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Study and Assessment of Rain Water Harvesting Techniques to Augment Water Supplies in Shiv Nagar Colony Area of Noida

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Abstract: **The major concern of water scarcity in the sub areas of National Capital Region (NCR) is increasing due to overcrowding and migration of people from various other states which leads to higher water consumption. The basic aim of our study is to understand the issues involved in adopting Rain water harvesting technique as a means to augment water supplies in Shiv Nagar colony area - Noida's worst affected zone - and suggest proper mechanism to make it a means to supplement the water requirements in this area. Moreover, the capacity, efficiency, and utility of rainwater harvesting structures vary over time and space. Thus, due to technical and structural variations a uniform exercise of water harvesting is not possible and making it important to do an in depth study of the area - Shiv Nagar colony in Noida. This study involves assessment of potential for augmenting water supply through rainwater harvesting techniques in accordance with building structure, geo-hydrology and land use. Also a detailed study to analyze the legal, financial and environmental issues and the feasibility of the technique and understand the people's perception is done. The status and potential of water bodies to complement the rooftop harvesting in the area is technically investigated and a review of various rain harvesting techniques and possible suggestion are provided to make it a means to supplement the water requirements in the area.**

1. INTRODUCTION

Water scarcity is major concern in the present scenario and requirement of water has been increased to a greater extent. The major sources of water are also depleting and due to increase in industrialization the water resources are affected as contaminated water are directly transferred without any standard cleaning process. The various other sources such as ground water is also decreasing due to excessive water consumption and ground water table has been depleted. The widespread use of ground water at construction sites, water plants, industry has also lead to depletion of ground water. The area for which study has been done is a sub area of Noida. Shiv Nagar Colony is a local area in Noida with approximately 500 houses. The area is located in Village Silarpur Khadar. The population of the entire area is approximately 2500. The physiography of area is plain with soil type of sand and silt. The location of the area lies in northern part of india with extreme winters and summers. The rainfall in this area is moderate approximately ….. mm rainfall per year.

Hydrology of the area-

- Ground water table also at about 200ft below the ground surface.
- The quality of water is also not fit for drinking purpose, the saline ground water with high amount of sulphur, nitrates and Lead.
- Non- availability of ponds, rivers.

2. LITERATURE STUDY (TECHNIQUES)

Various techniques so far has been reported for ground water table recharging.

2.1 Lined underground reservoir

It is a hole dug in the ground, used to collect and store surface runoff from uncultivated grounds, roads or laggas -dry streambed of a river that flows only in the rainy season. The main purpose is to provide water for livestock use and crop irrigation. The Cost is Very variable and depends on the size of reservoir. The Dimension of ponds will generally be square or rectangular shaped. The capacity is variable and depends on site conditions, i.e., how much rain falls in the area during rainy season and how much one wants to invest and the common ones are 400 to 1000 metre cube.

2.2 Contour Stone Bunding

A single line of stones, or a stone bund, depending upon the availability of stones, is laid along a contour. The contour stone bunds do not concentrate runoff but keep it spread. They also reduce the rate of runoff allowing infiltration. The Purpose is To conserve soil moisture for crop production and To reduce soil erosion. The Dimension of Structures are up to 25 cm high with a base width of 35 to 40 cm. They are set in a

trench of 5 to 10 cm depth which increases stability. The spacing between bunds varies but is usually between 15 to 30 m.

2.3 Terracing Contour bunds

Terracing contour bunds are ridges and ditches made of soil, dug across the slope along the contour. They are used to prevent run-off and to conserve soil and water. Crops are planted on the land between the bunds. The main Purpose is to conserve soil moisture for crop production and To reduce soil erosion. The Dimension of the trench is 60 cm wide by 60 cm deep, and the bund 50 cm high by 150 cm across at the base. The distance between bunds depends upon the slope and may be from 5 m apart on steeply sloping lands to 20 m apart on more gently sloping lands.

2.4 Permeable rock dams

Permeable rock dams consist of long, low rock walls with level crests along the full length across valley floors. This causes runoff to spread laterally from the stream course. This is a floodwater harvesting technique. The Purpose is to Spread and retain floodwater runoff for improved crop growth and Control gulley erosion. The Dimension of each dam is usually between 50 and 300 m in length. The dam wall is usually 1 m in height within a gully, and between 80 and 150 cm in height elsewhere. The dam wall is also flatter (2:1) on the down slope side than on the upslope side (1:2), to give better stability to the structure when it is full. A shallow trench for the foundation improves stability and reduces the risk of undermining. Large stones are used on the outer wall and smaller stones internally.

2.5 Recharge Pits / Trenches

Recharge pits and trenches are constructed for recharging the shallow aquifers and / or avoiding runoff damages. Pits are generally 1 to 2 m wide and 2 to 3 m deep. Trenches are generally 0.5 to 1m wide and 1 to 1.5 m deep and 10 to 20 m long depending upon availability of water. Both are filled with boulders, gravels & coarse sand to filter and increase water infiltration (minimizing evaporation loss).

2.6 Dried up well

When open well are dried up, it is possible to use them for recharging groundwater in diverting upstream runoff inside the well.

2.7 Check Dam

A check dam is a small, temporary or permanent dam constructed across a drainage ditch, swale, or channel to lower the speed of concentrated flows for a certain design range of storm events. A check dam can be built from logs of wood, stone, pea gravel-filled sandbags or bricks and cement.

The above techniques are so far suited as per the requirement of the area.

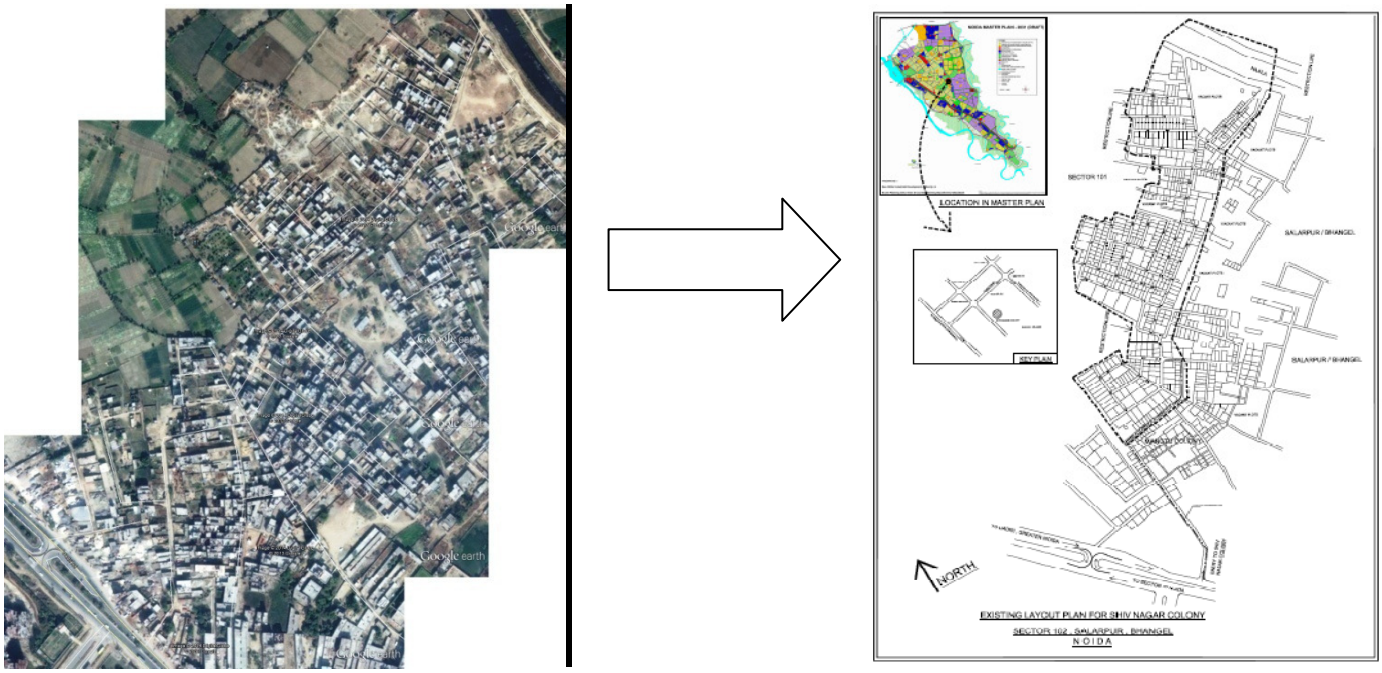

Fig.1. Satellite Image converted to AutoCad Drawing

3. WATER REQUIREMENT OF THE AREA

Water requirement of the area per person per day is approximately 100 litres as per the survey done in the concerned area. Survey is conducted with response form distributed and collected individually in each home. The above requirement is calculated on average basis. The sources of water available are bore wells, water tankers and packaged drinking water in the area. The frequent use of bore wells has depleted the water table level. Also, there is non-availability of any government water supply pipelines which leads to privatization of water in this area. The presence phosphorous, sulphur, lead and slats in ground water makes the water saline and unfit for drinking purpose.

4. DATA PREPARATION AND PROCESSING

The map of the colony is made with the help of autocad software by rastering the combined images of satellite images from google earth .The various images from satellite are overlapped 60% and the arranged in a proper manner and then the whole image is raster using autocad software to make a map for the area. Then the locations are marked on the map which are feasible for the rain water harvesting and the natural drainage pattern also marked on map, using the natural slope the area is selected for the storing of rain water. Fig.1 shows the satellite image converted to the existing layout plan using AutoCad software.

Analysis and discussions

Area's and water calculation

We have analysed that the total area of the colony is 1122567sq.ft. (104289 sqm) Approximately and if we assume the circulation roads to be 10 % of total area then total roof top area is 94000 sqm approx. the average rainfall in this area is 790 mm. total 74260000 litres, if the starting one or two rain water will not collected and exact 100% water harvesting is also not possible, so we will assume that the 70% rain water will be harvested i.e - 51982000 litres . If the distribution of water to be done, each house will get 103964 litres water per year means 8663.6litres per month and 284.05litres water per day.This study and research if implicated, then it will surely give the benefit to the residents of shiv nagar colony.

Location for storing rain water

Fig.2 satellite image

Fig.3 location of selected area

The location of site is taken because the natural water shed flow is aways in valley or lower levels of the area, so that's why we have selected this location, trenches will work efficiently for the collection of rain water

Structure suggested for collecting the rain water from roofs top

The r.c.c trenches will help to collect the water from roof top as it is cost effected and can be easily made in accordance with natural drainage system . the underground pipes will cost higher and life is also not more than the r.c.c. trenches. Trenches also accommodate the heavy rainfall in monsoon period.

Structure suggested for storage tank

The under ground r.c.c. tank will be efficient for storing water, as it does not allow water to seep out, it is a water proof structure. The collected water is treated in various aspects of quality check.The pump room will also located at the top of tank slab. The pumps will pump out the water through the pipe lines .The overflow water is harvested in the ground wuth the help of rain water harvesting pit (fig.4)

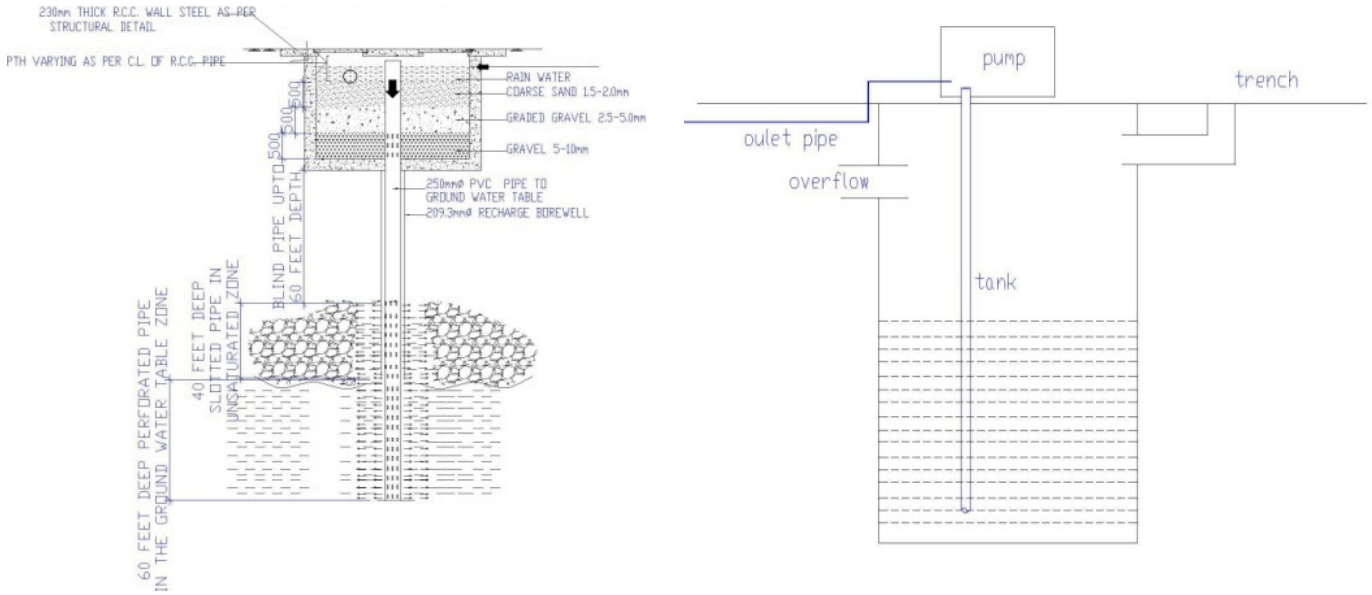

Fig-4 RWH PIT

5. CONCLUSIONS AND RECOMENDATIONS

The conclusion of the study is that the rain water harvesting technique will help to overcome the water needs of the area and also helps to increase the level of ground water table in this area.

The scarcity and quality of water will be improve with this technique and diseases from the saline and dirty water will also reduce.

This study will help the area and society of the area naturally and socially.

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