RAINWATER HARVESTING TECHNIQUES

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1.0 INTRODUCTION

Ground water is a very valuable economic commodity. It is recovered from wells for domestic, industrial and agricultural use. The conservation of ground water is very important because it moves from soil and many years may be required to replace the hastily pumped out water. Therefore, in areas where ground water is used extensively, care must be taken to see that no extra water is withdrawn in a year than the quantity replenished by natural process.

To avoid depletion of ground water level, the aquifers (ground water bodies) must be recharged in whatever way possible. There is an urgent need for harvesting every drop of rain water, since that is the only source of ground water.

Inspite of astonishing achievements in the field of Science and Technology, nature remains to be a mystery for human beings. Though scientists and technologists are doing experiments all over the world to obtain water by cloud seedings, desalination and by various other artificial means, still shortage of water is a perpetual phenomenon through out the world.

Getting water by the above mentioned means will only be a distant possibility but cannot be a permanent solution. Nature is always kind to us. The only problem is that we are not responding to it in a matching manner.

Our subcontinent is fortunate to get a fairly good amount of rainfall. If only we save each and every drop of water and recharge the underground aquifer, what a great relief and what a simple solution it will be for the water starving citizens and the owners of parched lands of the surrounding area. Therefore the solution lies in the simple harvesting of rainwater.

2.0 PRINCIPLES OF CONSERVATION

Ground water in its normal state is invariably moving. This movement is governed established hydraulic principles. In other words the volume of water which passes through a bed of sand is proportional to the pressure and inversely proportional to the thickness of the bed traversed. So, by changing the soil conditions, it is possible to improve the ground water flow.

The underlying fact is that we should allow rainwater to percolate into the soil to the underground water table called aquifer. This aquifer only helps humanity in providing drinking water, water for irrigation and many other uses through wells, ponds, lakes, rivers etc. The rainwater recharges the aquifer thereby increasing the level of ground water table which enable the water flow through various gradients in different directions. This underground water flow can be tapped for use by borewells, open wells, springs, lakes etc.

If there is continuous intensive rain for longer periods the soil may not be able to observe all of them and the water begins to collect over the ground and then flow to a lower level. This flowing water creates natural channels in which it can flow more easily. At a lower level, small channels join to form bigger channels which in turn join to form rivers which ultimately drains into the sea. In the case of rivers, the water flows through various gradients soak the soil and percolates down. It is only the excess water over the land which constitute the river flow. So, this underground water table helps in enriching the soil on the banks of river.

We often find rivers continuing to flow for longer periods even after the rains are over. This happens because of some water, which soaks into the soil, continues to flow underground and seeps into the river again at a distance place. This is how rivers have water even during dry seasons. So, it is our duty to enrich the underground water table so as to enable us to draw water during period of drought. At present, on account of tremendous pressure on the land due to over population and the concrete jungles coming up there is now way out for the water to flow into the rivers. Therefore, it becomes all the more necessary to construct percolation pits to drag the rain water and to allow it to soak into the soil.

3.0 DISTRIBUTION OF WORLD'S WATER SUPPLY

An account of the water supply of the world revealed that saline water in the oceans accounts for 97.2% of the total. Land areas hold 2.14%; ground water to a depth of 13,000 feet (4,000 meters) accounts for 0.61% of the total; soil moisture 0.005%; fresh water lakes 0.0009%; rivers 0.0001% and saline lakes 0.008% over 75% of water in land areas is locked in glacial ice or is saline.

4.0 NEED FOR RAINWATER HARVESTING IN CHENNAI CITY

Chennai being a coastal city, is always under threat of sea water intrusion along the coast, if more fresh water is extracted. Indiscriminate extraction in Minjur – a coastal area along the north sea coast of Chennai has been spoiled because of over exploitation. Action has already been taken by the Metrowater Board to push back the sea water through injection wells. The studies are in progress.

Keeping this in view, the Government of Tamil Nadu had introduced an Act to regulate and control the extraction of ground water. The Act is called **Chennai Metropolitan Groundwater (Regulation) Act, 1987.** It also has set of rules. The Act covers the Chennai city and 243 revenue villages around the city. Thanks to this Act, for example an area existing in between

Thiruvanmiyur and Muttukkadu (a coastal zone on the Southern side of Chennai city) has been saved. The water table which was existing on an average of 8 meters below ground level before the year 1988 now exists at between 2.5 meters and 3.5 meters below ground level.

Metrowater made a beginning in establishing a new strategy using locally available brackish water for treatment using the Reverse Osmosis Desalination process. Desalination Plant of 1.5 lakh litres capacity potable water was successfully commissioned at Fisherman Colony, Nochikuppam. Similar projects were commissioned in Velachery and Kasimedu also. These projects are forerunner as a health cum water projects to low income and socially disadvantage communities.

5.0 RAINWATER HARVESTING METHODS AND BENEFITS

The ultimate source of all fresh water is rainfall. It also occurs in heavy short spells of a few days and make it important for it to be conserved wherever it rains and for use during the rest of the year. It should not be allowed to go waste. Such conservation is called Rainwater Harvesting.

5.1 Why should rainwater be harvested?

(a) Rain water is the source of fresh water on earth.

(b) Rain fall in our country extends only for 2 to 3 months in a year and if we fail to conserve it, we will be left with no fresh water for the remaining period.

(c) Rain water if not harvested, runs off into the sea and gets wasted

(d) Failure to harvest rain water, will flood the low lying areas and cause lot of inconvenience.

5.2 Benefits of rainwater harvesting

1. Ground water table level will be raised and maintained.

2. Water quality is improved.

3. Salinity in water is reduced.

4. Crack formulation on walls and buildings will be minimised

5. Yield and number of crops can be enhanced.

6. Water disputes between conflicting interests could be minimised.

6.0 EXAMPLE

Records show that Chennai city receives rainfall ranging from 1100 to 1200 mm per annum. As per statistics, a house on one ground plot (223 sq.m.) gets about 700 liters of water a day by rainfall. Even in the case of multi-storeyed flats, where the effective space per resident may be as small as 50 sq.m., the rainfall corresponds to an amount of about 100 to 150 liters per day.

7.0 METHODS OF RAINWATER HARVESTING

Rainwater harvesting can be done through different methods as given below:-

1. Rainwater Harvesting through Percolation Pit method.
2. Rainwater Harvesting through Broken Brick Bed method.
3. Rainwater Harvesting through Well cum Canal cum Percolation Pit method.
4. Rainwater Harvesting through Open wells.
5. Rainwater Harvesting through Defunct Bore wells.
6. Rainwater Harvesting through Ponds.
7. Rainwater Harvesting through Ditch and Furrow Storage.
8. Rainwater Harvesting through Recharge wells
9. Rainwater Harvesting through Service well cum Recharge well.

The following general methods can also be adopted using the site condition :

(a) **Open ground :** Remove the top soil to a depth of 30 cm to 60 cm (1 to 2 feet) and place with river sand to allow for slow percolation of the rain water into the soil.

(b) **Paved surfaces :** Dig 1.20m (4 feet) deep square percolation pits measuring 60 cm (2 feet) each along its length and breadth, fill with small pebbles or river sand and cover with perforated concrete slabs.

(c) **Outlets :** Connect waste water outlets from the bathroom to pits, instead of to the drainage pipes.

(d) **Storm water drains :** Cover the drains existing within he premises and construct small boundary walls around them to a height of 30 to 60 cm (1-2 feet) to ensure, that rain water rushes into the drains and the water stagnates over the ground until it seeps into the soil.

(e) **Repairs :** Carry out these regularly to prevent cracks and holes from developing in the compound wall, otherwise rain water will flow out. Raise the ground level near the gate to retain as much water as possible within the compound.

Some of the roof top methods propagated by the Metrowater Board are explained with suitable sketches below.

7.1 Rainwater Harvesting through Percolation Pits (Individual House)

Dig a number of 3.0m deep and 30 cm dia. Percolation pits at 3.0 m intervals around the plinth. Fill them up with broken bricks and pack the top 15 cm with river sand. Erect 7.5 cm high dwarf walls at entrance to facilitate recharge.

Lead the rain water falling on the terrace, into the house well through a drain pipe, making it pass through a 60cm x 60 cm x 60cm broken brick filter under the ground level before reaching the well.

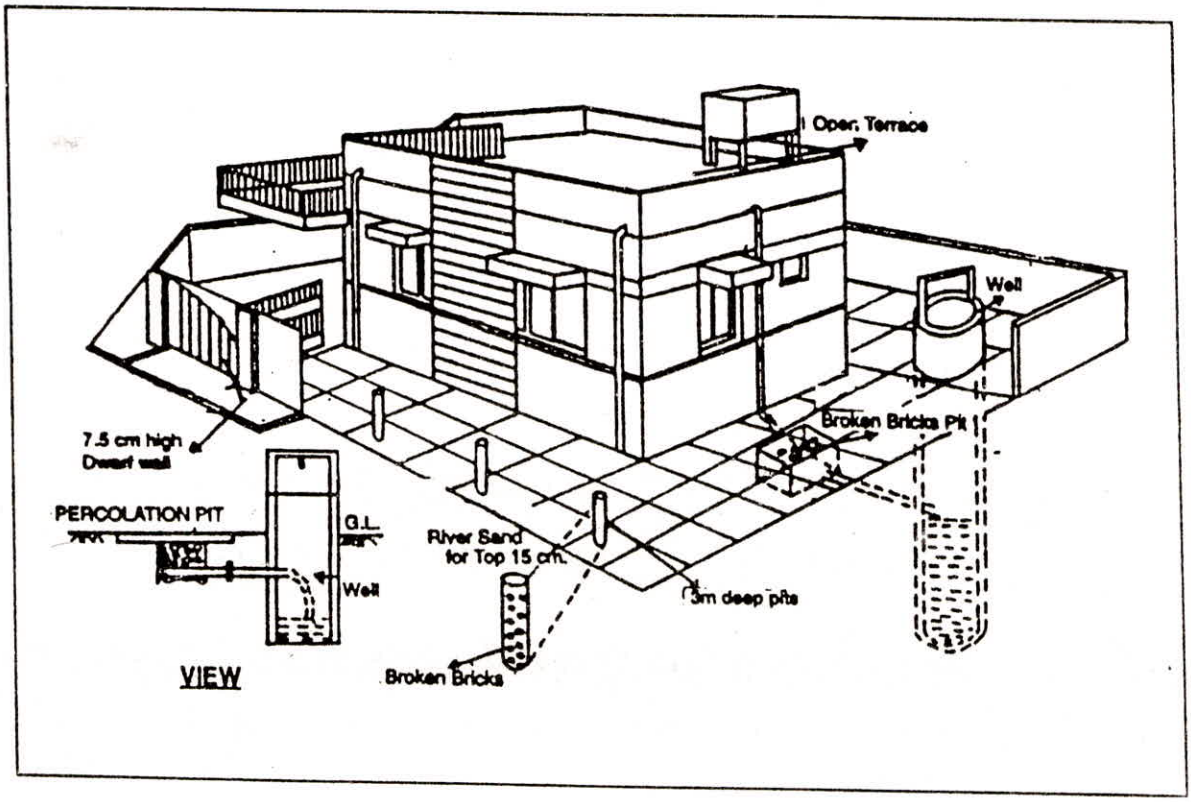

Fig. 1: Rainwater Harvesting through Percolation Pits (Individual House)

7.2 Rainwater harvesting through well-cum-canal-cum-percolation pit method

Dig a well of 1.2m dia for a depth of 6.0m at the rear side of the house plot. Provide a 3.0m x 3.0m x 1.0m deep sand bed surrounding the well. In addition, build a 0.23m wide trench around the building either near the compound wall or in the centre of the drive way. The depth of the trench may start from 0.23m near the gate (entrance) and run through 0.45m at the rear end of the plot towards the well. The trench has to be connected to the deep sand bed constructed around the open well.

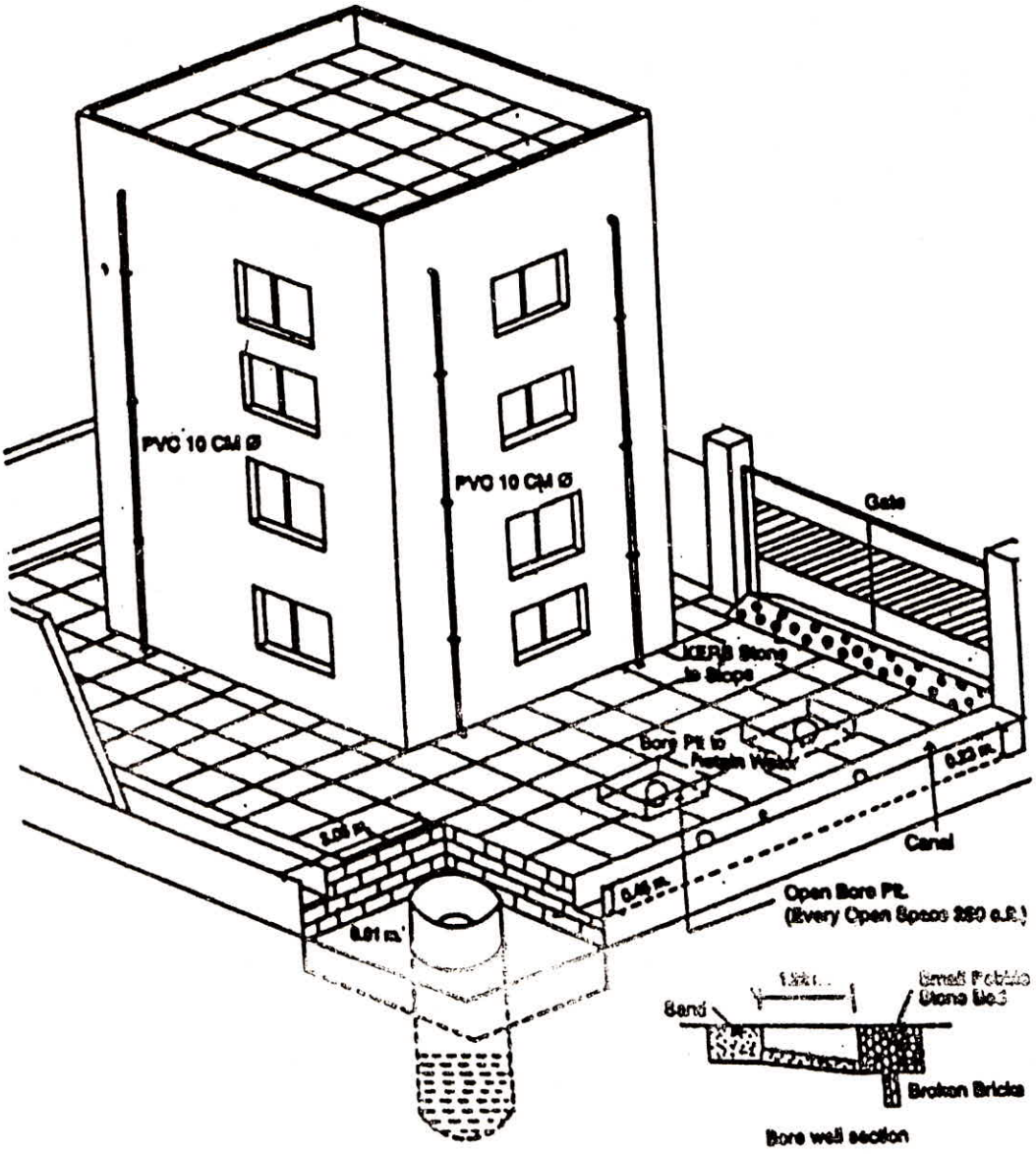

Fig. 2: Rainwater harvesting through well-cum-canal-cum-percolation pit method

7.3 Rainwater harvesting through service well-cum-recharge well method

Provide a well of 1.2m dia for a depth of 10.0m and divert the rain water from the terrace into the well through rain water down take pipes. Divert the rain water falling around the open space surrounding the building of the front gate wherein a gutter is provided for a depth of 1.0m and a width of 0.6m with perforated slabs. The rain water collected in the gutter in front of the entrance is discharged into another recharge well of 1.2m dia with 10.0m deep provided nearby through necessary piping arrangements.

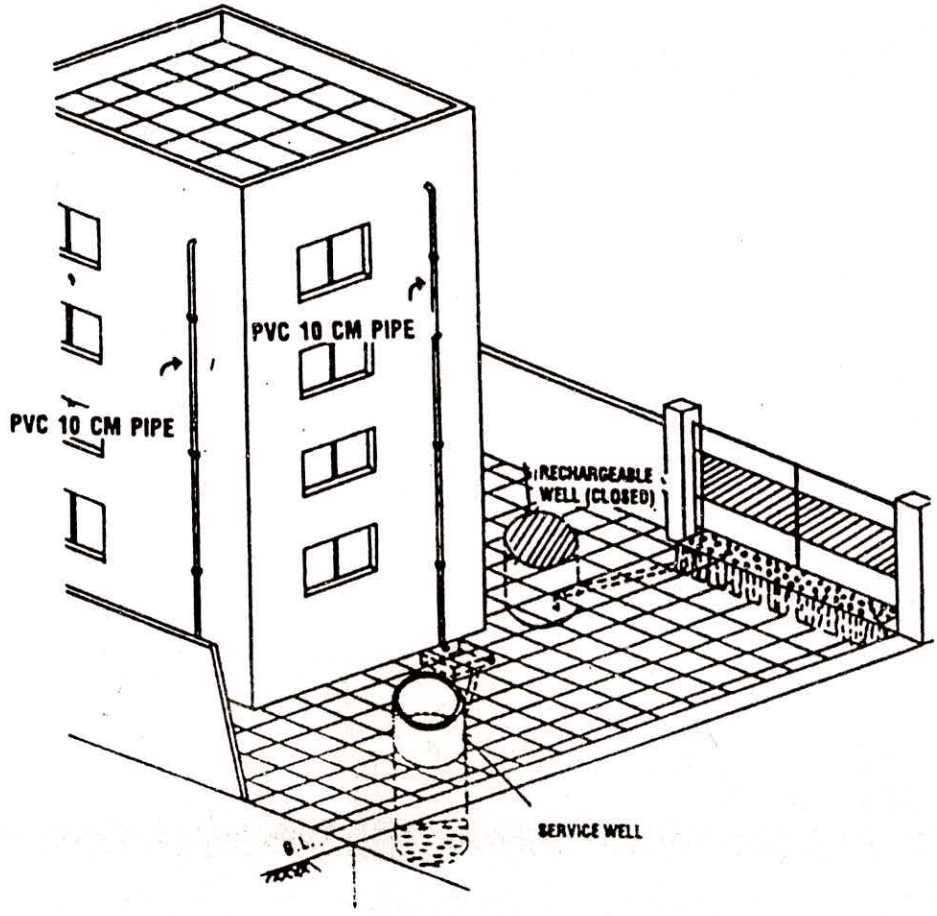

Fig. 3: Rainwater harvesting through service well-cum-recharge well method

7.4 Rainwater harvesting through defunct borewells

Dig a 1.0m dia circular pit for a depth of 0.6m below ground level around the borewell. Fill the borewell with broken bricks. Fill the circular pit also with broken bricks upto a height of 0.3m from the bottom and after this pack the top 0.3m portion with sand. Cover the circular pit with a perforated slab at the top. Do not forget to clean the slab periodically to keep the holes of the slab remain open to receive water.

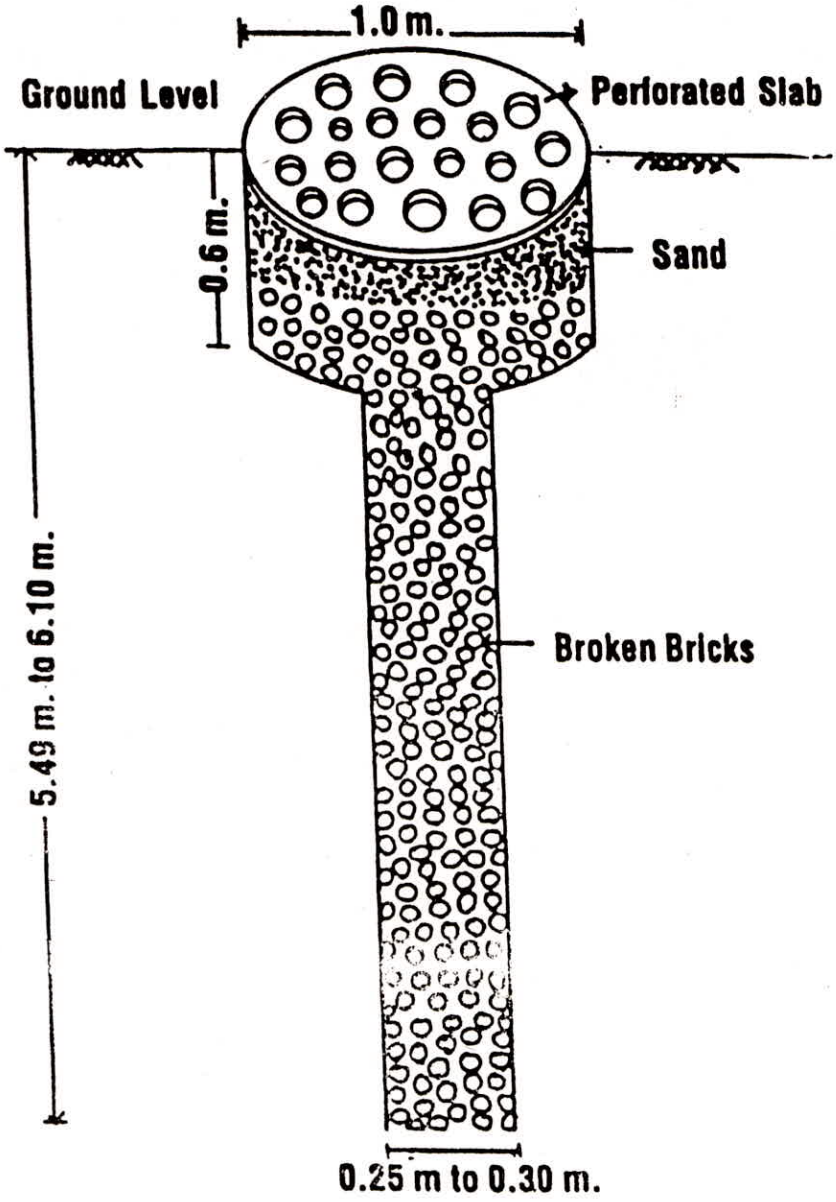

Fig. 4: Rainwater harvesting through defunct borewells

8.0 EFFECTS OF RAINWATER HARVESTING IN CHENNAI CITY

Due to the implementation of the Ground Water Regulation Act and Rainwater Harvesting Methods being advocated by Metro Water Board in Chennai city, the ground water levels show an increasing trend every year. This has been illustrated in the following figure.

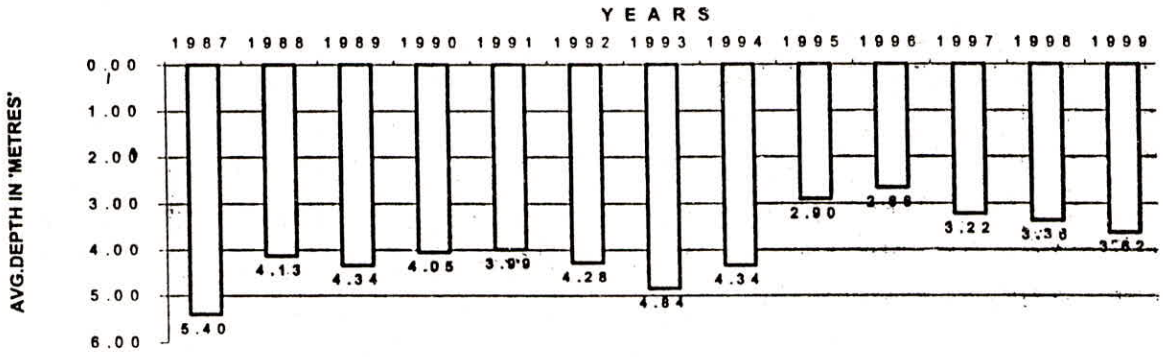

Fig. : Average Water Level – Chennai City

To assess the recharge effects of the Rainwater Harvesting, a study has been made in Anna Nagar area where Rainwater Harvesting methods are implemented by various agencies and individuals residents. The following is a comparative illustration of ground water levels in Anna Nagar area of the City with and without Rainwater Harvesting Systems.

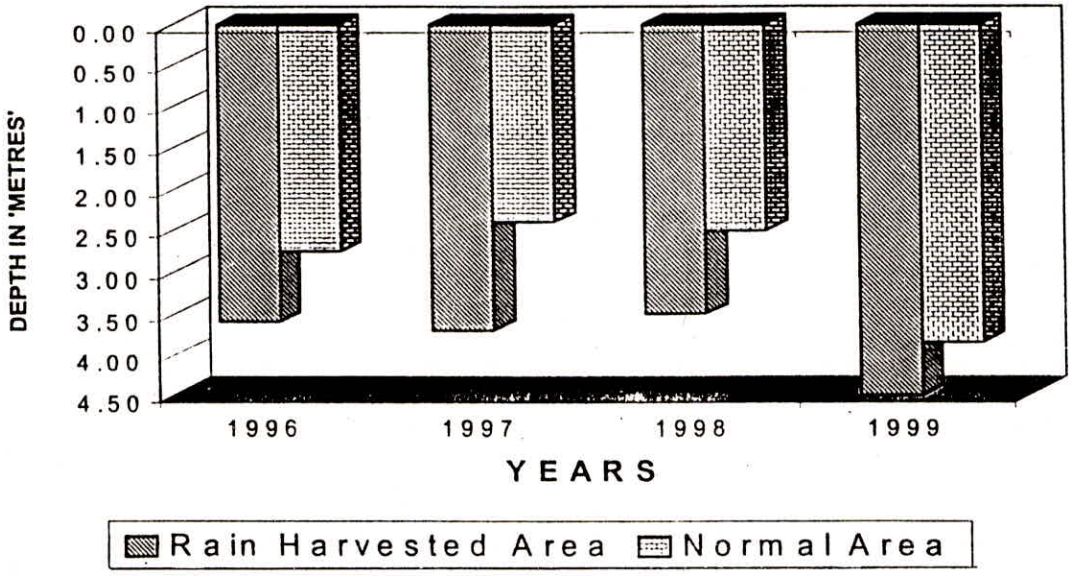

Fig.: Water Level in Anna Nagar

9.0 CONCLUSION

The Chennai Metrowater is now taking up serious efforts to dissiminate Rainwater Harvesting techniques to the citizens of Chennai. In the process, it has issued notifications to the builders who are constructing complexes with 1+3 floors and more to implement the Rainwater Harvesting measures mandatorily.

The Corporation of Chennai has issued necessary circular for implementing measures for conservation of rainwater while sanctioning the Planning Permission Applications (P.P.As), Building Applications (B.As) for ordinary buildings in detached areas, where the extent of plot is one ground and more with immediate effect.

The Chennai Metropolitan Development Authority also has passed a resolution explaining the need for the conservation of rain water to improve the ground water table in Chennai metropolitan area and the enforcement measures that are essential to achieve this goal.

Progress in Implementation of Rainwater Harvesting Measures in Chennai City

Description	1994 as on 01.12.1993	1995	1996	1997 upto 01.07.97
No. of Planning Permission Applications received from CMDA for clearance by CMWSSB	875	979	1189	585
No. of P.P.A's cleared with Rainwater Harvesting Proposals	494	490	623	324
No. of Applications rejected for want of provisions of Rainwater Harvesting	152	146	36	5
(%of Rejection of Rainwater Harvesting applications)	40%	30%	6%	2%

Note : After 1.7.97 the Planning Permission applications with rainwater harvesting proposals as per specification laid down by CMWSS Board are being cleared under single window system by CMDA.

10.0 LESSONS LEARNT

1. **Too Much Water for Two Months-Too Little for Ten Months** has been the experience of Chennai city. The major agency involved in the provision of drinking water to the city, the Metrowater, has therefore to consider all possible means to stabilise the situations. The Metrowater has had to evolve a combination of strategies that involved skill full engineering with policy changes and initiatives.

2. The major Policy initiative of introducing ground water legislation was followed with the even greater success in its implementation given the extenuating circumstances of the water-scenario in Chennai. The main reason for the effective implementation of the

legislation was the declaration of the major stake-hold of **Chennai Metrowater,** as the **Competent Authority** to implement the legislation.

3. In the introduction and the implementation of House to House Rainwater harvesting Systems the important lesson learnt was the need to follow up the directives of the Metropolitan Development Authority, with the **provision or denial** of water/sewerage services as **an effective tool to ensure implementation.** Though Rainwater Harvesting was introduced immediately after the drought of 1993, good monsoon years in 1995-96 and 1997 have somewhat, dimmed public responses.

4. The experience of Chennai city and the measures taken are typical of responses in a critical situation. That the opportunity to respond was not last and that lessons were well learnt to serve as a precedent and model to large number of Metropolitan and medium urban conglomerates which are confronted with similar situations.

5. There is now a need to work further at collecting rain water in ponds, river ways, canals and low lying areas in urban areas as part of future master plans for city water supply. The potential for collection of rain water for direct consumption in individual houses and building complexes has to be worked on in terms of technical feasibility and cost effectiveness given present day urban land costs.

"If water is saved, it will save you"