

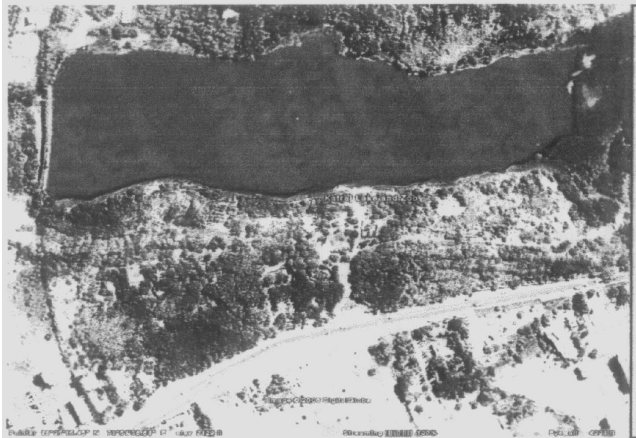
# 'EIA OF SURFACE WATER BODIES IN A CITY – LESSONS LEARNT FROM A CASE STUDY ON KATRAJ TANK, PUNE'

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## INTRODUCTION

**Environmental impact assessment** process involves evaluation of environmental implications and incorporation of necessary safeguards for those activities having a bearing on environment. Any economic development project, whether it is a simple and small or a large and complex it has some environmental implications. The environmental implications may be beneficial or adverse, but the main objective of impact identification is to specify areas that are likely to be affected by the implementation of a project. As a result, EIA has become of ever increasing importance as a tool for development of decision-making.

As per the guidelines established by NEPA and CEQ, it is necessary to submit EIA report to the concerned authority before starting any project. In India, the Ministry of Environment and State Pollution Control Boards together have prescribed certain norms for the grant of "*No Objection Certificate*" to the Industries which require undertaking a proper EIA study and submitting a report justifying the requirement as per Environment Protection Act 1986. Moreover, construction and operation of the proposed projects to be set up in the State of Maharashtra requires environmental clearance from Department of Environment, Government of Maharashtra.

The EIA of Katraj tank is taken up because it has a lot of importance in aspects of historical, economical, aesthetic, cultural and ecological value. A number of environments

are to be described for carrying out EIA of Katraj Tank. The first step was study of site location and collecting base line data. Second step was to collect and describe the Environment Inventory. Next step was depending on the result of the analysis future impacts were predicted. Finally to reduce the severity of the future impacts certain mitigation measures and suggestions were given and Environmental Impact Statement was made.

*EIA- A REVIEW:* "EIA may be defined as the systematic, reproducible and interdisciplinary evaluation of the potential effects of a proposed action and its practical alternatives on the physical, biological, cultural and socio-economic attributes of a particular geographical area"

## Objectives of EIA: -

- Immediate objectives of EIA are to: Improve the environmental design of the proposal; Ensure that resources are used appropriately and efficiently; Identify appropriate measures for mitigating the potential impacts of the proposal; and facilitate informed decision making, including setting the environmental terms and conditions for implementing the proposal.
- Long term objectives of EIA are to: Protect human health and safety; Avoid irreversible changes and serious damage to the environment; Safeguard valued resources, natural areas and ecosystem components; and enhance the social aspects of the proposal.

Three of the most significant new terms are "Environment Inventory", "Environment Impact Assessment", and "Environment Impact Statement" are studied with the help of three E's as Environment, Engineering and Economy. Impact Analysis Methods should provide a means for evaluation of competent EIA report. The EIA process in India is made up of phases like Screening, Scoping and consideration of alternatives, Base line data collection, Impact prediction, Public hearing, Decision-making, Monitoring the clearance conditions. As recommended by the Ministry of Environment and Forest, Government of India, Framework of EIA is as shown in Figure1.

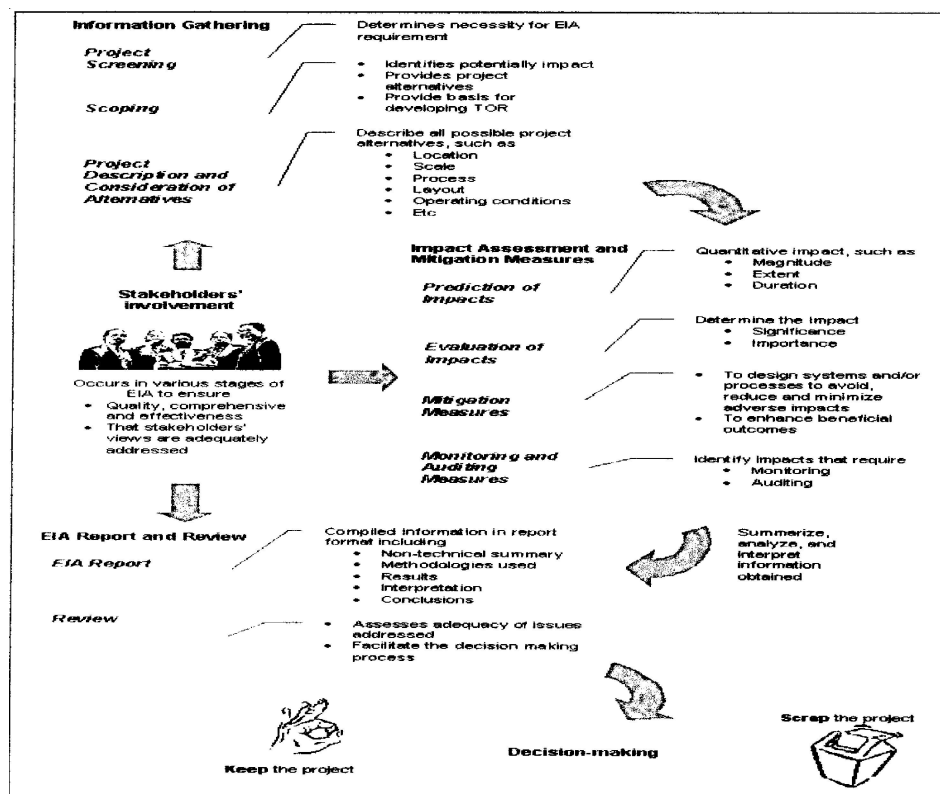


Fig.1: Framework of EIA

## PROJECT DESCRIPTION

**Overview of Project:** Katraj tank is situated to the south of Pune city, behind the 'Rajiv Gandhi Zoo' off Pune-Satara road. In 18<sup>th</sup> century during the time of second peshwa, water supply system from Katraj tank was designed to meet the demand of drinking water. This water supply system, constructed in 1750 by Balaji Bajirao Peshwa, comprises huge ducts and underground tunnels (The five-foot high, three-and-a-half-foot-wide tunnel system runs nine kilometers) originating from Katraj Tank of the city to the historic Shaniwarwada Fort, the ancient seat of the Peshwas. Today only 75% of its original area and half of its original depth are left because of siltation and increased human interferences. Due to increase in pollution load and human activities the water no longer serves for drinking purpose at source also. Thus it is very important to study the impact on the tank and take steps to minimize the activities which contribute in increasing the pollution load.

The tank also holds great importance in terms of scenic beauty as it is surrounded by greenery and hills because of which it has a lot of aesthetic value. As it is a peaceful location with fresh air and lots of trees, lot of people come to take a break from the polluted areas of the city. Katraj tank serves as a perfect habitat for many plants, animals and micro-organisms to grow and perpetuate, thus contributing in a big way to preserve the ecological richness. It is also regarded as one of the tourist attractions not only because of its scenic value but also because it holds a Zoo and a Snake Park on its side where activities like ex-situ conservation and research on many wild

species of animals are taking place, because of which a lot population make a visit. Boating is also carried out for the tourists who come to enjoy the beauty of the tank.

Thus due to its importance in all the spheres, a detailed study of its water, soil, socio-economic and cultural environment will help us know the present status of the tank, predict the impact caused on various environments and take measures to prevent the damage caused by human activities.

## DESCRIPTION OF DIFFERENT ENVIRONMENTS

**Water Environment:** - Study of water quality and quantity of the study area was done by analyzing the number of water samples from different locations for various parameters. The 6 generic step model for addressing tank water environment impacts is as follows:

1) *Identification of surface water quantity/quality impacts of the project:* Increase in water depth due to flow obstruction by constructing a weir across the flow. Human activities have degraded the water quality to a large extent, the water that was used to be clean and clear has become dirty because of high amount of suspended solids and algae formation. This has decreased the amount of sunlight entering the tank and also decreased the dissolved oxygen content of the water. The tank was supposed to be having double the depth till the end of 18<sup>th</sup> century, compared to the depth it has today. The main reason behind the decrease in its depth is the siltation caused by various human activities like dumping, celebrating Ganesh festival as well as natural causes like soil erosion, etc. The area it covers presently is also just 75% of what it used to be 8 years back

and the amount of water it holds is just half of what it used to be. Before a couple of years, the tank was used as a dumping site; waste water from other sources as well as drainage water was allowed to mix with the tank water. Fortunately such activities have been strictly stopped, which has again improved the quality of water and made it suitable for irrigation purposes, drinking water for animals and birds and for other than drinking.

2) *Preparation of description of existing surface water condition:* \*Average of 'three-katraj tank water samples' (collected from three different locations) analysis is as follows.

**Table 1: Water testing results**

Sr.	Environmental Parameter	Unit	Samples collected in* No.	
			March 1996	March 2006
1	2	3	4	5
01	Temperature	°c	24.125	22.5
02	Total Solids	ppm	650	675
03	Dissolved Solids	ppm	307.5	295
04	Turbidity	ppm	13.75	12.5
05	Conductivity	mS/cm	0.605	0.565
06	pH	---	8.575	7.665
07	Total Alkalinity	ppm	96.5	95
08	Dissolved Oxygen	ppm	3.533	7.0
09	Biochemical Oxygen Demand	ppm	137.5	---
10	Chemical Oxygen Demand	ppm	165	171
11	Total Hardness	ppm	133.5	129.35
12	Chlorides	ppm	71.35	83.453
13	Phosphate	ppm	0.0225	---
14	Potassium	ppm	420	---
15	% Sodium	ppm	93	---
16	Sulphate	ppm	---	0.007

3) *Procurement of relevant surface water quantity standards and guidelines:* \*\*Maximum Permissible limits for parameters are given as for Dissolved Solids- < 150ppm, Over 500 ppm for any monthly average is unacceptable, single test should not be over 750 ppm, pH- 6.5 to 8.6, Total Alkalinity-100 and 200, Poor streams have lower alkalinity levels, Dissolved Oxygen -> 5 ppm is considered unacceptable for most aquatic organisms, Biochemical Oxygen Demand->5 ppm means poor water quality, Total Hardness-< 250 as per BIS.

4) *Impact prediction:* Decrease in amount of sunlight penetration and dissolved oxygen depletion has led to anaerobic decomposition causing methane and carbon dioxide formation inside the tank and this if goes on increasing can prove to be a dangerous situation. One of

the major impacts on the water environment is the impact of dumping or solid waste disposal in water. This has degraded the quality of the water, thus made it unfit for drinking. Dumping of huge amounts of solid waste increases the organic and inorganic load leading to siltation, thus decreasing the depth of the tank causing reduction in the volume of water it can hold. This activity has decreased the depth and area of the tank to 50 % and if it continues to happen it is predicted to decrease the depth and area of the tank again to 50% in the next 10 years. If such activities continue to take place, the water of the tank will no longer safe.

5) *Assessment of impact significance:* Light's ability to pass through water depends on how much suspended material is present. Turbidity may be caused when light is blocked by large amounts of silt, microorganisms, plant fibers, sawdust, wood ashes, chemicals and coal dust. The most frequent causes of turbidity in tank are plankton and soil erosion from logging and dredging operations. In addition, a whole range of reactions (e.g. microbes breaking down organic matter, oxidizing ammonia also use up oxygen) that result in degradation of water quality occur when oxygen is lost from the water column, which is very important to the health of aquatic organisms..

6) *Identification and incorporation of mitigation measures:* Dumping of even the treated wastes from any nearby industries should be strictly prohibited to maintain the quality of tank water. Activities like washing, fishing, swimming, bathing etc should not be allowed in and around the tank. Use of motor boats should be strictly avoided to prevent water pollution due to smoke, fuel and oil leakage and noise pollution.

**Soil Environment:** - To provide a basis for addressing soil environment impacts, the 5 generic step model for addressing tank water environment impacts is as follows:

1) *Identification of surface water quantity/quality impacts of the project:* The impact of dumping of solid waste on land and in water is the major impact identified. As in future this activity might increase with the increase in the inflow of tourists. This can degrade

the quality of the soil, thus make it polluted and less fertile. The Katraj tank is surrounded by agricultural fields on its 3 sides. The run-off from these fields enters the tank and this water contains high amount of pesticides, chemical fertilizers, and suspended solids which can increase the inorganic load which can get deposited on the soil making it infertile and this can lead to loss of many micro-organisms, planktons and plant species.

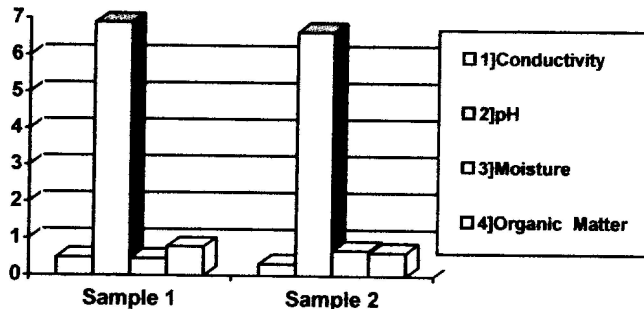
2) *Preparation of description of existing soil condition:* The results of soil sample tested on March 2006 are as follows,

Table 2: Soil testing results

Tests	Sample1	Sample2
1] Conductivity	0.48	0.31
2] pH	6.88	6.63
3] Moisture	45%	68%
4] Organic Matter	0.78	0.62

Graph 1: Soil testing results

Graph 1: Soil testing results



3) *Impact prediction*: Solid waste disposal on land has degraded the quality of the soil, though not to a huge extent but the soil samples analyzed were found to be mixed with many inorganic pollutants. The tourists bring food packets, water bottles, plastic bag etc with them and dump them into the park. Rainfall also has a considerable impact on the soil surrounding the Katraj tank. Excessive rains can cause flooding and it has happened twice in the past where nearby villages/areas i.e. Gujarwadi, Manjarwadi, Nityanand, Katraj, and Balajinagar have gone under water. Similarly less rainfall can also have negative impacts on the tank, i.e. its acidity, salinity might increase, and the concentration of pollutants also will increase as there will be very little water available for dilution. The run-off from agricultural fields enters the tank which contains high amount of pesticides, chemical fertilizers, and suspended solids which can lead to loss of aquatic species as well as increase the odour nuisance, change the color of water and make the water unsuitable for any further use.

4) *Assessment of impact significance*: Polluted water of the tank may also cause the bottom soil and soil surrounding the tank to degrade. This may affect the bottom breeding species and the submerged and rooted plants. Nitrate-nitrogen levels below 90 mg/L and nitrite levels below 0.5 mg/L seem to have no effect on warm-water fish, but salmon and other cold-water fish are more sensitive. The recommended nitrite minimum for salmon is 0.06 mg/L.

5) *Identification and incorporation of mitigation measures*: Watershed management should be done to reduce siltation due to soil erosion during rainy season to prevent loss of soil. Trees should be planted surrounding the tank to hold the soil firmly and preserve the moisture content of the soil. Farmers should be encouraged to use only natural fertilizers and biopesticides.

**Biological Environment**: - The biological component and their interaction with other components of an ecosystem provide a basis for addressing biological environment impacts. The following 6 step model is suggested for planning and conduction of impact studies.

1) *Identification of Biological Impact of the proposed projects*: Katraj tank is also the nesting site of lots of birds, it is also the home of many fishes, other aquatic species, plant species etc. thus contributing in a big way to preserve the ecological richness. Some migratory birds are also found to use the site to complete its life cycle. It serves as a perfect habitat for many plants, animals and micro-organisms to grow perpetuate and survive. Boating has an adverse impact on the ecology of the environment, disturbance to flora and fauna and also increase in pollution load. If the boating activity continues to increase at the present rate, it would have a severe impact on the aquatic species causing its change in behavior as well as decline in number and it will also increase the waste dumped into the water by tourists which will degrade the quality of water making it dangerous for aquatic flora and fauna to survive.

2) *Preparation of description of existing biological conditions and considerations of endangered or threatened species and critical habitat*: Lists of planktons found in the Katraj tank are as;

a) Algae: - Odogonium, Oocystis, Scenedesmus, Phytoconia, Euglena, Chlorella, Chlamydomonas, Pediastrum, Spirogyra, Hydrodictyon, Didinium

b) Zooplanktons: - Nostoc, Rotifers, Daphnia, Cyclops, Amoeba, Dinobiyon, Navicula, Tabellaria, Zygnema

3) *Procurement of relevant laws, regulation or criteria related to impacts and/or conditions*: There were no laws obtained under this section but it was observed that some plankton has completely vanished from the tank. About 10 years back more than 20 species of planktons were found but the sample collected shows hardly of the species.

4) *Impact Prediction*: Impacts on biological resources such as vegetation, wildlife, crops, & aquatic life. Decrease in the dissolved oxygen content of the water, has a significant impact on the aquatic flora and fauna and also led to anaerobic decomposition causing methane and carbon dioxide formation inside the tank and this if goes on increasing can prove to be a dangerous situation for the aquatic species inside the Katraj tank. About 10 years back more than 15 planktons were detected from the sample collected from the tank and the present sample shows only 9 plankton species, so the impact will become more disastrous in the future surviving hardly a few species. The children and some people have habit of throwing stones to the birds, uprooting plants, plucking flowers and leaves thus disturbing the biological environment. This has caused an adverse effect on the breeding habits of lot of aquatic species and birds which are provident from the data obtained which shows a considerable decline in the number of species.

5) *Assessment of impact significance:* Boating activity would have a severe impact on the aquatic species. The Katraj tank is surrounded by agricultural fields on its 3 sides. The run-off from these fields enters the tank and this water contains high amount of pesticides, chemical fertilizers, and suspended solids which can increase the inorganic load of water to a large extent and this can lead to loss of aquatic species as well as can increase the odour nuisance, change the color of water which can prove to be dreadful for the biological life.

6) *Identification and incorporation of mitigation measures:* Rules should be made and implemented strictly to restrict boating activities in certain areas having biological importance. Substances like eatables, plastics, papers etc should be prohibited to carry while boating. Artificial perching sites and islands should be constructed to attract more bird species to maintain healthy ecosystem.

**Cultural Environment:** - The impacts on Katraj tank due to cultural activities were studied and the data was collected by interviewing workers, officials, visitors and shop keepers. Following five step model is suggested for planning and conduction of impact studies.

1) *Identification of Cultural Impact of the proposed projects:* The tank was supposed to be having double the depth till the end of 18<sup>th</sup> century, compared to the depth it has today. The main reason behind the decrease in its depth is the siltation caused mainly by various human activities like dumping, celebrating Ganesh festival which includes Idol immersion. The area it covers presently is also just 75% of what it used to be 8 years back. Thus the amount of water that the tank could hold at that time was more than double it holds now.

2) *Preparation of description of existing cultural environment:* It was observed from the questionnaire method that people are still not aware about the impacts of human activities on environment and that give more importance to their cultural and religious beliefs. It was also evident that the activities used to take place enormously before 2 years but since past 2 years expertise in the field of environment, government bodies, NGOs have completely stopped Idol immersion and dumping into the tank. It was evident from the data obtained that the inflow of tourists increases during the peak season that from 15<sup>th</sup> April to 15<sup>th</sup> June and this exceeds the carrying capacity of the park.

3) *Impact Prediction:* Celebration of Ganpati festival, etc causes dumping of huge amounts of solid waste and mixing of inorganic substances like paint into the water thus killing lot of aquatic species. The organic and inorganic load increases siltation, thus decreasing the depth of the tank causing reduction in the volume of water it can hold.

4) *Assessment of impact significance:* The activity of idol immersion has contributed to decrease in the depth and area of the tank to 50 % and if it continues to happen it is predicted to decrease the depth and area of the tank again to 50% in the next 10 years thus affecting its water holding capacity.

5) *Identification and incorporation of mitigation measures:* Cultural activities like idol immersion etc which are responsible for increasing siltation in the tank should be strictly stopped.

**Social Environment:** - The Katraj tank holds great importance in terms of scenic beauty because of which it has a lot of aesthetic value. As it is situated away from the main city, it is minimally affected by traffic, commercialization and population. Thus it is still considered as a peaceful location with fresh air and lots of trees where a lot of people come to take a break from the polluted areas of the city. Following 6 step model is suggested for planning and conduction of impact studies.

1) *Identification of Social Impacts of the proposed projects:* One of the major impacts on the Katraj tank is the impact of tourism. According to the data collected by us, the number of visitors visiting the park daily have increased manifold in past few years. The tourists bring food packets, water bottles, plastic bag etc with them and dump them into the park or into the tank. This has led to a lot of land and water pollution, affecting the quality of soil and water. On one side where tourism has had its advantages, the other side of it has also brought about a lot of problems like dumping of solid wastes like plastic, paper, etc which has made the water unfit for drinking and also disturbed the natural environment which are likely to increase with the inflow rates of tourists in future.

2) *Preparation of description of existing social conditions:* Variation in the number of visitors in Zoo is as follows;

Table 3: Monthly variation in the number of visitors

Months	Year	No of Adults	No. of Child	Total
01	02	03	04	05
April	2005	72929	21281	94210
May	2005	109928	40351	150279
June	2005	75293	15250	90543
July	2005	51096	6739	57835
August	2005	48049	7199	55248
September	2005	48315	6071	54386
October	2005	42316	6606	48922
November	2005	96949	26685	123634
December	2005	96811	25021	121832
Jan	2006	106301	27717	134018
Feb	2006	59056	8993	68049

Table 4: Daily variation in the number of visitors

Date	Days	No. of Adults	No. of Child	Total
1/12/2005	Thursday	2413	643	3056
2/12/2005	Friday	1638	413	2051
3/12/2005	Saturday	2396	465	2861
4/12/2005	Sunday	6044	1443	7487
5/12/2005	Monday	2167	321	2488
6/12/2005	Tuesday	1979	480	2459
7/12/2005	Wednesday	Closed	closed	-
8/12/2005	Thursday	2524	369	2893
9/12/2005	Friday	2411	711	3122
10/12/2005	Saturday	3497	785	4282
11/12/2005	Sunday	7002	1821	8823
12/12/2005	Monday	2524	291	2815
13/12/2005	Tuesday	2411	878	3289
14/12/2005	Wednesday	Closed	closed	-
15/12/2005	Thursday	2709	384	3093
16/12/2005	Friday	2078	768	2846
17/12/2005	Saturday	3295	1194	4489
18/12/2005	Sunday	6433	1592	8025
19/12/2005	Monday	2977	637	3614
20/12/2005	Tuesday	3324	717	4041
21/12/2005	Wednesday	Closed	closed	-
22/12/2005	Thursday	3097	725	3822
23/12/2005	Friday	3092	1147	4239
24/12/2005	Saturday	3242	1395	4637
25/12/2005	Sunday	7578	1963	9541
26/12/2005	Monday	4921	1208	6129
27/12/2005	Tuesday	3493	985	4478
28/12/2005	Wednesday	Closed	closed	-
29/12/2005	Thursday	4377	1148	5525
30/12/2005	Friday	4060	1148	5208

Table 5: Number of visitors for boating (monthly)

Season	Months	Year	Four Seater	Two Seater	Total
Off season	July	2005	312	206	518
Off season	August	2005	386	192	578
Peak season	December	2005	769	503	1272
Peak season	January	2006	818	496	1314

Table 6: Number of visitors for boating (daily); peak season

Date	Day	Four Seater	Two Seater	Total
1/1/2006	Sunday	97	66	163
2/1/2006	Monday	27	20	47
3/1/2006	Tuesday	11	16	27
4/1/2006	Closed	Closed	Closed	Closed
5/1/2006	Thursday	8	12	20
6/1/2006	Friday	9	12	21
7/1/2006	Saturday	15	15	30

Table 7: Number of visitors for boating (daily); off season

Date	Day	Four Seater	Two Seater	Total
7/7/2005	Thursday	6	6	12
8/7/2005	Friday	5	8	13
9/7/2005	Saturday	13	22	35
10/7/2005	Sunday	40	33	73
11/7/2005	Monday	11	9	20
12/7/2005	Tuesday	2	-	2
13/7/2005	Closed	Closed	Closed	Closed
14/7/2005	Thursday	23	-	23

3) *Procurement of relevant laws, regulation or criteria a related to impacts:* Relevant laws or criteria were not found for this section.

4) *Impact Prediction:* One of the major impacts on the Katraj tank is the impact of tourism. According to the data collected, the number of visitors visiting the park daily have increased manifold in past few years. Though the number of tourists entering the park has not exceeded the carrying capacity of the park, the impact it has caused is not worth neglecting. The tourists led to a lot of land and water pollution, affecting the quality of soil and water, thus making it unsuitable for drinking. Boating also causes disturbances to a lot of aquatic species, it also affects the planted submerged in water.

5) *Assessment of impact significance:* Socialize has an adverse impact on the ecology of the environment, disturbance to flora and fauna and also increase in pollution load.

6) *Identification and incorporation of mitigation measures:* Rules and regulations should be made to keep a check on the inflow of visitors according to the carrying capacity of the park. Awareness level should be increased amongst officials, workers and visitors.

## DISCUSSION AND CONCLUSION

The detailed study of flora, fauna, water, soil, social and cultural environment of the Katraj Tank describes the following points,

## Water Environment

Dumping of even the treated wastes from any near by industries should be strictly prohibited to maintain the quality of tank water. Activities like washing, fishing, swimming, bathing etc should not be allowed in and around the tank. The concentration of oxygen in the water is very important to the health of aquatic organisms. In addition, a whole range of reactions that result in degradation of water quality occur when oxygen is lost from the water column. Oxygen in water is used by plants (at night) and animals. Microbes breaking down organic matter or oxidizing ammonia also use up oxygen. The water quality of near by water bodies should also be maintained to avoid mixing due to flooding during rainy season. Use of motor boats should be strictly avoided to prevent water pollution due to smoke, fuel and oil leakage and noise pollution.

## Soil Environment

Bunding construction should be done to reduce siltation due to soil erosion during rainy season to prevent loss of soil. Farmers of near by agricultural fields should be encouraged to use organic fertilizer and bio pesticide to avoid inorganic load on the soil due agricultural run off. Visitors should not be allowed to throw plastic, left over food, paper and other wastes on land.

## Biological Environment

Rules should be made and implemented strictly to restrict boating activities in certain areas having biological importance. Substances like eatables, plastics, papers etc should be prohibited to carry while boating. Artificial perching sites and islands should be constructed to attract more bird species to maintain healthy ecosystem.

## Cultural Environment

In this section, the impacts on Katraj tank due to cultural activities were studied and the data was collected by interviewing workers, officials, visitors and shop keepers. Cultural impacts include traditional patterns of life and work, family structures and authority, religious and tribal factors, archaeological features, social networks and community cohesion. Cultural activities like idol immersion etc which are responsible for increasing siltation in the tank should be strictly stopped.

## Social Environment

Environment is surroundings. Social environment is people surroundings, human beings and their products, their property, their groups, their influence, their heritage. Another aspect of social analysis is the consideration of EIA for a project which is being planned for implementation in an ecologically sensitive area, from which the local people are deriving their livelihood.

Rules and regulations should be made to keep a check on the inflow of visitors according to the carrying capacity of the park. Awareness level should be increased amongst officials, workers and visitors.

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