Water Budget of Drinking Water Supply Sources: Osmansagar and Himayatsagar Lakes, Hyderabad

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ABSTRACT

Osmansagar and Himayatsagar lakes are serving the drinking water needs of Hyderabad city. The lakes have been built around 1920's to cater the need of entire population of Hyderabad. Lakes are built on Musi and Musa rivers draining on southwestern part of the city. The salient features of Osmansagar lake on Musi river include storage capacity of 115 mcm at FRL 545.59 m during 1976 with a loss of about 64 mcm due to siltation. The lake has a catchment area of 736 sq km with 637 sq km of free catchment and rest has been intercepted. Himayatsagar lake on Musi river has a capacity of 115 mcm and has a catchment area of 1340 sq km. The Osmansagar and Himayatsagar lakes have been formed on 6^{th} & 5^{th} order streams respectively. A number of check dams have been constructed on first and second order streams under various government schemes during last 5 years. The indiscriminate constructions have resulted in reduction of storage volumes in the lakes. Lakes were receiving about 20 –25 mcm of base flow from the stream channels entering them during monsoon and up to November/December. Preliminary assessment of impact of the check dams on water resources in the catchment has showed that base flow component has reduced, whereas significant reduction in the surface runoff of streams draining into the lakes has been observed. The sustainable drinking water supply from the lakes have been at stake due to human intervention, forcing the government to search for alternate sources of drinking water supply to Hyderabad. A comprehensive watershed development programs has to be planned without endangering existing sustainable water supply sources to urban areas in the country in future.

INTRODUCTION

The Osman Sagar lake was constructed on the River Musi between 1912 and 1920. Subsequently Himayath Sagar lake was constructed between 1920 and 1927 on the stream Musa a tributary of Musi. The two lakes were constructed to meet a part of the drinking water needs of the people in the city Hyderabad. In 1920s they were catering for a population of about 5 lakhs. Two lakes are situated at a distance of about 10 Km from each other west of Hyderabad and relatively Osman Sagar lies towards North and Himayath Sagar to the South at a distance of 19.31 and 9.66 km respectively from Hyderabad city. The individual catchment area are parallel to each other and extend from East to West. The catchment area is falling in Rangareddy and Mahaboob Nagar Districts of Andhra Pradesh.

Osman Sagar lake has a catchment area of 736 sq. km. whereas Himayath Sagar lake has a total catchment area of 1340 sq. km (Fig. 1). The land slope of both Himayath Sagar and

Osman Sagar catchment area predominantly falls under three classes i.e. Nearly level, Very gentle slope and Gentle slope occurring in more than 90% of the area. This indicates that the area has uniform land slope over wide areas resulting in tendency for low surface runoff. Drainage pattern is dendritic i.e., irregular branching of tributary streams in many directions and at almost any angle usually at less than a 90^0. Some streams take a straight line course, which are showing structural control in the area. The drainage pattern around Himayatsagar is identified as radial where streams are diverging from a central elevation and surrounding of this finds number of 1^{st} order streams i.e. drainage density is more in this area than the entire area. The pattern of drainage in Musi catchment is typically of Trellis type where tributaries meet the main streams more or less at right angles grading between these two extreme patterns are the sub-dendritic pattern. Drainage density is of about 0.4 Km/sq. km. is observed in Shabad and Moinabad mandals and near Vikarabad it is about 0.6 – 0.8 Km/sq. km.

LAND USE & LAND COVER

15 watersheds drain Osmansagar lake whereas 14 watersheds are draining into Himayath Sagar lake. Land capability classification indicates the capability of soils to produce field crops, availability of pasturage, forestry, preservation of wildlife and other sustained uses. Thirteen variables are taken to decide the capability classes. These indicators are slope, degree of erosion, hazards, danger of water flow and water logging, soil depth, soil texture, soil fertility, drainage, water holding capacity of soils, land management practices, adverse effects of salinity and physical obstacles such as roads, sands, deep gullies, ravines etc.

The land use/Land Cover in the study area in November 1989 showed that land use/land cover area of Built up land of about 2.19 %, Agricultural land 63.50 %, Forest area (including Dense forest / Scrub forest) 1.78 % and Dry river/ Dry tank of 2.30 % . The land use/Land Cover in the study area in November 2004 showed land use/land cover area of Built up land 2.49 %, Agricultural land of 68.71 %, Forest area (including Dense forest / Scrub forest of 1.78% and Dry river/ Dry tank of 3.62 %.

WATER HARVESTING STRUCTURES

A large number of check dams have been built during 2000 –2004 in both the catchment areas along with large measures of water harvesting structures such as percolation ponds, mini-ponds, contour bunds and trenches, sunken ponds etc. (Table 1). The human interventions have reduced the surface runoff realized by both Osman sagar and Himayath sagar lakes. However the check dams have helped little improvement of groundwater conditions locally. In view of continuous drought conditions, enough storage could not be built even under the check dams during last three years. The depth to groundwater level has been found varying from 4 - 23 m.

A groundwater flow models of Catchment Areas of Osmansagar Lake and Himayatsagar lake catchment were prepared using the above hydrogeologic, geophysical and water quality data bases. Variable grid spacing of 500 m and 250 m has been used in the models. The natural groundwater recharge from monsoon rainfall is very low due to over exploitation and increasing thickness of vadose zone and is varying from 25 -50 mm/yr in different geological formations. The recharge rates depend on the formation and occur laterites < basalts < granites. The aquifer system is assumed to be in contact with Musi and Musa Rivers and Osmansagar and Himayatsagar lakes and stream-aquifer interaction is playing a dominant role in

controlling the base flows in rivers as well as in the lakes. Most of these flows occur during post monsoon season. Groundwater modeling solution has been obtained through use of visual MODFLOW software.

IMPACT OF WATER HARVESTING STRUCTURES

Assessment of interaction between rivers and groundwater regime in both catchments has been computed through zone budget by assigning separate zones for river and lake in the groundwater flow model. The Zone budget computed from the groundwater flow model indicates that under virgin conditions the base flow regenerations in Musa and Musi rivers in both catchments respectively are about 30 mcm (1 TMC) during 1970s. Presently the base flows have reduced due to over exploitation of groundwater. After assessing the present groundwater condition and budget, a prognostic scenario has been worked out considering the proposed expansion of farm houses/ resorts and their likely groundwater consumptive use pattern in the groundwater model. Prediction scenario has considered the proposed expansions of farm-houses/resorts and increase in groundwater withdrawals and the resulting water level configuration has been computed. The zone budget has indicated that under the precarious groundwater condition the increase of about 10000 m^3/day of water consumption will result in reduction of base flows of about 3000 m^3/day in Musi and Musa rivers. This will lead to further reduction in base flows replenishing the storage in the lakes. In view of the above scenario it is advisable not to disturb the present eco-system and plans should be launched to conserve and sustain the eco-system.

Surface runoff based on geological formations varies from 35-52 mm/year under normal annual rainfall. Lowest runoff occurs in granites in the immediate zone of the lakes. Highest runoff occurs in Laterites. Osmansagar lake receives about 1 TMC of surface runoff under present development whereas Himayatsagar lake can receive a1.8 TMC. Centre for Water Resources, JNTU has reported reduction of surface runoff rates from 12.1 to 6.9 % of annual rainfall during 1961 to 1996 in Osmansagar Lake Catchment and in the Himayatsagar, it has further reduced from 8 to 4 % of annual rainfall (Venkateswararao, B, 1999). Even this amount of surface runoff could not be realized due to implementation of watershed development programs envisaging construction of large number of check dams, percolation ponds and contour trenches etc on first and second order along the flow path leading to the Musi & Musa river courses. Thus the combined storages in the lakes during last 5 years could not exceeded 2 TMC at any time. During 1996 full flows Osmansagar lake could realize 3.726 TMC of October 2 1996 and Himayatsagar Lake has realized 2.245 TMC on November 28 1995 for annual rainfall exceeding 1000 mm during two successive years of 1995 & 1996(EPTRI& NGRI, 2005)

FUTURE PROSPECTS

The catchment area of Himayatsagar lake has generated a surface runoff of 39 mm i.e. 51.4 mcm during 2004-2005. Out of the surface runoff, the river Musa has contributed about 14.6 mcm of base flow for replenishing the declining water levels along its course during the same period. Thus the net storage realized in the Himayatsagar lake was only 36.8 mcm (1.3 TMC). Thus the lake has become completely dry during first week of November 2004. The catchment area of Osmansagar lake has generated a surface runoff of 29.7 mcm. The base flows contribution from river Musi is 1.5 mcm. The inflows received in the Osmansagar lake were

1.1 TMC only. Through appropriate controlled withdrawals from the lake, the lake has sustained water up to May end and has gone completely dry during first week of June 2005. A comprehensive water shed development plan should envisaged incorporating total water resources management in the watershed considering long term implications. Otherwise the watershed programs will ruin the designed drinking water supply sources of urban areas.

REFERENCES

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Table 1 Water Harvesting Structures Constructed in the Catchment Areas during 2000 – 2003

(Source: District Water Management Authority, Ranga Reddy District, APIDC)

	Osmansagar Catchment		Himayatsagar Catchment		Total
Check Dams	Shankerpally Vikarabad Navabpet Total	134 106 138 280	Shamshabad Chevella Shabad Mionabad Total	248 136 98 37 500	780
Rock Fill Dams	Shankerpally Vikarabad Navabpet Total	2260 1702 410 4377	Shamshabad Chevella Shabad Mionabad Total	931 2028 281 1451 4691	9071
Percolation Tanks	Shankerpally Vikarabad Navabpet Total	5 23 12 40	Shamshabad Chevella Shabad Mionabad Total	5 24 29	69
Mini Percolation Tank	Shankerpally Vikarabad Navabpet Total	74 46 4 124	Shamshabad Chevella Shabad Mionabad Total	12 24 36	160
Contour Bunding	Shankerpally Vikarabad Navabpet Total	2015 1123 745 3883	Shamshabad Chevella Shabad Mionabad Total	722 3927 709 175 5533	9416
Farm Pond	Shankerpally Vikarabad Navabpet Total	3 111 114	Shamshabad Chevella Shabad Mionabad Total	11 2 1 14	128
Sunken Pond	Shankerpally Vikarabad Navabpet Total	2498 392 513 3403	Shamshabad Chevella Shabad Mionabad Total	2498 1015 115 376 4004	7407
Continuous Contour Trench	Shankerpally Vikarabad Navabpet Total	142 749 283 1174	Shamshabad Chevella Shabad Mionabad Total	57 179 10 246	1420

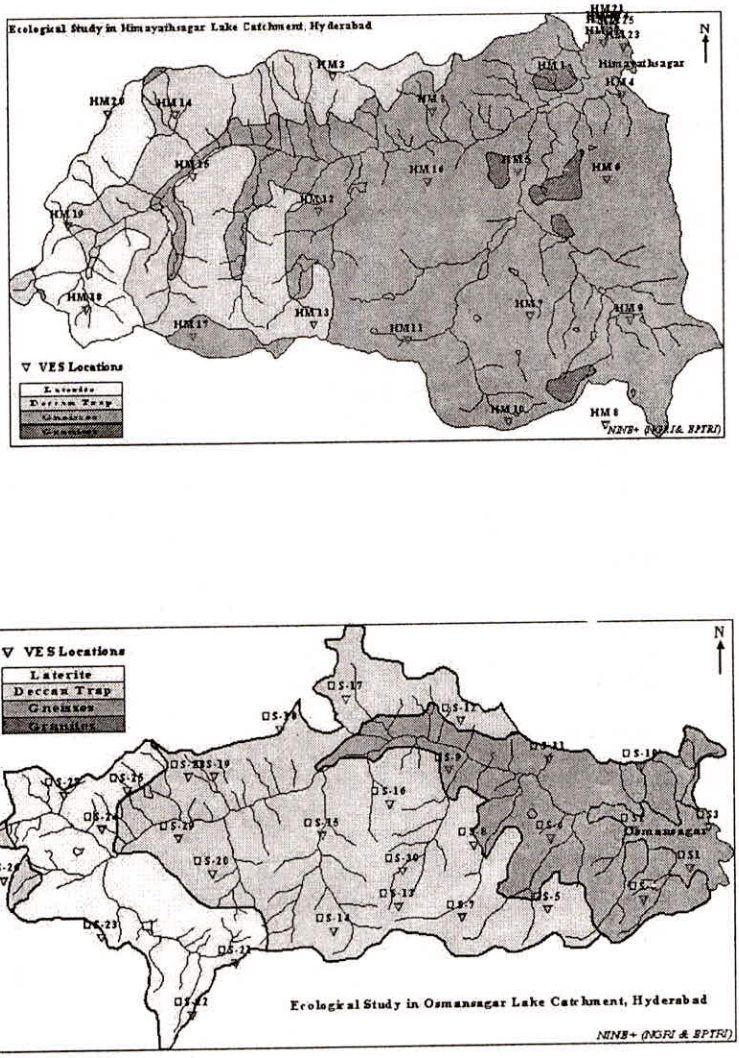

Fig. 1 Himayatsagar and Osmansagar Lakes Catchment Areas with Geological Formations

(Coloured photographs are given at the end)