RAIN WATER HARVESTING IN TWIN CITIES OF HYDERABAD AND SECUNDERABAD – EVALUATION, IMPROVEMENTS AND COMPAIGN LEADING TO PEOPLES PARTICIPATION

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1.0 INTRODUCTION

The twin cities of Hyderabad and Secunderabad with a radius of 15 Kms. covering an area of about 700 Sq.Km has a population of 44.00 lakhs as per 1991 census. Of this about 30 lakhs live in the densly populated Minicipal Corporation area 168 Sq.Km. The total requirement of water for domestic needs is about 720 million litres per day. The Hyderabad Metro Water Supply and Sewerage Board is supplying about 330 million litres per day for drinking purposes. The balance requirement is being met from ground water mostly by drilling of bore wells. It is believed that there about 38,000 bore wells in the twin cities of which about 8000 bore wells are fitted with hand pumps and the rest with Jet Pumps and Submersible pumps.

2.0 RAINFALL

Twin cities receive an average annual rainfall of 778 mm. The analysis of rain fall for the last 15 years indicates that except in three drought years i.e. in 1995, 1986 and 1999 the rainfall is around normal. Rain water is the only source for Ground water recharge and the major part of this precious source goes waste as runoff due to rapid unplanned urbanisation. Estimates indicate that the percent of rain fall infiltration in twin cities is veryless, about 6% only an against the average of 15% for similar hydrogeomorphic areas.

3.0 MONITORING OF WATER LEVELS AND QUALITY

Ground Water Department has established 34 observation wells in the twin cities and being monitored every month for variation in water levels and quality. The water level fluctuations in relation to rainfall and the monsoon recharge to Ground Water in twin cities is shown in Fig-1 The analysis of post and pre monsoon water levels for the last decade from 1989 to 1999 indicates gradual reduction in the built up of average post monsoon water levels, which indicates a gradual fall in net ground water recharge (except in year 1995 and 1998 which received good

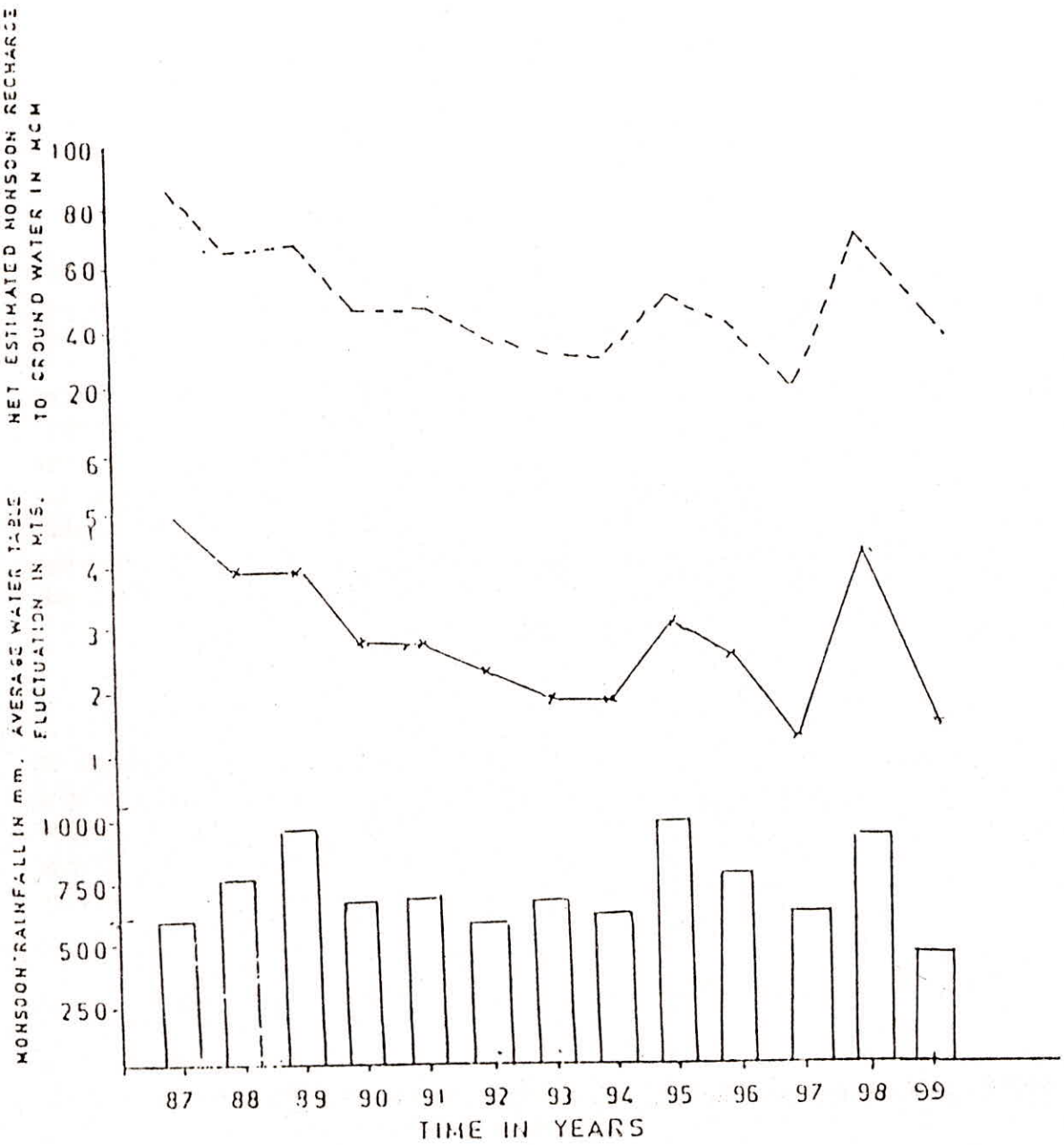


Fig. 1 : Rainfall VS Ground Water Table Fluctuation and Monsoon Recharge to Ground Water in Twin Cities of Hyderabad & Secunderabad

than recharge. The gradual reduction in water level build up in monsoon and gradual decline of water levels reflect the fact that construction of buildings and black top roads is leading to the sealing of the soil surface and thereby the scope for natural recharge is getting reduced.

4.0 ARTIFICIAL RECHARGE TECHNIQUES IN URBAN AREAS

There are many artificial recharge techniques suggested for augmenting the natural infiltration of rain water into the underground formation. But the roof top and road top rainwater harvesting techniques are best suitable particularly in densely populated urban set up like the twin cities of Hyderabad and Secunderabad.

4.1 Roof top water collection and recharge

Availability of rain water from roof tops is so high in the urban areas and if properly diverted and used for artificial recharge, will not only increase the groundwater availability but also help in reducing the water scarcity problem of cities and towns. Commonly runoff water from roof tops are let off into the drains. Instead of this, the outlets can be connected through a pipe and let into the trenches and pits filled with filter media. Not only the pits/trenches but also existing open wells/borewells etc., can also be utilised to serve as recharge points. The pits/trenches are to be filled with boulders (or 40 mm road metal), gravel (or 20 mm road metal) and sand in equally thick layers. This method is less expensive and very effective and if implemented in good spirit by each house/housing society will help in augmenting the groundwater recharge. Field tests conducted on three typical recharge pits indicated high infiltration rate 20 to 26 Cm/Hour through unit horizontal cross section of recharge structure, which is 10 times higher than average infiltration capacity of the top soil zones.

4.2 Road top runoff collection and recharge

The problems of storm run off and groundwater depletion in the city can best be tackled together by harnessing the road top runoff for artificial recharge of groundwater reserves. The storm run off generated within an area can be utilised for groundwater recharging by diverting it into suitably designed structures near pavements, parking lots, municipal parks, play grounds, stadiums, airports etc., and earmarking some open spaces exclusively for the purpose. The design of recharge structures should involve construction of sufficient number of recharge pits and trenches filled with filter media. The location of these recharge structures should be near to the place where storm runoff gets accumulated.

4.3 Design and cost benefit aspects

The volume of rainfall available for recharge from a roof top of 100 sq.m. individual house and 500 Sq.m. multi storied house are estimated to be 2 cu.m. and 10 cum respectively in a single spell of 20 mm. rainfall. Depending upon the size and configuration of the plot area, the dimensions and location of the trenches, pits and combination of trenches and pits are recommended. In general trenches with a minimum width of 0.5 m to a depth of 1.5 m. to 2.0 m. all along the compound and pits of 2 to 3 m. depth of 1 to 1.5 sq.m. size are recommended.

Taking 70% of the average annual rainfall as effective rainfall contributing to recharge, the total recharge is estimated to be 54.5 cu.m. for 100 sq.m. road top area and 272.50 cu.m. for 500 sq.m. rooftop areas. For collecting storing and subsequent recharge of this water the pits/trenches should be three times the available water i.e 6 cu.m. for 100 sq.m. and 30 cu.m. for 500 sq.m. roof top area, since 1/3 of filter media has voids. The approximate cost for construction of 6 cu.m. of recharge pits/trenches would be around Rs.4,000/- with which about 54,500 litres of water can be made available which will meet the water requirement of a family of 5 members for about 100 days in a year. Similarly the quantity available for recharge from 10 m. wide road top of 1 km. length is estimated to be 5,450 cu.m. The total quantity of water that can be made available for additional annual recharge to groundwater by taking recharge measures at 2.00 lakh units of 100 sq.m. roof top area and about 2,000 km. of roads is estimated to be 20 MCM, which can meet the domestic water requirement of 2,00,000 persons over 100 days.

5.0 EVALUATION OF RAIN WATER HARVESTING IMPLEMENT IN 1998.

Artificial recharge of ground water through diversion of rainfall water from roof tops, road tops and open lands into recharge pits and trenches was taken up by Government Departments, Builders and individual house owners in a big way during 1998. Government Departments have constructed these structures in the premises of public buildings, parks, traffic islands and in foot paths along road side. Builders and individual house owners have constructed the recharge structures in their building premises. In all about 2250 recharge structures were constructed during 1998. The Ground Water Department undertook evaluation of recharge structures taken up in 1998. The Metro board have entrusted same work to Dr. Prasad's Environmental Sciences (Pvt) Ltd. The Ground Water Department and Dr. Prasad Institute have presented their evaluation in the meeting held at the Metro Board on 12.4.99. It was decided to constitute a sub-committee to jointly inspect and evaluate the structures and suggest improvements needed. The sub-committee is constituted as follows:

A sub-committee was appointed to evaluate Rain Water Harvesting Structures. Members are drafted from Ground Water Department, Hyderabad Metro Water Supply & Sewerage Board, National Geophysical Research Institute, Dr.Prasad Environmental Services Pvt.Ltd., and Builders' Forum.

From the evaluation of the structures implemented during 1998, the following recommendations are made to enable to plan and implement rain water harvesting programme for artificial recharge to groundwater in urban areas in a systematic manner.

5.1 Clearance of recharge scheme

1. The site and type of recharge system is to be selected by a detailed study of the geological and hydrological characteristics of the area.
2. Recharge structures should be designed and constructed in favourable sandy soils and morrum. They should not be taken up in impervious clayey soils, rocky areas and steep slope areas.

3. Recharge structures should be preferred for taking up in depleted aquifers with deep water table. They should not be taken up in the shallow water table areas with depth to water level less than 3 m.bgl. in rainy season.

4. Recharge structures should be taken up with unpolluted surface water only. Adequate precautions should be taken to prevent entry of polluted urban surface runoff water and sewerage water into the recharge structures.

5. Recharge structures should be planned and taken up in areas experiencing intensive groundwater development for various uses and they need not be takenup in areas where groundwater development is negligible.

5.2 Design of recharge structures

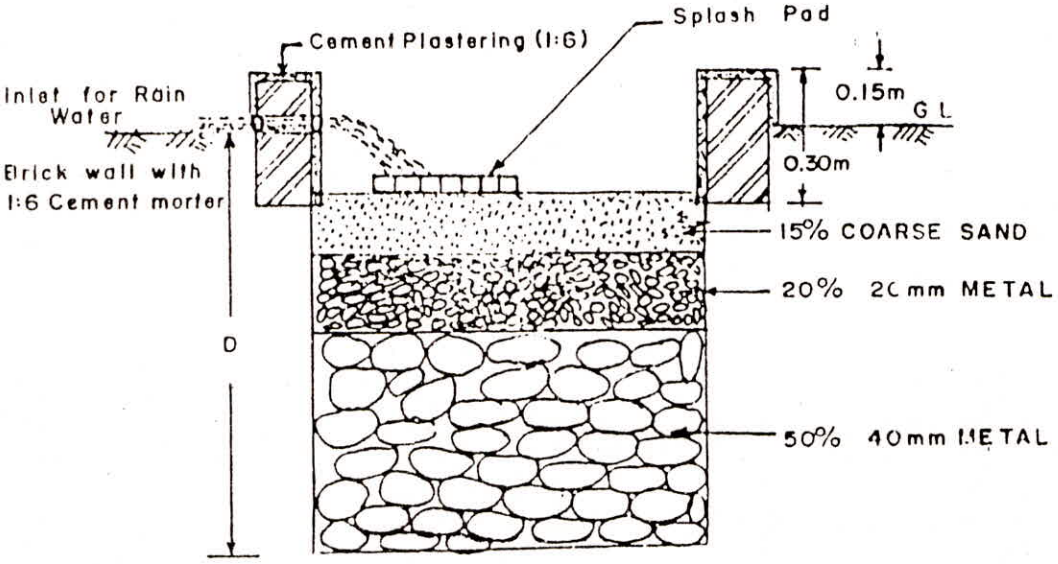
1. The methods suggested for artificial recharge in urban areas are : (a) Roof top collection and recharge through recharge pits, trenches, shafts, existing wells (b) Road top collection and recharge through pits, trenches shafts, wells etc and (c) Recharge through percolation tanks and check dams. However, this has limitations in its applicability in densely populated urban agglomerations due to non availability of adequate space.

2. The number, type and dimensions of recharge structures are to be designed as per site specific requirements and available source water. In general recharge pits and trenches of 2 to 3 m depth filled with filter media are suggested. A minimum of 6 cu.m volume of recharge pit/trench is recommended for a catchment area of $100m^2$ and multiples there of for large areas. Existing open wells/Bore wells if available in the area should be preferred for direct recharge of the aquifers. Open shafts/wells can also be taken up in favourable areas with deep weathered zone and deep water levels

3. Recharge water should be clean and free from contamination. Urban surface runoff water with lot of sediment load and pollutants should not be allowed for direct recharge with out adequate filtration. It is suggested to fill the recharge pits/trenches with 3 layered filter media comprising of pebbles or 40mm metal as bottom layer, gravel or 20mm metal as middle layer and coarse sand as top layer to ensure adequate filtration (Fig. - 2).

4. When recharging through open shafts/wells, the source water is to be sent through a silt filtering pit/silt settling chamber (Fig. - 3).

5. In the MCH model of catch pit and Recharge pit combination there is no effective mechanism for filtration. As an improvement to the model, the catch pit may be deepened upto 2.00m depth from the present 1.0m depth to facilitate deposition of sediment in the catch pit and to further arrest free entry of solid waste and pollutants into recharge pit, a filter pack comprising of layered filter media with a grating may be introduced in the vent from catch pit to recharge pit.



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W IS 1.2 TO 1.5m FOR PIT

W IS 0.60 TO 1.0m FOR TRENCH

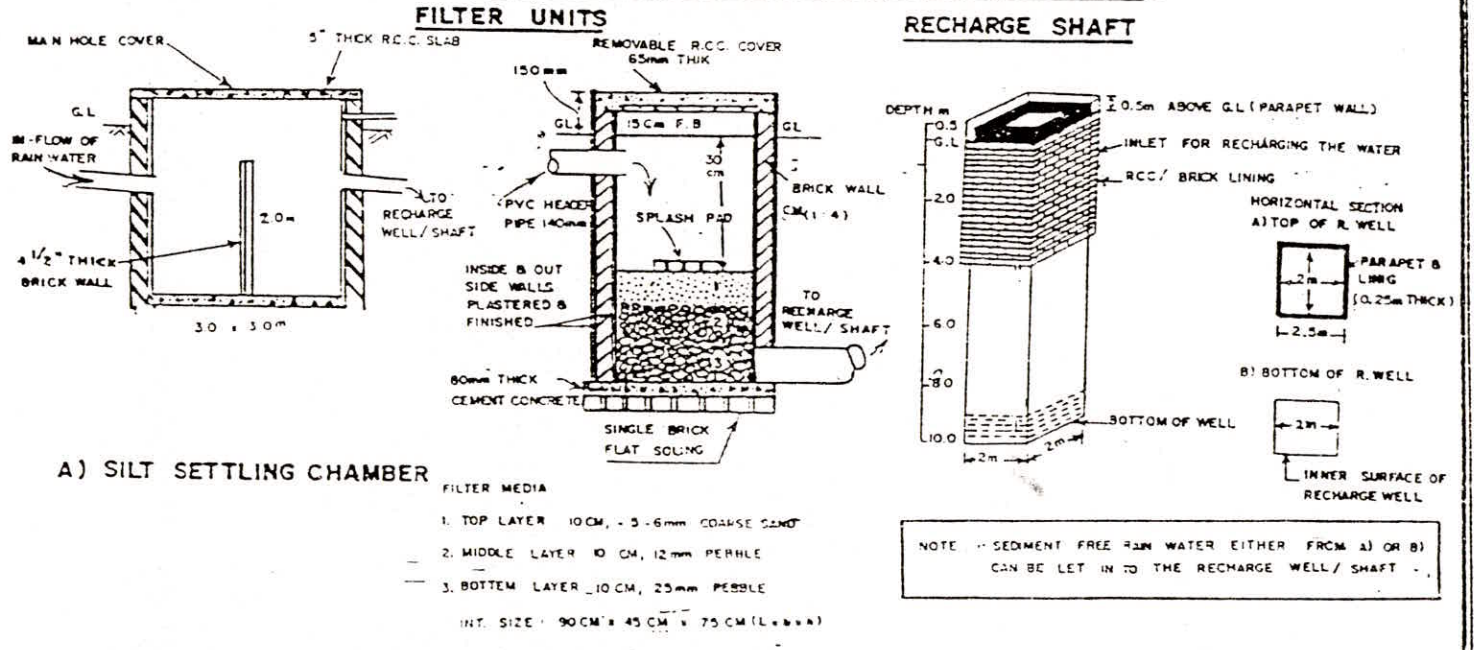
D IS 2.5 TO 3.0m FOR PIT

D IS 2.0 TO 2.5m FOR TRENCH

Fig. 2 : Typical Cross Section of a Recharge PIT/Trench

Fig : 2

SKETCHES OF TYPICAL FILTER UNITS AND RECHARGE WELL / SHAFT



6. The recharge pit/trench is to be provided with brick wall of 45 cm height at the top (of which, about 30 cm is below ground level and 15 cm above ground level.) to debar free entry of waste material into the structure and to give protection and demarcation to the structure (Fig.-2).

7. The lined portion of the pit can be left empty to accommodate more water and to facilitate percolation under gravity. Solid wastes, plastic bags, leaves etc should not be dumped in the recharge pits and trenches and close to them. If needed, as an additional precaution the pits and trenches may be provided with protective porous concrete covers, or, wire mesh as for site requirements.

8. The source water from roof tops is to be channeled through pipe drain into the recharge structure.

9. Road top rain water recharge structures are beset with quality problem. Hence these are to be planned and taken up cautiously in unpolluted and hygienic catchment areas only.

10. In order to arrest impact of flow on filter media a splash pad is to be placed on top of the filter media. Alternatively, a thin layer of 40mm metal can also be placed as top layer on sand for protecting the sand from the impact of flow. However this involves additional work to remove and replace for periodical cleaning of the sand layer.

5.3 Maintenance of recharge structures

1. The implementing agencies should furnish the details of all recharge structures to Ground Water Department in the data format enclosed for monitoring and computing the incremental rise in ground water resource. Furnishing of information on construction of recharge structures to HMWSSB/GWD should be made mandatory.

2. It is suggested to establish observation wells for monitoring of water levels and quality.

3. All the recharge structures implemented by Government Departments need to be distinguishable by planting boards and maintained properly.

4. The structures are to be inspected periodically and the accumulated silt, debris, solid waste materials etc. if any should be removed.

5. The top sand layer is to be loosened, cleaned and replaced once in a year before monsoon for effective percolation.

6. Maintenance works are required to be carriedout to all the structures implemented in 1998 by Government Departments before the on set moonsoon.

7. The builders, Non-Governmental organisations and Academic institutions should be involved as resource persons/Resource institutions to facilitate the programme. It is desirous to involve them at all stages of the programme i.e planning education, execution and monitoring.

8. All builders and people in large should be encouraged and involved in taking up of the recharge structures in their premises to achieve the desired impact.

9. Construction of Check dams/Nalla bunds across the stream courses in favourable locations would also help for recharge of surplus runoff water to ground water. However adequate precautions for not letting sewage and effluents into the stream courses are to be taken.

10. It is prudent to protect all the tanks and maintain for ecological balance. Diversion of the surplus runoff into these tanks and depressions will create additional recharge to groundwater.

The Department issued evaluation report on Rain Water Harvesting. Many of the sub-committee's recommendation are incorporated and the revised designs are incorporated. The following additional recommendations are made.

1. Areas with rock exposures and shallow basement should be avoided. Areas with shallow water table of less than 5.0 m during summer need not be considered for taking up of recharge structures. In these situations where recharge to groundwater are not feasible, it is prudent to store the roof water into sumps/ground level storage tanks instead of letting it out as run off. The stored water can be used for domestic purposes.

2. Construction of small check dams/nall bunds at favourable locations across the stream courses in the Jubilee hills and Banjara hills area where the formations are highly fractured, would also help for recharge of surplus runoff to groundwater. However, adequate precautions for not letting sewage and effluents into these stream courses are to be taken.

3. It is also prudent to protect all the tanks and maintain for ecological balance. The diversion of surplus run off into these tanks and depressions will create additional recharge to groundwater.

6.0 RAIN WATER HARVESTING PROGRAMME DURING 1999/2000.

During 1999 about 1577 no.of RWH structures are executed by R&B, HMWSSB, MCH., and Universities and Industries. Campaign is conducted in housing colonies but the response for surveys has been very poor. During 1999, the twin city has rainfall of 442 mm. as against normal rainfall of 788 mm. Many parts of the State faced a severe drought conditions. therefore, the Government of Andhra Pradesh have launched a special drive in entire State for promotion of rain water harvesting. The Ground Water Department has organized a Training of Trainers course to Groundwater Officers from Districts who would train community development societies members/neighbourhood group convenors during May, 2000 in all Municipalities. In twin cities intensive activities have been organized during the month of May,2000 by paper advertisement, conducting video display and campaign in public gatherings, distribution of pamphlets, circulation of slides. The prominent daily newspaper Eenadu launched massive feature every day elaborating the success stories of RWH the different countries, different States in India and the current progress of RWH activities in different parts of Andhra Pradesh. The Metro Water Supply and Sewerage Board has announced 50% subsidy for RWH structures in residential houses and also education institutions. The response from public is tremendous and

about 6000 applications are received by Metro Board. Many of the Industries, Education Institutions are surveyed by Ground Water Department to recommend RWH structures in their premises to recharge; not only diverting roof water but also overland flow by the construction rock fill dams, check dams and contour trenches.

This unprecedented awarness of RWH, upsurge of response from public and also from industries/institutions due to successful implementation of RWH structures during 1998, evaluation of RWH and revision of designs, campaign methods, multipronged publicity in press, TV, handouts, video displays, clip charts, cinema hall displays etc., and also due to the Government stepping in a large way to offer financial support and technical guidance from the Ground Water Department.