LAKE WATER QUALITY & BUDGET OF DURGAMCHERUVU LAKE NEAR HITEC CITY, HYDERABAD

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ABSTRACT

Durgamcheruvu watershed covering Durgamcheruvu and an area of about 14.85 sq. km. Durgamcheruvu, a head waters lake covers an area of about 50 ha (about 120 acres) and situated at about 550 m (amsl) to the north of old Hyderabad - Mumbai road near Gachibowli village. Urbanization in general and transformation of Madhapur into prestigious Hi-tech city has started showing their adverse effects on lake water quality. Lake water samples have been collected at 7 locations since October 2002 and analyzed for DO, COD, BOD, TP, TN concentrations. DO at a depth of 5 m in lake water seems to be less than the value at lake surface and the average DO in lake water is 4.9 mg/l. The lake water has shown BOD concentration ranging from 8 – 78 mg/l, whereas average BOD in the inlet channel is 40 mg/l and average BOD of lake water is < 25 mg/l with highest BOD concentrations reported during summer months. Trophic State Index has been computed using bimonthly measurements of Total Nitrogen and Total phosphorous concentrations of lake water and found that the lake has reached hyper- eutrophic condition.

The computed groundwater balance in the watershed indicates that to some extent evaporation losses may be compensated by groundwater effluence of about 465 m^3/day (0.46 MLD) to the lake, which is an insignificant one. Considering the lake water spread of about 50 ha and an average evaporation rate of about 4.5 mm/day, the lake would lose about 2.25 MLD through evaporation losses alone from the lake. For maintaining Full Tank Level (FTL) of the lake, there should be a balance between total inflows and outflows in the lake. The lake then would require inflow about 3.5 MLD considering enhanced seepage losses of 1.0 MLD for maintaining FTL in the lake. Conservatively the envisaged plan of establishing a Tertiary Sewage Treatment Plant (STP) of 5 MLD at Durgamcheruvu by HUDA seems to be initially satisfy the lake water budget.

INTRODUCTION

Durgamcheruvu watershed covering Durgamcheruvu and an area of about 14.85 sq. km. Durgamcheruvu, a head waters lake covers an area of about 50 ha (about 120 acres) and situated at about 550 m (amsl) to the north of old Hyderabad - Mumbai road near Gachibowli village. Urbanization in general and transformation of Madhapur into prestigious Hi-tech city has started showing their adverse effects on lake water quality. Major inflow enters Durgamcheruvu from the inlet channel from Madhapur (Fig. 1). Other minor inflows are from Agarwal society sewerage input, Jubilee Hills sewage inflow, spring flow near boating point on the East and spring flow from Hi-tech city on west. The lake received total inflow of about

4 MLD throughout the year with a significant average outflow of 10 MLD during August to December 2003. Major output from lake seems to be evaporation from lake water surface and with minor interaction of lake water and ground water. Lake water surface at present occupies about 48 ha with a mean depth of 4.0 m. Bathymetric data indicate the volume of Durgamcheruvu is 0.44 MCM (440 ML). Assuming an average total maximum outflow of 10 MLD, the residence time of Durgamcheruvu would be 44 days.

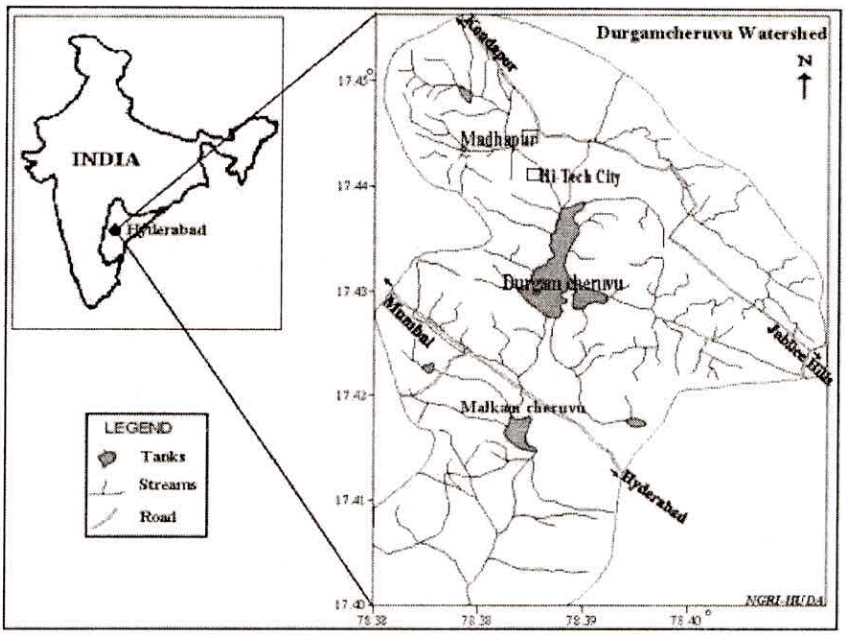

Fig. 1 Location map of Durgamcheruvu near Hitech City, Hyderabad

Groundwater level and water quality has been monitored covering the Durgamcheruvu watershed and its surrounding areas during October 2002, June 2003 and October 2003. Groundwater level measurements indicated that maximum depth to water level is 9.3 m and minimum water level has been observed in the foreshore area of lake < 1.8 m bgl (GWD, 2000). Groundwater level contours show a predominant groundwater flow towards the Durgamcheruvu. The lithologs of observations drilled by HUDA indicate that the top layer having sand with a thickness of 8.8 m underlain by second layer of weathered granite of 3.3 m thickness. The third layer is a fractured granite with thickness of 7.3 m underlain with massive granite as bedrock. In general, fractured zone has a considerable thickness compared with weathered zone in the upstream side of lake. In the downstream of lake around Malkamcheruvu, weathered zone thickness has been found greater than fractured zone. The weathered zone consists of mostly sand with medium to coarse grains.

LAKE WATER QUALITY

Lake water samples have been collected at 7 locations since October 2002 and analyzed for DO, COD, BOD, TP, TN concentrations. DO at a depth of 5 m in lake water seems to be less

than the value at lake surface and the average DO in lake water is 4.9 mg/l. The lake water has shown BOD concentration ranging from 8 – 78 mg/l, whereas average BOD in the inlet channel is 40 mg/l and average BOD of lake water is < 25 mg/l with highest BOD concentrations reported during summer months (APPCB, 2001). BOD values have reduced after fresh surface runoff entry during August 2003 and August 2004. COD in the lake water has varied from 32 - 282 mg/l with an average of 110 mg/l. COD levels have been found elevated > 100 mg/l in lake water during January to June of 2003 and 2004. Entry of surface runoff through inlet channels made slight reduction in COD values in lake water during August to December (Gurunadha Rao et al, 2004). The inlet channel from Madhapur has registered highest COD > 250 mg/l during summer months.

As regards total phosphorous (TP), there has been an increase in average TP ranging 2.0 – 7.0 mg/l from June 2003 to December 2003 followed by decrease in average TP range 4.0 – 6.0 mg/l up to June 2004 (Fig. 2). Maximum TP values found during summer months may be attributable to remobilization of phosphorous from lakebed sediments during anoxic conditions. In general TP values at 3-5 m depth have been found to be higher than at the surface value. The sediments have lost their phosphorous during remobilization phase in summer months to < 1 g/kg during June, which has been further reduced to < 0.08 g/kg during August 2003. Further the TP values in sediments have been reported to maintain < 100

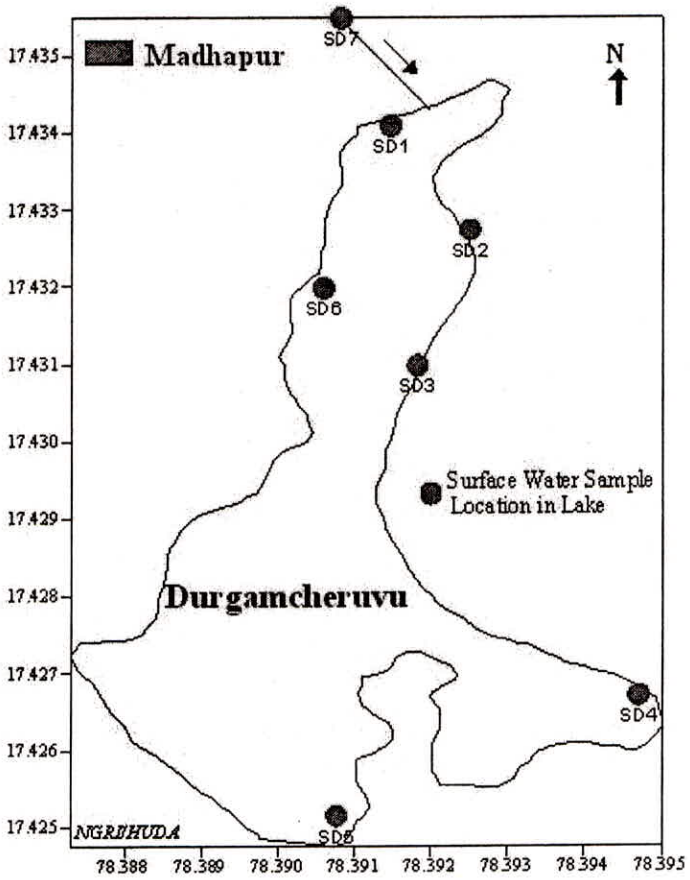

Fig. 2 Lake water Sampling locations in Durgamcheruvu

mg/kg during bimonthly sampling of October 2003 – August 2004. Build up of TP in sediments is found during August 2004. Presently the lake is under hyper-Eutrophic state with regard to trophic status index (TSI) based on TP (Carlson, 1977 & OECD, 1982).

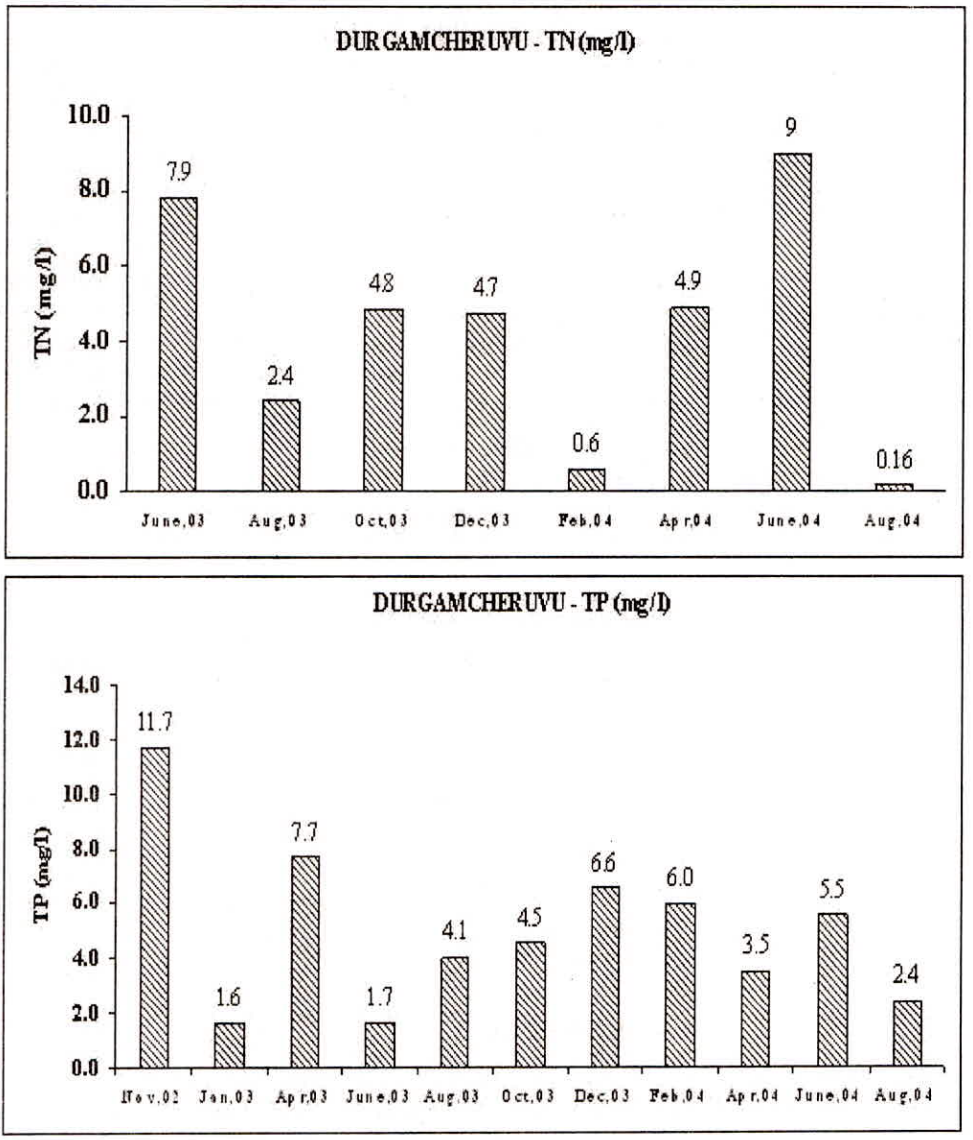

Fig.3. Variation of Total Nitrogen & Total phosphorous in Lake water of Durgamcheruvu during November 2002 – August 2004

Average TN concentration in lake water has been found to vary from 0.16 – 9 mg/l. Maximum TN values have been observed during June 2004, which are about 50 times the

minimum value. Due to last year drought condition, the lake has not received much surface runoff and thereby TN concentrations are found to be < 4.8 mg/l during August, October and December 2003 . It may be attributable to losses through seepage from lakebed as nitrates are in highly dissolved condition in lake water. The sediments have shown a concentration of TN varying from 2.6 – 6.8 g/kg during June 2003, which has been reduced to < 0.06 g/kg during August 2003. Later further reduction in TN values has been reported up to December 2003. The average TSI(TN) values of lake water is ranging 20 - 110, which seems to be slightly lower than TSI(TP) value(>140). The TSI(TP) is always found greater than TSI(TN) in lake water indicating that much of phosphorous is present in inorganic form (soluble form), whereas most of the nitrogen has been present in organic form in lake water and some of which could be escaped into the atmosphere as NH_3 gas converted by bacterial action.

GROUNDWATER QUALITY IN THE WATERSHED

In general TDS concentration in groundwater has shown high correlation with Sodium, Magnesium, Chloride and Sulphate followed by bicarbonates during October 2002. Nitrate as nitrate has shown a good correlation with Chloride and sodium ionic concentrations. Whereas fluoride has shown a good correlation with Magnesium and bicarbonate ions during the same period. Still higher correlation coefficients with regard to TDS have been computed for magnesium, calcium and sulphate during June 2003. As regards nitrate concentrations higher correlation coefficients are computed with respect to TDS and sulphate. Where as for fluoride concentrations all the elemental concentration has shown negative correlation during the same period. This implies that the origin of fluoride is in the top weathered zone waters only.

LAKE WATER BUDGET & RECOMMENDATIONS

Assessment of interaction between lake water and groundwater regime has been evolved through zone budget by assigning two zones in the groundwater flow model viz., Zone outside Durgamcheruvu and Durgamcheruvu (Gurunadha Rao et al, 2004). The computed groundwater balance in the watershed indicates that to some extent evaporation losses may be compensated by groundwater effluence of about 465 m^3/day (0.46 MLD) to the lake, which is an insignificant one. Considering the lake water spread of about 50 ha and an average evaporation rate of about 4.5 mm/day, the lake would lose about 2.25 MLD through evaporation losses alone from the lake. For maintaining Full Tank Level (FTL) of the lake, there should be a balance between total inflows and outflows in the lake. The lake then would require inflow about 3.5 MLD considering enhanced seepage losses of 1.0 MLD for maintaining FTL in the lake. Considering fast urbanization around Madhapur and needs of Hi-Tech City, additional sewage flow of 1.5 MLD would be received for treatment before entering the lake. Thus conservatively the envisaged plan of establishing a Tertiary Sewage Treatment Plant (STP) of 5 MLD at Durgamcheruvu initially seems justified from the lake water budget. Further dredging of lakebed sediments in Durgamcheruvu may help increase in lake storage capacity and removal of phosphates. The dredging may be attempted in the foreshore region only as large boulders cover rest of water spread.

REFERENCES

APPCB, (2001), A project Report on Protection, Development and Conservation of Lakes in Hyderabad Metropolitan Area for HUDA. pp.279.

Carlson, R.E. (1977), A Trophic State Index for Lakes. Limnol. And Oceanog. 22(2): 361-369.

GWD, (2000), Groundwater conditions in twin cities of Hyderabad and Secunderabad . Groundwater Department Government of A.P, April 2000.

Gurunadha Rao VVS, Sankaran, S, Prakash, BA, Mahesh Kumar, K, Yadaiah, P. and S.V.N. Chandrasekhar, (2004), Lake Water Budget of Durgamcheruvu and Groundwater & Surface Water Conditions in the Durgamcheruvu Watershed: HUDA Lakes Study, *Tech Rep No. NGRI-2004-GW-443, pp.30.*

McDonald, J.M. and Harbaugh, A.W., (1988), A modular three-dimensional finite-difference groundwater flow model. Techniques of Water resources Investigations of the U.S. Geological Survey Book.6, pp.586.

Nilson Guiger and Thomas Franz, (1996), Visual MODFLOW: Users Guide. Waterloo Hydrogeologic, Waterloo, Ontario, Canada.

OECD (1982), Eutrophication of water, Monitoring, assessment and control. Final Report. OECD Cooperative Program on Monitoring of Inland Waters (Eutrophication Control). Environmental Directorate, OECD, Paris.