

Lakes: The Heritage of Bengaluru through Birds Eye

UV Singh^{1*} and Deepthi Hebale²

¹Karnataka Lake Conservation and Development Authority, Karnataka, India

²Research Scholar, Energy, and Wetland Research Group, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, India

Review Article

Received date: 07/08/2019

Accepted date: 23/09/2019

Published date: 27/09/2019

*For Correspondence

Karnataka Lake Conservation and Development Authority, Karnataka, India.

E-mail: uvsingh@yahoo.com

Keywords: Environment, Population, Municipal corporations, Water bodies, Sewage treatment plants, Encroachments, Wetland ecosystem

ABSTRACT

In the Deccan plateau, Bengaluru is an important cosmo metropolitan city comprised of more than ten million human population. The city is located at an average elevation of about 900 meters from the sea level with highly undulating terrain of upper profile good red soil. Due to this character, the areas under-occupied township have large number of manmade tanks primarily constructed for the purpose of agriculture/horticulture irrigation and drinking. The tanks are scattered in series of clusters linked to each other through channels in that cluster. All the tanks in the city are the part of either of hebbal valley or rishbhavathi valley or kormangla-chelghatta valley. The constructions of tanks in the city have a long history and goes back even to Ganga dynasty (350 to 1000 CE), bellanduru tank was constructed in that period. The tanks in Bengaluru are the heritage of the city and caused to call "City of lakes". Most of the tanks are polluted and unfit for human use. Reuse of secondary treated water is one of the most difficult tasks before the Authorities. Treated water from STPs of koramangla-chelghatta valley is being used to fill the tanks of Kolar district. Twenty four tanks are filled until the last report. This article covers the essence of research works done in last thirty-four years.

INTRODUCTION

In 1791, Lord Cornwallis sent a contingent of Fort St. George, Madras of British East India Company to find an alternate route to Srirangapatna to fight Tippu Sulthan. The contingent landed at Bengaluru town on the way. The Captain of contingent was so amazed by the climate, the lakes, environment of the Bengaluru and described the town as LAND OF THOUSAND LAKES. Since then the Bengaluru is being known as a Land of Thousand Lakes too. Presently, Bengaluru is known as the silicon city of India.

It is to state that one of the limiting factors for growth of Bengaluru in past was the non-availability of water since there is/was no perennial river nearby. This could have been one of the reasons for construction of series of tanks to an average of one tank for a village/hamlet. But presently city is growing at one of the fastest on the Globe. The present Bengaluru city is a conglomerate of about more than 700 villages. The history of tanks in Bengaluru goes beyond the founders of Bengaluru i.e. kempegowda and wadiyars. It is reported that the bellandur lake has been constructed during the Ganga dynasty. The tanks in and around Bengaluru were constructed as and when the requirement of water felt

necessary for drinking and irrigation. Some tanks like Sankey tank was constructed by the British army. It is also observed that kempegowda himself has constructed some tanks like dharmambudi, kempambudi and sampangi tanks. Mrs. Janaki Nair in her book "The promise of the Metropolis: Bengaluru's twentieth century". Credits the evolution of this metropolis to the building and conservation of tanks/lakes.

Due to fast expansion of city and population explosion including immigrants, it has made the need/greed of land for habitation and other purposes and resulted into conversion of many tank beds for various other purposes including layout formation by making them disused through breaches. The trend continued and became alarming during 1960 onwards. It is noted that during that period there was a widespread malaria epidemic and prevalent mosquito menace linked with water bodies. For the Malaria Eradication Program many tanks have been breached and water was drained off resulted into dry tank beds which were converted into various purposes, many tanks were reported to use for the erection of buildings, etc. Examples of such tanks are:

- Subhash Nagar tank bed
- Miller tank bed
- Sinivagilu tank bed
- Akkithimmanahalli tank bed
- Kurubarahalli tank bed

Further, the government has also allotted some tanks in the metropolitan area under the jurisdiction of BDA, to some institutions i.e.

- Nagashetty Halli, allotted to Space Dept and others
- Karugondanahalli tank, to Ambedkar Medical College
- Kodihalli tank, to Space Dept
- Challagetta Tank, to KSTDC for golf course

Further, some tanks beds have been utilized by the BDA as civic amenity sites or Layouts i.e.

- Goddalahalli tank
- Karisandra tank
- Kodirenahalli tank

After the submission of the report of the Lakshman Rau committee ^[1] many of the lakes/tanks were handed over to the Forest Department for their preservation, conservation, and development. The Forest Department did fencing, removed some encroachments by taking the shelter of Section 64 (A) of the Karnataka Forest Act, 1963. The Department could not sustain the pressure of fast deterioration of the tanks due to population growth, political interference and sewage inflow into them. This led the State Government to constitute an Authority named as Lake Development Authority (LDA) in 2002 under the society act for the administration, management, development and conservation of lakes/tanks in the corporation area, metropolitan area, BMRDA and green belt of Bengaluru urban district and also outside Bengaluru in corporations. The LDA was having a governing council headed by chief secretary of State. The LDA was having lofty objectives like protection, conservation, reclamation, restoration, rejuvenation and integrated development of lakes but without infrastructure and statutory powers. The LDA was also having jurisdiction of lakes in other city municipal corporations and town municipal councils in the state. The LDA had 11 lakes in Bengaluru city under its custody. Since there were no statutory powers with LDA that became one of its limiting factors for non-handling the lakes properly. The LDA is now abolished through an act 2018.

Even after formation of LDA the situations of tanks/lakes did not improve much and having concern for continuous deterioration of lakes a WP No.817/2008 and others were filed before the high court of Karnataka ^[2]. The high court by its order dated 26-11-2010 in the said WP constituted a committee in the chairmanship of Justice NK Patil, the then high court sitting judge. The committee submitted a detailed report on 21-02-2011 to the state government and the high court ^[3]. The hon'ble high court had taken the cognizance of the report and directed to state government vides its order dated 11-4-12 to take follow of action as per the recommendations of the report. There is not much progress on the said recommendations and the time fixed for follow up action in the report has already been over. The state has appointed Sri N Lakshman Rau expert committee ^[1], Sri AT Rangaswamy joint legislative committee, hon'ble justice NK Patil, committee report and legislative committee of KB Koliwad dated 27-10-14 on encroachments in particular and suggested measures for restoration of lakes in general ^[3,4].

DISCUSSION AND CONCLUSION

Sri N Lakshman Rau Expert Committee

The state government by taking into consideration the allotments of tank beds made by BDA/government to various agencies/private entrepreneurs, deterioration of the environment water aesthetics and quality to improve underground aquifer, encroachment into the feeder channels, water crisis in the city and many other problems related to conservation, preservation, rejuvenation, administration and management of water bodies etc. had issued a government order No. PWD 82 IMB 85 Bengaluru, dated: 26th July 1985 to constitute an expert committee comprising of

- Sri. N Lakshman Rau, IAS (Retd) (Chairman)
- Sri S Hanumantha Rao (member)
- Sri K Ananth (member)
- Sri BG Channappa (member)
- Dr. Malavaiah (member secretary)

The committee also opted some working officials of other departments for expert advice; they were: Sri PD Geonkar, Sri N Sampangi, Sri SG Neginhal, Sri BN Thyagarajan, Sri MA Parthasarathy, Sri P Venugopal, Sri G Ashwathnarayan and Sri AC Anatha Murthy. The said committee submitted report in 1988 to state government for following of action. Some actions were taken but found insufficient/inadequate. It is observed that the committee did not indicate/identify all lakes in the city and surrounding areas.

During the period, the Committee had made interim recommendations to state government based on its meeting held on 09.08.1985. The said recommendations have been taken note by the government and directed the concerned authorities vide letter no. HUD 794 TTP 85 dated 31-12-85 for further needful.

The committee had identified 127 tanks in conurbation limits; out of this, 46 tanks have been identified as disused (do not have water). From the 46 disused tanks, 10 tanks had already been utilized by the horticulture department, Bengaluru city corporation, Bengaluru development authority or allotted to institutions. The remaining disused tanks have been proposed for developing tree parks in the tank bed mainly by the forest department. Accordingly, these tanks were handed over to forest department for further needful. The tourism and BDA have also entrusted the work of recreation activities for the use by surrounding habitats. Further, the remaining 81 tanks of conurbation area were proposed for foreshore planting and retention of water sheets.

The Committee observed that the existence of water bodies are an important asset to the environment of Bengaluru and also have an effect on the microclimate of the city. The city planets and all other concerned have accepted that there is a necessity for maintaining water bodies and also preventing them from getting polluted since they have a definite impact on the environment and local climate in particular and also enhance the aesthetic value of the city.

In regard to sinivagilu tank bed and jakkasandra tank bed, the BDA was in the process of formation of layouts when this report was written. The committee placed its objection for layout formation and wrote to the government to direct BDA not to take up layout formation. It is unfortunate to note that the lake has been converted into a layout in spite of the objection raised then. Now this has become a cause for flooding of the area during the rainy season. The committee recommended that in such cases, invariably the opinion of the minor irrigation department will have to be obtained even the area in which the tank is located is handed over to the development authorities.

After taking into consideration of various aspects more specifically for the preservation, restoration or otherwise of the then existing tanks in the metropolitan and green belt areas, the rau's committee made recommendations in the field of various aspects.

The existing encroachments from the tank beds shall be removed by following due course of law; the existing tanks should not be reached further and shall be retained as water bodies; large scale tree planting should be done in off-shore areas; the disused tanks should be converted to tree parks; de-weeding should be taken up and aquatic life must be restored; mosquito control measures should be entrusted to Bengaluru city corporation; the Bengaluru water supply and sewerage board should maintain water quality by not allowing the sewage into the lakes. Whenever a tank has been successfully reclaimed or renovated, a suitable area adjoining the tank may be earmarked for recreational and tourism activities including rest houses, restaurants, toilets, etc. For the implementation of these activities/works, the state government should set up an implementing agency. The committee wished to command urgent consideration of the recommendations made in the report.

It is further observed from this report that about 262 tanks were identified/indicated in the then Green Belt area. They are summarized taluk wise as

- Bengaluru North-61

- Bengaluru South-98
- Hoskote-23
- Anekal-44
- Magadi-11
- Nelamangala-13
- Devanahalli-12

The committee has also made certain specific recommendations for 13 tanks including bellanduru tank. They are: hebbal tank, Sankey tank, yedyur tank, kempambudhi tank, ulsoor tank, madiwala tank, sinivagilu tank, byrasandra tank, jakkasandra tank, mathikere tank, kacharakanasalla tank, bellandur tank, and lalbagh tank.

It is observed from the report that more emphasis had been laid to create tree parks on the disused tank beds to serve as recreational centers for city population coupled with prevention of encroachment of the tank beds. The committee was equally concerned of flow of sewage/polluted water into the tanks. No much emphasis was given on revival of disused water bodies. The present statuses of these disused tanks are not known. The live tanks were allowed to be continued in the same state except to do foreshore plantations. Desilting was not a priority and target of committee's recommendations. However, presently the live tanks/lakes are being developed for recreational centers with recharging of groundwater through desilting. It is observed that the committee did not fail to identify all the tanks in the metropolitan/conurbation area of the city.

Sri AT Rangaswamy, Joint Legislative Committee

The Karnataka State Legislature have constituted a committee i.e. a joint legislative committee under the chairmanship of Sri AT Ramaswamy, the then Member of Legislative Assembly (MLA) on encroachment in Bengaluru urban district. The committee submitted two interim reports i.e. in February 2007 and second interim report on 26-07-2007 [2].

In the first report, the committee observed that there are rampant allotments of dry tank beds by the government/Bengaluru development authority to various agencies and private persons without enquiring from the revenue, survey and settlement department and lake development authority whether the land/tank bed is a part of encroachment. They have issued various types of licenses and collected cess/taxes. The agencies have also issued completion and commencement certificates. The committee further observed that all the tanks are polluted due to impounding the sewage water. The pollution control board has not exercised its power under Section 24 of the Water Act, 1974.

In its second report, the committee observed that about 313 acres of land are under encroachment by 441 persons in the 48 tanks (as reported by DEPUTY conservator of forest on 14.02.2007). The land has been encroached by residents including some powerful persons. The Committee has also observed that some layouts in the tank beds have also informed and sold to the residents. The committee requested to evict all encroachments by following due process of law.

Hon'ble Justice NK Patil, Committee Report

On 26th November, 2010 the division bench of the hon'ble high court of Karnataka presided by hon'ble chief justice, while hearing a batch of petitions connected with WP 817/2008 club with some other writ petition appointed a committee consisting of 10 members headed by the hon'ble chairman of high court legal service, justice NK Patil, to examine the ground realities, to suggest the required steps and measures to be taken for preservation and restoration of lakes in and around Bengaluru and to submit its report [3].

Accordingly, the committee has met as frequently as required and deliberated on the various facts of the problems of lake conservation, sought the views of experts and experienced people, examined the root causes and ground realities and prepared the action plan for preservation and restoration of lakes located in the BDA area of 1300 Sq.km (co-terminals with BDA area) and submitted the report on 26th February 2011 to the state government and a copy to hon'ble chief justice, high court of Karnataka.

The committee after having series of meetings and discussions with the various departments/organizations/stakeholders had submitted a report to the state government on 21-02-2011 and also to the hon'ble high court of Karnataka with certain strategic suggestions/recommendations for the conservation, development, and management of lakes in Bengaluru city.

The committee recommended that the all the lakes and connected rajakaluves and their branches should be surveyed with total station as per village maps and other records and the encroachments found should be removed the lake beds should not be diverted for any other purpose and the 30 meter buffer should be maintained as required under the rules; sewage entry should be restricted and the sewage water should be treated and with this water the lakes water table should be maintained; the development, conservation of the lakes should be the integral part of the layout development,

the ecology of the lakes should be restored for the making of habitation for avian fauna, some lakes after proper water quality analysis should be selected for water supply to the city; and the rights of the traditional users shall be protected.

The BWSSB takes up sewage treatment through the Secondary Treatment Plants (STPs). The number of STPs and their installed capacity by 2011 is summarized below in **Table 1**. Presently there are 25 STPs for the capacity of 1067.5 MLD.

Table 1. Secondary treatment plants and their capacity.

S No.	Plant	Capacity in MLD	Treatment process adopted
1	Koramangala and Challaghatta valley	248	Secondary: Activated sludge process
2	Vrishabhavathi valley	180	Secondary-Trickling filters
3	Mylasandra	75	Secondary-Extended aeration
4	Hebbal valley	60	Secondary: Activated sludge process
5	Kadabeesanahalli	50	Secondary-Extended aeration
6	Rajacanal	40	Secondary-Extended aeration
7	Krishnaraja purum puram	20	Secondary-UASB+Extended aeration
8	Nagasandra	20	Secondary-Extended aeration
9	Jakkur	10	Secondary- UASB+Extended aeration
10	Yelahanka	10	Activated sludge process+filtration+chlorination (Tertiary)
11	Madivala	4	Secondary: UASB+oxidation ponds+constructed wetlands
12	Cubbon parkS	1.5	Membrane Bio-Reactor
13	Lalbagh	1.5	Extended Aeration+Plate Settlers+UV disinfection
14	Kempambudhi	1	Secondary: extended Aeration
Grand Total		721	

The BWSSB develop, manage and administer the Underground Drainage System (UGD). It is pertinent to note that in spite of large networking of UGD in the corporation area, a large quantity of sewage water flows in the open drainage system which is meant for rainy water. This flaw is one of the major issues of pollution in the lakes. The UGD networking and STPs by 2011 as reported in the NK Patil's report is reproduced in the table below (**Table 2**).

Table 2. Sewerage network and sewage treatment plants in all three valleys of Bangalore.

S. No.	Valley	Existing sewerage network in Kms	New sewerage network in Kms	Existing treatment plants and capacity	New treatment plants and capacity
1	Koramangala and Challaghatta	1481	1939.5	5 (305 MLD)	2 (150 MLD)
2	Vrishabhavathi	1649	1208.44	4 (276 MLD)	5 (403 MLD)
3	Hebbal	480.166	1021.76	5 (140 MLD)	5 (86 MLD)
4	Sub Total	3610.166	4169.7	14 (721 MLD)	12 (639 MLD)
Total		7779.7		26 (1360 MLD)	

Due to recommendations of the various committee and intervention, of course, the State government has taken up rejuvenation/restoration of the lakes in the Bengaluru city. The status by 2011 in this regard is presented in the below **Table 3**.

Table 3. Rejuvenation/restoration of the lakes in the Bengaluru city.

S. No.	Department	Already Restored	Restoration in Progress	Proposed for Restoration	Total lakes in custody
1	BBMP	13	18	98	129
2	BDA	7	6	31	44
3	LDA	9	-	2	11
4	KFD	2	0	3	5
Total		31	24	134	189

The NK Patil committee had taken note of 321 tanks/lakes in their report pertaining to various organizations/departments. A summary table in this regard is reproduced in **Table 4** below.

Table 4. Details of the tanks.

S. No.	Particulars	No. of lakes/tanks
1	Zilla panchayat (Bengaluru urban)	179
2	Minor irrigation department (BDA area)	18
3	Additional tanks/kunttes (in BBMP area) (for verification/ground verification)	68
4	Additional lakes and kunttes converted into other purposes (BBMP area)	53
5	Lakes diverted or have lost the characteristics	3
Total		321

The lake development authority by taking village maps into consideration had compiled the numbers of lakes/tanks in all the four taluks of Bengaluru urban district. The numbers so arrived are stated here in **Table 5**.

Table 5. The number of lakes in all the four taluks of Bengaluru urban district.

S. No.	Name of the taluks	No. of the lakes/tanks
1	Anekal	233
2	Bengaluru South	209
3	Bengaluru East	155
4	Bengaluru North	248
Total		845

It is observed that as per the list of the LDA there are 845 lakes/tanks while as per the koliwad committee report there are 837 lakes/tanks in Bengaluru urban district [4]. No other agencies have reported more than the numbers as indicated by these two entities. In addition to the above list, there were large number of kunttes (tiny water bodies) in these four taluks which have been not been accounted for. In the respective village maps, all these tiny water bodies were either located in the Government land or part of kharab B land in the private survey numbers. An attempt by LDA was made to compile such kunttes but the excise could not be completed.

Sri KB Koliwad, Legislative Assembly Committee

The State Government after taking note of discussion in the assembly, a legislative assembly committee was constituted under the chairmanship of the then speaker Sri KB Koliwad and other Members on 27-10-2014 mainly for enquiry into the encroachments in the lakes/water bodies [4]. The committee submitted a comprehensive report on 23.11.2017 to the state government. In the said report the number of total lakes in the Bengaluru urban district with

encroachments has been described in detail. The summary of the total encroachments in various categories is listed in Table 6.

Table 6. Abstract report of encroachment of lakes/tanks in Bangalore urban district.

S. No.	% of Encroachment	No. of lakes	Govt enc spots	Priv enc spots	Akb Area in acres	Govt Enc in acres	Priv Enc in acres	Total Enc	The available area in acres
1	0	88	0	0	1283.85	0	0	0	1283.85
2	0-15%	208	0	846	5947.68	0	239.13	239.13	5708.55
3		29	44	3	684.08	35.13	0	35.13	648.95
4		210	386	1478	11803.2	239.65	465.93	705.57	11097.63
5	15-25	22	0	160	412.58	0	79.26	79.26	333.32
6		1	3	0	11.53	1.75	0	1.75	9.78
7		70	190	592	2237.93	173.7	281.07	454.77	1783.16
8		18	0	70	162.7	0	50.22	50.22	112.48
9		6	15	0	155.3	47.98	0	47.98	107.32
10		47	136	476	2920.08	605	263.44	868.44	2051.64
11	50-75	9	0	46	93.53	0	59.5	59.5	34.03
12		2	3	0	11.9	6.78	0	6.78	5.13
13		14	40	120	341.03	73.67	125.67	199.34	141.69
14	75-100	4	0	27	48.08	0	42.5	42.5	5.58
15		2	2	0	14.03	12.73	0	12.73	1.3
16		19	59	159	465.43	212.08	212.2	424.27	41.16
17	100	31	0	53	248.2	0	248.2	248.2	0
18		22	25	0	361.78	361.08	0	361.08	0.7
19		35	72	116	698.59	424.79	273.8	698.59	0
Total		837	975	4146	27901.46	2194.3	2340.91	4535.21	23366.24

It is noted here that the encroachments as reported in Sri AT Rangaswamy, the joint legislative committee report was about 313 acres encroached by 441 persons have increased to 4535.21 acres. It is further noted that the number of lakes were covered in the report of Sri KB Koliwad, legislative assembly committee report. It is pertinent to observe here that the encroachments are one of the primary reasons for the destruction of the lake ecosystem in Bengaluru city.

Connected Acts, Rules and Supreme Court and High Court orders for the Tanks/Lakes

Except for law of the central government regarding water (water act, 1974) there was no exclusive law for the protection, conservation, and development of tanks/lakes the State. The state government was finding difficult to protect the water bodies in the state has finally decided to bring an act; the Karnataka tank conservation and development authority act, 2014 for establishment of a tank conservation and development authority having necessary powers and functions to achieve the object of protection, conservation and rejuvenation of water bodies, and for other matters connected therewith or incidental thereto. The jurisdiction for this act was for the entire Karnataka state but located outside the limits of all municipal corporations and Bengaluru development authority or any other water bodies as may be notified by the government.

Since the water bodies in the corporation areas and more to say the Bengaluru corporation which was not covered in the above-said act; the State of Karnataka brought another act the Karnataka lake conservation and development authority act, 2014 for exclusive water bodies located incorporation areas for the objectives of protection, conservation and rejuvenation of water bodies like tanks, lakes, wetlands and their catchment areas, inlets and outlets for ensuring long terms sustenance of such water bodies and for other matters connected therewith or incidental thereto. This act was promulgated to provide for the establishment of lake conservation and development authority. The act was applicable to all the lakes in the Karnataka states located within the limits of all municipal corporations and Bengaluru development authority or any other water body notified by the government.

Subsequently, the state government brought in amendments in the Karnataka tank conservation and development authority and certain other law (amendment) act, 2018 to amend the Karnataka tank conservation development authority act, 2014 (Karnataka act 32 of 2014) and to strengthen the tank development authority and repealed the Karnataka lake conservation and development act, 2014 (Karnataka act 10 of 2015) to transfer all tanks located within the limits of municipal corporations including Bruhat Bengaluru Mahanagar Palika to the control of minor irrigation and groundwater development department.

The hon'ble high court of Karnataka in a public interest litigation (W.P.No.1841/2006) of Sri Krishna Bhat v/s State of Karnataka directed to state government vide order dated 17-09-2008 that not to divert sewage and garbage to the lakes; survey of lakes as per Revenue records and planting of trees in the open areas of lake beds. To monitor and execute these activities the Hon'ble high court-appointed the member secretary of legal services authority as a coordinator.

In another public interest litigation of environment support group v/s State of Karnataka by No.WP.817/2008 clubbed with WRIT petition Nos.13690/2009, 31343/1995, 18030/2005, 6036/2006 the hon'ble high court issued interim direction to the state government that the lake development authority shall not enter into any fresh agreement with whomsoever and with reference to whatsoever lake is concerned [2].

The said writ petitions were finally disposed of vide order 11-4-2012 with the directions to the state government for taking necessary steps for the survey dated of lakes and tanks in Karnataka and thereto fencing them on demarcated boundaries; de-silting and de-weeding of the water bodies; removal of encroachments including 30 meter buffer zones; stoppage of ingress of sewage water into the water bodies; tree planting. To oversee the execution of these directions the hon'ble court has also directed to form committees at Bengaluru metropolitan area and at district levels. The hon'ble high court further directed to form an apex committee consisting of principal secretary, department of revenue, chief executive officer, LDA and member secretary of state legal services authority who shall oversee and supervise the maintenance of lakes by the committees.

Though the hon'ble high court found committees, no follow up action has been taken on the order 11.4.2012. The hon'ble high court in an interim order dated 08-06-19 in WP 38401/2014 has asked state government [5]. to file status on compliance on this order 11.4.12 within two months. The status reports shall include the details about the action taken by the apex committee and the state-level committee constituted by the state government by order dated 9th December 2013 in terms of the directions issued by this court. The status reports shall contain the details not only of the steps taken by the apex committee but also the other committees constituted under the Government Order dated 18th September 2013 namely the committee for proper maintenance and development of lakes and tanks in Bangalore urban area and the committees in respect of the other municipal corporations. The status reports will indicate the action taken by the committee and the number of meetings held of the said committees. Had the said order been complied with there would have been a different scenario of lakes in the city.

Since no action has been taken in the above order, another writ petition No. 38401/2014 C/W WP No. 11044/2018 [5] was filed before the Karnataka high court for raising several issues of public importance regarding maintenance of Storm Water Drains (SWD), illegal constructions, encroachments in SWD, discharge of sewerage into the SWD and in lakes overall leading to rejuvenation of city lakes. After thorough examination of legalities and various orders issued by the high court and supreme court the hon'ble high court issued certain interim directions on 18-06-2019 to state

government to appoint CISR National Environmental Engineering Research Institute (NEERI) as an expert agency to make in-depth study of causes of pollution of lakes in the city of Bengaluru within the limits of BBMP area and shall suggest short term and long term measures for protection and rejuvenation of the existing lakes as well as for the restoration of lakes on certain terms and conditions.

The hon'ble high court further directed to state government/BBMP to create a grievance redressal mechanism by providing all necessary infrastructures. The encroachments from the rajakaluves and lakes should be cleared in a time-bound manner. The BBMP shall also installed CCTV camera around the lakes. The BBMP should also clear litter and garbage are around the lakes every day. The BBMP/state government/Karnataka state pollution control board to take legal actions in violation of solid waste management Rules, 2016 and direction issued on 28.07.2016 under Section 33 and 41 of the Water Act, 1974. The BBMP should also make proper arrangement for immersion of idols in the lakes so as to minimize water pollution. The Court further directed to conduct various awareness programs for the citizens about their fundamental duties under Clause (g) of Article 51 (A) of the Constitutions of India for protecting lakes, tanks and water bodies.

The hon'ble supreme court of India while dismissing a civil appeal No. 1132/2011 of Jagpal Singh v/s State of Punjab on 28.01.2011 has directed all the chief secretaries of the States to evict the unauthorized encroachments from the water bodies [6]. The Hon'ble Court has decided the matter by taking into consideration of coordinate principals for ecological security of humanity: the public trust doctrine, the doctrine of intergenerational equity, polluter pays principle and the precautionary principle. The court also held that the public commons/common interest prevails over the individual. The court further held that fundamentally the interpretation of law and practice with regard to management and conservation of lakes as public commons. It has also been held that any order issued illegally by the authorities cannot be taken into consideration for regularizing the illegal possessions.

In addition to the various directions under the constitutional provisions by the courts the national green tribunal also takes cognizance of polluting of water bodies under the green tribunal act, 2010. While disposing an application No. 125/2017(M.A.No.1337/2018) with original application No.217/2017 (M.A. Nos.761/2017, 1073/2017, 1098/2017 and 1471/2017) has issued certain directions to rejuvenate three lakes namely bellandur, varthur and agara in Bengaluru city vide order dated 06-12-2018 [7]. To oversee the compliance of the directions has appointed a committee under the chairmanship of justice N Santhosh Hegde the retired supreme court Judge. The NGT has also directed the state government to deposit Rs. 500 crores in the escrow account to be used for the works during rejuvenation. The main works assigned are de-silting, fencing, removal of encroachments including 30-meter buffer zone and stoppage of ingress of sewage water. The compliance of the NGT directions is in progress [8].

It is observed that more than 100 lakes have been rejuvenated but water recharging situation in the city has not been improved. It is also observed that BBMP has rejuvenated about 74 lakes in its jurisdiction but as per the report of IISc only 6 to 8 lakes are being maintained, rest of them are again going to the original state of affairs. The sewerage networking (UGD) is found quite inadequate in the built-up areas and resulted in an inflow of sewerage into the Storm Water Drains and then to lakes. This is also one of the main causes of non-functioning of STPs to their ideal capacities. The encroachments in rajakaluves have not been removed results into flooding in the city during monsoon. Inadequate funds allotment adds further misery in this matter. The major issues remain the same as pointed out in Laxman Rau committee 1988 to the last order of the high court dated 18-6-2019 though the matter has been agitated time and again continuously through committee's reports and Court orders [9-12].

Due to regular inflow of sewage water into most of the lakes in Bengaluru corporation area and also in some lakes of surrounding areas the water quality of the lakes are found non consumable and many of them are highly polluted. As per the quality criteria laid down by central pollution control board on considering 18 parameters, the water bodies are categorized into A, B, C, D and E categories. The Karnataka State pollution control board carried out water quality analysis for 58 lakes in the corporation area. The categories are summarized as under in **Table 7**.

Table 7. Water quality analysis for lakes in the corporation area.

S. No.	Class-based on water quality	No. of lakes	Possible use of water
1	A	0	Drinking water without conventional treatment but after disinfection
2	B	1	Outdoor bathing
3	C	13	Drinking water with conventional treatment and disinfection
4	D	30	The habitation of wildlife, fisheries

5	E	14	Irrigation, industrial cooling, controlled waste disposal
---	---	----	---

The issue of a total number of lakes/tanks in Bengaluru city/ urban district has always been a matter of discussion and dispute. The number of lakes /tanks at various periods/time is given in the table below. For the actual numbers, one should depend on the village maps. Accordingly, the numbers as stated in koliwad report and LDA report seems to be more realistic (Tables 8 and 9).

Table 8. LDA report of the lake.

S. No.	Report of Lakshman Rau	Report of Justice NK Patil	Report of BK Koliwad	As per LDA
1	389	510	837	845

Table 9. List of existing STP's in Bengaluru (BWSSB) 20-07-2019.

S. No.	Name	Capacity in MLD	Location	Types of process for treating sewage	Drainage Zone	Average inflow and treated in MLD	Reusing Qty	Used by/ Disposed to
1.	KandC Valley	248	Belur Nagasandra (near Challaghatta)	Activated Sludge Process (ASP)-Secondary	K and C Valley	216	2	Karnataka Golf Association
	-	-	-	-	-	-	200	For recharging 126 Lakhs of Kolar District
2.	KandC Valley	60	Belur Nagasandra (near Challaghatta)	ASP with power generation-Secondary	K and C Valley	30	-	Bellanduru Lake
3.	Lalbagh	1.5	Lalbagh kere	Activated aeration+plate settlers +UV disinfection- Tertiary	K and C Valley	1.5	1.5	Horticulture Department
4.	Cubbon Park	4	Cubbon Park (upgraded)	Membrane Bio Reactor-Tertiary	K and C Valley	4	4	Horticulture department, Rajbhavan, Hon'ble High Court, Bengaluru Golf Course, Planetarium, War Memorial, CID, Vidhana Soudha, KPSC, KPWD, Civil Court
5.	K.R. Puram Ph-1	20	Tambuchetti Playa Road	UASB+Extended Aeration-Secondary	Hebbal	20	-	Vengaiiana kere
6.	Yelemallappa Chetti kere	15	Yelemallappa Chetti kere	Sequential Batch Reactor-Secondary	Hebbal	13	-	Yelamallappa Chetti kere

7.	Bellandur Amani kere	90	Varthur Kere	Activated Sludge Process (ASP)-Secondary	K and C Valley	30	30	For recharging 126 Lakes of Kolar District
8.	Kadabesahalli Ph-1	50	Marathalli Outer Ring Road	Extended Aeration-Secondary	K and C Valley	42	-	Presently letting into SWD -proposed for future utilization in
								KIADB Industrial Area at Narasapur with the completion of TTP at Narasapura.
9.	Kadugodi	6	Kadugodi	Sequential Batch Reactor-Secondary	K and C Valley /Hebbal Valley	1.6	-	Presently letting into SWD proposal to HPCL 2 MLD increasing to 6 MLD with completion of TTP at Narasapura
10.	Halasuru	2	Halasuru Lake	Sequential Batch Reactor-Secondary	K and C Valley	1.8	-	Halasuru Lake
11.	Rajacanal-Ph-1	40	Guddalahalli near Hebbal	Extended Aeration-Secondary	Hebbal	40	-	Presently to SWD proposal to devanahalli KIADB Industrial area with Completion of their Infrastructure
12.	Hebbal	60	Nagavara kere	Activated Sludge Process (ASP)-Secondary	Hebbal	32	-	Presently to Nagavarkere, proposal to recharge 65 tanks of Chikkaballapura
13.	Jakkur	15	Jakkur kere	Upflow Acrobic Sludge Blanket (UASB)+Extended Aeration-Tertiary	Hebbal	15	-	Presently to Jakkurkere proposal to recharge 65 tanks of Chikkaballapura
14.	Yelahanka Ph-1	10	Allalasanra kere	Activated Sludge Process (ASP) +filtration+Chlorination+Tertiary	Hebbal	8	5	M/s Kempegowda International Airport Limited, M/s Indian Tobacco Company, M/s Indian Air Force, M/s Bharath

								Electronics Limited, M/s Rail Wheel Factory
15.	Rajacanal	40	Geddalahalli near Hebbal	Sequential Batch reactor-Secondary	Hebbal	40	-	Presently to Jakkurkere proposal to recharge 65 tanks of Chikkaballapura
16.	Horamavu Agara	20	In between Kalkere and Horamavu agara kere	Sequential Batch reactor-Secondary	Hebbal	18	-	Presently to Horamavu Kere proposal to recharge 65 tanks of Chikkaballapura
17.	Nagasandra Ph-1	20	Near Madavara kere (near Tumkur Road)	Extended Aeration-Secondary	Vrishabhavathy	16	-	To Madavan lake
18.	Mallathahalli	5	Mallathahalli Kere	Sequential Batch Reactor-Secondary	Vrishabhavathy	5	-	To Mallathahalli Ullal Lakes respectively
19.	Nagasandra	20	Near Madavara Kere (near Tumkur Road)	Sequential Batch Reactor-Secondary	Vrishabhavathy	9	-	To Madavara lake
20.	Chikkabanavara	5	Chikkabanavara kere	Sequential Batch Reactor-Secondary	Vrishabhavathy	2.5	-	To Chikkabanavara Lake
21.	Mailasandra Ph-1	75	Mailasandra	Extended Aeration-Secondary	Vrishabhavathy	75	3	Bhagyalakshmi arms and M/s Tangline Developers (Global Village) balance to SWD
22.	V. Valley	180	Mysore Road	Two-stage high rate trickling process-Secondary	Vrishabhavathy	70	-	10 MLD to tertiary plant, balance to SWD
	TTP. 60MLD	-	Mysore Road	Densdag-Tertiary	Vrishabhavathy	-	2	M/s Arvind Mills, M/s. Wonder Blues, M/s Nandi Economic Corridor Enterprises

23.	Kempambudhi	1	N.R. Colony	Extended Aeration-Secondary	Vrishabhavathy	1	1	Kempambudi Lake recharge
24.	Doddabele	20	Doddabele	Sequential Batch Reactor-Secondary	Vrishabhavathy	20	-	Prsently SWD. Proposal to recharge existing Lake around Harohalli
25.	Kengeri	60	Near Kengeri bus stand	Secondary-Activated Sludge Process-Secondary	Vrishabhavathy	-	-	Disposal sewer line linking work in progress
	Total	1067.5*				711.4*	248.5*	

The information in the above-said table has been provided by the BWSSB [13-16]. As per the said information, the Bengaluru Water Supply and Sewage Board (BWSSB) have established 25 STPs for a capacity of 1067.5 MLD Secondary treatment of sewage. Out of the said quantity, around 711.4 MLD is the outcome of treated water (it may be on higher side). It is further observed that about 248.5MLD is being used for various purposes and the remaining 462.9 MLD is being discharged in sewage water drainage or lakes, allowed to mix with the sewage water making practically no use. The BWSSB has to go a long way to make the city free of sewage water and then make use to substantial purpose.

ACKNOWLEDGEMENT

Acknowledgement are due to the report of expert committee of Sri N Lakshman Rau, report of justice NK Patil dated 26-02-2011, report of the then MLA Sri AT Ramaswamy, the report of Sri KB Koliwad the then hon'ble speaker, Bengaluru water supply and sewage board for having references, emphasis and others.

REFERENCES

1. The report of the committee on lakes of Sri N. Lakshman Rau, IAS (Retd), 1988 submitted to the state government of Karnataka.
2. The judgment of the hon'ble high court of Karnataka in WP No.817/2008 dated 11.4.2012.
3. The report of the committee of justice N.K. Patil dated 26.02.2011 submitted to the state government of Karnataka and high court of Karnataka.
4. The report of the committee of Sri K.B Koliwad the then speaker of legislative Assembly on 27.10.2014 to the state government of Karnataka.
5. The judgement of the hon'ble high court of Karnataka in WP 38401/2014 dated 18.06.2019.
6. The judgement of the hon'ble supreme court of India civil appeal No. 1132/2011 dated 28.01.2011.
7. The order of the national green tribunal, India in application No.125/2017 (M.A.No.1337/2018) dated 06.12.2018.
8. The report of the committee of Sri A.T. Ramaswamy, member of legislative assembly February 2007 and second interim report on 26.07.2007 submitted to the state government of Karnataka.
9. Report of Karnataka state pollution control board to national green tribunal Delhi regarding pollution of lakes in Bangalore. 2019.
10. Village maps of the villages which were the part of the present Bangalore, commissioner of survey settlement Bangalore. 2019.
11. Report of lake development authority for the census of lakes in Bangalore urban district. 2012.
12. ENVIS technical report: 153. Agra, Belandur and Varthur lakes; energy and wetland group, Indian Institute of Science Bangalore. 2019.
13. ENVIS Technical report: 123. Frequent FLOODS in Bangalore; energy and wetland group, Indian Institute of Science Bangalore. 2017.
14. Report of BWSSB to national green tribunal Delhi regarding sewage treatment and underground drainage system. 2019.
15. Geological survey of India: topographical maps government of India. 2016.
16. Office of the registrar general and census commissioner, government of India, Census of Bangalore. 2011.