URBAN LAKES OF INDIA: AN OVER-VIEW OF THE PRESENT STATUS AND PROJECTIONS FOR THE FUTURE

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ABSTRACTS

The urbanization has been taking place in the world for more than 6000 years. In the developed countries about 75% of the population is concentrated in the urban areas. The rate of urban growth is especially high in developing countries like India. India has witnessed rapid urbanization since independence. The urban population in India was 62 millions (17.3 %) of total population in 1951 which increased to 218 millions (25.7 % of total population) in 1991. It is expected that by 2025 India's urban population will reach 50% of the total population of 1.2 billions. The population of India is expected to reach 1.64 billion by 2050. It is difficult to overstate the urgency of the problems confronting the urban lakes, which hold complete requirement of freshwater of urban area. A lake is a sort of catalyst in the development of the city, region and the country as a whole. In India most of the urban lakes are in crisis, beset by a myriad of problems that affect the quantity and quality of the water they contain, the organisms they support, and their ability to meet the water requirement. Some suffer from excessive water withdrawals and diversions, while others have witnessed deteriorating water quality because of polluting human activities on the surrounding land as well as in catchment area of the lake. This paper takes a candid look at what is happening today to urban lakes in India whether natural or artificial, freshwater or saline, and what is likely to happen to them if present trends continue into the future.

INTRODUCTION

Humanity faces the challenge of developing a civilization fit for a finite planet and one equipped to deal with a mounting scarcity of essential resources such as freshwater. It is difficult to overstate the urgency of the problems confronting the world's lakes, which hold more than 90 percent of all the liquid freshwater on our planet's surface. Many of the world's most important lakes are in crisis, beset by a myriad of problems that affect the quantity and quality of the water they contain, the organisms they support, and their ability to meet the water needs of the surrounding human population. Following the world trend, Indian Lakes area also suffering from excessive water withdrawals and diversions, witnessing deteriorating water quality because of polluting human activities on the surrounding land as well as in catchment area of the lakes. In recent decades, problems originating even beyond the immediate lake basin-- notably acid rain (at least for the lakes in the urban area) and climate change-- have added additional burdens to already stressed lake ecosystems. Indian Lakes, which are a primary source and storehouse of the country's easily-accessible freshwater, has now become a critical arena in this great transition of Indian society which degrades and depletes its own natural foundation. Many of these Indian Lakes are already in jeopardy.

STATUS AND PROJECTED FUTUTRE FOR URBAN LAKES OF INDIA

Sr.	Name of the water body and its location	Present Morphometric	Studies Undertaken	Projection for the future
	its location	details of the lake	Olidertakeli	ruture
	LAKES OF WESTERN INDI	A		
1.	PICHOLA LAKE in RAJASTHAN Situated in the heart of city of Udaipur at 5 Km from Udaipur City Railway Station at an altitude of 587 m above mean sea level. Man Made Fresh Water Lake. Constructed about 600 years ago.	Lake Area- About 3.0 Sq. Km Max. Depth— About 4.0 m Min Depth— Around 1.0 m. Present status of Pichola Lake is such that the lake gets completely dried up before onset of the monsoon.	Limnological studies by Sukhadia Univerist at Udaipur. National Institute of Hydrology, Roorkee, India has taken studies for detailed hydrological investigations of Pichola Lake and development of model for hydrological processes for the lake and its	The lake used to be 10.5 Sq. km in area, 8.0m in max. depth 5.0 m in min. depth The lake thus created has been filled by sediment deposits to its present level and ceased to function as a source of water resources. Future of this lake is quite bleak due to continued reducing input to the lake, domestic sewage and other source of pollution finding its way into the lake throughout the year.
	LAKES OF NORTHERN IND	NT A	catchment.	
2.	RENUKA LAKE IN	Length – 1.5 Km	Limnological	Shrinking at fast
	Natural, high altitude fresh water lake in sub-tropical monsoon climate. A long, narrow, oblong shaped lake situated near the town of Solan in Himanchal Pradesh. The lake situated at an altitude of about 700 meter above mean sea level is high altitude fresh water lake in sub-tropical monsoon climate, flanked by two parallel steep hills running east-west.	Breath – 0.3 km Max Depth – 10 m. Mean Depth – 5.66 m Average annual rainfall in catchment area is about 1500 mm. Catchment area – 254.3 ha in hilly forested terrain. One fourth of the lake area is covered by	and ecological studies with special reference to its flora and fauna by Himachal Pradesh State Government.	pace. Maximum depth is presently 10 m. only which was up to 25 m. in the last decade. Fresh water fish habitat, used to be in abundance, is now decreasing. The lake is facing serious threat of extinction due to its shrinkage.
3.	DAL LAKE IN SRINAGAR	marshes. Lake area is about	Limnological	The lake has been

	m abovel mean sea level in the flood plain of river Jhelum in eastern part of Srinagar city at the foot of Zabaravan mountains. It is a natural fresh water lake in arid cold climate. A small canal connects Dal Lake with the Anchor Lake and acts as an additional outflow channel.	Maximum depth is about 3.5 m. Shrinkage due to deposits of large quantities of silts being dumped into the lake by Telbal Nala. 80% of the inflow to the lake is supplied through the Telbal Nalla and 20% through direct precipitation.	studies have been carried out. Bathymetric survey was first introduced in 1976 in the lake study for Dal Lake. National Institute of Hydrology, Roorkee, India has conducted hydrological studies for the lake.	reclaimed to form man made islands separated by canals and areas of water covered by floating gardens. Total water spread area of the lake has shrunk to 12.4 sq. km from 23.4 sq. km in 118 years. The lake will shrink very fast due to heavy siltation and urbanization.
4.	MIRGUND LAKE IN JAMMU AND KASHMIR Situated at 15 km. north west of Srinagar between 34°08'E of latitude and 74°38'E of longitude at an elevation of 1580 m. above mean sea level on the flood plain of Jhelum. The climate of the lake area is warm, dry summer and cold & wet winter.	Highly eutrophic It is a shallow fresh water lake with reed beds. Present area of the lake basin is 300 ha and maximum depth of water in the lake is about 1.05 m.	Limnological and ecological studies have been undertaken by Jammu University.	Limnological and ecological studies have been undertaken for this lake. The study indicate that the lake is facing the problems of increasing siltation and eutrophication due to which the lake is bound to die.
5.	HOKARSAR LAKE IN JAMMU AND KASHMIR Situated at a distance of 10 km to the west of Srinagar at an altitude of 1580 m. above mean sea level, it is a fresh water lake. The lake is situated between 34° 05' N latitude and 74° 43' E longitude. Summer is warm & dry and winter is cold & wet.	It was once an ox- bow lake surrounded by fresh water marshes on the flood plain of Jhelum. Its a permanent eutrophic lake with very turbid water. Water spread area of the lake is 1300 ha. The maximum depth of water in the lake is 2.5 m.	Limnological and ecological studies have been undertaken by Jammu University.	Limnological studies have been conducted for this lake. The lake is suffering from heavy siltation.
6.	SHALLABUGH LAKE IN JAMMU AND KASHMIR Situated at 16 km. north west of Srinagar at an altitude of 1580 m. above mean sea level, it is a fresh water lake. The latitude is 34° 01' N and longitude is 74° 42' E.	Water spread area of the lake is 750 ha.	Limnological and ecological studies have been conducted for this lake.	The main threats to the lake are siltation, eutrophication and encroachment of the agricultural production.

7.	NAINITAL LAKE IN UTTARANCHAL Situated in the heart of city of Nainital at an altitude of 1937 m. above mean sea level. It Is a fresh water lake. There is a submerged island running across center of the lake dividing it into two basins.	Lake area – 5.85 sq. km. The lake is surrounded by high hills. Deforestation of the surrounding hills is causing land slide due to which heavy load of boulders and sediment get dumped in the lake from time to time	National Institute of Hydrology, Roorkee, India has conducted studies on water balance, sedimentation, hydrodynamics , pollution aspects, thermal behaviour, and groundwater- lake interaction of Nainital Lake.	Lake capacity is reducing The areal extent of the lake is also reducing. Maximum depth of lake has reduced from 27.45 m in 1950 to about 24 m. in 1980. Life of the lake has been found to be around 200 years.
8.	SULTANPUR JHEELS IN HARYANA These are a group of shallow frèsh water lakes having total area of 13,727 ha located at 15 km west of Gurgaon. The latitude and the longitude the lakes is 28°28' N and 76° 55' E respectively. The altitude of the lake varies from 220 - 230 m. The climate of the region is monsoon climate with very scanty rainfall. The lakes flood during monsoon and heavy rainfall. The siltation in the lakes is on the increasing scale.	The water body is eutrophic due to organic pollution and urban pollution. There is an excavation of sand from bed of the lake for lime industry. It was declared as Bird Sanctuary in 1971.	Water foul census had been carried out and abifauna has been well documented.	The siltation in the lakes is on the increasing scale. Planting of the salt tolerant species in surrounding area and restoration has been proposed to reduce erosion.
9.	PULLICAT LAKE IN ANDHRA PRADESH AND TAMILNADU Situated at 45 Km north of Chennai. Natural lake in temperate humid climate	Lake Area - 72,000 ha (including swamps of 20,000 ha). 46,000 ha in Andhra Pradesh and 26,000 ha in Tamilnadu. About 60 Km long, 5 to 15 km wide. Average depth is about 2m	The lake is separated from the sea by a shoal or sediment bar. During monsoon season Pelar river and the shoal gets over flooded and lake and sea becomes one body.	Sedimentation from catchment area in Andhra Pradesh. as well as Tamil Nadu. is reducing the lake capacity
10.	LAL BAGH IN KARNATAKA Situated in the heart of City of	Presently water spread area of the lake is about 0.5 Sq. Km	Maysoore University has undertaken Ecological and	Lake area of about 2 Sq. Km in 1950 has reduced to about 0.5 Sq. Km as on date.

Constructed in 1740 by Hyder Ali, King of Mysore Sprawling colonies have come up in the fringe area of the lake. Sprawling colonies have come up in the fringe area of the lake. Situated in the heart of city of Mysore, Krishnaraja Sagara is a man made fresh water lake in tropical monsoon climate. The lake was constructed during 1895-1940 by Krishnaraja Wodeyar IV, King of Mysore. The massive dam was conceived as a multipurpose project, for satisfying the water needs of the agricultural lands in Mandya, Mysore and ensuring power output of Sivasamudram project. 12. Kollaru Lake in Andhra Pradesh Situated at 50 Km east of Vijawada at 0-5 m above mean sea level. Natural fresh water lake with associated marshes between Krishna and Godavari rivers in tropical monsoon climate. 13. VEMBANAD LAKE IN KERALA Situated in the higher reaches of the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal backwaters of Cochin at an altitude of 0-5 m above mean sea level. Natural for the coastal b		Banglore. Manmade.		biological	Maximum depth of
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Cochin at an altitude of 0-5 m above mean sea level. Natural fresh water lake which gets saline due to intrusion from		Situated in the higher reaches		MANAGERS TRANSPORTATION AND AND	
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fresh water lake which gets saline due to intrusion from this lake. this lake. agriculture. To future is bleak for this lake.					
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		sea			uiis iakc.

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14.	POOKOT LAKE IN	About 60% of the	Limnological	Due to heavy
	KERALA	rainy days are in	and	rainfall in catchment
	Situated in the Western Ghats,	the southwest	hydrological	area, there is no
	Pookot Lake is a natural fresh	monsoon and 30%	studies have	threat to the lake.
	water body. Water spread area	of the rainy days in	been	
	of the lake is about 7.5 ha.	the north east	undertaken for	
	The slopes of the northern and	monsoon.	this lake.	
	eastern sides of the catchment	Water spread area	Maximum flow	
	are 80 and 56 m/km. The	of the lake is about	is during south-	
	elongation and circulatory	7.5 ha. The	west monsoon	
15	ratios are 0.4 and 0.2	catchment of the	period. There	
	respectively. The average	lake is 40 ha in	after sudden	
	annual rainfall in the	area and is	reduction in	
	catchment is 4433 mm and the	separated from	flow is	
	number of rainy days is 140.	adjoining	observed in	
		catchment by a	September.	
		chain of hills rising	The runoff	
		to the order of 800	coefficient	
		m above mean sea	reaches the	
		level.	maximum	
			value during	
			the month of	
			August	
			(ranging from	
			0.91 to 0.98).	
	LAKES IN CENTRAL INDIA	V	0.51 to 0.50).	
15.	UPPER BHOPAL LAKE IN	Post monsoon lake	Limnological	Fast shrinking. It
	MADHYA PRADESH	area is about 36	and ecological studies	had vast area of
	Situated in the City of Bhopal at an altitude of 508 m. above	Sq. Km. Pre monsoon lake	studies	1800 Sq. Km spread
	mean sea level. 1100 Years	area is about 18	National	up to Bhojpur at the time of construction
	old man made lake in semi	Sq. km.	Institute of	
	arid climate. Annual average	Sq. Kill.	Hydrology,	1100 years ago. Mughal emperors
	rainfall in catchment ara of the	Max. depth of the	Roorkee, India	reclaimed most
	lake is 1100 mm. This is a	lake is about 10 m	has under taken	parts of the lake for
	wetland of International	Min Depth of the	study for water	agriculture by
		lake is about 3 m.	balance,	putting earthen dam
	Importance, included in RAMASAR Convention.	iake is about 5 iii.	sedimentation,	at Kamla Park. Lake
	KAMASAK Convention.		thermal	area of about 195
			behaviour and	
				Sq. Km in 1671 has
			water quality aspects of the	got reduced to just about 30 Sq. Km by
			aspects of the	about 30 St. Kill DV
			lake.	the year 2000. In
				the year 2000. In dry season the lake
				the year 2000. In dry season the lake water surface area
				the year 2000. In dry season the lake water surface area even reduces to 5
				the year 2000. In dry season the lake water surface area even reduces to 5 sq. km.
				the year 2000. In dry season the lake water surface area even reduces to 5 sq. km. Encroachment is for
				the year 2000. In dry season the lake water surface area even reduces to 5 sq. km. Encroachment is for reclamation of land
				the year 2000. In dry season the lake water surface area even reduces to 5 sq. km. Encroachment is for reclamation of land for agriculture,
				the year 2000. In dry season the lake water surface area even reduces to 5 sq. km. Encroachment is for reclamation of land for agriculture, socio-economic
				the year 2000. In dry season the lake water surface area even reduces to 5 sq. km. Encroachment is for reclamation of land for agriculture,

	a			encroachment in the water surface area of the lake is by the State government for creating transport facilities for VIP, recreational activities etc.
16.	CHANDPATTA LAKE IN MADHYA PRADESH Situated at 5 km. east of Shivpuri in Madhav National Park of Madhya Pradesh at an altitude of 450 m. above mean sea level, Chandpatta lake is a man made lake. The latitude and longitude of the lake is 25° 26' N and 77° 42'E respectively. The climate of the lake is dry tropical monsoon climate.	Home of wild animals. Water spread area of the lake is 200 ha and its maximum depth is 12 m. Water level in the lake fluctuates in dry and wet season by about 2 m. The lake supplies water for irrigation.	Ecological studies have been undertaken for this lake.	The lake is eutrophic due to organic pollution and sedimentation from the catchment area. The lake is facing dark future.
17.	SAGAR LAKE IN MADHYA PRADESH Situated in the heart of City of Sagar of Madhya Pradesh at an altitude of 517 m. above mean sea level, latitude of 23°50' N and longitude of 78°45' E, Sagar Lake is a man-made fresh water lake. The lake constructed in 1912, is divided into two parts, the main lake with water spread area of 107.7 ha at full tank level and the small lake with water spread area of 37.03 ha. The volume of the lake is 389 ha-m at full level. The mean depth of water in the lake is 2.48 m with maximum depth of 5.3 m at full tank level. The	There is high level of organic pollution in the lake. The lake is eutrophic. Fringe area of the lake has been encroached for urban development. The lake has a periphery of 5.23 km with maximum length of 1.247 km and width of 1.207 km. The water level drops in the summer season and the lakes	Biological and ecological studies have been conducted. National Institute of Hydrology, Roorkee (NIH) has conducted hydrological studies for water balance and sedimentation of the lake. NIH has also conducted studies for chemical analysis of	Till half a century ago the lake used to be a continuous source of water supply to the city of Sagar. Over the last decades the lake has shrunk to its present status due to heavy siltation in the due to deforestation in the near by area. Forest Department, Sagar, M.P. has estimated the total annual quantity of silt deposition to be 0.45 ha-m in which 55% is contributed from

	climate of the area is arid tropical climate.	may become totally dry in	lake water	the built-up free catchment area of
	tropical chinate.	draught years.		4.08 sq. mile and the rest is
		Catchment area		contributed from
		of the lake is	Y -	the built-up free
		1817 ha, out of		catchment area of
		which the total		3.22 sq. miles of
		water spread area		the feeder Kanera
		is 1435 ha, at full		Canal.
	1	tank level.		
	LAKES OF NORTH-EAST	T INDIA		
18.	LOKTAK LAKE IN	Lake area of the	Limnological	Fast shrinking.
	MANIPUR	lake is about	studies by	Maximum depth
	Situated in the city of	26,000 ha.	Manipur	of lake has
	Imphal at an altitude of		University.	reduced from 29
	770 m. above mean sea	Max. depth of	-	m. in 1950 to
	level . Natural lake in	the lake is about	Preliminary	about 20 m. in
	Tropical Monsoon	20 m.	field	1980. Due to
	Climate. There is a	_	investigation	eutrophication and
	hydropower plant of 10	Min depth in	for	siltation, vast
	mw being operated by lake	some part of the	hydrological	portion of the lake
	water	lake is about 5	study by	has been covered
		m.	National	by thick algae
			Institute of	locally called
	=		Hydrology,	phumdi due to
			Roorkee	which power
			50	production from
				suffering.
19.	RUDRA SAGAR	Lake area is	Limnological,	Catchment area of
	(LAKE) IN TRIPURA,	about 6 Sq. Km	ecological	the lake has been
	INDIA	Water spread	and	encroached by planners and
	Situated in the City of	area of the lake	biological	planners and developers. Input
	Agratala. Natural lake in	has reduced to	studies have	to the lake is
	humid tropical humid	about 6 sq. km	been undertaken	monsoon runoff
	climate	from 12 Sq. Km	for this lake	from the
		in 1950.	The state of the s	catchment area
		Maximum depth	by Tripura University.	bringing debries
		of water has reduced to 6 m.	Oniversity.	from the urban
		from 20 m in	-	land and sediment
		1950.		from agricultural
		1930.		field.
20	DEEDAD DEEL IN	Lake area is	Limnological	Half of the lake
20.	DEEPAR BEEL IN	Lake area is about 4000 ha.	and	dries in winter
	ASSAM	about 4000 Ha.	ecological	and the shore line
	Situated at a distance of 10	Depth at	studies have	is converted to
	km south west to Guwahati	Depui at	Studies Have	is continued to

	at an altitude of 53 m	maximum	been	rice fields. Due to
	above mean sea level.	flooding is about	undertaken	this there is
	Natural fresh water lake in	4 m which drops	for this lake.	continuous
	tropical humid monsoon	down to 1 m in	National	encroachment by
	climate	dry season.	Institute of	the farmers
		N.78	Hydrology,	resulting in
			Roorkee,	shrinkage of the
			India has	lake. Forest to
			undertaken	south of the lake
			for	are being felled
			hydrological	due to which
			studies of this	heavy sediment
	-		lake such as	load is coming
			water	into the lake
			balance,	resulting in its
			sedimentation	shrinkage.
			etc.	9882
	LAKES OF NORTH-WES	T INDIA		
21.	LONAR LAKE IN	Mean Depth of	Limnological	Though, there is
	MAHARASTRA	About 100 m., is	studies have	underground
	Situated at 140 Km. from	left only to about	been	feeding of the
	Aurangabad. Largest and	50 m due to	undertaken	lake, mean depth
	oldest natural lake of	bottom being of	for this lake	of about 100 m
	meteor origin in the world	highly weathered	by Pune	has reduced to
	in semi-arid climate.	trap	University.	about 50 m. due
	Around 50,000 years old.	2 i		to continued
				siltation in the
				lake.

CONCLUSIONS

This paper presents a candid look at sordid affairs of urban lakes in India, whether natural or artificial, freshwater or saline, and what is likely to happen to them if present trends continue into the future. The Upper Bhopal Lake at Bhopal in Madhya Pradesh has shrunk from more than 100 sq. km. 500 years ago to about 19 sq. km. by the year 2002. Encroachment by the public as well as government agencies are rampant. If the present trend of encroachment and land use in the catchment continues, the Upper Bhopal Lake will meet its untimely death in just next 96 years, the magic figure arrived on the basis of sedimentation and water balance studies conducted for the Upper Bhopal lake. Pichola Lake at Udaipur in Rajasthan has completely dried up, though Pichola Lake used to be the main source of meeting water requirement of city of Udaipur and feeding source for other connected water bodies. This paper recognizes the critical state of many of these fragile, vulnerable, and often strikingly beautiful resources of India. It convinces people of the need to ensure healthy lakes as a primary source and storehouse of the easily-accessible water resources, as sources of food and economic livelihoods, utilizing them in a manner that maximizes their sustainable use, while also preserving their quality and ecosystem integrity for current and future generations.

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