STEPWELLS: CONSERVATION OF RAINWATER

FOR SOCIAL CHANGE

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ABSTRACT

When people started saving water from earlier times till now, complexity in design become more intricate. From simple great bath of Indus valley civilization to massive stepwell of Abhaneri step- by- step we wrote our whole history and many epics but never tried to save those magnificent structures. On the other hand, preservation of amenities for worst time is in blood of Indians, ironical to this statement maintaining natural hydrological cycle became very much difficult to accomplish. While conservation is essential for the development of our heritages, development of country and development of its citizens we not proceeding positively to its direction.

Although, modernization and globalization are away from principles of simple Indians but with changing time and humane values… we all have changed. As in this changing scenario when human is not helping the other human how water could be helped…? Moreover in the race of becoming more unique, more powerful and position- seeking, we are losing our principles, swiping away from human basic need "ROTI, KAPDA, MAKAN" to "PIZZA, ZARA, and CAR". I think every journey whether of people, resources or sustaining natural heritages would become tough in a country like India as it was never be a simple country. At every hundred meters language changes, people and thinking would also be. Every change is not simple and one individual can't change the world. This is the simple approach for understanding the future issues regarding water resource and its impacts on the society as villages are converting to cities, cities to mega- cities while resources are limited to an extent. Especially in the regions of arid climate zones people maintain a natural process of recharging, collecting and harvesting rainwater by adding alum in water at Jaisalmer region to purify water and make it habitable for intake to human body – it's the best and cheapest methods for purifying it. And the structures used for its collection is called stepwells. Stepwells are the means of primary water source in earlier times in India where it also serves as social gathering place of the society. Let's see how much these stepwell can teach the technology of the contemporary India.

SYNOPSIS- FOR A SOCIAL CHANGE

Everything on Earth have certain period of time i.e.

WHAT COMES WILL END ONE DAY,

But what if we increase the time duration of everything possible for the betterment of life, that's quite sustainable and long lasting. Same is the case with step wells, they are once made and going on still with immense beauty.

AIM- To conserve and rejuvenate stepwells for fulfilling water requirements in semi-arid areas of India (Rajasthan and Gujarat) and hence to find out that stepwells or rainwater can still serve in urban context or not.

OBJECTIVES- As step wells, parr system, jhiris, chauka system are traditional practices of collecting and harvesting rain water from earlier days till now…especially people of Rajasthan are still using the benefits of these system. My study will greatly be influenced by

- collection of rain water,
- social utilization of water,
- water for day-to-day use per person,

SCOPE- Due to limited time interval, I would like to study the main context behind step wells as they are still on their legs holding water for so many years and its relation with water especially rain water.

LIMITATIONS- Why these social gathering spaces are lost; why people are becoming self-centered as rain is still showering for so many years but social culture is losing day-by-day.

I will be studying step wells in Rajasthan and Gujarat, specifically two or three step wells in an area or/study a region with a desired number of step wells i.e. Jaisalmer and will like to calculate per person per day utilization of water from that stepwell.

METHODOLOGY- Staring with my net study I'll have a site study or a case study for particular wells i.e. CHAND BAORI and ADALAJ NI VAAV. And would like to find the contents of making stepwell there, the story behind its water conservation, its area and how many people could be fetched from its existing area or volume.

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ABBREVIATIONS-

- A.D. - After Death of Jesus Christ
- i.e.- that is
- etc – et cetera

1.0 INTRODUCTION

Earth's crust and core have many resources for human survival but water is the fundamental need of any planet or being to survive. For example- human came to Earth defined life as an individual being, searched any special material (i.e. obviously water, but at that time they didn't know what to name it) for washing their faces or just to make themselves feel fresh, than only they proceed further for the search of food. Moreover, intelligent mammal like human always made his settlements near river banks to conquer his daily demands while it's Indus Valley Civilization or Mohen-Jodaro Harappa civilization or any other future city development. Soon after devastation of these early settlements Mohen- Jodaro and Harrappa, Vedic Culture period came into existence where settlements grow near river banks, future continues but clean water not.

Today's world is in extinction of fresh water as greedy people can't understand the importance of disappearing treasures. Water and its resources are the precious resources one could understand despite waiting for life to destroy. Essentially, we require fresh water for the following purposes i.e. agricultural activities, industrial activities, household works, recreation and environment. Neither of these activities can be neglected for the best survival of humans. Hence, all we need to respect nature and its kind belongings. All the hydrological cycles can't be started again but what we have as a gift, we should respect it by trying to maintain the same pace. Thinking about earth and its conditions one question arises in my mind i.e. could environment and habitat survive more or not as water resources such as lakes, rivers, ponds and underground aquifers are degrading day-by-day. The answers and solutions are yet to find.

This research introduces the conservation of water traditional methods… to be appropriate stepwells (traditional ways for conserving rainwater) and reflecting a little light on contemporary needs for water. The line explains the traditional techniques very well:-

> *"The key to the well-being of our country's water resources lies in the indigenous water conservation systems which are being forgotten by the society."* *- Anil Agarwal*

1.1 WATER AS A RESOURCE

In India approximately 83 percent of available fresh water is used for agricultural practices, rainfall is the primary source of collecting fresh water. Collection of anything is done only when we are in intense need or have faced the deficiency. The term 'Conservation' is widely used for preserving old monuments, heritages, and structures; same as water is also conserved and renewed. The concept behind water is to harvest it when it touches the ground and use it durably. Cherrapunji is blessed with the highest rainfall in the world, but still faces water problems due to lack of water conservation techniques while in contrary the desert city Jaisalmer is famous for its basement tankkas or hudis in each and every house.

Today water resources are under stress influencing many factors like people, as precipitation is greater than evaporation on land, supplies of freshwater (water without a significant salt content) exist. Most of the precipitation which is not transpired by plants or evaporated in environment, infiltrates through soils and becomes groundwater, hence flowing through rocks and sediments discharges into rivers. Rivers are primarily generated by groundwater, and in turn provide most of the freshwater which is rarely used for human intake but mostly discharges to the sea. While over the oceans evaporation is greater than precipitation, so the net effect is a transfer of water back to the atmosphere. In this way freshwater resources are continually renewed by balancing differences

between evaporation and precipitation on land and at sea respectively. Freshwater accounts for only some 6 percent of the world's water supply, but is essential for human uses such as drinking, agriculture, manufacturing, and sanitation.

If you dig deeply enough anywhere on Earth, you will hit water.[1]

Groundwater is picturized as an underground source of river and lake but in reality it is not like that, it is rarely a distinct water body (large caves in limestone and coal aquifers are one exception). Moreover, groundwater typically fills very small spaces (pores) within rocks and between sediment grains.

The water table lie to the topmost layer of saturated zone while it changes with topography. It might lie hundreds of meters deep in deserts or near the surface in moist ecosystems. Water tables shifts from season to season as precipitation and transpiration level changes, increasing during rainy periods and decreasing during dry phases when the rate of recharge (precipitation minus evaporation and transpiration that infiltrates from the surface) drops. In temperate regions, the water table tends to follow surface topography (excess of water flow is termed as surface run- off), while rising under hills where it discharges to streams and falls under valleys where the water table intersects the surface in the form of streams, lakes and springs.

Water now-a-days is the most essential resource which should be preserved free from contaminates. The 1986 trial recounted in the book and movie **A Civil Action** focused on town drinking wells in Woburn, Massachusetts, that were polluted with industrial chemicals suspected of causing cancer among residents.

The pore structure of soils, sediment, and rock is a central influence on groundwater movement. Hydrologists define this primarily:

• Porosity: the proportion of total volume that is occupied by voids, like the spaces within a pile of marbles. Porosity is not a direct function of the size of soil grains—the porosity of a pile of basketballs is the same as a pile of marbles. Porosity tends to be larger in well sorted sediments where the grain sizes are uniform, and smaller in mixed soils where smaller grains fill the voids between larger grains. Soils are less porous at deeper levels because the weight of overlying soil packs grains closer together.[2]

• Permeability: how the medium transmits water (percolating within the holes), based on the size and shape of its pore structure and how they are interconnected it's all permeability.

Materials such as sand, gravel, sandstone, fractured rock and basalt have high porosity and high permeability produce good aquifers. Low-permeable rocks and sediments slow down the flow of groundwater which includes granite, shale, and clay. Water have that characteristic of flow i.e. it always flows from higher elevations (hill slopes) to lower level (bottom of valleys) hence the overall movement of groundwater is downhill. However, within an aquifer water often flows upward toward a discharge area or pit. Depending on the local rainfall, land use, and geology, streams may be fed by either groundwater discharge or surface runoff and direct rainfall. Perennial streams and rivers are primarily supplied by groundwater, referred to as base flow. During dry periods they are completely

[1](Water Resources)

supplied by groundwater; during storms there is direct runoff and groundwater discharge also increases.

In this greedy world our people are extracting water so quickly from aquifers than the replenishment process can't be continue for the next use. During heavy rainfall season the aquifers drains, making excess of groundwater changes the flow patterns around wells and can drain nearby rivers and streams. This happens because pumping changes the natural equilibrium that exists in an undeveloped aquifer with discharge balancing recharge. When pumping starts, groundwater stores (aquifers and other natural water streams) are depleted, creating a cone of depression in the Earth's surface. If a new water source such as a river or stream is available close by, the well may capture (draw water from) that source and increase its recharge rate until this flow matches the pumping rate. If no such source is available and pumping draws the water table down far enough, it will dry up the aquifer or deplete it so far that is it not physically possible or affordable to pump out the last stores of water.

1.2 SCENARIO OF WATER SCARCITY IN RAJASTHAN

As Rajasthan covers most of the hot and dry desert area in India, it is regarded as one of the places of less rainfall and scarify of water. But in reality this is not the one to be assumed as. It's a traditional city of forts, places, heritages, lakes, ponds… it always maintained its own essential needs rather than asking from anyone. The basic hydrological cycle… they collect the rainwater of July and August months (60 days), preserve it for the year ahead (366 days of a year). But increasing demands of people become so much greedy that it's impossible to make the train on track again. Jaipur is the first planned city of India, water security is planned in its construction. The old city continued to benefit from the original natural water systems until the 1930s but later the population of Jaipur exceeded the capacity of the old city.

The city soon had to turn to reservoirs located outside the immediate reaches of the city.

Compounded by a lack of infrastructure (sewage systems, water piping or drainage systems) with rapid growth, defied any unified government planning making Jaipur prey to water scarcity while supply began to deteriorate.

There are some news headlines which are consistence in the summer months relating to the main objective i.e. water scarcity and needs of the people of Rajasthan. Many government policies and schemes have been issued but the solution is not respecting nature's true methods, distributing water in every summer would not fulfill the demands of future generation… it's not renewable nor sustainable. We need something which will be there for the people, the upcoming generation so that they could not depend on the changing Government and schemes as nothing is constant in the democracy, only problems are constant.

13,500 villages in Rajasthan run out of drinking water as crisis deepens2

|WRITTEN BY HARSHA KUMARI SINGH | UPDATED: MAY 09, 2016 03:04 IST

Ajmer becomes the desert state of Rajasthan as the whole city is sank under water crisis in the alarm hour of summers. Approximately 13,500 villages do not have access to safe drinking water, solely fetched by the mercy of water tankers sent by the government. Rajasthan has the largest land area in our country, having approximately 10 per cent land mass but only 1.1 per cent surface water can be made out of it. Making people dependent on ground water which is ten to 15 stories deep and hence fast depleting. Only 10 percent of wells have water that is

safe for human consumption, rest of the water contain salinity and fluoride in it which can be treated by old conventional methods but time is less and demand is more.

> *"I walk three kilometers to fetch water. Sometimes we do three trips in a day. How many pots can I carry in one trip? My children are almost always thirsty and in this situation when we don't have enough for ourselves, can we give water to our animals?" said Shobha, one of the household in Ajmer.*

Every day, women in Baalpur make multiple trips to fetch water under the scorching sun to the only well which have safe drinking water. They however manage to bring back two pots of water in each trip about 5-7 litres of water collection per day is made not enough for a family of five. The Sarpanch of the village told to have 10 wells out of 150 wells in and around for safe drinking water. While the Government have other parts of situation to handle i.e. 100 percent water has been withdrawn but only 22 percent can be recharged, hence exploitation of ground water, soil and land in combination is happening which will have adverse effects in near future as 190 blocks out of 236 blocks are either overused or critically short.

Rajasthan: Water crisis in 19 districts, nearly 17,000 villages face acute shortages. [3]

UPDATED: APR 18, 2016, 02:00 PM IST, PTI

Water crisis again and again agitating 19 out of 33 districts of Rajasthan, Government is helping villages by sending water trains to Bhilwara and other area of acute shortage. In general, 17000 out of 44672 villages are affected by water crisis where transportation of water is done by rail and tankers in other remaining areas by state public health and engineering department.

> *"We have already allocated Rs.50 lakh to each district to carry out necessary works to improve water supply. Transportation of water has been started from Nasirabad to Bhilwara and water is being supplied through tankers in other parts of the state where it is required," PHED Minister Kiran Maheshwari told PTI.*

90 percent of water related schemes in the state are dependent on ground water but ground water table is sinking day – by – day hence surface run – off water is being preserved and being used. While mechanical methods are in process as repairing of hand pumps and other alternate arrangements are being made by state government. 2- 3 hand pumps are repaired daily by labourers, 421 teams are working for repairing at least 7 hand pumps daily. In this process, 7 lakh hand pumps has been repaired. Moreover, in the places of acute shortage water is supplied through water trains and tankers sent by state government who is investing Rs. 10 lakh per day. Ajmer, Banswara, Baran, Barmer, Bhilwara, Chittorgarh, Churu, Dungarpur, Hanumangarh, Jaipur, Jaisalmer, Jalore, Jhunjhunu, Jodhpur, Nagaur, Pali, Rajsamand, Udaipur and Pratapgarh are the districts which are famine affected. Last year rainfall i.e year 2015 was deficit in nine districts of Rajasthan Bhilwara, Bharatpur, Dholpur, Karauli, Sawaimadhopur, Jaipur, Alwar, Dausa and Pratapgarh.

[3] http://www.dnaindia.com/india/report-rajasthan-water-crisis-in-19-districts-nearly-17000-villages-face-acute-shortage-2203359

Studies are being conducted time to time, one of the study is done by two students Kathleen Roberts & Michael Reiner from Northwestern University on management of water and the related water scarcity in Jaipur. In that they concluded that:

> *"Although Jaipur receives only an average of 600 mm of precipitation per year, mostly in the monsoon months of June-September, believing that management issues exacerbate Jaipur's water scarcity challenges."*[4]

From 1990(s) Jaipur water demands depends on Ramgarh Dam as the main surface water source but this dam became a non-viable source in the late-1980s or early-1990s, leading to shift onto groundwater making a complete depletion of aquifers day by day. While in general Jaipur is currently experiencing growing water scarcity and diminishing drinking water sources. Therefore, one can imagine the case of villages in particular. Jaipur relies extensively on groundwater and a single surface water source, the Bisalpur Dam, which is located 120 km southwest of Jaipur which is shared with Ajmer and Tonk District villages. When a capital city have such issues one can imagine the problem faced by remote areas. Therefore, conserving the old techniques, practices and values can bring us one step further. We just have to work patiently in bringing up ground water table.

[4] (Kathleen Roberts, 2013)

2.0 ANCIENT WATER CONSERVATION METHODS IN RAJASTHAN

Since ages, people across different regions of India, have experienced either excess or scarce water due to varied rainfall and land topography. They then managed to harvest their agricultural fields with local techniques and day to day practices. Their traditional ways though less popular are still in use and effective. Many methods have been used by simple illiterate villagers yet are successful water managers of incredible India, their methods are so immensely used that stepwells are still on their legs holding so much water for decades. But the negative part of the story is no one cares about the old structures, no one wants to follow the steps of the hard working people and hence as a result we are at the extinction of our historic monuments. The Dholavira city have massive reservoirs some of which are destroyed naturally. The water conservation techniques of the city was based on rain water harvesting, it is a complex water harvesting system comprising of large rocket reservoirs. They drew water from seasonal streams (which were filled by rain water) which conserves the life system and supports in harvesting the parched landscape. The water management system was so appropriately designed that it consume each and every drop of available water i.e. no water is wasted. That time, this is the only unique and the most efficient supportive system against harsh and hot arid climate.

In ancient India, near about 3000 to 800 B.C. climate played major role which adds new dimensions in the personality of ancient Indian civilizations. With building up several stylistic stories stepwells were excavated to reach to the bottom of underground water level. The concept of stepwell was actually originated in India. It is popular throughout the years for its architectural and water engineering. It is the manmade pond with significant ornamental architectural structure for water conservation of ancient India. These wells are commonly found at western region of India which are semi- arid regions (receives rainfall for 2- 3 months in a year) for irrigation. Storage of water is mainly done to cope with seasonal fluctuations. Stepwells are usually known as bawdi, stairwells, baori, baoli or vaav in local languages. Stepwells provide water for drinking, washing, bathing, harvesting and almost for every human activities.

Anciently they were originated as reservoirs and storage tanks and were masterpieces of sculpture in Hindu temples. Every emperor have its influence on the architectural elements of the created stepwell which were elaborated in size and intricate in stone carvings. Every stepwell have its own story which can be depicted by its plinth, column, overhead shed pavilions. May be the queen built it for the sake of her vow, or the impressed king for his people but every year thousands of stepwells had been built by various artisans. Moreover, many people and groups have been benefited by this type of construction. The travelers, pilgrims and the caravans stay here during heat summer days or overnight. Every day every household fetch its water by the same stepwell, every member of family especially women would walk and carry earthen pots to the well. These became a happy place by chit- chatting of many household ladies. The majority of serving stepwells were originally served as laser, religious and ceremonial purpose as well as providing the water. Later it became a festive place where all the people of the society gathers and celebrates all small and big festivals. This was a not a main building but it's a part of social culture, a jolly body which should not be forgotten as it joins our separating society. Sometimes the complex architecture of Hindu and Islamic design made them stylish and unique. Arched niches, arcades and deep intricate carvings are the masterpieces of Islamic architecture while decorative columns and pillars are the one done by Hindus. While few are seen as the fusion of both styles, termed as Indo- Islamic or Indo- Saracenic architecture style.

Water is respected everywhere but in Rajasthan water is God of all.

"This kind of efficient system of Harappans of Dholavira, developed for conservation, harvesting and storage of water speaks eloquently about their advanced hydraulic engineering, given the state of technology in the third millennium B.C."-R.S.Bist

As the area of western part of today's India is greatly influenced by the innovations of Harrapans and mohen-jodareans, these techniques developed by generation to generation and experience to experience among the people of the society. These are the following water techniques:-

2.1 KATTA

SOURCE: GOOGLE IMAGES

FIGURE- 1 PEOPLE CROSSING BRIDGE MADE WITH MUD AND STONES

Katta is a temporary structure, type of a wall made by binding mud and loose stones available locally. This wall is built across small streams and rivers to slow down the flow of water across both sides, providing a large amount of water to be collected on either (depending upon its height) during the dry months of the year. The collected still water gradually seeps into ground and increases the groundwater level of nearby wells and areas. In coastal areas, these structures are very useful as they minimize the flow of fresh water into the sea and helps in fresh water conservation. It is a manual method invented by rural people in need yet is cost effective and simple. Series of stone with mud build one behind the other have proved to be more effective than modern concrete dams in some villages as these local structures can be easily repaired by farmers with minimum tools while concrete needs essential technical support as well. Villagers don't demand any tools or labours for building it as they collectively share the cost of structure while the building it are one from them with skilled techniques. Moreover, Government don't consider these methods appropriate or the methods are rare to find but people are using these techniques because they are cheap and easy to maintain. However, with more people opting for personal bore-wells and hand-pumps, the water level in open wells has gone down many storey, taking a toll on marginal villages. Thus, rejuvenating these community Kattas can go a long way in sustainable water management.

2.2 SAND BORES

Sand bores provide a safe alternative for farm irrigation without affecting groundwater consistency and level. This technique uses the concept of extracting water strained by sand particles. Sand particles act as great water filters by retaining the salt content at bottom and pushing pure water out by scientific principle of buoyancy. White sand as compared to black sand believed to yield enough clean water for drinking. Modern technique is based on this principle of cleaning water in which water is neutralized by inserting casing PVC pipes as a filter with an electric or diesel motor to pump sweet water out. For making this arrangement possible sand deposits along river banks is dug using manual soil cutter.

SOURCE: GOOGLE IMAGES

FIGURE- 2 FARMER PREPARING THE PVC PIPE FILTER

The entire set-up costs around INR 5,000-7,000 and requires less maintenance when sand deposits are fine and clean. The sand bore technique has been used in Karnataka since decades. The only drawback is it can only be practically used in coastal regions or in areas with high sand depositions. High sand areas like Jaisalmer, Bund and some parts of Udaipur in Rajasthan can have this filtration technique possible to a greater extent.

2.3 JOHADS

Johad is a rainwater storage tank with less depth principally used for the purpose of drinking by humans and cattle in the state of Rajasthan. These are water soaking pits which collects and stores water throughout the year. It's one of the oldest systems used to conserve ground water needs in rural India. These are called Madakas in Karnataka, Pemghara in Odisha and Johads in Rajasthan.

It is generally constructed on a high elevation area with natural shape boundary, approximately three- fourth sides are at a little higher slope. Soil is excavated to create a storage pit while the soil is used to create a wall on fourth side to hold water. Particularly, Johads collect monsoon water which slowly seeps into recharging groundwater and maintaining soil moisture.

SOURCE: GOOGLE IMAGES

FIGURE- 3 JOHAD FROM SEMI- ARID REGION IN INDIA

"What needs to be done today is revival of old Johads, many of which have fallen into disrepair due to growth of weed plants and dumping of waste."
By Shikha Shah, Ecoideaz- online repository of all eco-friendly innovations created in India.

On a general note many Johads are interconnected with a gulley or deep channel with a single outlet in a river or stream nearby to prevent structural damage to the wall created by excavated soil. This cost-efficient and simple structure requires annual maintenance and cleaning of the storage pit from weed growth. These Johads are still been widely used by farmers to irrigate fields in many parts of India. In fact, the arid state of Rajasthan has seen a drastic improvement in water conservation due to the efforts of many skilled people. Rajendra Singh of Tarun Bharat Sangh is one of them who is reviving Johads.

2.4 BAWDI

SOURCE: SHOT ON SITE

FIGURE- 4 CHAND BAORI, STEPWELL IN ABHANERI

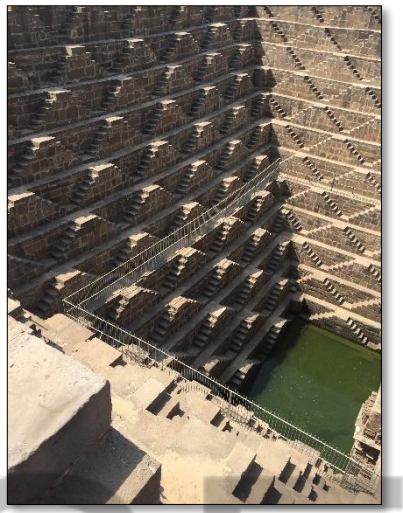
Step-wells are wells or ponds in which water is reached by descending a set of steps making convenient for going down and fetching water depending upon the water level. These are grand structures of high archaeological significance constructed since ancient time mainly honoring kings and queens. Typically, square shape step wells are constructed having beautiful arches, motifs, steps

and sometimes colonnades on either sides, four sides or depending upon requirements. Apart from storing water for basic needs, they served as a jolly festive place for the nearby village. Basically, these wells are located away or water found is always farther from the residential areas, hence members of the family fetch water from these bawdis. The water of quality in these Bawdis is considered to be good for consumption as many natural additives or purifiers are added to clean water. These are built with large investment of material and numerous skilled laborers but the sad part is that these magnificent structures today stand discarded by society. Now, many of these structures have been conserved by Government and NGO(s) as they are becoming a mere dumping sites. Renovation of few of them in Rajasthan has restored their huge water storing capacity and with the use of electric pumps to draw water, it has proved useful during dry periods. Gujarat, Rajasthan and Karnataka have the maximum number of these structures, which attract tourists from all over the world.

3.0 STEPWELLS IN RAJASTHAN AND GUJARAT[5]

Stepwells are well or man-made inventions in which water is preserved, conserved and collected. Bawdis are most common in western India and some parts of the southern zone i.e. Karnataka, Gujarat, Delhi, Madhya Pradesh and Maharashtra. Some of the magnificent bawdis are listed below:

3.1 CHAND BAORI



SOURCE: SHOT ON SITE

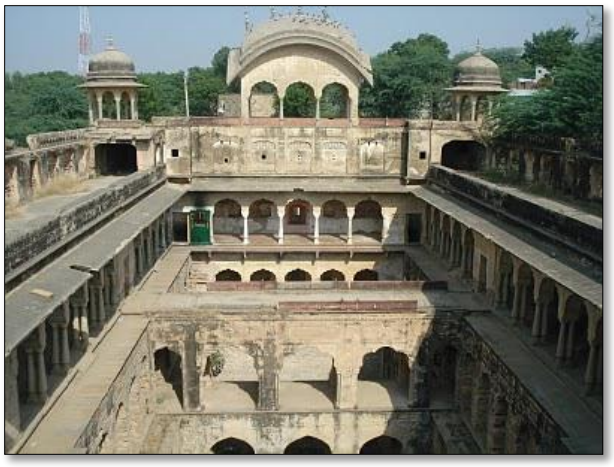
FIGURE- 5 CHAND BAORI

Location: Abhaneri (near Jaipur)
Year: 800- 900 AD
It has been termed as the largest stepwell of the India named Chand Baori buit by Raja Chand. It is situated 95 km away from Jaipur on Jaipur Agra road on the opposite side the temple of Harshat mata (goddess of joy and happiness). Both the structures are fine example of fine architectural expertise which couldn't be ignored. Chand baori has thirteen stories with 3500 steps arranged symmetrically. It is the deepest one in world having a marvelous example of glorious past.

3.2 BHANDAREJ BAWDI

Location: Dausa
Year: 1732 AD
It was constructed by Daulat Singh and Thakur Deep Singh. The intricate details on soffits and column can easily defines the work as a grand fusion of Mughals and Rajput.
The rulers of that time decided to make tunnel beneath the bawdi as a secret path during battles, therefore this five storied bawdi is attached to a tunnel to Bhadrawali palace. Although, with such ancient time till now with no maintenance. It is said that rose fragrance comes from this bawdi.

[5] (Wonder of the Indian Architecture "Bawdi") and (Bawdi: The eloquent example of hydrolic engineering and ornamental architecture)



SOURCE: GOOGLE IMAGES

FIGURE- 6 BHANDERAJ BAORI

3.3 HADI RANI KI BAWDI or TONDA RAI SINGH BAWDI

SOURCE: GOOGLE IMAGES

FIGURE- 7 HADI RANI KI BAWDI

Location: Tonk District
Year: 1200 AD
Tonda Rai Singh is a city of archaeological importance surrounded by beautiful natural hills. This is a three storied Bawdi with an ornamented dome on each storey.

3.4 SHEKHAWATI KI BAWDI

Location: Sikar, Rajasthan
Fatehpur is a famous city in Sikar district where Shekhawati Bawdi is famous for its ornamented and natural beauty. The bawdi have a rectangular plan in centre with a dome upright it. The architecture details in it reminds an ancient stage play. This became a favorite place for many film makers as many shootings of films have done here.

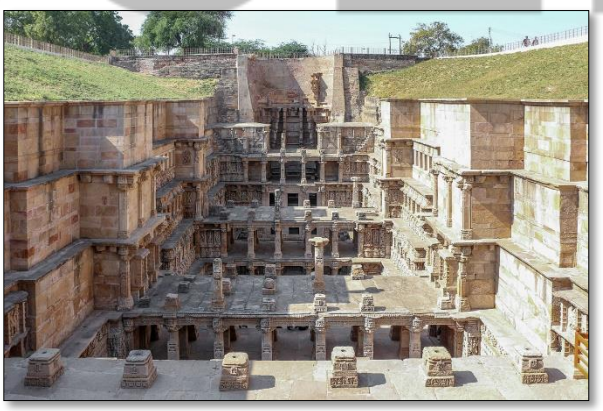
3.5 NIMRANA BAWDI

SOURCE: GOOGLE IMAGES

FIGURE- 8 NIMRANA BAWDI

Location: Neemrana
Year: 15TH Century AD
This is an eleven storied bawdi with nine stories above the water body and two storeies under the water. There are 170 flight of stairs to reach the water surface. Entering the baori feels that people are going in a submerged cave. At the end of flights there is a verandah for taking rest. Its inner temperature is very cool. Besides the above Bawdis in Rajasthan there are Rani ki Bawdi, Nahar Garh fort Bawdi, Jinnat ki Bawdi, Dhoulpur also, It have great place in Rajasthan‘s region.

3.6 RANI KI VAAV



SOURCE: GOOGLE IMAGES

FIGURE- 9 RANI NI VAAVI

Location: Patan, Ahmedabad
Year: 11TH Century AD
It has been declared World Heritage by UNESCO. The Vav is an embellished architecture of 11th Century having elegant multistoried pavilions which is situated on the bank of river Saraswati. The architectural style elaborates the complex technique and the design form with more than five hundred sculptures which shows the heights of craftsmanship. The sculptures are Mahishasur mardani, dashavatar, apsaras, are some of them.

3.7 ADALAJ NI VAAV

Location: Patan, Ahmedabad

Year: 1499 AD

The Ahmedabad of Gujarat has a famous five storied stepwell known as Adlaj is also famous for its magnificent structure. It is the fusion of Islamic and Hindu architecture and design built by Rani Rudabai wife of Rajput noble Vikram Shah Vaghela in 1499 A.D. Idols of Hindu gods and goddess, columns and balconies decorated with flora and fauna motifs.

SOURCE: SHOT ON SITE

FIGURE- 10 ADALAJ NI VAAV

4.0 CONSERVATION INITIATIVES

Globally, *768 million people lack access*[6] to an improved water source, and more than 80 % of these people live in rural areas (WHO and UNICEF 2013). Water access to poor is associated with many water-related illnesses, food insecurity, lost productivity, and poor school attendance, especially for women and girls. Daily access to clean water is necessary to satisfy basic needs of drinking, cooking, washing, and bathing—i.e., domestic uses of water. In rural areas, water is also critically available for livelihood activities such as horticulture and crop irrigation, livestock raising, brick-making and small-scale commercial activities. These activities increase a household's income and food security. In peri-urban areas as well, water is necessary for a range of livelihoods.[7] While in India, water is abundantly available but not useful for safe drinking like in rivers and three oceans.

4.1 GOVERNMENT SCHEMES

Rajasthan attempts to resolve water scarcity through campaigns.[8]

PTI | JUN 27, 2016, 02.54 PM IST

Jaipur the desert state of Rajasthan has been struggling with water scarcity for a longtime and now state government looks forward to address water crisis with campaigns focusing on rainwater conservation and promoting groundwater recharge by reviving old water structures.

The Mukhya Mantri Jal Swavlamban Abhiyan[9] launched in January this year emphasizes on solutions for rising water scarcity by reviving old water structures with public participation and providing water management techniques in the rural regions of the driest state of the country. A total of 21,000 villages of the state are targeted to be benefited in a period of three years and over 3,000 villages have been identified on the basis of priority from low water requirement to higher requirements of water needs in this respective year. This scheme is well spread over 342 lakh hectares of land, out of which 60 per cent constitutes of the Thar Desert (Rajasthan) which faces acute water shortage as it suffers from the lowest amount of annual precipitation in the country.

"The Abhiyan ensures effective implementation of water harvesting and conservation related activities in the rural regions of the state," Sriram Vedire, Chairman of the Rajasthan River Basin and Water Resources Planning Authority told.[10]

The first phase of the campaign is completed on June 30, 2016 while the result will be noticeable after monsoon and future. The satellite images and maps of the area has been prepared with a scientific approach towards increasing water conservation in rural India. Five departments of the state government were worked in synergy of the water campaign. Moreover, maps are drafted in Hindi to enable laymen to understand the planning in there nearby areas. The campaign's main target is to make the Rajasthan state free from drought and its impact will be visible in next three years. Under the campaign, villages are being made self-reliant in water supply. The campaign is run by public

6 (Ralph P. Hall, The human rights to water: The importance of domestic and productive water rights)

7 (Kurian and McCarney 2010)

8 https://timesofindia.indiatimes.com/city/jaipur/Rajasthan-attempts-to-resolve-water-scarcity-through-campaigns/articleshow/52937557.cms

9 Mukhya Mantri Jal Swalamban Abhiyan

10 Mukhya Mantri Jal Swalamban Abhiyan

participation (labours, local people and all the working force involved) and 3499 people have so far provided Rs 33,75,87,950 for it.

Some of the efforts include harvesting available run off in rural area by treatment of catchment, utilization of available water and irrigation of lands through harvested water.

Water harvesting and conservation works will be implemented from the funds available under State departments, Non- Government Organizations, Corporate Social Responsibility (CSR), Non Residents Villagers Club (NRV Club) and other such organizations.

4.2 SOCIAL INITIATIVES

How a Village in Rajasthan Went from Dry to Water Sufficient in Just One Year.[11]

BY SHREYA PAREEK6 MONTHS AGO

A small part of society is always neglected same as a village in Rajasthan, the people there were suffering from an acute water crisis over years. The ground water table had depleted, youngsters were migrating and harvest yields were very low. Hence, time for the Sehgal Foundation to intervene in between. The place is Khohar village near Alwar which was not a typical Rajasthani village full of gaily dressed people, humming with activity and welcoming tourists. Life is hard there. No one could be seen in the village, many houses were locked and not much activity was visible even during pleasant weather. The reason behind this desolate conditions there was mass migration. Most of the men had moved to the cities in search of better livelihood options and the few who were left were not motivated enough to try anything new to earn a living.

A middle aged woman Ramdulari had seen her husband migrating to Gujarat to find employment several years ago and now her son left too. The culprit in all these situations was the acute water scarcity in the area as agricultural practices are not possible. People have to search for outside options for filling their stomachs. The region received very little rainfall and about 78% of the water available was saline. The villagers main problem is not irrigation for agriculture practices but maintaining day-to- day water needs are difficult as the water level in the village had been depleted alarmingly over the years. Villagers with tube wells fitted in their fields managed to cultivate their land twice a year, while those who did not have tube wells had to depend on the rains or purchase their water from tube well owners.

For this hopeless situation the Sehgal Foundation first encountered and then decided to go there in 2014. Sehgal Foundation was started by Dr. Surendra Mohan Sehgal in 1999, its mission is to empower the rural India. Its intervention changed the face of the village in a matter of two years. The organization achieved this overwhelming result by constructing a check dam to solve the acute water crisis. The dam construction work started in March 2014 where The Foundation identified a water source near the Aravalli Hills, which went into a drain during the rainy season. The SF team decided to build a check dam here to improve the water table in the area. Check dams are small but useful structures across channels that help reduce the velocity of water same as Johads in ancient India.

[11] https://www.thebetterindia.com/39112/khohar-sehgal-foundation-rajasthan-village-check-dam-water-crisis-drought/

These are mostly constructed using stone or brick masonry which is sandwiched between different layers of soil.

"Since water flows at a very high speed, it does not percolate into the ground. These dams reduce the velocity of water and hence water stays at one location for a longer period, which gives it a chance to percolate into the ground. This leads to an improved ground water table," explains Salahuddin Saiphy, Program Leader, SF.

In dry areas like Khohar, check dams like structures helps increasing groundwater recharge areas. Water was stored in aquifers and catchment areas, from which it can be drawn during the dry season for irrigation, livestock watering, and even drinking water supply. The construction of these check dams requires little machinery, funding and large scale work, hence this technique is perfectly suitable for a location like Khohar where the whole community can be engaged in the construction of the dam as a work force.

Whenever social projects and initiatives are done the first task is to mobilize the community and make the villagers aware of the benefits of check dams.

"Though they had contacted us themselves, many of the households were reluctant to contribute. Also, since regular supply of water was required for construction work, many villagers were not ready to share the water," says Salahuddin.[12]

Sehgal Foundation sensitized and trained a group of people amongst the villagers for construction and maintenance of the dam, named them as water management committee. After 126 days of hard work, the team become ready with a check dam which was 185 metres long and 5 metres high. The Foundation also constructed a catchment area, which was 255 acres big and have a capacity to store 32 crore litres of water annually. The entire cost of construction was about Rs. 56 lakh which was taken care of by the Sehgal Foundation. The community also contributed a total of Rs. 1 lakh which was earmarked for repair and maintenance purposes in the coming future.

"We also constructed small water sheds near the original check dam to reduce the force of water on the check dam," says Salahuddin.

The team had expected to see the benefits of their work in the coming two to three years but were surprised to see positive results during the first monsoon itself. The intervention by SF did not just benefit the 150 households in Khohar but also people from nearby villages approximately 10,000 in number. The water yield increased by 30% and migration too reduced to a great extent. Despite scanty rainfall in year 2016, the check dam has already helped increasing 60% soil moisture and raised ground water levels. As a result the water availability increased amazingly, agricultural activities have also received a boost in the village. Moreover, the villagers have started showing interest in organic

[12] Sehgal Foundation Report

farming and are trying their hands at composting too. This all become possible by addressing their water crisis.

Khohar is just one success story of the Sehgal Foundation. The organization has constructed over 26 major check dams so far and even small dams at various locations, benefitting over 2.5 lakh people in Rajasthan.

5.0 NEED FOR URBAN WATER – THE WATER CRISIS

Urban demands and their fulfillment defines any city or town and its journey through the best and good times. Urbanization has been associated with increases in impervious surfaces, concrete forests and less fertile soil which in turn results in increased runoff of fresh rainwater and decreased quality management of various resources. Let's take the example of future smart urban city of the world i.e. Shanghai, China. A 50-year case study demonstrated there tells an extensive relationship between water quality and urbanization of that particular area and around industrial complexes. Due to increased impervious surfaces there, transport of storm water runoff-associated with contaminants into surface waters has been caused with increased quantity. These contaminants include heavy metals, oils, and rubber residues, among others. In addition, improperly treated human wastes from urban and sub-urban areas cause significant water quality problems. Moreover, in recent decades increased migrants from rural residents to urban areas largely attributable to the pursuit of employment, has caused significant sanitation and water quality problems in the society.
On urban level, the flow chart works as follows:

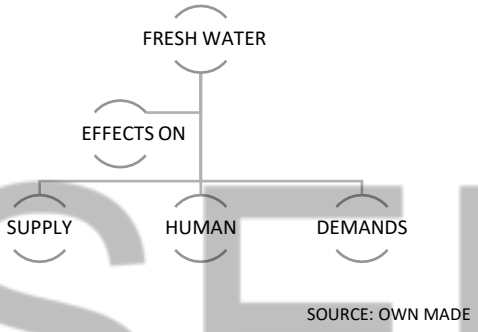


FIGURE- 11 FLOW- CHART DESCRIBING URBAN WATER NEEDS

Moreover, sustainable development more focuses on issues rather than the need of people. Its very much important to study the difference between two terms:

Absolute Water Scarcity- When water is absolutely scarce, it limits the survival and development of an individual, population and society.(its rare)[13]

Relative Water Scarcity- When water is relatively scarce its limiting character can be overcome with technical, economical measures at higher costs.(in most situation).[14]

Discussing about surface water and water run- off from heavy rain shed areas water depletion and sanitation plays an important role making society and their needs quite effective.

Degradation in water quality in industrial processes in and around the city have great and negative effects on the quality of surface waters. Seeking example of urban city Jaipur, Amanishah Nala has become unsightly and foul smelling due to the discharge of industrial wastewater to its storm water drainage network.[15]The site and its conditions helps in decreasing water quality causes and increasing health risks and health care. Hence, these conditions allowed an increased risk of pollution of shallow aquifers in that area. Investing money and resources would not even help if time exceeds thereafter as these urban areas and water problems would continue to devastate the society if we take steps at the eleventh hour.

[13] W. SCHILLING AND A. MANTOGLOU, SUSTAINABLE WATER MANAGEMENT IN AN URBAN CONTEXT

[14] W. SCHILLING AND A. MANTOGLOU, SUSTAINABLE WATER MANAGEMENT IN AN URBAN CONTEXT

[15] (Kathleen Roberts, 2013)

Emphasis on traditional water channels and systems it could be easily concluded that these traditional system were kept small enough to be easily served the society. Moreover, these were not managed and controlled by urban technical systems, labor or any other specimen. Hence, traditional water systems are failure to the society and by the society.

At micro level, locals and the community took care of catchment areas near wells and other johads supporting all the economic independence and optimization of local resources. Sometimes some social prohibitions often curbed grazing in certain seasons like using catchment areas for toilet purposes and dumping of animal carcasses. But these social issues cannot be healed easily, hence religion and water is sacred both are related terms. Moreover local feels that traditional systems could not meet the water demands due to the growth in population. Hence, the government has developed a bias for large costly systems with low capital efficiency, fostering a greater dependence on the state for all matters such as maintenance of existing systems. This has decreased community participation in maintenance and care of their water system leading to extinction of stepwells. For example - The forts built in and around Jaipur original layout exhibits traditional water harvesting techniques. *Jaigarh Fort* has many wide water channels and three big water tanks with the largest tank having the capacity of storing 6,000,000 gallons of water per year.

6.0 CASE STUDIES

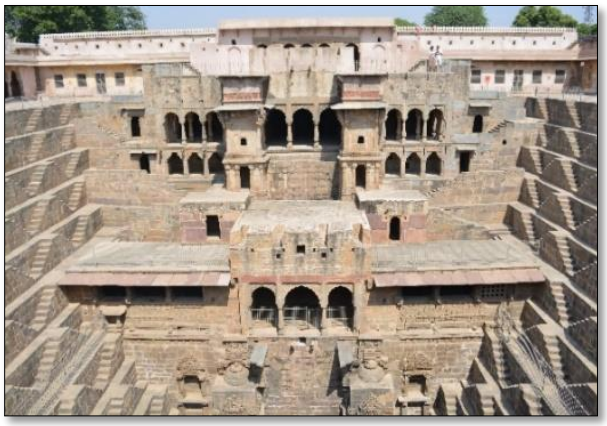
6.1 CHAND BAORI

As referred in section 3.1, Chand Baori is the famous and most attractive stepwell in the world. The stepwell is located in the village of Abhaneri Jaipur, Rajasthan. It is the one of the oldest and deepest step wells in the world. It was built by King Chanda (Chandra) of the Nikumbha Dynasty between 800 and 900 AD. It is situated opposite to the temple of Harshat Mata, the goddess of joy and happiness.

SOURCE: SHOT ON SITE

FIGURE- 12 HARSAT MATA TEMPLE IN ABHANERI

The stepwell have an immense beauty with 3500 narrow steps which could lead to 13 stories of any modern building. As one can assumes its construction techniques of that time, it's not tough to conclude that Chand Baori is a fine example of architectural excellence prevalent in the past. It was a sustainable solution of water crisis of this area but over a period of time the water get contaminated and almost no possible solutions were done.



SOURCE: SHOT ON SITE

FIGURE- 13 ENTRANCE OF CHAND BAORI

In the site, the entrance is placed in North direction and a doubled- flight of staircases on the remaining three sides. The northern side consists of a multi- storeyed corridor supported on pillars

with two projecting balconies where images of Mahisasurmardini and Ganesha has been carved out. Three closure, boundary wall, side verandah and pavilion are the additions done.[16]

Moreover, this location served as filmography part with its elegant beauty in The Fall and The Dark Knight Rise- Batman.

Construction - 28 m X 30 m X 19.5 m with a square plan.
Material - All locally available stone i.e. raw sand stone.
Conclusions - It's a magnificent baori with inside depth up to 7 meters planned on a rectangular form. It's a rainwater harvesting stepwell made only fulfilling water demands of the people nearby. Starting from its history the baori have many phases to discuss as follows:

1) Earlier, it was only made for fulfilling the water demands of village people and on later years the baori is elaborated to colonnade corridors.[17]
2) Harsat Mata temple is built in for making the surroundings more spiritually connected with people as these water feeding places have very sentimental value in people's heart.
3) The evergreen stone structure is now conserved and Archaeological Survey of India took care of it. Moreover, collection of water in the pit is already going on in every rain (can easily be seen in pictures) hence preserving it and many other stepwells is not a loss to the society.

SOURCE: SHOT ON SITE

FIGURE- 14 WATER COLLECTION PIT OF CHAND BAORI

[16] Archaeological Survey of India
[17] Archaeological Survey of India

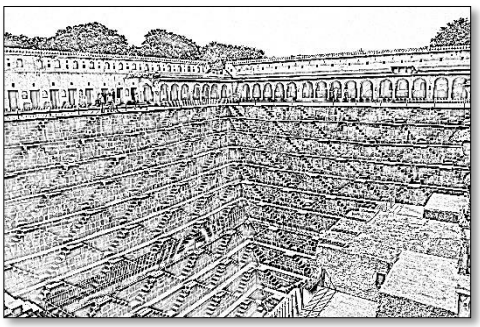


FIGURE- 15 ISOMETRIC VIEW OF BAORI

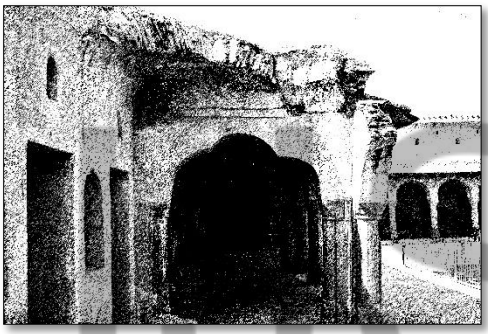


FIGURE- 16 COLONNADE AREA OF BAORI

FIGURE- 17 PLAN OF INTERIOR OF CHAND BAORI

6.2 ADALAJ NI VAAV

The Adalaj Ni Vaav is located in the village Adalaj in the district of Gandhinagar, Ahmedabad which is one of the renowned stepwells of the country for its ornamental and intricate details. But this Adalaj vav is one of the few wells with a richly documented history featuring the tragic love story of its

creation. The carvings on walls inside the structure depicts its story in Sanskrit and Pali language. According to the story in 1499 A.D. the area was known as *Dandai Desh* was brutally sacked and the ruler was killed, leaving behind a beautiful young queen. The conquering king was a neighboring Muslim ruler named Mohammed Begda who fell in love with the queen. She demanded the ruler to complete the construction of the stepwell in memory of her husband which he had started if he wanted her hand in marriage. He agreed and set to work building the most beautiful well again which is five stories deep, adding intricate carvings of leaves, flowers, fish, and animals in a blend of Islamic architecture and Hindu symbolism (Indo-sarcenic architecture).

SOURCE: SHOT ON SITE

FIGURE- 18 WATER COLLECTION PIT OF ADALAJ NI VAAV

When the well was completed Begda presented his work to the queen and asked her to honor him with her kind words. But the crowning dome was incomplete and remained incomplete. She inspected the work, walked around the well, said a prayer and threw herself into the depths of well. Although, six other mason's grave who worked on the construction can be seen nearby.

Legends holds that when the stone carvers were asked by the proud ruler whether they might be able to build another well so beautiful, their answer of "yes" sealed their fate.[18]

In the site, entrance is placed from south to north direction with three flight of staircases descended to a spacious landing with octagonal opening supported by eight pilasters. At each inclined end of octagon small rooms are placed with oriel window which are four in number. The octagonal shaft is five-storey high having a levels play in the planning. The entry to upper four storeys are from spiral staircases placed in western and eastern sides of the well. One can see the elaborated pillars, pilasters, entablatures, lintels and all other form of architectural elements of study.

[18] 45 CHITROLEKHA INTERNATIONAL MAGAZINE ON ART AND DESIGN, VOL. 5, NO. 2, 2015

SOURCE: SHOT ON SITE

FIGURE- 19 ENTABLATURE AT ADALAJ NI VAAV

Moreover, many erotic scenes, bearers in attendance, churning of buttermilk, female dancers, birds-animals like Gaja- Sardula, mother Goddess, half- medallions, scroll motifs evolving out of Kirttimukha can be seen carved on the walls and everywhere possible. Among sculptures present inside the monument, one depicting the King seated on a stool with parasol and two chauri- bearers in attendance is a remarkable carving.

SOURCE: SHOT ON SITE

FIGURE- 20 FIFTH FLOOR AT ADALAJ NI VAAV

Construction - 5 m x 4.5 m x 6 m with a square plan (approximately measured by proportions).
Material - All locally available stone i.e. raw sand stone and some marble patti for motiffs.
Conclusions - It's a small sized baori with massive ornamental structure interfaces planned on a rectangular form. Again starting from its history the baori have many phases to discuss as follows:
1) In the beginning the construction of stepwell was started by a Hindu King as depicted in the story but later years added Muslim architectural elements in the construction. Hence, it's a combination of Indo-sarcenic architecture.
2) This well serves as a community gathering place for various festivals with fulfilling local water demands.
3) Water is still collecting in the pit, very transparent in nature. Archaeological Survey of India took care of the well and has been declared it as a historical conserved monument.

7.0 INTERPRETATIONS AND ANALYSIS

Water is an indispensable object for human life and the fetcher, fetching units have huge respect in the mindset of user or the people involved from its starting construction to the end of inauguration. Many story relates water to its society joining religious value too. It can be easily concluded that water is God and stepwell is a Temple with a huge amount of people worshipping there. Again in scientific world worship not fulfill the water demands or annual rainfall is not associated with rituals. But it's all human mind and fear of losing anything which make them prey to the superstitious world. Hence, calculation for water can be done by *Manning Formula or Gauckler- Manning Formula*[19]. It is first presented by French engineer Philippe Gauckler in year 1867 and later on developed further. From it water requirement needs per person per day can easily be calculated. Manning equation is frequently used for estimating average velocity of a liquid present in a volume or for calculating flow variables on surface i.e. for open conduits channels as well as closed conduits channels. Formula states as follows:

Rational Method Equation, $Q = C \times I \times A$

where

Q = peak discharge

C = rational method runoff coefficient

I = rainfall intensity

A = drainage area or area of collecting pit,

Jaipur is considered as the heavy- shed rainfall zone in whole Rajasthan having 600mm annual rainfall (according to last three years survey). Hence considering an example-

Let C = coefficient of run- off of water as in Rajasthan is consider to be .9 as most of the water get wasted during heavy rains,

I = intensity of rainfall i.e. total amount of annual rain in that area = 600 mm = 600/ 1000 m.

A = area of collection pit as 10 m x 10 m x 1m = 100 m^3

Now putting all the above values,

= C x I x A

= (.9 x 600 x 100)/1000

= .9 x 60

= 54 m^4

And

1 m^3 = 1000 litres

1 m^2 = 100 litres

Hence, Water that can be conserved = 540000 litres/ year

Water consumption of per person per day in India is 135 litres. Therefore, if a family have 4 members consuming 135 litres per day per person. Then,

4 x 135 litres = 540 litres per day[20]

So, amount of water can be used for these number of days = 540000/ 540 = 1000 days From above equations it can be easily concluded that if a family of four members conserve three months rainfall yearly than they can save water for almost 3 years.

[19] Wikipedia

[20] Water utilization per person per day in India

Considering the formula for finding water conservation of stepwells one by one as follows:

7.1 CHAND BAORI

C= coefficient of run- off water i.e. for solid stones and concrete it is 0.75- 0.9
I = intensity of rainfall i.e. 100 mm- 313 mm = 200/ 1000 m^{21}
A= area of collection pit i.e. 28 m x 30 m x 7 m = 5880 m^3

Now putting all the above values,

= C x I x A
= (0.9 x 200 x 5880)/1000
= 588 x 1.8
= 1058.4 m^4

And 1 m^3 = 1000 litres
1 m^2 = 100 litres

Hence, Water conserved per year = 10584000 litres

Water utilized by per person per day = 135 litres …(reference from 20)
Water utilized by per person per year = 135 x 365 days
= 49275 litres are required.

Therefore, total water in the pit/ per person per year required = 10584000/ 49275
= 215 people.

The great CHAND BAORI with its existing volume can fulfill water requirements of 215 people yearly by just saving only three months rainfall. Although I'm considering evaporation losses maximum despite negligible losses are possible.

7.2 ADALAJ NI VAAV

C= coefficient of run- off water i.e. for solid stones and concrete it is 0.75- 0.9
I = intensity of rainfall i.e. 500 mm- 1107 mm = 600/ 1000 m^{22}
A= area of collection pit i.e. 5 m x 4.5 m x 6 m = 135 m^3

Now putting all the above values,

= C x I x A
= (0.9 x 600 x 135/1000
= 135 x 0.54
= 72.9 m^4

And 1 m^3 = 1000 litres
1 m^2 = 100 litres

Hence, Water conserved per year = 72900 litres

Water utilized by per person per day = 135 litres …(reference from 20)
Water utilized by per person per half year = 135 x 180
= 24300 litres are required.

[21] RAINWATERHARVESTING.ORG

[22] RAINWATERHARVESTING.ORG

As for case of Gujarat rainfall is shed twice in a year.

Therefore, total water in the pit/ per person per half year required = 72900/ 24300

= 3 people.

This small size baori i.e. same as a small size room can fulfill 3 people daily utilization of water for half a year basis on precipitation per half- year.

8.0 CONCLUSIONS

Bawdi have immense value whether in religious way or traditional water heritages in the heart of people. *Bhumi Pujan and Jal Puja* are the precious terms used in every single household of Rajasthan. *Athithi Devo Bhava* like quotes a can easily defines the culture of India and the people respecting their own heritages. Similarly, stepwells are the ones which depicts the traditional structures present in India from the classical ages of Harrapan- Mohenjodaro Civilisations. Great bath is one of the fine example of a water collection pit of that time. Time and technology made detailed out structures in the field of traditional water resources. With increasing water demands these temporary water- shed structures become more complex. A greatly influenced evolution can be observed. With time of Ramayana and Mahabharta till now… 5th century to 15th century only wells are built. Hence, we have a great collection of wells at least in India.[23]

Coming back to the two case studies many things become clear about stepwells, these are as follows:

1) After independence stepwells became a burden to the society as unison living culture is started to be lost from then only. Moreover, these are not in a pathetic conditions for a year or two but decades is responsible for its ignorance. Although government is giving stepwell a new name because of tourism attraction and its main purpose is lost.

2) Water, society and demands these are inter- related terms which have a great impact in every part of society whether rich or poor. But social cause and change is always affect the poor. Hence, working on this part of well- being can up bring society and architecture.

3) Considering the two case studies following points can be concluded as follows:

CHARACTERISTICS	**CHAND BAORI, RAJASTHAN**	**ADALAJ NI VAAV, GUJARAT**
CLIMATE	HOT AND SEMI- ARID REGION WITH CAPRICIOUS RAINFALL	HOT AND SEMI- ARID REGION WITH CAPRICIOUS RAINFALL
SOIL	TYPICALLY SANDY AND SALINE SOIL TYPE	PREDOMINANTLY SANDY CLASS OF SOIL
AVERAGE RAINFALL (mm)	313- 675	578- 1107
STEPWELL		
PLAN	SQUARE PLAN	SQUARE PLAN
LAYOUT	ONE ENTRACE	3 ENTRANCES
SIZE	LARGE SIZE WITH VOLUME 58880 m^3	SMALL SIZE STEPWELL WITH VOLUME 135 m^3
DEPTH	7 METERS	6 METERS
MATERIAL USED	LOCALLY AVAILABLE STONE i.e. **SAND STONE** IN RAW FORM.	LOCALLY AVAILABLE STONE i.e. **SAND STONE** IN RAW FORM.
OPEN/ CLOSED	OPEN STEPWELL WITH MORE CHANCES OF EVAPORATION LOSSES.	CLOSED WELL COVERED WITH FIVE STOREY STRUCTURE, CHANCES OF EVAPOARTION LOSS IS NEGLIGIBLE.
WATER SOURCE	RAINWATER	RAINWATER
RELIGIOUS ATTRIBUTE	BUILT FOR THE PEOPLE NECESSITY BY THE KING, ON LATER PERIOD IT IS ATTACHED WITH HARSAT MATA TEMPLE.	BUILT BY RULER FOR FULFILLING DRINKING WATER NEEDS OF THE VILLAGE, NOW A TEMPLE OF AMBA JI IS ASSOCIATED WITH IT.

[23] Aaj bhi kahrein hain talab, Anupam Mishra

ARCHITECTURAL ORNAMENTATION	ALTHOUGH WORLD'S DEEPEST AND THE LARGEST STEPWELL TILL NOW BUT HAVE A SIMPLE PLAN WITH ARRANGEMENT OF BIG STONES IN A SYMMETRICAL WAY i.e. RUBBLE MASONARY.	BUILT UNDER TWO DIFFERENT RULERS, HENCE TWO TYPE OF ARCHITECTURE DESIGN CAN BE OBSERVED. RAJPUT AND MUSLIM ARCHITECTURE DESIGNS.
CONSERVATION	ARCHAEOLOGICAL SURVEY Of INDIA, JAIPUR UNIT	ARCHAEOLOGICAL SURVEY Of INDIA, AHMEDABAD UNIT

TABLE- 1 DIFFERENCES AND SIMILARITIES BETWEEN TWO CASE STUDIES

4) Pictorial representation of conservation of water by both the step wells:

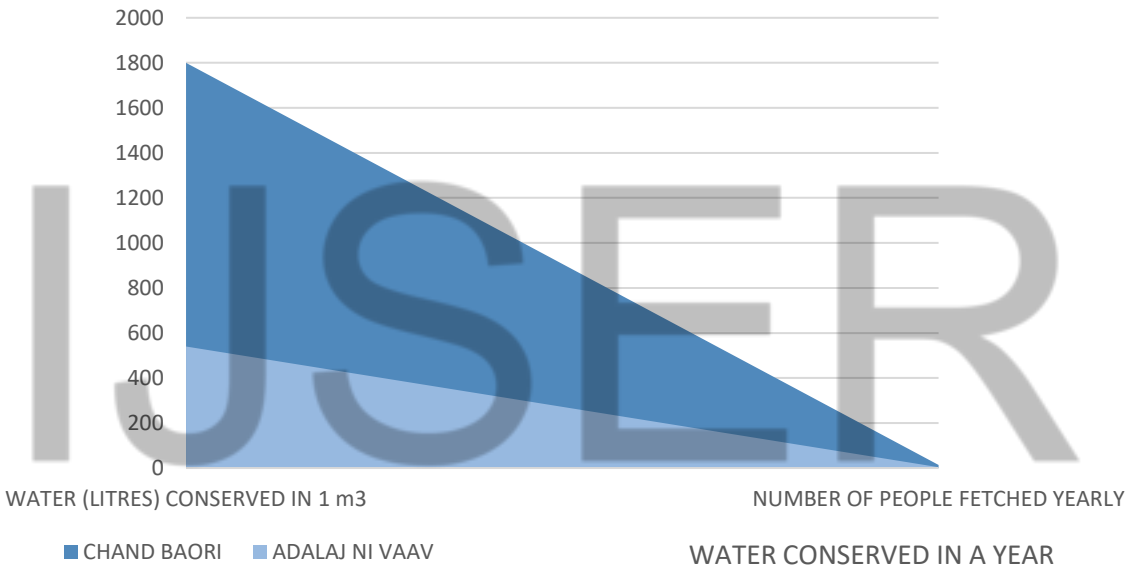


FIGURE- 21 WATER SAVED BY BOTH BAORIS

Hence, it can be easily concluded that 90 people drinking water demands can be fulfilled by three months rainfall in Chand Baori while 27 people can be fetched with small sized baori of Adalaj yearly.

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