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Rainwater Harvesting In Jhalawar, Rajasthan

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ABSTRACT: In Jhalawar, Rajasthan, Rainwater harvesting (RWH) is the collection and storage of rain, rather than allowing it to run off. Rainwater is collected from a roof-like surface and redirected to a tank, cistern, deep pit (well, shaft, or borehole), aquifer, or a reservoir with percolation, so that it seeps down and restores the ground water. Dew and fog can also be collected with nets or other tools. Rainwater harvesting differs from stormwater harvesting as the runoff is typically collected from roofs and other surfaces for storage and subsequent reuse.[2]:10 Its uses include watering gardens, livestock,[3] irrigation, domestic use with proper treatment, and domestic heating. The harvested water can also be committed to longer-term storage or groundwater recharge.[4]

Rainwater harvesting is one of the simplest and oldest methods of self-supply of water for households, having been used in South Asia and other countries for many thousands of years.[5] Installations can be designed for different scales including households, neighbourhoods and communities and can also be designed to serve institutions such as schools, hospitals and other public facilities.[6]

KEYWORDS: RWH, aquifer, irrigation, groundwater, recharge, supply of water, reuse, run off, livestock

I. INTRODUCTION

Domestic use

Rooftop rainwater harvesting is used to provide drinking water, domestic water, water for livestock, water for small irrigation, and a way to replenish groundwater levels.

Paar system: Paar is a common water harvesting practice in the western Rajasthan region. It is a common place where the rainwater flows from the agar (catchment) and in the process percolates into the sandy soil. In order to access the rajani pani (percolated water) kuis or beris are dug in the agor (storage area). Kuis or beris are normally 5 metres (m) to 12 m deep. The structure was constructed through traditional masonary technology. Normally six to ten of them are constructed in a paar. However depending on the size of the paar the numbers of kuis or beris are decided. Bhatti mentions that there are paars in Jaisalmer district where there are more than 20 kuis are in operation. This is the most predominant form of rainwater harvesting in the region. Rainwater harvested through PAAR technique is known as Patali paani.

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In Jhalawar of Rajasthan

Talab / Bandhis
Talabs are reservoirs. They may be natural, such as the ponds (pokhariyan) at Tikamgarh in the Bundelkhand region. They can be human-made, such the lakes in Udaipur. A reservoir area of less than five bighas is called a talai; a medium sized lake is called a bandhi or talab; bigger lakes are called sagar or samand.
The pokhariyan serve irrigation and drinking purposes. When the water in these reserviors dries up just a few days after the monsoon, the pond beds are cultivated with rice.

Saza Kuva

An open well with multiple owners (saza = partner), saza kuva is the most important source of irrigation in the Aravalli hills in Mewar, eastern Rajasthan. The soil dug out to make the well pit is used to construct a huge circular foundation or an elevated platform sloping away from the well. The first is built to accomodate the rehat, a traditional water lifting device; the sloping platform is for the chada, in which buffaloes are used to lift water. Saza kuva construction is generally taken up by a group of farmers with adjacent landholdings; a harva, a man with special skills in groundwater detection, helps fix the site.

Johad
Johads are small earthen check dams that capture and conserve rainwater, improving percolation and groundwater recharge. Starting 1984, the last sixteen years have seen the revival of some 3000 johads spread across more than 650 villages in Alwar district, Rajasthan. This has resulted in a general rise of the groundwater level by almost 6 metres and a 33 percent increase in the forest cover in the area. Five rivers that used to go dry immediately following the monsoon have now become perennial, such as the River Arvari, has come alive.[1,2]

Pat
Bhitada village , Jhabua district of Madhya pradesh developed the unique pat system. This system was devised according to the peculiarities of the terrain to divert water from swift-flowing hill streams into irrigation channels called pats.

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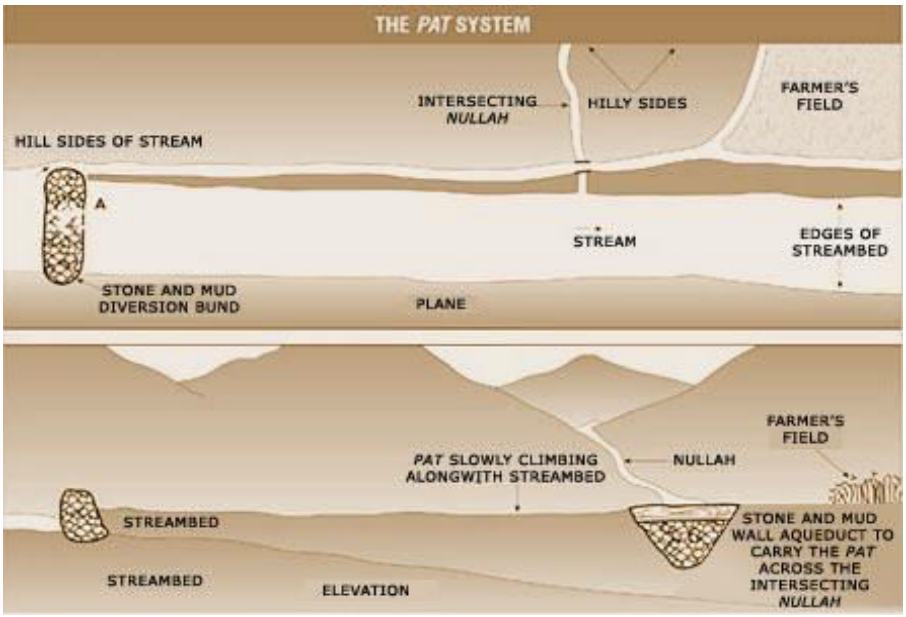

Source: Making water everybody's business

The diversion bunds across the stream are made by piling up stones and then lining them with teak leaves and mud to make them leakproof. The pat channel has to negotiate small nullahs that join the stream off and on, and also sheer cliffs before reaching the fields. These sections invariably get washed away during the monsoons. Stone aqueducts have to be built to span the intervening nullahs. [3,4]

II. DISCUSSION

In Jhalawar, Rajasthan, The villagers irrigate their fields by turns. The channel requires constant maintenance and it is the duty of the family irrigating the fields on a particular day to take care of the pat on that particular day. It takes about two weeks to get the pat flowing and the winter crop is sown in early November.

Naada / Bandha

Naada/bandha are found in the Mewar region of the Thar desert. It is a stone check dam, constructed across a stream or gully, to capture monsoon runoff on a stretch of land. Submerged in water, the land becomes fertile as silt deposits on it and the soil retains substantial amounts of water.[5,6]

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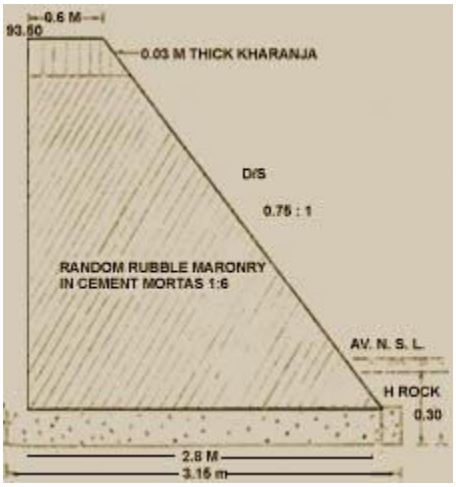

Rapat

A rapat is a percolation tank, with a bund to impound rainwater flowing through a watershed and a waste weir to dispose of the surplus flow. If the height of the structure is small, the bund may be built of masonary, otherwise earth is used. Rajasthan rapats, being small, are all masonry structures. Rapats and percolation tanks do not directly irrigate land, but recharges well within a distance of 3-5 km downstream. Silting is a serious problem with small rapats and the estimated life of a rapat varies from 5 to 20 years.

Chandela Tank

These tanks were constructed by stopping the flow of water in rivulets flowing between hills by erecting massive earthen embankments, having width of 60m or more. These hills with long stretches of quartz reefs running underneath them, acted as natural ground water barrier helping to trap water between the ridges. The earthen embankments were supported on both sides with walls of coarse stones, forming a series of stone steps. These tanks are made up of lime and mortar and this is the reason why these tanks survived even after thousand years but the only problem, which these tanks are facing, is siltation of tank beds. Chandela tanks usually had a convex curvature somewhere in the middle of the embankment; many older and smaller tanks were constructed near the human settlement or near the slopes of a cluster of hills. These tanks served to satisfy the drinking water needs of villagers and cattle.

Bundela Tank

These tanks are bigger in size as compared to Chandela tanks. These tanks had solidly constructed steps leading to water in the tank; But these structures had chabootaras, pavillions and royal orchards designed to show off the glory of the king who built them. But these tanks are not as cost effective and simple as Chandela tanks. These tanks were constructed to meet the growing water demands in the area, maintenance of these tanks was done by the person employed by the king but in case of smaller tanks villagers collectively removed silt and repair embankment.[7,8]

Kunds / Kundis

A kund or kundi looks like an upturned cup nestling in a saucer. These structures harvest rainwater for drinking, and dot the sandier tracts of the Thar Desert in western Rajasthan and some areas in Gujarat.

Essentially a circular underground well, kunds have a saucer-shaped catchment area that gently slopes towards the centre where the well is situated. A wire mesh across

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water-inlets prevents debris from falling into the well-pit. The sides of the well-pit are covered with (disinfectant) lime and ash. Most pits have a dome-shaped cover, or at least a lid, to protect the water. If need be, water can be drawn out with a bucket. The depth and diameter of kunds depend on their use (drinking, or domestic water requirements). They can be owned by only those with money to invest and land to construct it. Thus for the poor, large public kunds have to be built.

Kuis / Beris
Found in western Rajasthan, these are 10-12 m deep pits dug near tanks to collect the seepage. Kuis can also be used to harvest rainwater in areas with meagre rainfall.[25]

The mouth of the pit is usually made very narrow. This prevents the collected water from evaporating. The pit gets wider as it burrows underunder the ground, so that water can seep in into a large surface area. The openings of these entirely kuchcha (earthen) structures are generally covered with planks of wood, or put under lock and key. The water is used sparingly, as a last resource in crisis situations.
Magga Ram Suthar, of village Pithla in Jaisalmer district in Rajasthan, is an engineer skilled in making kuis/beris.[9,10]

III. RESULTS

Tankas

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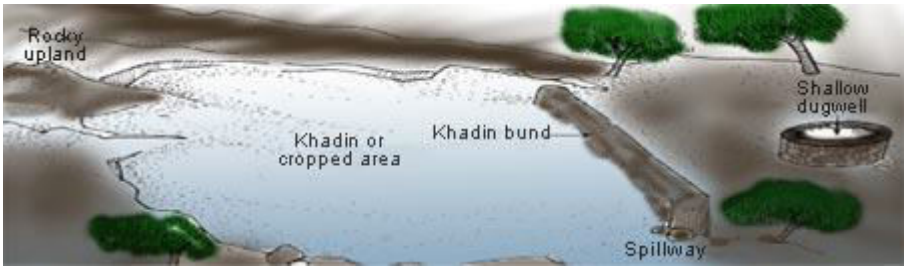
Tankas

Tankas (small tank) are underground tanks, found traditionally in most Bikaner houses. They are built in the main house or in the courtyard. They were circular holes made in the ground, lined with fine polished lime, in which raiwater was collected. Tankas were often beautifully decorated with tiles, which helped to keep the water cool. The water was used only for drinking. If in any year there was less than normal rainfall and the tankas did not get filled, water from nearby wells and tanks would be obtained to fill the household tankas. In this way, the people of Bikaner were able to meet their water requirements. The tanka system is also to be found in the pilgrim town of Dwarka where it has been in existence for centuries. It continues to be used in residential areas, temples, dharamshalas and hotels.

In Jhalawar of Rajasthan

Khadin

A khadin, also called a dhora, is an ingenious construction designed to harvest surface runoff water for agriculture. Its main feature is a very long (100-300 m) earthen embankment built across the lower hill slopes lying below gravelly uplands. Sluices and spillways allow excess water to drain off. The khadin system is based on the principle of harvesting rainwater on farmland and subsequent use of this water-saturated land for crop production.



First designed by the Paliwal Brahmins of Jaisalmer, western Rajasthan in the 15th century, this system has great similarity with the irrigation methods of the people of Ur (present Iraq) around 4500 BC and later of the Nabateans in the Middle East. A similar system is also reported to have been practised 4,000 years ago in the Negev desert, and in southwestern Colorado 500 years ago.[11,12]

Vav / vavdi / Baoli / Bavadi

Traditional stepwells are called vav or vavadi in Gujarat, or baolis or bavadis in Rajasthan and northern India. Built by the nobility usually for strategic and/or philanthropical reasons, they were secular structures from which everyone could draw water. Most of them are defunct today.

The construction of stepwells date from four periods: Pre-Solanki period (8th to 11th century CE); Solanki period (11th to 12th century CE); Vaghela period (mid-13th to end-14th century CE); and the Sultanate period (mid-13th to end-15th century CE).

Sculptures and inscriptions in stepwells demonstrate their importance to the traditional social and cultural lives of people.[23,24]

Stepwell locations often suggested the way in which they would be used. When a

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stepwell was located within or at the edge of a village, it was mainly used for utilitarian purposes and as a cool place for social gatherings. When stepwells were located outside the village, on trade routes, they were often frequented as resting places. Many important stepwells are located on the major military and trade routes from Patan in the north to the sea coast of Saurashtra. When stepwells were used exclusively for irrigation, a sluice was constructed at the rim to receive the lifted water and lead it to a trough or pond, from where it ran through a drainage system and was channelled into the fields.[13,14]

A major reason for the breakdown of this traditional system is the pressure of centralisation and agricultural intensification.

Source:Making Water Everybody's Business

Ahar Pynes

This traditional floodwater harvesting system is indigenous to south Bihar. In south Bihar, the terrain has a marked slope -- 1 m per km -- from south to north. The soil here is sandy and does not retain water. Groundwater levels are low. Rivers in this region swell only during the monsoon, but the water is swiftly carried away or percolates down into the sand. All these factors make floodwater harvesting the best option here, to which this system is admirably suited.

An ahar is a catchment basin embanked on three sides, the 'fourth' side being the natural gradient of the land itself. Ahar beds were also used to grow a rabi (winter) crop after draining out the excess water that remained after kharif (summer) cultivation.

Pynes are articifial channels constructed to utilise river water in agricultural fields. Starting out from the river, pynes meander through fields to end up in an ahar. Most pynes flow within 10 km of a river and their length is not more than 20 km.

The ahar-pyne system received a death-blow under the nineteenth-century British colonial regime. The post-independent state was hardly better. In 1949, a Flood Advisory Committee investigating continuous floods in Bihar's Gaya district came to the conclusion that "the fundamental reason for recurrence of floods was the destruction of the old irrigational system in the district."[21,22]

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IV. IMPLICATIONS

In Jhalawar of Rajasthan

Kul

Kuls are water channels found in precipitous mountain areas. These channels carry water from glaciers to villages in the Spiti valley of Himachal Pradesh. Where the terrain is muddy, the kul is lined with rocks to keep it from becoming clogged. In the Jammu region too, similar irrigation systems called kuhls are found.

Naula

Naula is a surface-water harvesting method typical to the hill areas of Uttaranchal. These are small wells or ponds in which water is collected by making a stone wall across a stream.

Khatri

Khatris are structures, about 10x12 feet in size and six feet deep carved out in the hard rock mountain. The specially trained masons construct them at a cost of Rs 10,000-20,000 each. These traditional water harvesting structures are found in Hamirpur, Kangra and Mandi districts of Himachal Pradesh.

There are two types of khatris: one for animals and washing purposes in which rain water is collected from the roof through pipes, and other used for human consumption in which rainwater is collected by seepage through rocks. Interestingly, the khatris are owned by individual as well as by a community. There are government khatris as well, which are maintained by the panchayat.[19,20]

Kuhl

Kuhls are a traditional irrigation system in Himachal Pradesh- surface channels diverting water from natural flowing streams (khuds). A typical community kuhl services six to 30 farmers, irrigating an area of about 20 ha. The system consists of a temporary headwall (constructed usually with river boulders) across a khud (ravine) for storage and diversion of the flow through a canal to the fields. By modern standards, building kuhls was simple, with boulders and labour forming the major input. The kuhl was provided with moghas (kuchcha outlets) to draw out water and irrigate nearby terraced fields. The water would flow from field to field and surplus water, if and, would drain back to the khud. The kuhls were constructed and maintained by the village community. At the beginning of the irrigation season, the kohli (the water tender) would organise the irrigators to construct the headwall, repair the kuhl and make the system operational. The kohli played the role of a local engineer. Any person refusing to participate in construction and repair activities without valid reason, would be denied water for that season. Since denial of water was a religious punishment, it

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ensured community participation and solidarity. A person was also free to participate by providing a substitute for his labour. The kohli also distributed and managed the water.[15,16]

Zabo

The zabo (the word means 'impounding run-off') system is practiced in Nagaland in north-eastern India. Also known as the ruza system, it combines water conservation with forestry, agriculture and animal care. Villages such as Kikruma, where zabos are found even today, are located on a high ridge. Though drinking water is a major problem, the area receives high rainfall. The rain falls on a patch of protected forest on the hilltop; as the water runs off along the slope, it passes through various terraces. The water is collected in pond-like structures in the middle terraces; below are cattle yards, and towards the foot of the hill are paddy fields, where the run-off ultimately meanders into.

Cheo-ozihi

The river Mezii flows along the Angami village of Kwigema in Nagaland. The riverwater is brought down by a long channel. From this channel, many branch channels are taken off, and water is often diverted to the terraces through bamboo pipes. One of the channels is named Cheo-oziihi - oziihi means water and Cheo was the person responsible for the laying of this 8-10 km-long channel with its numerous branches. This channel irrigates a large number of terraces in Kwigwema, and some terraces in the neighbouring village. There are three khels and the village water budget is divided among them.[17,18]

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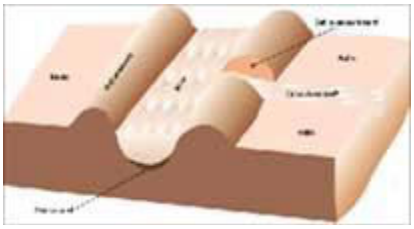
Of late, though, some villages in Bihar have taken up the initiative to re-build and re-use the system. One such village is Dihra.
It is a small village 28 km southwest of Patna city. In 1995, some village youths realised that they could impound the waters of the Pachuhuan (a seasonal stream passing through the village that falls into the nearby river Punpun) and use its bed as a reservoir to meet the village's irrigation needs. Essentially, this meant creating an ahar-pyne system
After many doubts, the village powers-that-be gave the go-ahead. Money was collected and work began in May 1995. After a month of shramdaan (voluntary labour) the villagers completed their work mid-June.
Their efforts have borne fruit. By 2000 AD, the ahar was irrigating 80 ha of land. The people grow two cereal crops and one crop of vegetables every year. The returns from the sale of what they produce are good. The village is no longer a poor one.
Bengal's Inundation Channel
Bengal once had an extraordinary system of inundation canals. Sir William Willcocks, a British irrigation expert who had also worked in Egypt and Iraq, claimed that inundation canals were in vogue in the region till about two centuries ago. Floodwater entered the fields through the inundation canals, carrying not only rich silt but also fish, which swam through these canals into the lakes and tanks to feed on the larva of mosquitoes. This helped to check malaria in this region. According to Willcocks, the ancient system of overflow irrigation had lasted for thousands of years. Unfortunately, during the Afghan-Maratha war in the 18th century and the subsequent British conquest of India, this irrigation system was neglected, and was never revived.



Source:Making Water Everybody's Business

According to Willcocks, the distinguishing features of the irrigation system were:
1.) the canals were broad and shallow, carrying the crest waters of the river floods, rich in fine clay and free from coarse sand;

2.) the canals were long and continuous and fairly parallel to each other, and at the right distance from each other for purposes of irrigation;

3.) irrigation was performed by cuts in the banks of the canals, which were closed when the flood was over.
Dungs or Jampois
Dungs or Jampois are small irrigation channels linking rice fields to streams in the Jalpaiguri district of West Bengal.
Cheruvu
Cheruvu are found in Chitoor and Cuddapah districts in Andhra Pradesh. They are reservoirs to store runoff. Cheruvu embankments are fitted with thoomu (sluices), alugu or marva or kalju (flood weir) and kalava (canal).

Kohli Tanks
The Kohlis, a small group of cultivators, built some 43,381 water tanks in the

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district of Bhandara, Maharashtra, some 250-300 years ago. These tanks constituted the backbone of irrigation in the area until the government took them over in the 1950s. It is still crucial for sugar and rice irrigation. The tanks were of all sizes, often with provisions to bring water literally to the doorstep of villagers.

Bhanadaras

These are check dams or diversion weirs built across rivers. A traditional system found in Maharashtra, their presence raises the water level of the rivers so that it begins to flow into channels. They are also used to impound water and form a large reservoir.
Where a bandhara was built across a small stream, the water supply would usually last for a few months after the rains.
They are built either by villagers or by private persons who received rent-free land in return for their public act
Most Bandharas are defunct today. A very few are still in use.
Phad
The community-managed phad irrigation system, prevalent in northwestern Maharashtra, probably came into existence some 300-400 years ago. The system operated on three rivers in the Tapi basin - Panjhra, Mosam and Aram - in Dhule and Nasik districts (still in use in some places here).

The system starts with a bandhara (check dam or diversion-weir) built across a rivers. From the bandharas branch out kalvas (canals) to carry water into the fields. The length of these canals varies from 2-12 km. Each canal has a uniform discharge capacity of about 450 litres/second. Charis (distributaries) are built for feeding water from the kalva to different areas of the phad. Sarangs (field channels) carry water to individual fields. Sandams (escapes), along with kalvas and charis, drain away excess water. In this way water reaches the kayam baghayat (agricultural command area), usually divided into four phads (blocks).

The size of a phad can vary from 10-200 ha, the average being 100-125 ha. Every year, the village decides which phads to use and which to leave fallow. Only one type of crop is allowed in one phad. Generally, sugarcane is grown in one or two phads; seasonal crops are grown in the others. This ensures a healthy crop rotation system that maintains soil fertility, and reduces the danger of waterlogging and salinity.

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The phad system has given rise to a unique social system to manage water use.

Kere

Tanks, called kere in Kannada, were the predominant traditional method of irrigation in the Central Karnataka Plateau, and were fed either by channels branching off from anicuts (chech dams) built across streams, or by streams in valleys. The outflow of one tank supplied the next all the way down the course of the stream; the tanks were built in a series, usually situated a few kilometres apart. This ensured a) no wastage through overflow, and b) the seepage of a tank higher up in the series would be collected in the next lower one.

The Ramtek model has been named after water harvesting structures in the town of Ramtek, Maharashtra. A scientific analysis revealed an intricate network of groundwater and surface waterbodies, intrinsically connected through surface and underground canals. A fully evolved system, this model harvested runoff through tanks, supported by high yielding wells and structures like baories, kundis, and waterholes. This system, intelligently designed to utlise every raindrop falling in the watershed area is disintegrating due to neglect and ignorance.

Constructed and maintained mostly by malguzars (landowners), these tanks form a chain, extending from the foothills to the plains, conserving about 60-70 per cent of the total runoff. Once tanks located in the upper reaches close to the hills were filled to capacity, the water flowed down to fill successive tanks, generally through interconnecting channels. This sequential arrangement generally ended in a small waterhole to store whatever water remained unstored.

The presence of the Ramtek ridge in the middle, having a steep slope on both sides, results in quick runoffs and little percolation. This might have led the residents of the southern plains of the Ramtek hills to construct different types of water conservation structures (like tanks) where they could trap the maximum

Zings

Zings are water harvesting structures found in Ladakh. They are small tanks, in which collects melted glacier water.

Essential to the system is the network of guiding channels that brings the water from the glacier to the tank. As glaciers melt during the day, the channels fill up with a trickle that in the afternoon turns into flowing water. The water collects towards the evening, and is used the next day.

A water official called the churpun ensures that water is equitably distributed.

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Baoris / Bers

Baoris or bers are community wells, found in Rajasthan, that are used mainly for drinking. Most of them are very old and were built by banjaras (mobile trading communities) for their drinking water needs. They can hold water for a long time because of almost negligible water evaporation.

Jhalaras

Jhalaras were human-made tanks, found in Rajasthan and Gujarat, essentially meant for community use and for religious rites. Often rectangular in design, jhalaras have steps on three or four sides.

Jhalars areground water bodies which are built to ensure easy & regular supply of water to the surrounding areas .

the jhalars are rectangular in shape with steps on three or even on all the four sides of the tank . the steps are built on a series of levels .

The jhalaras collect subterranean seepage of a talab or a lake located upstream .

The water from these jhalaras was not used for drinking but for only community bathing and religious rites .

Jhodhpur city has eight jhalaras two of which are inside the town & six are found outside the city .

The oldest jhalara is the mahamandir jhalara which dates back to 1660 AD

Nadis

Nadis are village ponds, found near Jodhpur in Rajasthan. They are used for storing waterfrom an adjoining natural catchment during the rainy season. The site was selected by the villagers based on an available natural catchments and its water yield potential. Water availability from nadi would range from two months to a year after the rains. They are dune areas range from 1.5 to 4.0 metres and those in sandy plains varied from 3 to 12 metres. The location of the nadi had a strong bearing on its storage capacity due to the related catchment and runoff characteristics.

Tobas

Tobas is the local name given to a ground depression with a natural catchment area. A hard plot of land with low porosity, consisting of a depression and a natural catchment area was selected for the construction of tobas.

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V. CONCLUSIONS

In Jhalawar of Rajasthan Eri Approximately one-third of the irrigated area of Tamil Nadu is watered by eris (tanks). Eris have played several important roles in maintaining ecological harmony as flood-control systems, preventing soil erosion and wastage of runoff during periods of heavy rainfall, and recharging the groundwater in the surrounding areas. The presence of eris provided an appropriate micro-climate for the local areas. Without eris, paddy cultivation would have been impossible. Till the British arrived, local communities maintained eris. Historical data from Chengalpattu district, for instance, indicates that in the 18th century about 4-5 per cent of the gross produce of each village was allocated to maintain eris and other irrigation structures. Assignments of revenue-free lands, called manyams, were made to support village functionaries who undertook to maintain and manage eris. These allocations ensured eri upkeep through regular desilting and maintenance of sluices, inlets and irrigation channels.
The early British rule saw disastrous experiments with the land tenure system in quest for larger land revenues. The enormous expropriation of village resources by the state led to the disintegration of the traditional society, its economy and polity. Allocations for maintenance of eris could no longer be supported by the village communities, and these extraordinary water harvesting systems began to decline. Read more about Ganesan, the neerkatti who managed eris

Ooranis
The tanks, in south Travancore, though numerous, were in most cases oornis containing just enough water to cultivate the few acres of land dependent on them. The irregular topography of the region and the absence of large open spaces facilitated the construction of only small tanks unlike large ones seen in the flat districts of the then Madras Presidency, now Tamil Nadu.
Dongs
Dongs are ponds constructed by the Bodo tribes of Assam to harvest water for irrigation. These ponds are individually owned with no community involvement.

Bamboo Drip Irrigation
Meghalaya has an ingenious system of tapping of stream and springwater by using bamboo pipes to irrigate plantations. About 18-20 litres of water entering the bamboo pipe system per minute gets transported over several hundred metres and finally gets reduced to 20-80 drops per minute at the site of the plant. This 200-year-old system is used by the tribal farmers of Khasi and Jaintia hills to drip-irrigate their black pepper cultivation. Bamboo pipes are used to divert perennial springs on the hilltops to the lower reaches by gravity. The

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channel sections, made of bamboo, divert and convey water to the plot site where it is distributed without leakage into branches, again made and laid out with different forms of bamboo pipes. Manipulating the intake pipe positions also controls the flow of water into the lateral pipes. Reduced channel sections and diversion units are used at the last stage of water application. The last channel section enables the water to be dropped near the roots of the plant. Bamboos of varying diameters are used for laying the channels. About a third of the outer casing in length and internodes of bamboo pieces have to be removed while fabricating the system. Later, the bamboo channel is smoothened by using a dao, a type of local axe, a round chisel fitted with a long handle. Other components are small pipes and channels of varying sizes used for diversion and distribution of water from the main channel. About four to five stages of distribution are involved from the point of the water diversion to the application point.

Apatani

This is a wet rice cultivation cum fish farming system practiced in elevated regions of about 1600 m and gentle sloping valleys, having an average annual rainfall about 1700 mm and also rich water resources like springs and streams. This system harvests both ground and surface water for irrigation. It is practiced by Apatani tribes of ziro in the lower Subansiri district of Arunachal Pradesh.

In Apatani system , valleys are terraced into plots separated by 0.6 meters high earthen dams supported by bamboo frames. All plots have inlet and outlet on opposite sides. The inlet of lowlying plot functions as an outlet of the high lying plot. Deeper channels connect the inlet point to outlet point. The terraced plot can be flooded or drained off with water by opening and blocking the inlets and outlets as and when required. The stream water is tapped by constructing a wall of 2-4 m high and 1 m thick near forested hill slopes. This is conveyed to agricultural fields through a channel network.

Virdas

Virdas are shallow wells dug in low depressions called jheels (tanks). They are found all over the Banni grasslands, a part of the Great Rann of Kutch in Gujarat. They are systems built by the nomadic Maldharis, who used to roam these grasslands. Now settled, they persist in using virdas.

These structures harvest rainwater. The topography of the area is undulating, with depressions on the ground. By studying the flow of water during the monsoon, the Maldharis identify these depressions and make their virdas there.

Essentially, the structures use a technology that helps the Maldharis separate potable freshwater from unpotable salt water. After rainwater infiltrates the soil, it gets stored at a level above the salty groundwater because of the difference in their density. A structure is built to reach down (about 1 m) to this upper layer of accumulated rainwater. Between these two layers of sweet and saline water, there exists a zone of brackish water. As freshwater is removed, the brackish water moves

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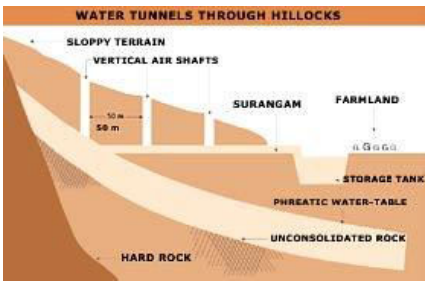
upwards, and accumulates towards the bottom of the virda.

Katas / Mundas / Bandhas
The katas, mundas and bandhas were the main irrigation sources in the ancient tribal kingdom of the Gonds (now in Orissa and Madhya Pradesh). Most of these katas were built by the village headmen known as gountias, who in turn, received the land from the Gond kings. Land here is classified into four groups on the basis of its topography: aat, (highland); mal (sloped land); berna (medium land); and bahal (low land). This classification helps to select
A kata is constructed north to south, or east to west, of a village. A strong earthen embankment, curved at either end, is built across a drainage line to hold up an irregularly-shaped sheet of water. The undulations of the country usually determine its shape as that of a long isosceles triangle, of which the dam forms the base. It commands a valley, the bottom of which is the bahal land and the sides are the mal terrace. As a rule, there is a cut high up on the slope near one end of the embankment from where water is led either by a small channel or tal, or from field to field along terraces, going lower down to the fields. In years of normal rainfall, irrigation was not needed because of moisture from percolation and, in that case, the surplus flow was passed into a nullah. In years of scanty rainfall, the centre of the tank was sometimes cut so that the lowest land could be irrigated.



Source:Dying Wisdom

Surangam
Kasaragod district in the northern Malabar region of Kerala is an area whose people cannot depend directly on surface water. The terrain is such that there is high discharge in rivers in the monsoon and low discharge in the dry months. People here depend, therefore on groundwater, and on a special water harvesting structure called surangam. The word surangam is derived from a Kannada word for tunnel. It is also known as thurangam, thorapu, mala, etc, in different parts of Kasaragod. It is a horizontal well mostly excavated in hard laterite rock formations. The excavation continues until a good amount of water is struck. Water seeps out of the hard rock and flows out of the tunnel. This water is usually collected in an open pit constructed outside the surangam.

A surangam is about 0.45-0.70 metres (m) wide and about 1.8-2.0 m high. The length varies from 3-300 m. Usually several subsidiary surangams are excavated inside the main one. If the surangam is very long, a number of vertical air shafts are provided to ensure atmospheric pressure inside. The distance between successive air shafts varies between 50-60 m. The approximate dimensions of the air shafts are 2 m by 2 m, and the depth varies from place to place.

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Surangams are similar to qanats which once existed in Mesopotamia and Babylon around 700 BC.1,2 By 714 BC, this technology had spread to Egypt, Persia (now Iran) and India. The initial cost of digging a surangam (Rs 100-150 per 0.72 m dug) is the only expenditure needed, as it hardly requires any maintenance. Traditionally, a surangam was excavated at a very slow pace and was completed over generations. Today, engineers such as Kunnikannan Nair are faster and keep the tradition alive.

Korambus

Korambu is a temporary dam stretching across the mouth of channels, made of brushwood, mud and grass. It is constructed by horizontally fixing a strong wooden beam touching either banks of the canal. A series of vertical wooden beams of appropriate height is erected with their lower ends resting firmly on the ground and the other ends tied to the horizontal beam. Closely knitted or matted coconut thatch is tied to this frame. A coat of mud is applied to the matted frame. A layer of grass is also applied carefully which prevents dissolution of the applied mud. Korambu is constructed to raise the water level in the canal and to divert the water into field channels. It is so built that excess water flows over it and only the required amount of water flows into the diversion channels. The height of the Korambu is so adjusted that the fields lying on the upstream are not submerged. Water is allowed to flow from one field to another until all the field are irrigated. They are built twice a year especially before the onset of the monsoon season in order to supply water during winter and summer season. In Kasargod and Thrissur districts of Kerala, Korambu is known as chira.

Jackwells

The difference in the physiography, topography, rock types and rainfall meant that the tribes in the different islands followed different methods of harvesting rain and groundwater. For instance, the southern part of the Great Nicobar Island near Shastri Nagar has a relatively rugged topography in comparison to the northern part of the islands. The shompen tribals here made full use of the topography to harvest water. In lower parts of the undulating terrain, bunds were made using logs of hard bullet wood, and water would collect in the pits so formed. They make extensive use of split bamboos in their water harvesting systems. A full length of bamboo is cut longitudinally and placed along a gentle slope with the lower end leading into a shallow pit. These serve as conduits for rainwater which is collected drop by drop in pits called Jackwells. Often, these split bamboos are placed under trees to harvest the throughfalls (of rain) through the leaves. A series of increasingly bigger jackwells is built, connected by split bamboos so that overflows from one lead to the other, ultimately leading to the biggest jackwell, with an approximate diameter of 6 m and depth of 7 m so that overflows from one lead to the other.

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