Delineation of Urban Surface Water Bodies at Full Tank Level using Historical Topographical Maps- A Case Study of Hyderabad City, Telangana, India.

Ravi Loudya[1], Manjula Vani Kunchepu[2], Anji Reddy Mareddy[3]

[1]Research Scholar in Center for Spatial Information Technology, JNTUH-UCEST,
Email:ravi.rams.77@gmail.com.
[2]Professor in Department of Civil Engineering, JNTUH-UCEST,
Email:manjulavani@jntuh.ac.in.
[3]Professor in Center for Environment, JNTUH-UCEST,
Email:mareddyanjireddy@rediffmail.com.

ABSTRACT: Water bodies are natural resources; consequently it is crucial to contemplate how their characteristics have changed through temporal variation. Urban water bodies are crucial for maintaining the ecological balance of the surrounding area because they regulate excess floodwaters during monsoon seasons, control microclimate conditions, recharge groundwater sources, nurture wetland ecosystems, serve as feeding and breeding grounds for numerous local and migratory birds, and provide priceless aesthetic appeal to the urban landscape. Urbanisation leads to rapid growth in industries, built-up areas, and effects on natural resources like air, water, and sound pollution. Conservation of natural resources is the primary priority for the sustainability of urban areas. Study area: Hyderabad city, which is exposed to growing day by day in terms of information technology and pharmacy industries. The municipal governing body, Greater Hyderabad Municipal Corporation, which has 650 sq. km and a 250m perimeter length, is chosen as the research area boundary.

This study describes the spatial extent of water bodies in the mid-20th century, which provides further scope to monitor waterbody possession using the historical satellite dataset available. To identify the earlier water body boundary, typical topo sheet data sets are used, and they remain constant. The datasets used are provided from Survey of India topo sheets, which are medium scale from 1977 to 2014. The delineation task is done using geographic information system software such as ARCGIS and QGIS. Georeferencing, digitization, and spatial adjustment are the activities performed on topo sheets. After executing all the tasks on historical datasets, it is estimated that the study area has 230 water bodies occupying an area of 23.04 sq. km, and one urban river is 2.73 sq. km.Waterbodies were classified based on their spatial coverage into six categories. This article determines the full tank level of waterbodies, and further scope of the research demonstrates change detection of waterbodies using a digital elevation model and satellite imagery.

Keywords:Digitization, Georeferencing, Spatial adjustment,Urban water bodies.

I. INTRODUCTION

The classification of lakes in India, according to Reddy and Char (2006), is dependent on the classification's attaining and the classifier

instead of residing rigid or unique. Urban lakes are bodies of water that are located in urban regions.Non-urban lakes, such as rural freshwater, inland brackish water, and holy lakes and tanks. In spite of its location on the Deccan Plateau, Hyderabad city is filled with numerous lakes, which have played a significant role in forming the city's physical environment. Many of the city's water bodies have completely vanished as a result of the city's rapid urban sprawl and growing state and private agency authority over them.

Hyderabad, the sixth most significant city in the nation, is known as the "City of Pearls" due to its involvement in the pearl trade, unique vibrancy, welcoming and fascinating cultural diversity, and reasonable standard of living. The town's population density increased from 266 people per km2 in 1961 to over 18172 people per km2 in 2011(EPTRI,2015). The Study area has experienced rapid growth over the past two decades, which has contributed to the simultaneous growth of household and commercial sewage and solid waste production. The lack of adequate municipal infrastructure to handle growing solid and liquid wastes ultimately led to water body pollution. Only 700 Million Liters per Day of Hyderabad's more than 1600 MLD of sewage water is treated(ESCI,2017).This physical legacy of Hyderabad has been greatly destroyed over the past 50 years of its development. Over the past few decades, large-scale encroachments have caused lakebeds to be flooded and converted to built-up areas by both public and private organization's(Ramchandraiah,2004).

According to the Composite Water Management Index published by NitiAayog in 2018, groundwater will run out in 21 cities by 2020, including Delhi, Bengaluru, Chennai, and Hyderabad, impacting 100 million people. For the creation of an interactive database of cities, urban wetland/water bodies, and their related characteristics, a GIS and remote sensing expert is required (UWWBM,2021).

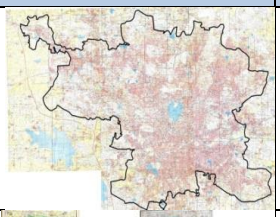
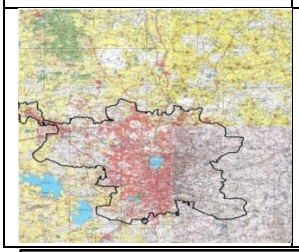
A map is a scale-drawn representation of the features of the earth. The infrastructure and legal definitions of the property borders are highlighted on the map, along with locations of current and future utilities including the sanitary sewer system, potable water sources, and electric and gas grids(AnjiReddy,2008). The surface area of the water bodies was determined using Survey of India topographical maps at a scale of 1:25000, and the present extent was then compared using satellite images. (M B Sridhar, 2020).

Article 51A (g) of The Constitution of India Fundamental duties: It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures;

II. MATERIALS AND METHODS

A. Study Area

Hyderabad, the capital city of Telangana State, is also known as the "City of Lakes & Gardens". Its population was 1 million in 1950, increased to 11 million in 2020, and is about to predict an increase of 15 million in 2030. In and around the metropolis, there were more than 250 artificial lakes. Most of them today are submerged beneath concrete buildings, and those that are still there have been turned into "toxic lakes." Urban flash floods occur as a result of high-intensity, brief precipitation in the city, which pollutes both surface and subterranean water.

Map	Toposheet No	Scale	Year
	Map1-Map8 Guide Map of Hyderabad City	1:20k	2014
	56K6NW 56K6SW 56K7SW 56K7NW 56K10SW 56K10NW 56K11SW 56K11NW	1:25 K	1977 ,198 5
	56K6 56K7 56K10 56K11	1:50 K	2011

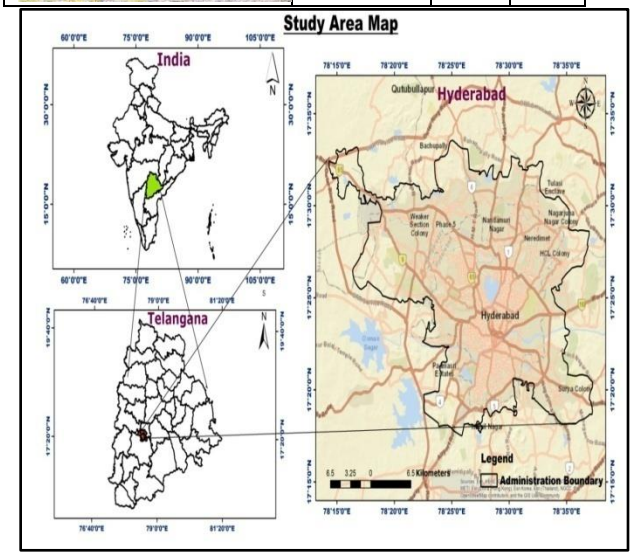


Figure.1. Showing Study Area Map

B.Data Used

The dataset used are Survey of India topo sheets with different scales. Topographic maps of scale 1:50k were downloaded as open source from the Central Government website, Nakshe.Maps of scale 1:20,000 cm and 1:25,000 cm were brought at a nominal cost from the Survey of India, Uppal, and Hyderabad. A topographic map, or topo sheet, depicts a three-dimensional geographic area in two dimensions.Since topographic maps display both the horizontal and vertical location of the landscape, they set themselves apart from other types of maps. It utilises a combination of colour, symbols, labels, contour lines, and other graphical elements. Topographic maps show the shapes, locations, and a variety of other human and natural elements.

C. Scales of data

The ratio between a distance on Earth and a corresponding distance on a map is termed the map scale. There are three main scale types featured on maps: fractional scales, graphic scales, and written or verbal scales.

Table 1. Study Area Data Set Used

Here, we make use of fractional scales, which are usually depicted as a ratio of 1:50,000 and indicate that one unit (an inch, a centimetre, etc.) on the map corresponds to a second of the same units on Earth.In the above table, various datasets with different scales and years of data were used. A guide map of Hyderabad city, which was distributed in eight maps, was used with a scale of 0.2km units and data published in 2014. The other data set was published in two different years, 1975 and 1985, with a scale of 0.25km units. The final medium scale of 0.5km was published in 2011, and all the datasets were published by the Survey of India.

III. METHODOLOGY

The work flow proceeded in four steps

A. **Georeferencing**

It is assigning the real-world coordinates to the unknown raster. Here, the scanned raster was digitized using four coordinates provided in the topographical map, and the RMSE value for the task is maintained below 0.5. The first step of the project is to scrutinise and maintain a database, followed by two projections: WGS 1984 and UTM Zone 43N. The total

georeferenced topo sheets are 20, and each data set year,topo sheet number, and scale are provided in Table 1.

B. **Digitization**

All georeferenced topographic sheets were separated according to the temporal dataset. The database is maintained according to the year of data acquisition and scale. As tank and perennial water symbols are provided in the topographical map, the digitization task is started, and all water bodies are digitized. However, in the 2011 and 2014-year data, a few water bodies disappeared. The final aim of the study is to provide all the full tank levels boundary shape files from historical topographical maps.

C. Attribution

For every database created, it is mandatory to furnish the information. In this task, the attributes used for each water body are

Table No. 2: Attributes of Waterbodies

FID	Name of Lake	Coordinates	Display Status	Area in HA	Perimeter

In the above-given table no. 2, the attributes provided by FID are automatically generated through software during digitization. The name of the lake is identified from topographical maps, and a few open-source data sets like Google Earth, Google Maps, and the TSPCB website's data were used.Display status is a visual classification provided in the topographical map through which data is classified into Dry, Semidry, and Dead status. The rest of the display status lakes are accepted as being in good condition. Each water body's boundary area is calculated in hectares and its perimeter in metres.

D. Validation

Digitized and updated information about water bodies is validated through open sources like Google Earth Pro and Google Maps for local attributes such as the name of the lake. All water body data was accuracy checked by using coordinates as control points and placed in the open source data.

IV.RESULTS AND DISCUSSION

All water bodies were digitized based on the tank symbol view on the topo sheet for different temporal datasets. Using different year datasets is to analyse waterbodies, i.e., increases or decreases in them.The total water bodies delineated are 230 surface water bodies and the Musi River. In 1977–1985, 226 water bodies were digitized. From 2011 medium-scale data, out of 226 water bodies, nine disappeared as residential and barren land in the topo sheet. In 2014, a total of 188 water bodies were digitised, and 43 water bodies disappeared as they were converted to various residential activities. Additionally, five water bodies were newly added.

Table no .3. Classification of Delineated Lakes based on its Spatial extent.

Lake Status			
S.No	**Category-Hectares**	**Spread Area Hectares**	**Count**
1	I	0 to 2	81
2	II	2 to 5	59
3	III	5 to 10	44
4	IV	10 to 20	23
5	V	20 to 50	18
6	VI	50 to above	5
	Musi River	273	1
			231

Total digitized waterbodies from different years are two hundred and thirty-one, and one urban river named Musi has an average flow of 273 ha in the study area with a perimeter of 30 to 35 km. The total water bodies were categorised based on their spatial occupancy. From the output of the data, it was categorised into six types, as visualised in Table No. 3.

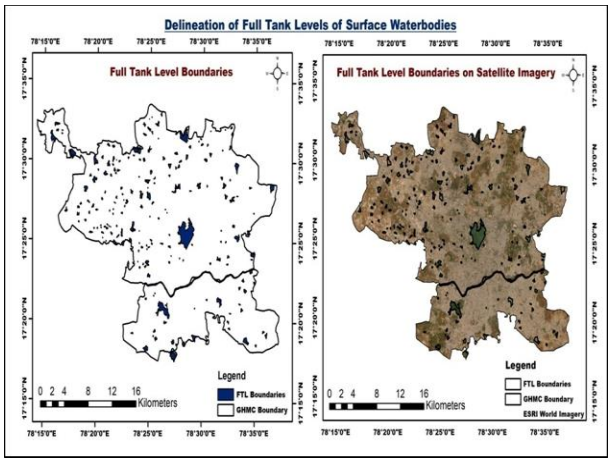


Figure 2. Digitized Full Tank Level Boundaries View on Base Shape File and Satellite Imagery

Table No. 4: Names of Delineated Surface Water Bodies with their Spatial Extent and Coordinates

S.No	Name	Coordinates	Area (ha)
1	Ali Talab	78° 22' 56.585" E,17° 30' 11.304" N	2.20
2	Alicheruvu	78° 28' 44.931" E,17° 30' 55.715" N	5.54
3	Ambar Cheruvu	78° 23' 46.141" E,17° 30' 39.718" N	61.44
4	AnumulaKunta	78° 26' 52.218" E,17° 25' 24.186" N	1.47
5	Aparna County Villas	78° 21' 39.113" E,17° 29' 24.405" N	5.19
6	APHB Colony	78° 21' 33.078" E,17° 26' 56.878" N	0.84
7	Banda Cheruvu	78° 32' 45.486" E,17° 27' 39.229" N	17.18
8	Bandlaguda Tank-1	78° 16' 41.091" E,17° 31' 49.311" N	1.12
9	Banjarakunta(SingadiKunt)	78° 26' 10.257" E,17° 24' 50.738" N	3.11
10	BathakammaKunta	78° 30' 45.360" E,17° 23' 39.451" N	2.65
11	BathulaCheruvu	78° 36' 4.382" E,17° 19' 12.098" N	9.66
12	BathurKunta	78° 24' 2.571" E,17° 24' 51.232" N	0.82
13	BattemmaCheruvu	78° 21' 43.090" E,17° 24' 51.927" N	14.68
14	Bharathnagar Near	78° 32' 38.925" E,17° 32' 10.233" N	3.95
15	BhimuniKunta	78° 24' 1.966" E,17° 30' 4.556" N	2.36
16	BoinCheruvu	78° 29' 37.128" E,17° 28' 30.363" N	21.40
17	BondacheruvuOpp	78° 32' 56.841" E,17° 27' 50.035" N	0.84
18	Botanicalgarden	78° 21' 42.350" E,17° 27' 21.223" N	0.75
19	Budh Nagar	78° 30' 54.918" E,17° 24' 47.375" N	4.71
20	ChakiCheruvu	78° 15' 47.285" E,17° 31' 24.101" N	48.06
21	CheliKunta	78° 17' 6.219" E,17° 26' 50.380" N	8.60
22	Cherlapally Tank	78° 36' 31.191" E,17° 28' 27.644" N	39.57
23	ChinnaCheruvu	78° 33' 44.476" E,17° 20' 46.485" N	6.20
24	ChinnaCheruvu	78° 28' 27.237" E,17° 30' 17.982" N	11.18
25	Chinnarayan/Shikam	78° 30' 14.883" E,17° 30' 7.484" N	9.75
26	ChintaKunta	78° 20' 58.082" E,17° 25' 45.359" N	4.65
27	Chinta Kunta-2,3,4,5	78° 20' 56.191" E,17° 25' 54.041" N	3.67
28	ChintalKunda Behind	78° 33' 1.554" E,17° 20' 7.068" N	1.99
29	ChintalKunta Near	78° 33' 8.040" E,17° 20' 32.817" N	6.59
30	ChiranKunta	78° 25' 9.033" E,17° 25' 2.626" N	2.82
31	Cold Storage	78° 32' 39.798" E,17° 20' 32.823" N	1.55
32	Deccanpark	78° 23' 54.759" E,17° 23' 41.613" N	0.41
33	DevuniKunta	78° 26' 53.139" E,17° 23' 41.186" N	2.04
34	DhangarKunta	78° 21' 24.839" E,17° 25' 25.367" N	3.50
35	Dhobi Ghat	78° 30' 26.183" E,17° 21' 23.029" N	1.98
36	Dipti Nagar Lake	78° 20' 29.372" E,17° 30' 11.011" N	5.01
37	Directorate Of Rice	78° 23' 26.049" E,17° 19' 13.275" N	3.18
38	DurgamCheruvu	78° 23' 24.217" E,17° 25' 49.408" N	37.37
39	EluguGuttaCheruvu	78° 33' 7.949" E,17° 24' 4.829" N	0.87
40	Errakunta Tank	78° 32' 55.218" E,17° 26' 1.031" N	7.00
41	ESI	78° 26' 37.604" E,17° 26' 47.199" N	0.32
42	Fathulguda-Village	78° 34' 54.796" E,17° 22' 28.680" N	3.98
43	Fox SagarKottacheru	78° 28' 11.376" E,17° 31' 34.729" N	111.38
44	GaddiAnnaramCheruvu	78° 31' 56.115" E,17° 21' 49.615" N	7.38
45	Gajularamaram RF	78° 25' 18.735" E,17° 32' 29.982" N	0.72
46	GangaramCheruvu	78° 19' 49.899" E,17° 29' 57.937" N	35.82
47	Godrej Boyee	78° 25' 24.623" E,17° 28' 37.143" N	1.56
48	GopiCheruvu	78° 19' 45.968" E,17° 28' 47.383" N	24.41
49	Gundlakunta-Buffalo	78° 19' 38.038" E,17° 27' 8.514" N	5.86
50	GuntlaCheruvu	78° 26' 53.298" E,17° 24' 39.849" N	4.25
51	GurramCheruvu	78° 29' 16.169" E,17° 19' 0.586" N	26.39
52	HakeempetKunta	78° 24' 46.105" E,17° 24' 29.191" N	0.83
53	HCL	78° 22' 32.182" E,17° 27' 31.943" N	0.29
54	HCU Opposite	78° 20' 29.351" E,17° 27' 35.494" N	3.52
55	HCU-Inner	78° 19' 17.015" E,17° 26' 43.034" N	3.06
56	Hitex Road	78° 22' 24.219" E,17° 27' 53.598" N	1.35
57	HMT Colony Cheruvu	78° 21' 2.794" E,17° 30' 58.106" N	6.27
58	HMT Colony Lake	78° 26' 16.697" E,17° 30' 10.858" N	6.40
S.No	**Name**	**Coordinates**	**Area (ha)**
59	HMT Colony-01	78° 21' 26.030" E,17° 30' 54.135" N	0.39
60	HMT Colony-01	78° 21' 32.609" E,17° 30' 52.761" N	5.18
61	Hmws	78° 34' 35.805" E,17° 23' 10.567" N	11.77
62	Hmws-01	78° 34' 38.643" E,17° 23' 56.969" N	2.27
63	Hussain Sagar	78° 28' 26.666" E,17° 25' 26.599" N	444.6
64	Hussainsagar Above	78° 28' 48.252" E,17° 26' 13.928" N	18.66
65	Hussainsagar-01	78° 27' 42.221" E,17° 25' 30.753" N	2.39
66	ICAI Bhavan	78° 27' 50.948" E,17° 23' 56.957" N	0.49
67	IDL Road	78° 24' 47.813" E,17° 28' 19.536" N	0.46
68	IIIT Opposite	78° 21' 31.973" E,17° 26' 39.459" N	1.09
69	Indira Park	78° 29' 0.948" E,17° 24' 48.934" N	1.71
70	IrlaKunta	78° 20' 45.867" E,17° 29' 10.473" N	13.37
71	IrlaKunta -01	78° 20' 57.990" E,17° 29' 8.345" N	0.32
72	ISB Checkdam	78° 20' 24.570" E,17° 25' 51.096" N	1.43
73	Jamal Kunta	78° 24' 25.502" E,17° 23' 33.309" N	1.16
74	Jayabheri	78° 19' 45.298" E,17° 25' 44.751" N	0.80
75	KaithlapurKunta	78° 24' 7.881" E,17° 28' 4.090" N	2.88
76	KamuniCheruvu	78° 24' 11.560" E,17° 27' 49.549" N	16.65
77	KapraCheruvu	78° 33' 10.840" E,17° 29' 43.239" N	37.13
78	KapraiCheruvu	78° 34' 6.941" E,17° 18' 52.652" N	29.48
79	Katora Houz	78° 24' 5.782" E,17° 23' 19.999" N	2.52
80	Khairatabad T.P	78° 27' 55.818" E,17° 24' 57.755" N	1.38
81	KhajaKunta	78° 25' 25.910" E,17° 28' 55.557" N	1.62
82	KhajagudaCheruvu	78° 22' 22.164" E,17° 25' 28.311" N	11.89
83	KindiKunta	78° 23' 26.839" E,17° 30' 19.591" N	1.88
84	KLN Yadav Park	78° 26' 28.226" E,17° 26' 59.007" N	0.56
85	Kodikunta	78° 20' 46.240" E,17° 28' 0.000" N	2.44
86	Komati Kunta	78° 17' 52.764" E,17° 27' 45.107" N	6.99
87	KothaCheruvu	78° 24' 17.498" E,17° 24' 35.911" N	4.45
88	KothaKunta	78° 24' 59.474" E,17° 24' 38.036" N	0.44
89	Kotha(AlwalCheruvu)	78° 30' 41.526" E,17° 30' 28.165" N	7.70
90	KottaCheruvu	78° 22' 18.091" E,17° 28' 16.171" N	4.73
91	KottaCheruvu	78° 22' 1.645" E,17° 25' 16.731" N	3.78
92	KottaKunta	78° 21' 18.471" E,17° 29' 4.475" N	3.36
93	Krishnakanth Park	78° 25' 50.494" E,17° 26' 24.972" N	1.84
94	Kummari Cheruvu	78° 35' 48.005" E,17° 19' 25.188" N	4.72
95	Kunta-No Name	78° 27' 46.711" E,17° 29' 58.537" N	1.72
96	Kunta-No Name	78° 27' 54.535" E,17° 30' 1.864" N	2.55
97	Kunta-No Name	78° 27' 25.795" E,17° 29' 35.576" N	2.27

98	Lal Sahebguda Near	78° 24' 52.669" E,17° 32' 0.227" N	9.52
99	Lal Sahebguda-1 Near	78° 24' 26.134" E,17° 32' 16.505" N	6.34
100	LallaramCheruvu	78° 26' 30.878" E,17° 19' 55.133" N	6.69
101	Langarhouz Park	78° 24' 56.454" E,17° 22' 50.276" N	10.99
102	LingayaCheruvu	78° 26' 2.037" E,17° 32' 55.047" N	4.27
103	Little Angels High S	78° 23' 57.777" E,17° 28' 59.720" N	0.83
104	Lotus Ponds	78° 25' 12.774" E,17° 24' 50.064" N	2.42
105	MagalCheruvu	78° 26' 50.448" E,17° 29' 44.017" N	13.50
106	MaisammaKunta	78° 18' 55.818" E,17° 26' 13.937" N	3.67
107	MaisammaKunta Below	78° 18' 31.701" E,17° 25' 56.826" N	1.04
108	MaisammaKunta Below	78° 18' 36.627" E,17° 25' 58.684" N	0.76
109	MaktaKunta	78° 21' 58.538" E,17° 29' 22.692" N	5.39
110	MalakaCheruvu	78° 23' 10.982" E,17° 25' 0.656" N	13.73
111	MallaiahKunta	78° 20' 6.772" E,17° 29' 24.189" N	1.36
112	MallakamKunta	78° 33' 31.683" E,17° 22' 8.623" N	5.39
113	MallenCheruvu	78° 32' 44.534" E,17° 31' 45.670" N	7.59
114	MangavaiKunta	78° 34' 28.015" E,17° 28' 25.475" N	3.60
115	ManikondaCheruvu	78° 22' 28.098" E,17° 24' 49.086" N	11.63
116	MannevariKunta	78° 30' 41.684" E,17° 31' 55.649" N	0.49
117	MeraKunta	78° 35' 5.874" E,17° 18' 34.093" N	3.60
118	Mettakadigudem Near	78° 25' 9.901" E,17° 31' 47.783" N	2.88
S.No	**Name**	**Coordinates**	**Area (ha)**
119	Mir AlamCheruvu	78° 26' 20.021" E,17° 20' 43.365" N	148.10
120	Miyapur	78° 21' 48.621" E,17° 30' 1.626" N	0.14
121	Miyapur/GurunathCheruvu	78° 21' 31.653" E,17° 30' 5.565" N	7.83
122	MohiniCheruvu	78° 31' 32.355" E,17° 23' 55.836" N	12.41
123	MothkulaCheruvu	78° 30' 24.628" E,17° 31' 3.859" N	2.69
124	Mothula Lake	78° 29' 53.210" E,17° 31' 5.193" N	4.32
125	Moula Ali Cheruvu	78° 33' 12.295" E,17° 26' 16.195" N	8.75
126	Moulali Near	78° 33' 15.082" E,17° 27' 52.895" N	1.00
127	MundlaKatwaCheruvu	78° 18' 18.072" E,17° 30' 58.333" N	23.49
128	MysammaCheruvu	78° 24' 53.381" E,17° 27' 48.514" N	32.02
129	MysammaKunta	78° 32' 3.906" E,17° 32' 1.866" N	0.55
130	NaaiKunta	78° 27' 26.711" E,17° 30' 30.557" N	9.17
131	NacharamCheruvu	78° 32' 44.804" E,17° 25' 46.107" N	7.91
132	NagariKunta	78° 25' 15.879" E,17° 27' 22.989" N	4.71
133	NagulaCheruvu	78° 33' 51.688" E,17° 22' 36.987" N	6.49
134	NaineniKunta	78° 22' 6.024" E,17° 29' 57.307" N	2.82
135	NallaCheruvu	78° 34' 45.983" E,17° 24' 14.005" N	24.74
136	NallaCheruvu	78° 25' 5.363" E,17° 29' 18.542" N	8.67
137	NallagandlaCheruvu	78° 18' 56.259" E,17° 28' 12.770" N	23.70
138	Nallakunta	78° 18' 28.631" E,17° 27' 15.729" N	3.47
139	Name_Unidentified	78° 31' 49.927" E,17° 30' 44.504" N	1.20
140	Name_Unidentified	78° 24' 1.028" E,17° 25' 37.174" N	0.28
141	Name_Unidentified	78° 32' 11.999" E,17° 25' 0.888" N	1.60
142	Name_Unidentified	78° 32' 25.640" E,17° 23' 35.617" N	9.62
143	Name_Unidentified	78° 32' 27.846" E,17° 20' 0.593" N	3.55
144	Name_Unidentified	78° 33' 32.943" E,17° 21' 7.858" N	1.90
145	Name_Unidentified	78° 34' 49.816" E,17° 26' 49.563" N	0.74
146	Name_Unidentified	78° 29' 56.664" E,17° 31' 35.539" N	0.59
147	Name_Unidentified	78° 29' 46.385" E,17° 31' 25.622" N	1.86
148	Name_Unidentified	78° 31' 44.364" E,17° 25' 2.242" N	1.72
149	Name_Unidentified	78° 24' 41.541" E,17° 21' 23.013" N	2.93
150	Name_Unidentified	78° 25' 32.990" E,17° 21' 43.828" N	0.74
151	Name_Unidentified	78° 29' 17.869" E,17° 20' 49.764" N	0.49
152	Name_Unidentified	78° 16' 13.565" E,17° 31' 49.686" N	5.22
153	Name_Unidentified	78° 27' 20.244" E,17° 28' 7.626" N	8.68
154	Name_Unidentified	78° 27' 36.967" E,17° 28' 24.802" N	25.45
155	Name_Unidentified	78° 29' 29.901" E,17° 29' 55.235" N	1.09
156	Name_Unidentified	78° 29' 19.615" E,17° 29' 52.381" N	2.89

157	Name_Unidentified	78° 28' 59.596" E,17° 29' 50.122" N	0.96
158	Name_Unidentified	78° 28' 55.217" E,17° 29' 38.186" N	1.63
159	Nandi MusalaiGuda	78° 26' 26.157" E,17° 21' 35.030" N	2.98
160	NangaluKunta	78° 27' 41.758" E,17° 29' 41.369" N	6.15
161	NayaQuilaTalab, Golkonda	78° 24' 37.273" E,17° 23' 23.872" N	3.10
162	Near Hitech Garden	78° 22' 22.184" E,17° 26' 43.166" N	2.66
163	Near Hussainsagar	78° 27' 45.480" E,17° 25' 54.905" N	1.87
164	Nehru Park	78° 27' 2.978" E,17° 24' 5.268" N	0.50
165	Nerala Tank	78° 21' 50.482" E,17° 27' 41.590" N	3.39
166	NGRI UNIVERSITY	78° 25' 25.259" E,17° 19' 3.308" N	1.10
167	NIN Opp	78° 31' 45.359" E,17° 25' 43.225" N	1.09
168	NITHM	78° 21' 53.214" E,17° 25' 54.224" N	1.75
169	NoahsAmusementpark	78° 29' 34.852" E,17° 31' 16.417" N	0.80
170	Noorinagar	78° 27' 37.883" E,17° 18' 32.623" N	3.33
171	Nur Mohammad Cheruvu	78° 25' 39.588" E,17° 18' 54.337" N	8.12
172	Oil Kunta	78° 18' 24.998" E,17° 26' 18.106" N	2.26
173	Oil Kunta Above	78° 18' 40.528" E,17° 26' 24.326" N	0.68
174	Old HafizpetCheruvu	78° 21' 45.799" E,17° 29' 12.338" N	1.70
175	Opp Of APIIC	78° 20' 3.593" E,17° 25' 45.146" N	1.33
176	PalleCheruvu	78° 27' 16.816" E,17° 18' 42.372" N	14.55
177	ParkiCheruvu	78° 24' 53.509" E,17° 30' 41.159" N	11.23
S.No	**Name**	**Coordinates**	**Area (ha)**
178	Parkwood International	78° 27' 48.958" E,17° 24' 52.925" N	3.38
179	Patel Cheruvu	78° 21' 3.915" E,17° 29' 46.955" N	13.55
180	Peacock Lake	78° 19' 59.338" E,17° 26' 53.833" N	3.38
181	PeddaCheruvu	78° 33' 16.880" E,17° 25' 16.246" N	31.10
182	Pedda Cheruvu	78° 32' 34.616" E,17° 19' 35.968" N	2.62
183	Pedda Cheruvu	78° 18' 15.146" E,17° 27' 2.874" N	5.45
184	PinjariKunta Cheruvu	78° 26' 49.528" E,17° 29' 6.095" N	2.62
185	Pragathi Nagar Lake	78° 24' 28.539" E,17° 31' 38.927" N	5.22
186	Premavatipet Cheruvu	78° 24' 44.078" E,17° 18' 15.953" N	29.07
187	Public Gardens	78° 28' 11.776" E,17° 23' 49.689" N	1.41
188	Pushparahill Cheruvu	78° 25' 32.002" E,17° 19' 22.730" N	5.78
189	Ragikunta	78° 34' 19.763" E,17° 18' 42.799" N	7.49
190	Rajendra Nagar Cheruvu	78° 33' 6.163" E,17° 23' 47.934" N	0.43
191	Rajendra Nagar Cheruv1	78° 33' 15.189" E,17° 23' 35.587" N	1.96
192	Rama Cheruvu	78° 34' 19.347" E,17° 25' 36.088" N	13.82
193	Ramakrishnapuram cheruvu	78° 32' 0.404" E,17° 28' 31.381" N	15.64
194	Ramanna Cheruvu	78° 28' 48.660" E,17° 28' 10.209" N	1.86
195	Ramantha Cheruvu	78° 32' 25.630" E,17° 24' 5.822" N	5.41
196	Ramaram Cheruvu	78° 25' 42.342" E,17° 32' 19.151" N	9.86
197	Rangadhamuni	78° 24' 44.843" E,17° 28' 44.196" N	17.69
198	Rayasamudram Cheruvu	78° 17' 41.121" E,17° 30' 24.948" N	44.57
199	Safilguda Cheruvu	78° 32' 10.606" E,17° 27' 50.837" N	11.10
200	Sainagar Cheruvu	78° 34' 3.098" E,17° 21' 58.545" N	12.27
201	Sakti Nagar Near	78° 31' 46.403" E,17° 29' 0.963" N	4.51
202	SalkamCheruvu	78° 28' 18.641" E,17° 18' 35.513" N	14.53
203	SangamNathKunta	78° 21' 29.746" E,17° 29' 44.333" N	2.18
204	Santa Mariya School	78° 19' 22.158" E,17° 29' 2.369" N	3.63
205	SarurnagarCheruvu	78° 31' 37.863" E,17° 21' 18.088" N	37.32
206	Sez Near	78° 20' 34.365" E,17° 25' 9.296" N	0.33
207	ShahatamCheruvu	78° 24' 47.451" E,17° 23' 38.230" N	18.98
208	ShikariKunta	78° 24' 53.726" E,17° 24' 36.183" N	0.96
209	Shilparamam	78° 22' 37.731" E,17° 27' 9.251" N	0.85
210	Sri Colony Near	78° 32' 33.567" E,17° 28' 53.817" N	1.35
211	Sufah Colony	78° 18' 18.287" E,17° 26' 8.374" N	1.60

212	SunnamCheruvu	78° 24' 12.902" E,17° 27' 7.988" N	6.46
213	SunnamKunta	78° 25' 0.762" E,17° 26' 31.700" N	0.55
214	Tall Kunta	78° 25' 26.442" E,17° 21' 35.343" N	0.68
215	TCS DLF	78° 21' 12.693" E,17° 26' 50.918" N	0.99
216	Tempus Constructions	78° 20' 53.274" E,17° 24' 56.873" N	0.81
217	Timmidkunta Lake	78° 22' 49.580" E,17° 27' 26.044" N	8.53
218	Tirumalagiri Tank	78° 30' 24.147" E,17° 28' 29.636" N	1.85
219	Tumkunta	78° 19' 27.138" E,17° 25' 29.613" N	6.13
220	UmdaSagar	78° 27' 19.047" E,17° 17' 49.939" N	54.96
221	University of Hyd	78° 19' 11.446" E,17° 27' 24.979" N	3.86
222	Ushodaya Nagar Near	78° 25' 44.791" E,17° 31' 24.730" N	0.53
223	VattiKunta	78° 24' 44.052" E,17° 24' 43.016" N	1.40
224	Wipro Lake	78° 20' 33.013" E,17° 25' 28.607" N	3.32
225	Yapral Lake	78° 32' 32.172" E,17° 30' 55.131" N	5.94
226	Yellamma Cheruvu	78° 24' 25.096" E,17° 30' 4.488" N	7.91
227	YerraKunta	78° 23' 58.971" E,17° 24' 22.195" N	1.84
228	Zoo Park Above	78° 25' 53.666" E,17° 21' 31.247" N	3.06
229	Zoo Park Above-1	78° 26' 14.366" E,17° 21' 33.050" N	1.12
230	ZOO Park Lake	78° 26' 38.758" E,17° 21' 0.000" N	3.76

Digitized full tank level boundaries were visualised through their spatial extent on both the base shape file and ESRI high-resolution satellite imagery. The output of two hundred and thirty-one waterbodies was displayed with a coordinate system in degrees, minutes, and seconds. The projection used to display the dataset is UTM Zone 43N. The background-based shape file is the Study Area Greater Hyderabad Municipal Corporation boundary. All polygon boundaries were given attributes, namely a future identity number, the name of the lake, display status (water body status view on the topo sheet), coordinates, area, and perimeter information. The name of the lake is identified through various processes, such as the fact that a few waterbodies have names on topo sheets and the rest were identified through Open Street Maps, Google Earth, and Telangana State Pollution Control Board Lakes Pollution Information. Other fields, such as FID, Area in hectares, Perimeter in metres, and Coordinates, were automated information provided through the Projected Coordinate System in ArcGIS Software.

In the below table, no. 4, all surface water bodies names were retrieved from the attribute table of the digitized shape file. A total of 19 water bodies names were not identified, and the name of the waterbody is placed as Name_Unidentified. For a few unidentified waterbodies, it is placed by the nearby bookmark name viewed on the topo sheet.

V. CONCLUSION

The delineated boundary of water bodies shape files is used to identify the change detection of waterbodies. spatial extent as an additional advantage in urban areas to monitor the conversion of surface water and wetlands into built-up or land use. Study area water bodies were classified into five categories to easily identify the changes explored in Table 3. A digitised boundary shape file of waterbodies was shown in a pictorial representation in Figure 02. Identification of lakes is difficult as the study area coverage is 650 sq. km, so each waterbody is given an attribute field of coordinates and name in Table 2. A further scope of work is to use historical satellite datasets to monitor changes in waterbodies.

REFERENCES

[1] Reddy, M., & Char, N. (2006). Management of lakes in India. Lakes & Reservoirs: Research & Management, 11(4), 227-237.

[2] Environment Protection Training and Research Institute.(2015) State Of Environment Report-Hyderabad.

[3] Engineering Staff College of India-Centre for Climate Change, (2017).Urban Lakes Restoration & Management.

[4] Ramachandraiah.C,Sheela Prasad(2004),Impact of Urban Growth on Water Bodies The Case of Hyderabad, Centre For Economic And Social Studies ,Begumpet, Hyderabad.

[5] Urban Wetland/Water Bodies Management Guidelines, School Of Planning & Architecture, New Delhi, January 2021 VolumeII.
[6] Anjireddy.M.(2008),Textbook of Remote Sensing and Geographical Information Systems Third Edition,ISBN : 81-7800-135-7.
[7] M B Sridhar and R Sathyanathan 2020 IOP Conf. Ser.: Mater. Sci. Eng. 912 062069.

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