. So the authorities shall under stand the 'lake ecosystem' are supporting system for the mankind apart from direct irrigation.

Poor City Master Plan

Urbanization is inevitable. The rural people migration to urban centre increases day by day. The local planning authorities and urban authorities did not visualize the extent of damage that thy see in the water bodies. Due to encroachments in the natural drains and lakes flooding is a regular problem in every rainy season. Increase of vehicles, unplanned layout, and scarcity of protected drinking water

always threatens the urban people. Providing water supply, electricity, road and other amenities are the priorities for the administrative authorities. So they give least importance to the solid waste management, sewage treatment plant and conservation of lakes.

More over all government departments who act as service sectors stopped the intake of technical experts and engineers for their development activities. Due to employment ban, the technical experts reduced in the engineering departments who maintain the lakes, drains and do development activities. So it is hectic for the limited available technical staffs for the effective planning. The social and other situation drive the policy makers to recruit only the IAS and clerical staff. The engineers, technical assistants luskars (lowermost staff who maintain the lake and distribution system) have not been recruited sufficiently to execute the development activities and as well as to curtail the encroachments and misuse of lakes.

The English people and post independence rulers felt the need of maintaining lakes and to develop the water resources. So, major reservoir constitutions were implemented after independence. The first five year plan programmers insisted the need on water resources development for nation's overall development. But today the policy has switched to industrial sector. Today for any developing country industrial development is essential are the Vedic words from the developed country view point. But even for the industrial development and urbanization, water is the basic need where the lakes support the mankind lot is not understood by the planners, stakeholders other than farmers, public as well as misusers.

Hiring of Consultants concept

Hiring local and international consultants for every development schemes developed the non responding attitude. During 1960, 1970,s in India all the major Reservoirs and Dams were constructed by our own Engineers and Technical experts. For past two to three decade the situation changed due to the pressure of international funding agency like IMF, USAID and World Bank. The consultants hired from the direction of these funding agencies do not take responsibilities when any natural disasters like flooding Tsunami take place. In CATHRINA named cyclone incident in United States the Government help extended only after two or three days of the incident because of the consultant concepts. But in India if you take any disaster the government help better than any developed country in spite of more financial constraints because the government is taking responsibilities. But here also the consultant concepts slowly reduce the strength of the Government Departments shall be realized by the policy makers. Lack of funds and staff strength

coupled with the political system lead to the poor maintenance of lakes.

Lack of awareness on the role on water bodies and Nature

The generation who started their career after 1970's does not felt the importance of lakes. If any 100 year old building is demolished for any alternative use, the archeological department and public are protesting not to demolish the same. But these lakes were 600 years to 2000 years old. Whether it is encroachments, dumping of solid wastes, discharging of industrial and domestic waste water, nobody thought of protecting the lakes. They happily involved in the disasters, because they directly or indirectly benefited the short term benefits. They failed to understand the importance of good old lakes supported to the mankind from generation to generation. People not interested to understand the nature's gift and nature.

They wanted to succeed the nature by their scientific inventions and like to lead a luxury life as in developed countries. They are marching towards the economic race where no values even for father, mother, relations, god and nature. The only aim is to become rich man, wealthy man with big bungalows, modern cars and all luxury materials. In this economic race, man virtually become mad for economic development and forgotten the role of other natural supportive systems such as lakes, rivers, streams and forests.

Crazy ornamental Consumerism

Consumerism can be simply defined as the purchase of goods for the day to day life. The consumerism has changed from basic needs of consumerism to crazy ornamental consumerism. This crazy consumerism has changed the good old habits of respecting nature and water bodies. The crazy consumerism lead to change of life styles which demand more urbanization, industries, markets. All these growths tend to produce more solid wastes.

Huge quantity of fisher died in one lake at Ahamedabad due to immersion of gigantic Ganesh idols made with plaster of Paris, tin sheets and colourful paints.

Fast food culture demand more hotels in urban area which generate more wastages and the waste quantity is increasing day by day. Use and through objects produce more waste which denies the reuse and recycle concepts.

The crazy consumerism change the thinking power of the people, because of brain washing advertisement and consequently people forget the values of water bodies and environment. So awareness on environmental protection, reuse and recycling concepts and water bodies' protection are

so necessary, for urban people while launching the plan of restoration of polluted lakes.

Restoration programme

Restoration action plan of the polluted lakes shall be prepared carefully considering the causes and impacts of pollution. The restoration of any polluted lakes has three objectives as listed below.

1. To increase or restore the water holding capacity of the lake
2. To improve the water quality of the lake.
3. To evolve sustainable management plan after restoration.

These objectives shall be fulfilled only if the polluted lake shall be addressed in the holistic approaches. Conventional method of restoration insists desilting, strengthening and widening of bunds, repairing the sluices and weir. These structural components are essential for safety aspects during rainy season. But degradation of lakes takes place not only due to damage of bunds and weirs as mentioned in earlier paragraph but, dumping of solid wastes, encroachments, discharge of waste water also. The micro organisms such as zoo plankton and phyto plankton are so important in maintenance the fresh water of lakes. So without knowing the Physical Chemical and Biological characteristics of the lake water one could not prepare a sustainable restoration plan.

Role of zoo plankton and phyto plankton

The zoo plankton is a smallest aquatic fauna which plays major role in maintaining the lakes. Phyto plankton is a smallest aquatic flora such as Azolla and A.microphylla is so much important in fresh water system. The grazing on phyto plankton which is a smallest form of aquatic flora feeds zoo plankton. These two forms of flora and fauna do their activities when the pollution load is within the carrying capacity of lake.

Numerous plants and animals ranging from microscopic algae to large trees and from protozoa to mammals, possess various morphological, anatomical and physiological adaptations that allows them to survive and grow in water.

Many organisms are planktonic (freely drifting within surface layers of water). They include numerous algae, crustaceans, and larval stages of several group of organisms, phyto-and zoo plankton occur in all habitats, but maximum development of their population occur in standing water which has high influence on water quality.

Basis for new approach

The degradation of lakes occurs both due to either a biota or biota factors (or) structural and non

structural damages. Few structural damages are listed below.

1. Damage of bunds, sluices, weirs
2. Encroachments of lakes
3. Siltation of lakes
4. Growth of water weeds

These factors can be called as A Biotic factors.

Non structural damages are listed with water quality and ecosystems.

1. Dumping of solid wastes
2. Discharge of waste water
3. High nutrients for the growth of water weeds
4. Conceptional change in sluice operations.
5. Sustainable maintenance plan
6. Deposit of silt due to catchment degradation

These factors can be called as biotic factors.

After desilting and strengthening the water stored in the lake shall meet the standards for the assigned purpose. The pollution of lakes shall be stopped or curtailed. The action plan interlinked with non structural components shall be included in all the DPR. The above structural damages could be handled by widening and strengthening of bunds desilting of lakes, de weeding activities. Normally the Engineering community is well versed with these activities. The lake restoration DPR definitely shall have these components.

The degraded lakes shall be restored by implementing the following activities.

- a. The city shall be implemented the scientific municipal solid waste management plan.
- b. The untreated or semi treated waste water from domestic and industries shall be treated effectively and allowed into lake otherwise, diverted to other areas.
- c. If the water stored in the lakes could not be released from the lake, then the polluted water shall be scientifically treated using bio remediation and ozone technology which are natural and cost effective technologies proved by the Environmental Cell Division of Tamilnadu Public Works Department.
- d. The nutrients enters into the lake shall be stopped for arresting the growth of water weeds and eutrophication.
- e. The stake holder's involvement in necessary to increase the productivity of water in the lakes.
- f. Formation of core groups for maintaining the lakes and training and capacity building
- g. In majority of lakes, ayacut area has been reduced due to urbanization. So sluice operation could be closed and well irrigation only shall be allowed direct irrigation could be closed so that water could be stored for more months.
- h. Bio remediation and Ozonisation are new technique, without desilting, the treatment

of lakes for stagnated water could be treated, where all organic pollutants will be oxidized and the silts are considerably reduced.

Untreated industrial waste water mixes in many lakes. Without stopping the untreated water or installing effective treatment plant before the inlet of lakes, the restoration will not be success.

Treated water as a Resource

If the waste water could be treated as per the standard norms, the treated water will become resource for the lake. But PCB rules objects for the discharge of treated water into lakes. The change of attitude is needed to address the issues.

Even if the municipalities are planning for UGD (Under Ground Drainage) / USS (Underground Sewer System) some where, some quantity of waste water flows into lakes are inevitable. So planning of simple treatment plant, at the end of supply channel is necessary so that the waste water could be converted as resource for the lakes. Here by pass arrangements could be made so that during normal course the waste water take diversion to treatment plant and treated water will come to supply channel. During rainy season the dilution effect will take place and so the diluted water could be allowed directly to the lakes as shown in fig.

Bio remediation concept

Bio remediation technique helps to treat the lake without desilting, when the lakes are with full quantity of water permanently like in Ooty and Kodaikanal in Tamilnadu. The bio remediation technique has five components.

1. One time removal of water weeds and disposal.
2. STP using Bye pass arrangements.
3. on line Treatment of lakes
4. Beautification of lakes and protecting arrangements
5. Sustainable Maintenance Plan

One time removal of water weeds

The water weeds shall be manually or mechanically removed one time and proper conversion of removed weeds into bio compost and vermin compost are the important components in weed management. Normally they remove the weeds and dumped near the lake bund shall be avoided.

STP using bye pass arrangements

The existing lake water treatment is not adequate, because the incoming waste water shall be addressed using bye pass arrangements. This STP is also could be designed using bio remediation

concepts, where land area for treatment plant shall be reduced.

The microbes' application in the STP will reduce the land area and also the aeration helps to increase D.O. level and microbial population. These microbes' actions oxidize the organic compounds of pollution.

On line Treatment of lakes

Applying microbes in the lakes water either in the form of powder or liquid and EBB Block and supplying aeration for microbial actions are the main components. The exogenous microbes is necessary to handle the pollution load, high ranges of BOD, COD, odor could be reduced within the norms. Regular application of microbes, aeration for one year to two year can treat the lake. Even the silts at the bottom will be oxidized and the de Siltation takes place without desilting.

Beautification and fencing of Lakes.

After implementing the three components beautification of lakes bunds and gardening could be planned in and lake area. Widening of bunds, Revetment and Turfing at on and off the shore side of bunds and planting herbs and shrubs may useful to improve the aesthetic value of the lakes. Chain link fencing or barbed wire fencing is also constructed to stop encroachments and misuse until core group take charge of the regular lake maintenance.

Sustainable Maintenance Plan

After implementing the above four components the lakes shall be maintained successfully without any further encroachments and pollution. The maintenance involves the following activities.

- Annual repair and maintenance of bunds
- Regular water supplying and analysis of inlet water and lake water
- Training, seminar, workshop, exposure visit to the are group for acquiring the knowledge on lakes conservation
- Regularize the aqua culture activities.

Stake holders' involvement

The various stake holders using the lake for their use shall be involved in the maintenance plan. A core group shall be formed comprising all the users such as famous, industrialists citizen group, fishing firms, educational institution and government departments so that maintenance of lakes could be made sustained. This group may be selected based on rotation basis and their commitment. Training, seminar and Exposure visits will be given to the core group as capacity building activities and in turn to implement effectively.

CONCLUSION

Restoration of polluted lakes involves the repairing of physical structures and improves the quality of water. It is like both side of the coin. The structural repair and remediation helps to hold more quantity of water to reduce impacts of the flooding and solve the water scarcity. If the quality of water is good for the assigned purposes, then only the lake water is useful to the society. The quality improvement activities will keep the lake water fresh and aquatic micro organisms like zoo plankton and phyto plankton existence will help to keep the lake water fresh by nature itself. More funding is necessary for the maintenance. From aquaculture, restricted boating and Eco tourism can generate income for maintenance of the lakes. So the lake authorities shall prepare the details project report (DPR) with new approach involving all the components mentioned above. So the Engineering and Technical community who have the implementing powers, shall always bother about the safety of the lakes shall also come forward to understand the other scientific functions of lakes and accordingly the Detailed Project Report has to be prepared for the welfare future generation.

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