RESEARCH ARTICLE OPEN ACCESS

COMPREHENSIVE STUDY ON LAKES AND ANALYSIS OF RAINFALL RUNOFF ALONG NH44

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Abstract:

Rainfall and runoff are main substantial constitute sources of water for storage and recharge of ground water in the water shed. Evaluation of availability of water is most essential by understanding the rainfall and runoff pattern. The surface water resources are available in the watershed from national highways and state highways.

The present study is done form an area about 160km^2 in national highway is the main catchment area of the basin and same considered for runoff model. Runoff keeps rivers and lakes full with water but also changes the landscape by the action of erosion. Only about 35% of the precipitation ends up in oceans and seas, other 65% is absorbed into soil and remaining is evaporate. Lake Sediment removal is usually undertaken to deepen a lake and increase its value to enhance irrigation practices and fishery etc

***Keywords* — Rainfall, Runoff model, Ground water, Lakes**

I.INTRODUCTION

Lakes are an inherent part of the ecosystem. Lakes have traditionally served the function of meeting water requirements of the populace for drinking, household uses like washing, agriculture, fishing and also for religious and cultural purposes. Apart from these functions, which involve direct use of the lake water, lakes are also known to recharge ground water, channelize water flow to prevent water logging and flooding. Lakes are also host to a wide variety of flora and fauna, especially birds.

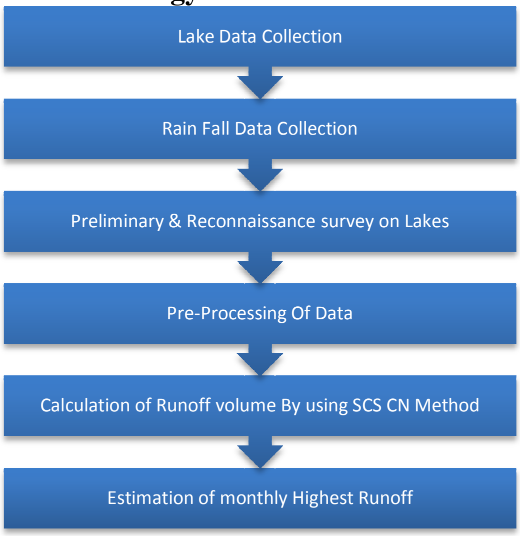
The need to initiate efforts to restore, conserve, manage and maintain the lakes as a valuable part of the whole ecosystem could no longer be ignored.

We should realize that if the lakes are not conserved without loss of time, the restoration costs later will not only reach phenomenal heights, but will more importantly cause a permanent ecological damage. This may lead to scarcity in potable water, cause heat islands in the cities and affect biodiversity in cities as well as villages.

Study Region-NH44 from Hebbal in Bangalore to Chickballapur in Bangalore rural district

Chickballapur is the district headquarter of the newly created in the state of Karnataka, India. It is located within 3 km of Muddenahalli. A $400 million Pharmaceutical SEZ is coming up in Chickballapur on 325acres (1.32 km^2). Furthermore, the noted Traveler Bungalow is being converted into a state of the art Bus terminus. A new District Government Headquarters and police headquarters is being constructed at a cost of $5 million. In addition, the state government is releasing over $10 million to develop the city and expand underground sanitary systems. It is a regional transport and educational hub, and is a major site for grape, grain, and silk cultivation. With recent development, it is widely believed that Chickballapur will become part of "Greater Bangalore.

II. Methodology



SCS-CN Method (Soil conservation service, curve number method)

The runoff curve number (also called a curve number or simple CN) is an empirical parameter used in hydrology for predicting the direct runoff or infiltration from rainfall excess. The curve number method was developed by the USDA Natural Resources Conservation Service, which was formerly called soil conservation service or SC-the number is still popularly known as "SCS runoff curve number" in the literature. The runoff curve num was developed from an empirical analysis of runoff from small catchments and hill slopes plots monitored by the USDA. It is widely used and is an efficient method for determining the approximate amount off direct runoff from a rainfall event in a particular area.

STEP 1: DATA COLLECTION

Here, the data required for our studies is collected i.e. the rainfall data from 1985 to 2015 from statistical department, Bangalore

STEP 2: PRE-PROCCESSING

In preprocessing missing data if any is checked, rainfall data is rechecked and processed by using "ARITHMATIC MEAN METHOD ",for all the 32 rain gauge station to calculate rainfall for a particular study area.

ARITHMATIC MEAN METHOD

When the rainfall measured at various stations in a catchment show little variation, the average precipitation over the catchment area is taken as the arithmetic mean of the station values. Thus if P_1, P_2,P_3.....$P_n$are the rainfall values in a given period in N stations within a catchment, then the value of the mean precipitation P over the catchment by the arithmetic mean method is as

$$P = \frac{P_1+P_2+\cdots+P_n}{N} = \frac{1}{N}\sum_{i=1}^{n} P_i$$

STEP 3: RUNOFF CALCULATION

For this calculation we have adopted "SCS CN METHOD", for this method we need soil characteristics data that is directly taken from "CENTRAL GROUND WATERBOARD"

$$Q = \frac{(P-0.2S)^2}{(P+0.8S)}$$

$$Q = \begin{Bmatrix} 0 \quad for\ P \leq I_\alpha \\ \frac{(P-I_\alpha}{P-I_\alpha+S} for\ P > I_\alpha \end{Bmatrix}$$

IN our study area we have chosen AMC II for our calculation & we have chosen soil group classification B which has moderate infiltration. Hence we have adopted the value of curve number 60 which is best situated condition for our study i.e. land with scrub confirming to the hydrologic soil group classification.

Table 1 AMC class details

AMC class	Description of soil condition	Total five day antecedent rainfall (mm)	
		Dormant season	Growing season
I	Soil is dry but not to the wilting point, satisfactory cultivation has taken place.	<12.7mm	<35.56mm
II	Average conditions	12.7mm – 27.94	35.56mm – 53.34mm
III	Heavy rainfall or light rainfall and low temperature have occurred within last 5 days; saturated soils	>27.94mm	53.34mm

III. List of Lakes in the Study Region and their Details

1. Hebbal Lake

Fig. 1 Aerial view of Hebbal Lake

SL. NO	Name of the lake	Total area(in m^2)	Total capacity(in m^2)	Silt accumulation(in m)	Volume of silt accumulation(in m^3)	Present capacity(in m^3)
1	**Hebbal lake**	**750000**	**238003.09**	**FTL**	**FTL**	**238003.09**

2. Amruthalli Lake

Fig.III.2 Aerial view of Amrutahalli lake

SL.NO	Name of the lake	Total area(in m^2)	Total capacity(in m^2)	Silt accumulation(in m)	Volume of silt accumulation(in m^3)	Present capacity(in m^3)
2	Amruthalli lake	102300	431265.57	0.420	42966	388299157

Table 2 Hydrological soil group classification

Soil Group	Description	Minimum infiltration rate(mm/hr)
A	Soils in this group have a low runoff potential (high infiltration rate) even when thoroughly wetted. They consist of deep, well to excessively well drained sand or gravels. These soils have a high rate of water transmission	7.62 - 11.43
B	Soils in the group have moderate infiltration rates when thoroughly wetted and consists chiefly of moderately deep to deep, well drained to moderately well drained soils with moderately coarse textures. These soils have a moderate rate of water transmission.	3.81 – 7.62
C	Soils have slow infiltration rates when thoroughly wetted and consists chiefly of soils with a layer that impedes the downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.	1.27 – 3.81
D	Soils have a high runoff potential (very low infiltration rates) when thoroughly wetted. These soils consists of clay soils with high swelling potential, soils with high water table, soils with a clay layer near the surface, and shallow soils over nearly impervious materials. These soils have a slow rate of water transmission.	0 – 127

3. Allalsandra Lake

Fig. 3 Aerial view of Allalsandra Lake

SL.NO	Name of the lake	Total area(in m^2)	Total capacity(in m^2)	Silt accumulation (in m)	Volume of silt accumulation (in m^3)	Present capacity(in m^3)
3	**Allalsandra lake**	**168200**	**703673.64**	**FTL**	**FTL**	**703673.64**

4. Jakkur Lake

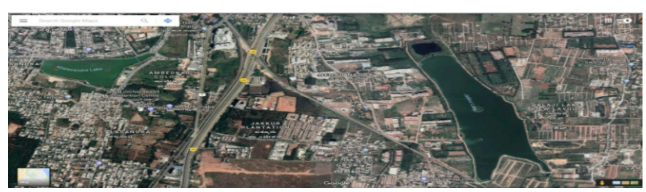


Fig. 4 Aerial view of Jakkur lake

SL. NO	Name of the lake	Total area(in m^2)	Total capacity(in m^2)	Silt accumulation(in m)	Volume of silt accumulation(in m^3)	Present capacity(in m^3)
4	Jakkur lake	664300	897000	FTL	FTL	897000

5. Yelahanka Lake

Fig. 5 Aerial View of Yelahanka lake

SL. NO	Name of the lake	Total area(in m^2)	Total capacity (in m^2)	Silt accumulation (in m)	Volume of silt accumulation (in m^3)	Present capacity (in m^3)
5	Yelahanka lake	1182000	2495500	FTL	FTL	2495500

6. Kogilu Lake

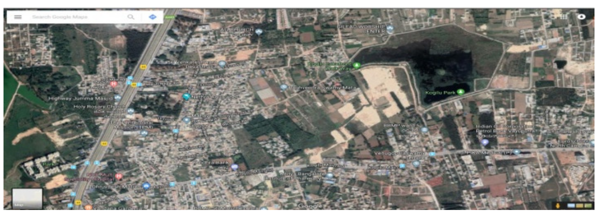


Fig. 6 Aerial view of Kogilu Lake

SL. NO	Name of the lake	Total area(in m^2)	Total capacity (in m^2)	Silt accumulation (in m)	Volume of silt accumulation (in m^3)	Present capacity (in m^3)
6	Yelahanka lake	298200	585000	0.410	122262	462738

7. Palanahalli Lake

Fig. III.7 Aerial view of Palanahalli Lake

SL. NO	Name of the lake	Total area(in m^2)	Total capacity(in m^2)	Silt accumulation(in m)	Volume of silt accumulation(in m^3)	Present capacity(in m^3)
7	Palanahalli lake	104000	21620000	1.415	147160	72840

8. Hunusmaranahalli lake

Fig. 8 Aerial view of Hunusmaranahalli lake

SL.NO	Name of the lake	Total area(in m^2)	Total capacity(in m^2)	Silt accumulation(in m)	Volume of silt accumulation (in m^3)	Present capacity(in m^3)
8	Hunusmaranahalli lake	99400	339802.16	1.340	133196	206606.16

9. Chikjala lake

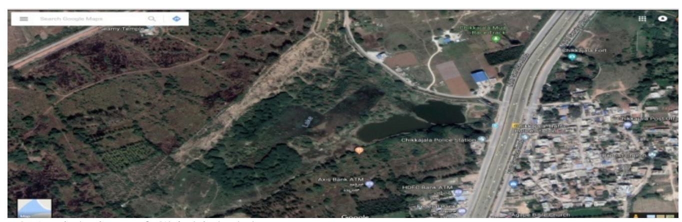


Fig. 9 Aerial view of Chickjala lake

SL.NO	Name of the lake	Total area(in m^2)	Total capacity(in m^2)	Silt accumulation(in m)	Volume of silt accumulation(in m^3)	Present capacity(in m^3)
9	Chikjala lake	163700	463546.78	1.20	196440	267106.78

10. Devanahalli Lake

Fig.10 Aerial view of Devanahalli Lake

SL.NO	Name of the lake	Total area(in m^2)	Total capacity(in m^2)	Silt accumulation (in m)	Volume of silt accumulation(in m^3)	Present capacity (in m^3)
10	Devana halli lake	160000	45306 9.55	0.40	64000	389069. 55

11. Savukanahalli Lake


Fig.11 Aerial view of Savukanahalli lake

SL. NO	Name of the lake	Total area(in m^2)	Total capacity(in m^2)	Silt accumulation(in m)	Volume of silt accumulation(in m^3)	Present capacity(in m^3)
11	Savukanaha lli lake	87000 0	86281 4.26	0.80	696000	166814.26

12. Venkatagirikote Lake


Fig.12 Aerial view of Venkatagirikote lake

SL. NO	Name of the lake	Total area(in m^2)	Total capacity(in m^2)	Silt accumulation(in m)	Volume of silt accumulation (in m^3)	Present capacity (in m^3)
12	Venkatagi ri lake	1690000	36936 49.47	0.950	1605500	208814 9.47

13. Kandavara Lake


Fig. 13 Aerial view of Kandavara Lake

SL. NO	**Name of the lake**	**Total area(in m^2)**	**Total capacity(in m^2)**	**Silt accumulation(in m)**	**Volume of silt accumulation(in m^3)**	**Present capacity(in m^3)**
13	**Kandaua ra lake**	**1331900**	**2309238.8 4**	**0.720**	**958968**	**1350270.84**

IV.RESULTS AND CONCLUSION

Showing highest monthly rainfall & Runoff for the year 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016 & 2017.

1. Devanahalli town to Chikkaballapur

Year	Month (June-Nov)	Total (AVG.)
2009	Rainfall(mm)	288
	Runoff(mm)	233.31
2010	Rainfall (mm)	281
	Runoff (mm)	227.86
2011	Rainfall(mm)	228
	Runoff(mm)	176.55
2012	Rainfall(mm)	270
	Runoff(mm)	218.205
2013	Rainfall(mm)	220
	Runoff(mm)	163.667
2014	Rainfall(mm)	208
	Runoff(mm)	155.34
2015	Rainfall(mm)	257
	Runoff(mm)	208.788
2016	Rainfall(mm)	250
	Runoff(mm)	200.155
2017	Rainfall(mm)	208
	Runoff(mm)	164.99

2. Hebbal to Devnahallli toll booth

Year	Month (June-Nov)	Total (AVG.)
2009	Rainfall (mm)	277.4
	Runoff(mm)	221.3
2010	Rainfall(mm)	285.8
	Runoff(mm)	228.43
2011	Rainfall(mm)	229.99
	Runoff(mm)	176.11
2012	Rainfall(mm)	254.12
	Runoff(mm)	203.97
2013	Rainfall(mm)	295.26
	Runoff(mm)	211.25
2014	Rainfall(mm)	276.99
	Runoff(mm)	225.6
2015	Rainfall(mm)	291.2
	Runoff(mm)	223.58
2016	Rainfall(mm)	202.15
	Runoff(mm)	151.79
2017	Rainfall(mm)	212.22
	Runoff(mm)	169.21

V. CONCLUSION

- By providing proper drainage system and improvised canals, the runoff water from the National highways can be diverted to the nearby lakes. At certain places where drainage system fails, pipes can be used.
- The flow is carried out by gravitational method which is very economical.
- Reconnection of storm drains to tanks and networking of tanks can be done in order to shift extra amount of water without any loss.
- Dredging of tanks is a must where in both the storage capacity and volume of the tank increases.

3. Toll booth to Devanahalli town

Year	Month (June-Nov)	Total (AVG.)
2009	Rainfall (mm)	207.2
	Runoff(mm)	153.86
2010	Rainfall(mm)	265.3
	Runoff(mm)	208.58
2011	Rainfall(mm)	229.99
	Runoff(mm)	221.55
2012	Rainfall(mm)	250
	Runoff(mm)	184.35
2013	Rainfall(mm)	278.29
	Runoff(mm)	219.27
2014	Rainfall(mm)	195.56
	Runoff(mm)	142.91
2015	Rainfall(mm)	254.14
	Runoff(mm)	152.19
2016	Rainfall(mm)	266.26
	Runoff(mm)	216.16
2017	Rainfall(mm)	241.28
	Runoff(mm)	197.23

VI. REFERENCES

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