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A Study on Geo Hydrological And Qualitative Status of A Byramangala Lake

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ABSTRACT: The Byramnagala Lake is located at Bidadi , Ramanagram Taluk, Bangalore Rural District on latitude 12'47''N and longitude 77'20''E,provided water security in a region with variable rainfall and moderate discharge in the yesteryears. But due to urbanization and industrialization from past many years the lake has been highly polluted but people are still dependent on the water for various other purposes. Hence in the paper study has been conducted to determine the quality of water in the lake and to determine geohydrological parameters such as water spread area of the lake is known from Remote sensing Images, infiltration capacity of soil empirically Hence the study helps in lake water restoration, rejuvenation and development of water body.

Keyword: Quality, Discharge, BIS, Rejuvenation.

I. INTRODUCTION

Water conservation encompasses the policies, strategies and activities to manage fresh water as a sustainable resource, to protect the water environment, and to meet current and future human demand. Population, household size and growth and affluence all affect how much water is used. The strategies for water conservation may be demand oriented or supply oriented and/or management oriented. The strategies may vary depending upon the field of water use domestic, irrigation or industrial. For example water conservation measures in industries should include: (i)Water efficient design and technology; (ii)Reducing water demand in the landscape; (iii)Capture and storage of rain and storm water; and (iv)Recycling waste-water for irrigation.

The study reveals that the reservoir is highly polluted and the reservoir sediments are also contaminated. The annual rainfall data of 789mm and average monsoon rainfall of 551.69mm were collected from the records of the rain gauge installed at Byramangala. [1]

The minimum annual inflow to the reservoir is 23.92M3 and maximum annual inflow is 114.5x109 M3. The bund constructed for Byramangala reservoir is of earthen type and its height at the deepest point is recorded as 22.85m. The length of the bund is recorded as 2286m and top width of the bund as 3.66m. The MWL of the reservoir is noted as 32.9m its FRL as 32m and its sill level as 22.85m.[1]

The Reservoir is provided with 2 channels, viz., Left Bank canal and Right bank canal. The left bank canal is 26.4 km in length and Right bank canal is 8.4 km length having a command area of 1330 ha and right bank canal is 8.4 km having a command area of 444ha. Reconnaissance survey reveals that the soil in the command area is polluted with the application of sewage water. [1]

II. STUDY AREA AND DATA COLLECTION.

Byramangala lake is located at Byramangala ,Bidadi , Ramanagram Taluk, Bangalore Rural District. Its exact position on the map is on latitude 12'47''N and longitude 77'20''E.The taluk covers 62,930 hectares of geographical area and consists of 4 Hoblies. Namely, Kasaba, Kailancha, Kootagal, and Bidadi where the lake is located. According 2001 census the Taluk had 126 villages, 23 Gram Panchayats, 1 Municipal Council. It also total population of around 2, 37,078. About 157,713 live in the rural part of taluk. This is around 67% of the entire population of Taluk. Investigations also show that 2000 people live in the immediate vicinity of Lake Shoreline. The total area of lake is 412 hectares. The lake water is being utilized for agriculture, fisheries and for other various vegetation purposes. About 1600 hectares of the surrounding agricultural areas are being irrigated by the same water from this lake. The lake quickly joins the Arkavathi River downstream-one of various other tributaries that finally join the Cauvery Basin further south.

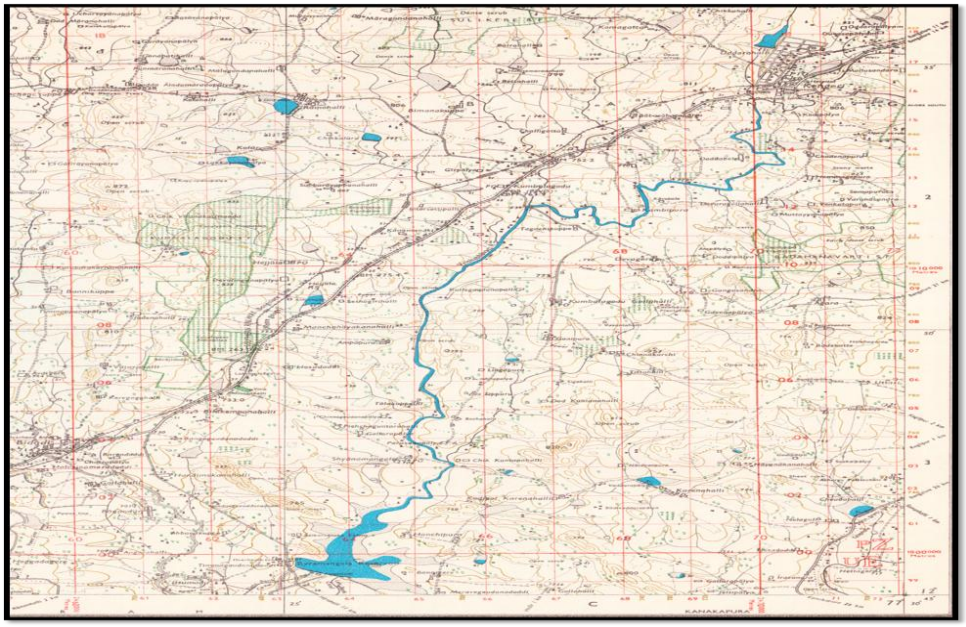
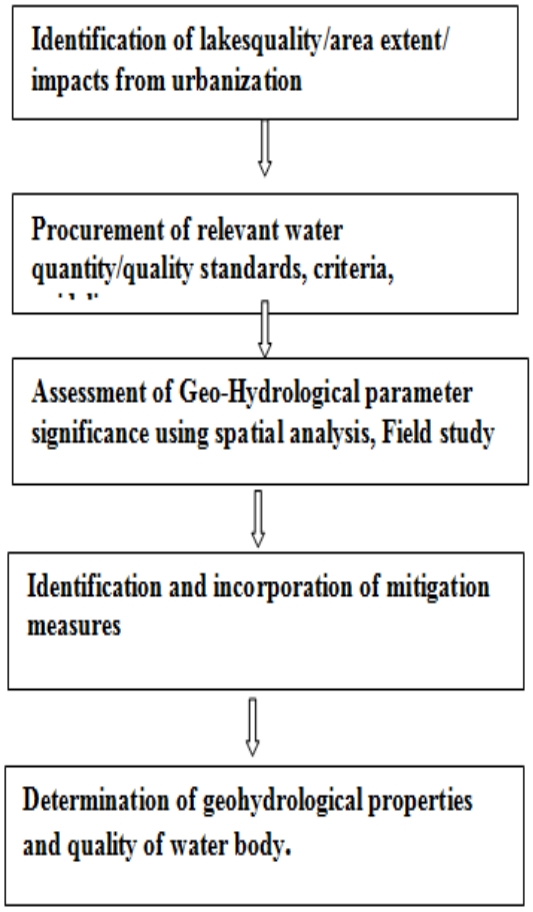


Fig.1 SOI Toposheet 57/H-5

SOI Toposheet as a base map, Remote sensing images, GIS maps preparation,Google maps, Rainfall data for calculation of soil properties and water quality analysis data to determine pollution level in the lake.

II. METHODOLOGY:

The flowchart methodology:



- The methodology involves the preparation of land use and land cover maps, soil map of the study area using RS and GIS.
- Determination of geo hydrological parameter studies and water quality testing of important parameter of lake.

IV . RESULT AND DISCUSSION

The catchment of Byramangala includes Bangalore urban areas which come under Bhruhath Bangalore MahanagaraPalike and villages of Bangalore rural area, Rajajinagar Industrial area, Peenya Industrial area, Kumbalgod Industrial area and the Bidadi Industrial are located in the Reservoir catchment area. The Vrishabhavathi river which flows in the catchment carries urban domestic sewage, industrial sewage and storm water from urban, semi urban and rural areas. The agricultural wastes resulting from intensive farming in the rural areas of the catchment also enter the reservoir.

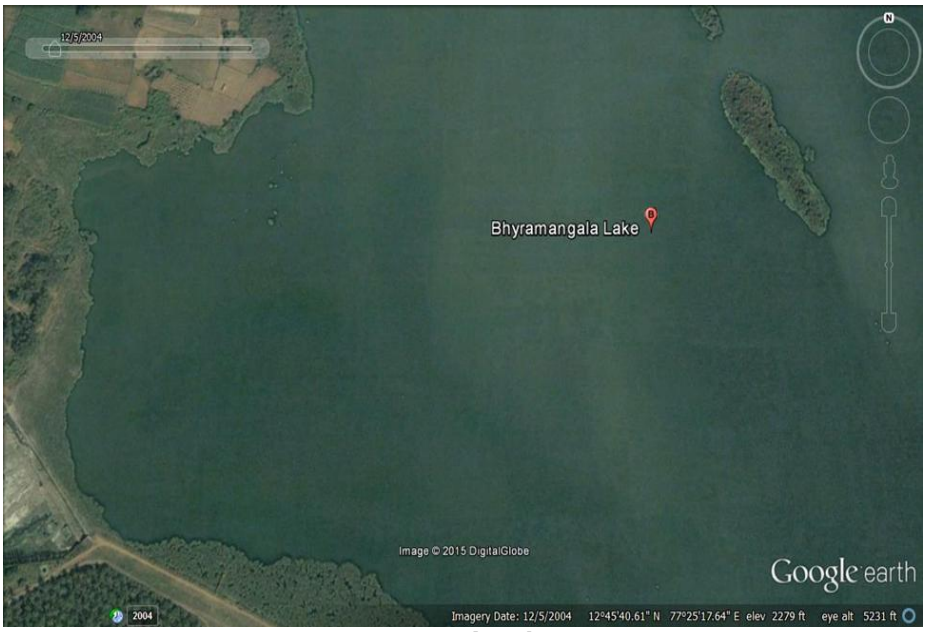


Fig.2 Byramangala Lake in 2004

Fig.3 Byramangala Lake in 2009

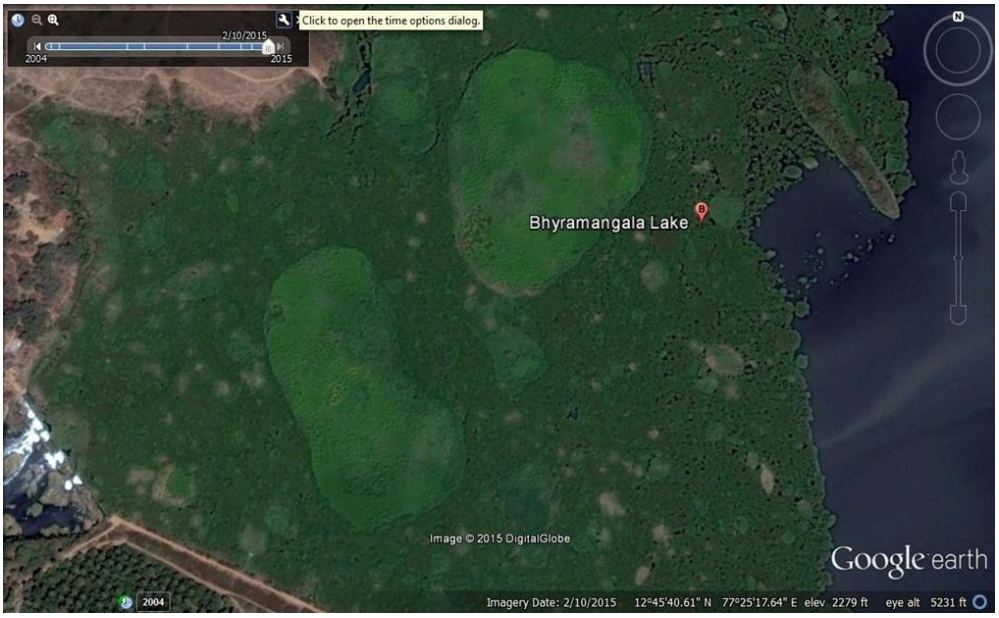


Fig.4 Byramangala Lake in 2015

Fig5. Present Status of Lake

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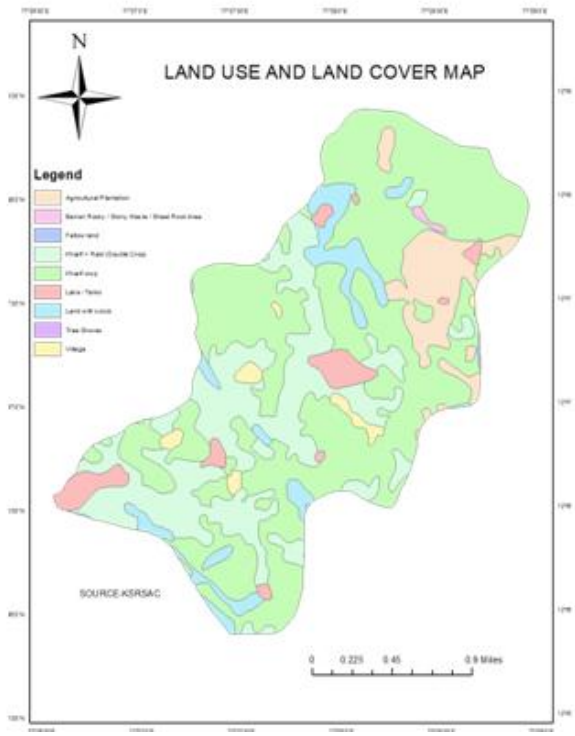

Fig 6.Landuse Land cover pattern Map

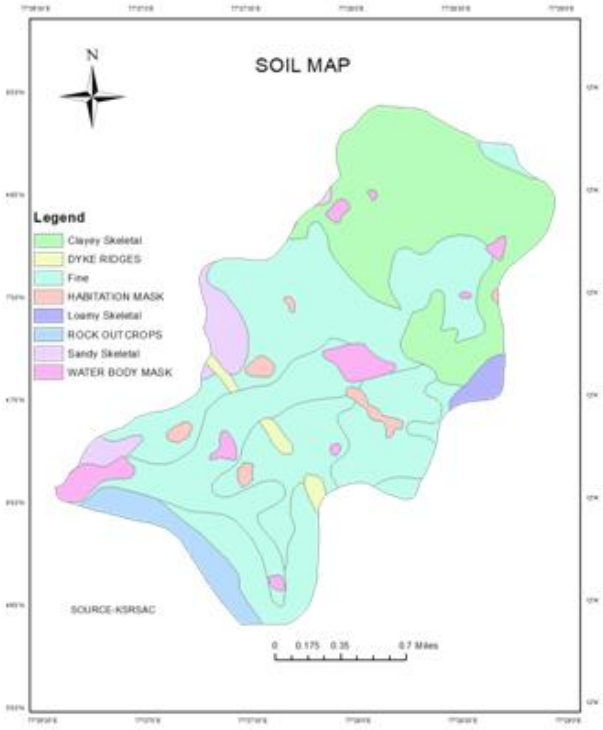

Fig 7 Soil Map

4.1. Water Samples Collected:

In order to monitor and estimate the contamination hydrological investigations of Byramangala Lake and effluent channel of industrial area samples from 3 different locations of the lake were collected:

Table 1 Sampling Locations

Sample	Longitude	Latitude	Coordinate
Sample-1	12.711522	77.447462	12°42′41.5″N 77°26′50.9″E
Sample-2	12.712197	77.444146	12°42′43.9″N 77°26′38.9″E
Sample-3	12.713926	77.446466	12°42′50.1″N 77°26′47.3″E

4.2.Parameters of Water Quality Analyzed

For the assessment of water pollution status of the lake water, the following water quality parameters were analyzed in accordance with BIS Standard.

Table.2: Physicochemical analysis of water-

S.No.	Tests	Sample-1	Sample-2	Sample-3	Desirable Limit	Permissible Limit
1	DO	3.87	3.87	3.87	5	5
2	COD	48	12.8	48	100-250	LESS THAN 250
3	BOD	28.7	28.7	28.9	5	5
4	Total hardness	360	356	358	300	600
5	Calcium hardness	260	192	250	75	200
6	Mg hardness	100	164	134	30	100
7	Chloride content	6.987	6.987	1.8	250	1000

8	Iron content	0.8	0.513	0.710	0.3	1
9	pH	6.62	6.8	8.17	6.5-8.5	No relaxation
10	Total coli form	Present	Present	Present	Absent	Absent
11	Sulphate	4.2	-	-	400	400
12	Iron	0.07	-	-	1	1.5
13	Alkalinity(phenol phthalein)	220	250	256	200	600

4.3. Calculation Of Infilteration Capacity:

Green Ampt Method

Infiltration is the process of water penetrating from ground surface into soil. Many factors influence infiltration rate including condition of soil surface and its vegetative cover. The properties of soil such as porosity, hydraulic conductivity and current moisture of soil.Green and Ampt in 1911 proposed the simplified from of infiltration.

Green Ampt Parameters

Applications of the Green Ampt model requires estimates of the hydraulic conductivity k , the porosity Ψ ,the wetting soil section at Ψ can be expressed as a logarithm function of a effective saturation S_e .The below table shows the Green Ampt infiltration parameters of various soil classes: For Sandy Clay Loam: the study area comprises of about 50% of clay soils

θ_e=0.330 ,η=0.398,Ψ=21.85 cm, k=0.15 cm/hr,S_e=0.3

$\Delta\theta=(1-S_e)\theta_e$ = (1-0.3)0.330 =0.231

ΨΔθ=21.85*0.231 =5.047 cm

The cumulative infiltration at t= 1h is calculated employing the method of Successive substitution

Taking F(t) =K(t) = 0.65 F = K(t)

F (t) = cumulative infiltration = K(t)

K = Hydraulic- Conductivity η =porosity

Ψ = wilting front soil suction head Ψ θ = soil moisture content

Se = Effective saturation θ_e = effective porosity

t=1

Table .3 Newton's Iteration Method

k=0.65, t=1,Ψ=16.7,Δθ=0.34

The cumulative infiltration at t=1h is calculated employing the method of successive substitution in equation. Take a trial value of F(t)=k

F/(ψΔθ)	1+F/(ψΔθ)	ln(1+F/(ψΔθ)	ψΔθ	kt	Kt+ ψΔθ ln(1+F/(ψΔθ)	F
0.11448	1.11448	0.10839	5.6708	0.65	1.26541	0.65
0.22286	1.22286	0.20119	5.678	0.65	1.79238	1.26541
0.31567	1.31567	0.27435	4.678	0.65	2.20774	1.79238
0.38882	1.38882	0.32846	5.678	0.65	2.51498	2.20774
0.44293	1.44293	0.36668	5.678	0.65	2.732	2.51498
0.48116	1.48116	0.39282	5.678	0.65	2.88045	2.732
0.5073	1.5073	0.41032	5.678	0.65	2.97979	2.88045
0.5248	1.5248	0.42186	5.678	0.65	3.04533	2.97979
0.53634	1.53634	0.4294	5.678	0.65	3.08814	3.04533
0.54388	1.54388	0.4343	5.678	0.65	3.11594	3.08814
0.54877	1.54877	0.43746	5.678	0.65	3.13392	3.11594
0.55194	1.55194	0.43951	5.678	0.65	3.14552	3.13392
0.55398	1.55398	0.44082	5.678	0.65	3.15298	3.14552
0.5553	1.5553	0.44167	5.678	0.65	3.15779	3.15298
0.55614	1.55614	0.44221	5.678	0.65	3.16088	3.15779
0.55669	1.55669	0.44256	5.678	0.65	3.16286	3.16088
0.55704	1.55704	0.44278	5.678	0.65	3.16413	3.16286
0.55726	1.55726	0.44293	5.678	0.65	3.16495	3.16413
						3.16495

*t=.0.65cm and then calculate -

F(t) = 0.65×1+5.047 ln(1+(0.65/5.04))

= 1.22 cm

F(t)= K(t)+ΨΔθ ln(1+F(t)/ΨΔθ) ----(1)

Put T=0.15, Ψ=21.85 ,Δθ=0.231 ,F=3.16
Substituting F=1.22 in R.H.S of F(t)= kt+ΨΔθln(1+ F(t)/ ΨΔθ) gives F=3.16 after solved by Newton's iteration Method
Therefore, f= (K/T)((ΨΔθ/F)+1)
=1.82 cm/hr
This is infiltration rate after 1 hr.
From the above maps and Table it can be seen that

- Soil is having to clayey in nature. It has less infiltration capacity.
- The qualitative parameter of the lake is not within the permissible limit. The DO, BOD Alkalinity, Hardness is exceeding the limit. The coli form is present in the lake.
- Lake capacity has been reducing from years to years as seen from the Google map due to discharges of effluents from the industries around.

V. CONCLUSION

It is observed from the field study and thematic map that the catchment area is reduced from 350ha to 38ha.From qualitative analysis it is revealed that lake water is unfit for drinking purposes and for agricultural activities. If the lake water is supplied to the agricultural field then it increases the soil salinity, pH. Finally it leads to another problem of sewage sickness of the land. Soil in the study area is clayey in nature. Hence most of the water will flow as overland flow carrying the pollutants which effects nearby villagers and their fields also. Hence by suitable lake water management and restoration, rejuvenation work has to be taken up so that water can be made pollution free from contaminants, which is threatening the lake ecology and environment around it.

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