TRADITIONAL RAINWATER HARVESTING METHODS IN HERITAGE SITES OF JAIPUR AND THEIR PRESENT SCENARIO

Abstract: Due to rapid development, the number of water-scarce regions around the state is increasing high growth. The rapid growth of the urban population has led to an increase in water demand. Meeting these growing water requirements with geographically constrained water supply systems is often a very difficult task, especially in the drought prone state Rajasthan. To a large extent, traditional water saving is a question of "for or against". Much intelligence has been used to prove whether traditional water-saving technologies are effective. However, we know very little about how it works in a particular area. This research seeks to analysis the rainwater harvesting system used at Historic forts in Jaipur the capital city of Rajasthan. By understanding the methods used earlier at such place where water scarcity is prevalent, this paper draws the attention to how those traditional system of Rain/spring water harvesting can be used in our modern times. The methodology used for this paper is the collection of primary data by visiting six locations in Jaipur, Rajasthan and looking for mechanics of how RWH systems worked and also look for problems currently faced by the site and solutions for the same. Therefore, by understanding RWH systems and applying it to modern times can solve the problem of water scarcity. Thus, the association between the administration and the private area leading the mix of development and information can assume a significant job in Rainwater harvesting's long-haul feasibility
Keyword: Rainwater Harvesting, RWH, Stepwell, Tank, Kund and Aquifers

I. INTRODUCTION

All major cities are required to ensure that residents are provided with adequate drinking water. Since Jaipur is not near any perennial rivers and does not have any perennial water sources, rainfall (the only source of water) used to be only three months. But still need water throughout the year. This poses a problem for Jaipur City planners. For amber rulers, collecting and storing rainwater in different ways is essential, so they plan and construct various types of water bodies. The water the executive's arrangement of Jaipur comprises of waterways, lakes, repositories, dams, water tanks, water assortment wells, water wells, step wells, stream channels, reservoir conduits, and so on. On a very basic level, the framework advances the upkeep and circulation of water to meet different human needs. Request inside and outside the city. The new city is connected to the ancient fortress town of amber, and to the two fortresses "Nahargarh" and "Jaigarh". These fortresses are just like any other fort, with one exception, that is, they have well-designed water collection and storage systems. Amber has a large body of water-lakes, Kunds or water tanks, Baolis or stepped wells, some of them are worth mentioning. One of them is "Maota Lake" located under the amber palace on the top of the mountain. The other is the ancient 'Sagar' lake, which is located in the valley of the hilltop palace, northwest of Jaigarh Fort, and is also an important water source.

Another important water structure of Amber or Baoli Reservoir is the "Panna-Meena-Ka-Kund" built by Mina Panna. Four octagonal "Chhatris" may have a colonnade. Sawai Jai Singh is very concerned about the water supply in the new capital, and he has paid attention to this issue from the beginning. No matter where you can use the natural route of the river, draw it on the map and describe it in the relevant description and then estimate and actually measure the length of the waterway. In order to facilitate the supply of water to Jaipur City, he planned to build a canal from the nearby "Darbhawati" stream and extend a certain distance northeast of the urban area between Jaipur and Amber, so he built the "Jai Sagar River", "Man Sagar "lake. The water supply system further added water bodies called "Kunds" located in the center of "Bari-Chaupar" and "Choti-Chaupar", which were further connected to the wells and "Baolis" or stepped wells on the inner street. The old city plan refers to the wells placed next to the planned streets and other connected streets.

II. METHODOLOGY

The aims and objective of the study, design of the study, collection of data and interpretation of data have been discussed:

2.1. Aim and Objective of the Study

The paper aims to experience and develop understanding regarding the traditional rain water harvesting methods at heritage sites of Jaipur.

The objectives of the study are:

- To understand the water harvesting techniques and systems at ancient forts
- To understand the difficulties faced at 6 different heritage sites in Jaipur, India.
- To find possible solution from the methods used traditionally for the modern problems of water scarcity

The proposed study is focused to identify and attempt to find solutions for water scarcity and recommendations for making the traditional

2.2 Methodology adopted for Study

The methodology of the study involves mainly collection of primary data and also problem identification and generation of solution for the same. **Six** important historic sites/structures were selected viz., Jaigarh Fort, Amber Fort, Nahargarh Fort, Jal Mahal, Panna Meena Ka Kund and Galta Ji Temple.

2.3 Design of the study

An integrated approach is used to gather valid reliable information for the study therefore; this has an exploratory research design. The data sources which includes investigation of related literatures and survey methods, interviews techniques as a tool for gathering

data to be used in the study. The research tries to study the pre-modern methods of rainwater harvesting of 6 historical sites in Jaipur which could lead to solving and planning new houses or colonies with the rainwater harvesting techniques effectively. The study analyses how historical architectural structural were a great success even without any hard and fast technologies.

2.4 Collection of Data

Both Primary and Secondary sources were used in the study:

2.4.1 Primary Sources

- **Survey**: the sites used in the study went under a detailed observation more or less to find it the mechanics used at different sited for water harvesting and relating it the present times where scarcity of water is being faced, therefore the survey played an important part in this research.
- **Questionnaire:** a small set of questions were put together in form of questionnaire to be asked from the residents nearby sites for an easy access to the challenges faced in the site areas.
- **Interview:** the expertise of the heritage sites were interviewed for the deep understanding of the site mechanism and the brief history and how the situations have changed in the present period.
- **Schedule:** the interview was taken over the Telephonic conversation as per respondent's priority.

2.4.2 Secondary Sources

- Government data;
- Published Materials

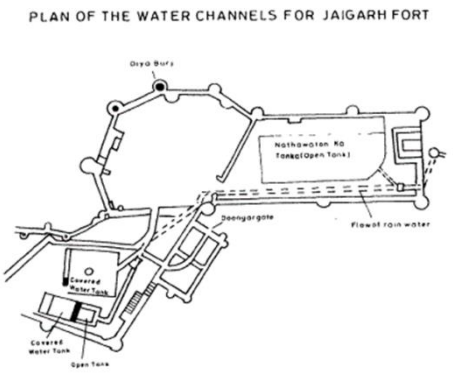
2.5 Analyses and Interpretation of Data

Data gathered through essential and optional sources were investigated subjectively, which was encouraged using outer and inward analysis. Qualitative and quantitative investigation was for a better study approach.

III. TRADITIONAL RAINWATER HARVESTING METHODS AT VISITED SITES

3.1 Nahargarh Fort: The water catchment area of Nahargarh extends about 6 kilometers around the fortress. A network of six closed catchment areas is connected by small canals, while water channels and drainage channels are placed inside and outside the fortress. The small canal brings rainwater from the upstream of the hills.

3.2 Jaigarh Fort: The rainwater catchment area of Jaigarh extends to about 4 kilometers from the fort. Drainage channels, small canals and their arterial networks are laid inside and outside the fortress. Rainwater is guided along these channels into small canals or stucco channels, which are connected to the main water tank in the fortress. These small canals brought rain up the hill.



3.3 Amber Fort: There are two sources of water in Amber Fort:

i. **Maota Lake** brings water to the eastern edge of the palace and collects rainwater inside the palace to store it in an underground water tank.

ii. **Man Singh Mahal ka Tanka:** This tank can hold about 200 tons of rainwater 3 liters of fresh water.

The six stages lead the water from Maota Lake all the way to the palace. At each stage, the water is lifted and transferred to a water tank for temporary storage. Persian wheels are installed at each height and are used to lift water to overcome gravity.

3.4 Jal Mahal: Mansagar Lake (Mansagar Lake) is an artificial body of water. It was built near the Darbhawati River. The sewage from the Walled City of Jaipur was transferred to the lake because it was no longer used for recreational activities and the palace was abandoned

3.5 Panna Meena Ka Kund: Panna Meena ka Kund is a square stepped well with adjacent stairs on all four sides and a room on the north wall. People in Amer could collect water, which was later used by many nearby temples

3.6 Galta kund: surrounded by Aravalli Hills, where devotees from across the state come to bathe. The water seeping from the mountain is the source of water for the Kund. There are a total of 7 kunds in Galtaji.

IV. PRESENT SCENARIO OF SITES

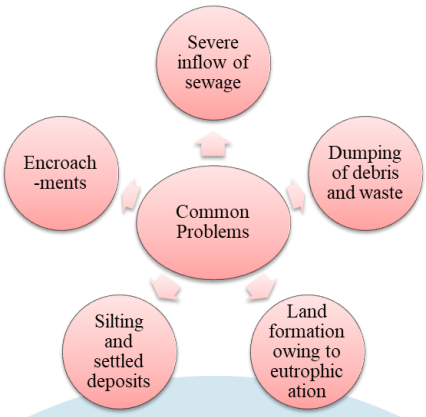


Fig 4.1 Common problem at the sites

It could be said that the sites had their specific problems, as in Rajasthan water scarcity is itself prevalent. The traditional rainwater harvesting systems in this study are totally dependent on annual rain and number of tourists, as the higher the number of tourists at a certain locations more will be the emphasize of development in that area by the government.
Therefore, it can be said that the sites expect galta ji had little to no amount of water and some dumps were made by locals in them.

V. SIGNIFICANCE OF TRADITIONAL RHS IN MODERN ERA

5.1 General Concept of Rain Water Harvesting

Water harvesting is suitable for arid and semi-arid areas, where rainfall is either insufficient to maintain good crops and pastures, or the irregularity of precipitation leads to a very high risk of crop failure.

Stepwells: ensure water supply during drought. Step wells have important social, cultural and religious activities. After being subjected to an earthquake, these stepped wells proved to be elaborate and solid structures.

4.2 Use of Rainwater Harvesting in Rajasthan

Facts have proved that water harvesting is a valuable tool, especially in arid marginal areas

(1) Increase crop yield and reduce crop planting risk
(2) Promote forage growth
(3) Promote afforestation
(4) Allow a higher degree of food production
(5) Prevention of soil erosion
(6) Make full use of existing water resources
(7) Inhibit soil salinity, in some cases,
(8) Recharge groundwater

5.3. Modern Methods of Rainwater Harvesting Include

- **Pit:** The recharge pit is used to recharge shallow aquifers.
- **Aquifers:** Aquifers are porous, water-saturated sand, gravel or bedrock layers that produce large amounts or usable water. These buildings have a width of 1 to 2 m and a depth of 1 to 1.5 m and are backfilled with boulders, gravel and coarse sand.
- **Trenches:** These trenches are constructed when there are permeable rocks in the shallow layer. The width of the trench may be 0.5 to 1 m, the depth is 1 to 1.5 m, and the length is 10 to 20 m, depending on the availability of water. These are backfilled with filter material.
- **Digging pits:** existing digging pits can be used as a replenishment structure, and water should first pass through the filter medium before entering the digging pits.
- **Hand pump:** If the available water is limited, you can use the existing manual pump to replenish the shallow / deep aquifer. Water should pass through the filter media to avoid clogging the supply well.
- **Replenishment wells:** Replenishment wells with a diameter of 100 to 300 mm are usually built to make up water for deeper aquifers. Water passes through the filter media to avoid clogging of the replenishment wells.
- **Recharge wells:** To recharge shallow aquifers below the clay surface, recharge wells with a diameter of 0.5 to 3 m and a depth of 10 to 25 m were constructed and backfilled with boulders, gravel and coarse sand.
- **Lateral shaft with wellbore:** To inject water into the upper and deeper aquifers, a 1.5 to 2 m wide and 10 to 30 m long side - wellbore is constructed, depending on the construction of one or two wellbore wells.

VI. OBSERVATIONS

Site	Year	RWH Systems	Total Water Capacity	Present Status (condition)	Issues	Water Source
Nahargarh	1737	3 Stepwell 1 Tank	~100Million L	Good	• No natural or artificial supply of Water • Less Water	Rain
Jaigarh fort	1726	5 tanks	~25 Million Gallon	Need Improvement	Need cleaning of present water	Rain
Panna Meena ka Kund	1500's	1 Stepwell	~50,000 L	Good	Now only used as Tourist Spot	Tanker Rain

Site	Year	RWH Systems	Total Water Capacity	Present Status (condition)	Issues	Water Source
Amer Fort	1592	2 Tank	~300 million L	Good	• Artificial supply of Water • Less Water	Rain + Tankers
Galta Kund	1700's	7 tanks	~50,000L	Need Improvement	Need cleaning of present water and development of route infrastructure	Rain
Jal Mahal	1500's	1 lake	~20-30,000	Recently Restored	eutrophication	Tanker Rain

Despite of being capable of serving whole Jaipur city with their water, these 6 sites lack public interest for making use out of them, as these sites are only being used for generating Income by making them Tourists Spot.
The Rainwater Harvesting systems which have already served the city in Pre-modern times and could have been proven of great use if looked upon

- Dumping waste
- No water supply
- No Cleanliness
- No Respect for Heritage
- Lack of governmental policies implementation

These were few issues that are needed to be dealt with, and hence the RWH systems can flourish whole the city.

VII. RESULTS AND CONCLUSION

• In these fortifications, especially in Jaipur Fort, one can see the wastewater treatment framework and water storage tanks. Jaigarh Fort has many wide water channels and five water tanks, the largest of which can store 6 million gallons of water. The diversion channel was constructed in the Aravalli watershed, and then the water was transported to Jaigarh Fort. Amer and Nahargarh Fort also have frameworks for catchment and capacity.
• As of late, the Jaipur government plans to reintroduce customary water harvesting innovations. At present, all houses more than 300 meters must have a water assortment structure.
• Many existing RWH frameworks center just around the objective of sparing water, without considering other potential advantages identified with the multipurpose idea of RWH.
• Rainwater Harvesting can reduce the loss of aquifers that affect food, water and energy supply. Traditional knowledge also reduces dependence on expensive and resource-intensive rainwater infrastructure and centralized water distribution systems.
• RWH can be used independently or in combination with modern infrastructure. The distribution, water loss and maintenance costs generated by RWH are negligible. Rainwater harvesting is the essential reason is:-Surface water is not enough to meet our needs, we must rely on groundwater. GIS can be affective in remote areas where less secondary data is available for identifying rainwater harvesting sites. Field investigation of geology of the area is also a prerequisite to authenticate the storage and potential RWH structures.
• Other benefits of RWH include reducing the impact of rainwater pollution on the environment and human health. For sustainable use of water resources, collecting rainwater is essential Includes surface water. The partnership between the government and the private sector and the combination of innovation and traditional knowledge can play an important role in Rainwater harvesting's long-term viability.