International Journal of Engineering Science Invention Research & Development; Vol. IV, Issue VIII, FEBRUARY 2018
www.ijesird.com, E-ISSN: 2349-6185

A STUDY ON DALAVAYI TANK IN MYSURU FOR REHABILITATION

Sowmyashree,B.K [1], Vidya V.K[2], Putty,M.R.Y [3]. Manjunath,K.C [3]
[1] P.G student, N.I.E Mysuru, [2] Formerly with Department of Civil Engineering N.I.E Mysuru , [3] Professor in Department of Civil Engg. N.I.E Mysuru,
[1]sowmyashreebk057@gmail.com,[2]vidyavk2006@gmail.com, [3]puttynie@gmail.com, [3]kcmnie@gmail.com

***Abstract*— Urbanization is a very important factor leading to the deterioration of small tanks, which are a popular and decentralized means of runoff harvesting in the South Indian plateau. The city of Mysuru is host to a large number of tanks, which are prone to destruction due to rapid urbanisation and lack of measures to prevent their fall. Dalavayi tank in the city has been studied in the present work to understand its present status and to suggest steps that are necessary make it more beneficial to the urban and rural population using it. Investigations have been done to know the total volume of runoff entering into the tank, the amount of sewage water that is generated and to understand the quality of the water in the tank, which is already getting sewage as inflow. It is found that the tank gets very huge amounts of runoff only during the rainy season and that treated sewage water can be diverted into the tank so as to maintain the storage during the dry seasons. It is found that quality of the Dalavayi tank water is not that bad, it is good and suitable for irrigation and its quality is improving along the downstream of the tank due to self-purification. It is also inferred that by a small improved sewage treatment, the water can be made suitable for high yield crops, aquaculture and domestic purposes.**

***Index Terms*— Urban tanks, Curve Number method, GIS – RS applications, Irrigation Water quality parameters, recycling domestic sewage .**

I. INTRODUCTION

India is a agro based country and the water bodies here are utilized for irrigation. Small tanks, a very popular system of rainwater harvesting in South India, and are one of the primary sources for water supply in this region. Along with meeting the irrigation requirements, tanks also act as sources of drinking water , domestic uses and cater to industries and other related purposes. Lakes are a boon to mankind. But, due to increased rate of urbanization, there is an increased water demand for domestic and industrial requirements. Along with the increased demand, the amount of sewage generation is also increased and the sewage is commonly disposed off in to the tanks, leading to their deterioration. Hence, there is an urgent need for proper maintenance and utilization of fresh tank water. Further, proper treatment of the sewage will also help in the meeting the enhanced demand for water. Looking at the importance of tanks, kings (Maharajas) of the erstwhile Mysuru state constructed many tanks[1] . Dalavayi kere (tank) is one among them - this tank supported the life of a number of villages till recent times. The tank gets water from the elevated areas of Chamundi hill during rains and also runaway water from the urban Mysuru city areas in storm drains. The lake also gets its inflow from sewage generated in parts of the city. But, there are complaints that urbanization and improper drainage system are now affecting the quality of water in the Dalavayi tank. It is complained that improper maintenance has led to pollution and contamination of lake water and groundwater near it. The intention of the present study was to investigate the status of the tank and to suggest measures to manage the thank so that it is more beneficial.

The main objective of the present study was to estimate the total volume of runoff water entering into the tank, to check the influence of sewage water on the quality and suitability of lake water and groundwater near it for various purposes and to suggest ways to utilize the tank for recycling sewage.

II. THE STUDY AREA

The Mysuru city is well known for its rich heritage, culture and tradition, which encompass the tanks too. Presently, the city is spread over an area of about 195 km^2, with a population of about one million, excluding the floating population. The normal annual rainfall of the city is about 780 mm. There are numerous tanks in and around the City. The Dalavayi Tank, located in the southern part of Mysuru is selected for the study. This lake can be located in the SOI topo-sheets numbered 57D/11/6 and 57D/12/NE at 12 0 15' latitude and 76 0 39'E longitude. Its water is used through two canals - LBC having a length of 2.20 km and RBC having length of 0.69 km. The total atchkat of the canals is 360 acres, where Paddy, Sugarcane, vegetables etc. are grown twice in a year. The villages benefited are Bandipalya, Hosagundi , Gundamadanahalli, etc., The villages are having a good yield from utilization of a tank water. The excess water that flows down in stream is used for the domestic purposes like for washing and bathing and at the end of the stream, water is also used for drinking purposes.

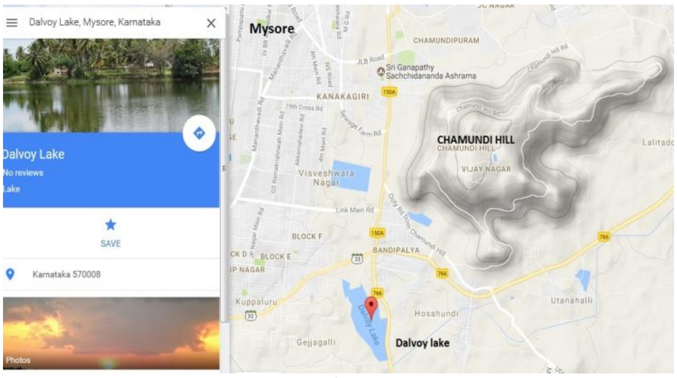

Fig. 1. Location of the Dalavayi Lake

III. Fresh Water Yield Available

In the present study the SCS-CN method is used for estimating the runoff volume entering into the Dalavayi Tank. The SCS - Curve Number (SCSCN) method promoted by Ministry of Agriculture India [2] is a simple, predictable and stable conceptual method for estimation of direct runoff depth based on storm rainfall depth. The SCS-CN is a quantitative description of land use / land cover / soil complex characteristics of a watershed. This model is a widely used hydrological model for estimating runoff using curve number (CN). The CN is an index that represents the watershed runoff potential. For the project area daily rainfall data of 1991 , which is a typical rainfall year, obtained from the statistical department, Mysuru ,is used for calculation of yield. The SCS runoff equation [7] is given by

$$Q = (P - Ia)^2 / [(P - Ia) + S] \qquad \text{------(1)}$$

where, Q = runoff (mm) P = rainfall (mm) S = potential maximum retention after runoff begins (mm) and Ia = initial abstraction (mm). Initial abstraction (Ia) is all lost before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and S is related to CN by:

$$S = 25400/CN - 254 \qquad \text{------ (2)}$$

The major factors that determine CN are the hydrologic soil group (HSG), cover type (LULC), hydrologic condition, and antecedent moisture condition (AMC). The methodology adopted in the present work for assessing runoff potential of the study area is explained in the following steps:

Along with the demarking of catchment, the Land use Land cover (LULC) information of the study area is determined using a GIS software. Toposheets were used as base maps for the purpose of demarking the catchment. A supervised classification of the Geo-registered Google earth image of the year 2010 was carried out for obtaining the land-use land-cover (LULC) details. Tanks, Streams, Catchment Areas, Land Use characteristics (Plantation, Water bodies, Built up area, and Fallow land.) were delineated. Fig.2 shows the Dalavayi catchment and the streams. Fig.3. shows the LULC details. The tank is found to cover an area of 0.51 km^2, while the catchment area supplying runoff to the tank is 34.7 km^2.

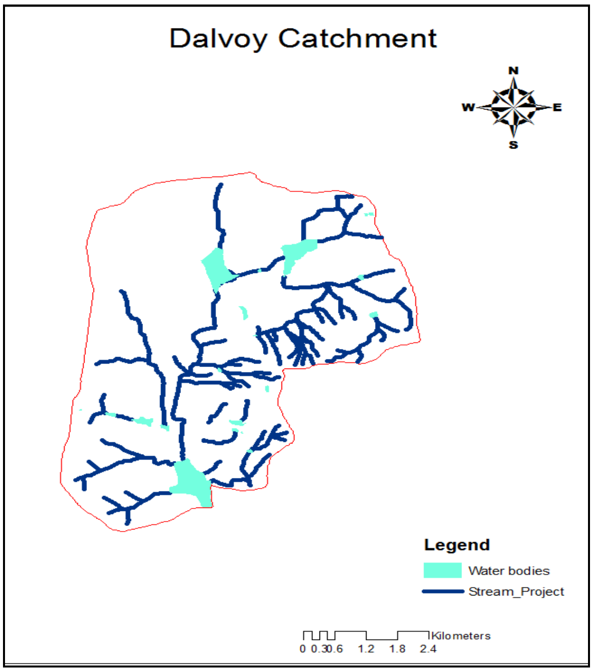

Fig. 2: Tank catchment and streams

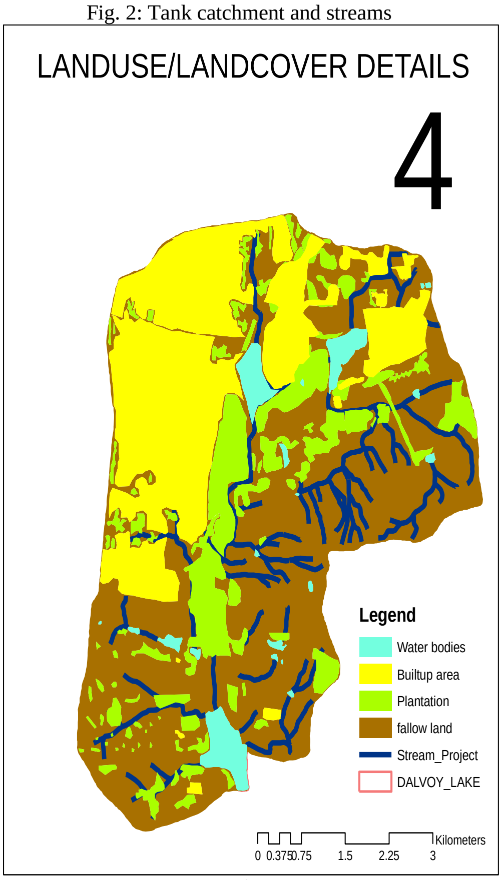

Fig.3: LULC details of the tank catchment.

Table 1 shows LULC Details obtained from the processing of images and the CN for various hydrologic soil cover complex under AMC II condition for the study area, Area weighted composite curve number for various conditions of land use and hydrologic soil different AMC conditions are found to be : CN I = 59; CN II = 77.8; CN III = 89. The computation of daily runoff was done on an EXCEL spread sheet. The yield available was calculated by taking catchment area as 34.7 km^2 daily yield values were summed to obtain the monthly values that are presented in Table 2.

TABLE I
LULC details and Curve Number

Sl. No	Landuse/Landcover	Area km^2	% Area	CNII
1	Built-up area	8.43	22.32	94
2	Plantation	5.3	14.04	74
3	Fallow land	20.12	53.24	71
4	Water bodies	0.83	2.21	100

TABLE III
Monthly fresh water inflows

Month	Rainfall (mm)	Runoff volume (1000) m^3
January	2.5	2.67
February	0	0
March	0	0
April	29	76
May	131	1035
June	175	1146
July	32.2	24
August	40.8	71
September	146	1297
October	185	1980
November	34	78
December	0	0
Total	775.5	5712

IV. SEWAGE WATER AVAILABILITY

Volume of sewage generated is calculated by taking the Population in Dalavayi tank catchment as 25000, according to the census of 2011. Per capita demand is taken as 135lpcd , so total quantity of sewage generated is 540 m^3/day. It can be noted that approximately this quantity of sewage is available everyday throughout the year

V. SUITABILITY OF WATER FOR IRRIGATION

Samples were collected from the LBC And RBC canals as well as in the streams of Dalavayi Tank as per standard procedures. Ground water quality is checked by collecting samples from 4 different bore wells and 1 No. Of open well at different locations in the downstream of the tank.

Irrigation water quality refers to its suitability for agricultural use. It mainly depends on the dissolved salts in it. Sodium Adsorption Ratio (SAR) is a measure of the suitability of water for use in agricultural irrigation, as determined by the concentrations of solids dissolved in the water. It gives a measure of suitability of water for irrigation with respect to the sodium (alkali) hazards . High SAR values may cause damage to soil [3]. The %sodium and SAR can be calculated as below:

%age sodium = $[(Na^{+})/(Ca^{2+} + Mg^{2+} + k^{+} + Na^{+})]$ X100

Then, -------- (3)

SAR= $[(Na^{+})/(Ca^{2+} + Mg^{2+})] * .5]$ ----- (4)

In this expression values of calcium and magnesium are calculated in terms of hardness. Hardness is that property of water which prevents lathering of water with soap solution. Hardness is of two types temporary and permanent. Total hardness is a sum of temporary hardness and permanent hardness present in the water. The presence of bivalent ions of Ca^{2+} and Mg^{2+} are responsible for hardness in water. The bicarbonates of Ca^{2+} and Mg^{2+} ions are responsible for temporary hardness where as chlorides and sulphates impart permanent hardness to the water.

Quality analysis of water is done as per the IS standards .Table 3 shows the values of parameters with respect to irrigation water quality obtained from the studies on samples collected from the field.

VI. DISCUSSION OF RESULTS

The capacity of the Dalavayi tank is 1129x 10^{3} m^{3}[4]. whereas the inflow to the tank during rainy seasons is around 5700 x 10^{3} m^{3}. Hence, the tank gets huge amounts of inflow, This water is utilized for the agriculture during two seasons . However, as seen from the Table2, a major part of this inflow is available during the months of May, June, August and October. Hence , augmenting the tank storage during the dry months is necessary and beneficial. It is observed that sufficient amount of sewage is available to fill the tank almost once every 10 days. Hence, a suitable management strategy [5] must be adopted to mix sewage with fresh water. It is seen that the partially treated sewage which is entering into the tank is undergoing self purification along the canals - it is observed that the SAR value of the water samples taken at the different location is less than 10, implying water is suitable for all types of crops and all types of soils. Even the Sulphate value is well within the limit of 0-192 , Chloride value is within a permissible limit of 0-142 and Sodium too is low (limit is 0-60). These result show the excellent quality of water for irrigation. However , odour colour and turbidity of the water are found to be poor, forbidding use for domestic purposes. Therefore providing Preliminary treatment to the sewage to be diverted, may be by passing it through an oxidation pond and reed beds, would help in the complete utilization of water, for better quality of crops, along with for other purposes like domestic usage , cattle water needs etc.

TABLE IIIII
Water Quality Parameters with respect to irrigation water quality

Sl NO	Sample	Chloride	Hardness	Sulphate	Sodium	%age sodium	Potassium	SAR
1	Lbc- off tank	65	200	24	3.50	.017	0.9	0.034
2	Lbs-at 1.00km	60	200	21	3.20	0.015	0.9	0.031
3	Rbc off tank	65	200	20	3.20	0.016	0.9	0.032
4	Rbc at 0.5km	65	196	23	3.20	.017	0.9	0.033
5	Halla 1st km	97	196	13	3.40	0.018	0.9	0.035
6	Halla 2nd km	111	216	8	3.80	0.016	0.70	0.035
7	Halla 4th km	108	188	8	4.00	0.023	0.50	0.043
8	Halla 8th km	107	220	18	3.90	0.015	0.40	0.034
9	Borewell at u/s	25	184	9	2.30	0.013	0.10	0.025

	of lbc							
10	Open well at u/s of lbc	130	216	40	5.60	0.023	7.50	0.051
11	Borewell hosahundi	57	170	33	5.30	0.036	0.80	0.062
12	Borewell gudmadanahalli	36	156	26	2.20	0.018	0.00	0.028
13	Borewell at u/s of halla at 8th km	204	260	20	5.40	0.016	2.9	0.041

VII. CONCLUSION

The hydrological investigations of Dalavayi tank in Mysuru city indicate that the tank gets huge amounts of inflow in rainy seasons, and this water can be used for irrigation and aquaculture. During the dry season, the capacity of the tank can be better used by allowing pre-treated sewage. It is observed that quality of the water improves along the downstream of the tank because of the self purification process - most of the water quality parameters tested in the surface water are well within the desirable limits. However, the quality of ground water near the tank is not good and that it can't be concluded that its quality is improving away from the tank. Hence by adopting improved sewage water treatment methods the tank can be put to better use. A strategy for proper management of the tank with fresh water as well as sewage can be evolved with further investigations described by [5].

ACKNOWLEDGEMENT

The authors acknowledge with thanks the help rendered by Mr. Raju, Ms. Shwetha, Mr. Raghu, Mr. Kumar N.J., Mr. F.A. Abu, Mr. Jaybhim and Ms. Azra Tarannum in carrying out this research.

REFERENCES

[1]. Free encyclopaedia, htpps://en.m.wikipedia.org
[2]. *Hydrological status of a few tanks in Mysuru : A study using GIS & Remote sensing* -Karthik G. Mysoor R.Yadupathi Putty., and K.C.Manjunath.
[3]. Dalavayi Lake, *Mysore / Asecret muse – livemint* www.livemint.com
[4]. Vidya V. K. et al. / Aquatic Procedia00 (2015) 000–000
[5]. Seth SM, Kumar Bhism, Thomas T, Jaiswal RK (1997-98) *Rainfall-Runoff Modelling for Water Availability Study in Ken River Basin Using SCS-CN Model and Remote Sensing Approach*. Technical Reports, National Institute of Hydrology, Roorkee, No. CS/AR-12/97-98.
[6]. Jena SK, Tiwari KN, Pandey Ashish, Mishra SK (2012) RS and *Geographical Information System-Based*
[7]. *Evaluation of Distributed and Composite Curve Number Techniques*. Journal of Hydrologic Engineering, ASCE, Vol. 17, No. 11, November 1, 2012: 1278-1286.