WATER WISDOM

IN TIMES OF CLIMATE CRISIS

OXFAM

TROSA
TRANS-BOUNDARY RIVERS OF SOUTH ASIA

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'WATER WISDOM IN TIMES OF CLIMATE CRISIS'

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1. FOREWORD

Water is the most vital natural resource for life on earth and its depletion is the greatest challenge facing humanity today.

India has a long and rich tradition of water harvesting and conservation throughout history, Indians have found ingenious ways to harvest, store and distribute water. Water has been collected from rooftops, from open community lands, from swollen streams and flooded rivers and stored in various types of water bodies.

From time immemorial, India has been endowed with extraordinarily diverse and distinctive traditional water bodies found throughout the country, commonly known as ponds, tanks, lakes, ahars, johads, eris, talabs and others.

Integrated water management in India has never been more relevant than it is today. India is facing an unprecedented water crisis, with certain estimates indicating that water demand will exceed supply by a factor of two by 2030 if we continue with a "business-as-usual" approach.

Now is the time to promote more decentralised but integrated water resource management and delivery, that prioritises bottom-up processes of water governance with the active participation of women and youth who are key stakeholders in how water is managed today and in the future.

To find a way forward and meet the challenges, India only has to look at its rich traditions of water conservation and sustainable use, in the culture of ponds and lakes and in the wisdom associated with traditional communities.

Reviving India's drying rivers, ponds and lakes, and restoring the ecosystem services, including the traditional and indigenous water management practices, is at the core of the solution.

Some of these traditional water management practices, documented as part of the Oxfam Transboundary Rivers of South Asia (TROSA) programme, highlight ways communities have been maintaining and restoring water ecosystems to ensure water security and equity at the local level. The urgent need to adapt and respond to the impacts of climate change and the pattern of flood and drought requires action at all levels and the revival of traditional water institutions and willingness to learn from the associated wisdom is critically important.

I hope the cases presented in this publication will inspire and support action for more inclusive water governance practices.

PAULINE TAYLOR MCKEOWN
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Oxfam

Aji, Arunachal Pradesh, India.

2. INTRODUCTION

The worst impacts of the unfolding climate crisis, on both people and ecosystems, will be felt through its effect on water. Some areas will become much drier, some wetter.

In India, erratic monsoons, prolonged dry spells and heavy rainfall incidents are already overwhelming its 1.3 billion citizens. Relentless groundwater extraction, unprecedented pollution of surface water, and alienation of communities from their water resources have further compounded the water stress situation across the country.

It doesn't have to be this way. For decades, environmentalists and social scientists have repeatedly pointed to India's long history and diversity in water harvesting and conservation.

For centuries, Indians have crafted ingenious water channels like the Kuhls in Himachal Pradesh that channel water from Himalayan glaciers, Dongs of Assam, Aghers in Arunachal Pradesh, Pynes in Bihar, and Bandhs of all size and varieties that channel water from rivers and monsoon runoff and nearby hills and elevated areas. The water is usually directed to storage tanks, sometimes built in a series, with overflow from one becoming runoff for the subsequent one, like Talaabs, Pokharas, Ahars, Johads and Eris. There are a plethora of such traditional, low-cost, easy to maintain, and community-run examples of water systems all over the country.

A number of these ancient traditional water harvesting and irrigation practices have survived the test of time and social upheavals and continue to give sustenance to communities through periods of water scarcity.

Oxfam's Transboundary Rivers Of South Asia (TROSA), a project in collaboration with governments, private sectors, civil society networks and alliances at all levels is exploring and promoting various Integrated Water Resource Management strategies to help transboundary communities ensure water security in a time of climate crisis.

Oxfam believes that empowered communities, having access to and control over water resources, can significantly contribute to reducing poverty and inequality, and achieve prosperity.

The traditional practices featured in '**Water Wisdom**' illustrate the urgent need to reengage communities in water management, using simple, low cost, traditional, and highly efficient systems to ensure water security.

The efforts by local communities in India to improve water availability are lauded universally. A widespread revival of these traditional practices will contribute to India attaining its Sustainable Development Goals and ensuring water security, food security, and disaster risk reduction.

Ahar, Bihar, India.

3. KUHL OF HIMACHAL PRADESH AND UTTARAKHAND

Spiti, one of the least populated regions of the world, is located at a mean elevation of 3000-4000 meters in the Himalayas. This rugged and desolate region receives scanty rainfall and yet agriculture is the mainstay of the local economy thanks to the ingenious Kuhl irrigation system that carries water from glaciers to the villages.

Tapped from the head of a glacier, the Kuhls (diversion channels) bring water over long distances, running down steep mountain slopes and across crags and crevices, to large tanks in the villages. Water is collected in the night, and the next morning, it is diverted to the fields as required. This cycle is repeated daily. The Kuhl consists of moghas (kuccha outlets) to draw out water and irrigate nearby terraced fields. A typical community Kuhl can serve approximately 6 to 30 farmers and irrigate an area of 20 hectares.

Between sowing in April and harvesting in September, water availability is for approximately 70 days. All available and accessible patches of lands along various snow streams and rivers are cultivated. Barley fields near potatoes and green peas are sown in May, and the crop is harvested at the end of August.

In the lower valleys of Himachal Pradesh and Uttarkhand, besides irrigating the fields, Kuhls carry water to run the flour mills, gharaat. Villagers use homemade wooden wheels as turbines to run the mills.

The knowledge and ability to build, maintain, and operate the Kuhls rests entirely and securely in the hands of the Kohli community whose life sprang from these waters. The Kohlis manage the maintenance and distribution of water, supported by the whole community.

Before the beginning of sowing season, the Kohlis repair the temporary bunds and the Kuhls with the help of farmers. Any person who refuses to participate in these activities is denied water for that season.

Until the eighties, exclusive rights to kuhl waters belonged to the bada ghars (big houses), usually the families of founders or original settlers of a village, but the water was shared with all the villagers, who pitched in to maintain the system. In some Kuhls, irrigation turns are determined by drawing of lots. The night time of an irrigation turn is given to watering grasslands and common pastures.

Since the nineties, the irrigation department has taken control of the Kuhls and introduced several innovations. Kuhl heads have been reinforced with cement or concrete, old Kuhls were repaired, and some Kuhls have been complemented with pipes.

Hikkim village, Spiti, Himachal Pradesh - Lying in the rain shadow of the mighty Himalayas, Spiti (4000 mts) receives scanty rainfall. Spiti's water comes from snow –snow fall and snow melt from glaciers.

Kuhl near Langza, Spiti, Himachal Pradesh - Kuhls are water channels found in precipitous mountain areas. These channels carry water from glaciers to villages in the Spiti valley of Himachal Pradesh. Some of them are over 10 kms long and have existed for centuries.

Barley farms, Komik, Spiti, Himachal Pradesh - Agriculture in Spiti is the mainstay of the local economy and shares a delicate balance with the geo-climatic conditions of this cold desert region. Agriculture is limited to one crop a year and is solely dependent on the winter snow melt.

Water tank, Langza, Spiti, Himachal Pradesh - Kuhl channels lead to village tanks, from which water is released as and when required for irrigation. Every family in the village is involved in maintenance of kuhls and tanks.

Community tank, Komik, Spiti, Himachal Pradesh – The kuhl system succeeds because Spiti residents cooperate and share. But shortsighted developmental policies, though well intentioned, now threaten both this unique irrigation system and the social consciousness that spawned it.

4. AJI OF ARUNACHAL PRADESH

Ziro Valley, inhabited by the Apatani tribe, lies tucked in the lower ranges of the eastern Himalayas at the height of 5600 feet in Arunachal Pradesh. The Apatani, aka Tanni people, practice centuries-old tradition of water harvesting for irrigating their highly efficient rice-fish culture fields (Aji).

Apatanis tap the small streams and springs from the hills around the valley and divert the flow of the water to their fields by making temporary bunds (Agher), which act as barriers and provide storage.

Multidirectional channels (Siikho/Parkho/Hehte) are made from the main channel to provide water through an intricate web of contour dams that divide the plots along the gentle gradient of the valley. Bamboo matting supports the bases of the bunds, and all plots have inlets and outlets made of bamboo to control the flow of the water.

This unique system of irrigation enables Apatanis to grow two crops of rice (Mipya and Emoh) and one harvest of fish (Ngihi). Rice production usually varies from 3-4 tons a hectare, and fish production is around 50 kgs per hectare.

The community takes collective responsibility for the management and maintenance of the system, and all beneficiaries contribute towards repairs, cleaning, and upkeep of the channels. Every year after the Mloko festival in March, the Apatanis and agricultural workers organizations, locally known as Patang, begin the agricultural activity by repairing dams, cleaning of channels, the release of irrigation water and preparation of rice seedlings.

The local drainage system carrying poultry droppings (Paro pai), pig excreta (Alyi ekha), cow dung (Sii ekha) and human excreta is merged with the irrigation system, which enhances soil fertility and feeds the fish. Other sources of organic fertilizer for the fields are rice husks (Piina), a waste product of local beer (Poi), ashes from household fires / burned products (Mubu), remains of burnt straws (Muyu), decomposed straws (Liisi), weeds (Tamih) and stalks (ankho).

For fish culture, a vertical pit called Parkho is dug in the middle of the plot. The mouth of the Parkho is covered with a bamboo mesh to prevent the fish from escaping. Fish fingerlings are usually introduced in July, a week after paddy transplantation and harvested in August and September. The fish culture is also taken up from November to February after harvesting of paddy crops is completed and before transplantation for the next season begins. Millet cultivation (sarson) on the bunds is a common practice as well.

The practice of the terrace-wet-rice farming began with Abotani, the earliest ancestor of the Apatanis. Even today, this highly evolved indigenous farming systems, harvesting available water and integrating aquaculture with agriculture assures higher productivity and year-round employment opportunities for farmers.

Fish- Rice Farm, Ziro, Arunachal Pradesh - A woman from the Apatani tribe of Ziro, Arunachal Pradesh preparing the bund of her fish-rice farm, a centuries old tradition that taps small streams from the hills to irrigate the fields where wet rice cultivation is often carried out together with pisciculture.

Paddy seedlings, Ziro, Arunachal Pradesh - Apatani paddy-cum-fish agro-ecosystem is highly productive (400-500 kg ha-1), 3 to 4 time of the average yield of the paddy in the state and is economically viable as the cost of cultivation is low with minimal external inputs.

Fish-Rice Farm, Ziro, Arunachal Pradesh - Paddy fields with strong bunds are essential for fish culture. Strong bunds (Agher) prevent leakage of water, help retain water to a desired depth and also prevent the escape of cultivated fishes during floods.

Fingerlings at hatchery, Ziro, Arunachal Pradesh - Fish is reared from the month of April to September when the paddy crops grow in the field. The fish culture is also taken up from the month of November to February after harvesting of paddy crops is completed and before transplantation for the next season begins.

Bamboo sluice gates, Ziro, Arunachal Pradesh - Water flow from one farm to another is controlled through the manipulation of bamboo sluice gates. The paddy fields generally have two outlets (hubur) and one inlet. One outlet is used for over flow of water and the other is meant for draining of the water during harvest of paddy and fishes.

5. DONG OF ASSAM

Bodos, believed to be the earliest inhabitants of Assam, practice a highly efficient community managed irrigation system known as the Dongs-Jamphai system that is over 100 years old. Dongs are created by digging earthen canals that channel water from the many rivers and streams flowing down from Bhutan into Assam to reach fields and homesteads in the downstream villages.

Typically, a dong network starts at the point of diversion from a river or water source. The larger dong systems comprise subsidiary channels, around three to five feet wide, taking off from the main dong channel (7-12 feet wide). These subsidiary canals break off eventually into jamphai or field channels that supply water to the agricultural areas. Usually dongs dry out naturally at the end of their course or meet other large water bodies like rivers or beels.

The dongs are not wide but very long, distributing its branches and sub-branches extensively throughout the paddy field. Dongs have the capability of irrigating approximately a thousand to five thousand hectares of land in the dry season. The longest dong is reported to be of at least 10 km; however, the length of most dongs are between 2 and 5 km.

The bundh (temporary embankment) is demolished once the inundation of the area to the desired level is accomplished. The dong system operates on sound principles of water management i.e., efficient use of water, ensuring equitable distribution among people.

Community institutions called "dong-bandh committees" oversee each point of this intricate network. These committees are found throughout the four districts of Bodloland Territorial Administration Council in Kokrajhar, Baksa, Udalgiri, and Chirang. These traditional institutions have survived within the community.

The equity, inherent within the dong system, is a reliable indicator of appropriate social positioning of a sustainable resource mobilization technology and management process. Reverend Sidney Endle, in his 1911 seminal monograph, 'The Kacharis', describing the Dong system says " failing some very overwhelming convulsion of Nature, it would seem to be hardly possible that famine could take place here.'

Oxfam India and its partners North East Research and Social Networking (NERWSN) and Aaranyak in Assam and Bhutan Transparency International (BTI) and Bhutan- India Friendship Forum (BIFF) is working with local communities and governments to strengthen people-to-people ties between India and Bhutan for sustainable maintenance of the Dong system in Kokrajhar district.

Saralbhanga river, Indo-Bhutan border, Kokrajhar, Assam - Dongs are man-made structures akin to canals, to route water from available water sources, which are usually perennial, to the paddy cultivating fields. The water sources are small rivers, perennial swamps, beel, streams, etc.

Saralbhanga river, Indo-Bhutan border, Kokrajhar, Assam - Dong can have a breadth of 7-15 feet on average or even more. The breadth gradually increases over the course of its flow from the source till the end point.
Usually dongs dry out naturally at the end of their course or meet other large water bodies like rivers or beels.

Dong irrigation system, Kokrajhar, Assam - Gravity makes water flow along the dongs that lead to agricultural fields and homesteads across villages. While the main dongs, which start at the rivers, are about 12-feet wide, smaller subsidiary dongs that branch off from the main ones are around three-feet wide.

Jamfwi or Dong channels, Kokrajhar, Assam. - Dongs are opened for a specific period for a particular village so that the residents can use the water in their paddy fields and also store the water in the ponds in their backyard. Every household in each village is supposed to send at least one member to work voluntarily on the dong to ensure 24×7 flow of water.

Sarpang Dong Bandh Committee members, Kokrajhar, Assam - The Dong committees which are responsible for the smooth running of the irrigation system is a well managed one, and it entrusts one member for each sub-canal, whose duty is to monitor the canal everyday and report to the committee about any damage or any repair which might be needed.

6. AHAR PYNE OF BIHAR

Ahar Pyne is a 5000-year-old floodwater harvesting system that evolved during the Mauryan Empire to bring water to the undulating and rocky terrain of Magadh, in south-central Bihar. In Hindi, Aa—to come, Har—to capture, and Pyne–water or water channels in this case.

Ahars are reservoirs with embankments on three sides and are built at the end of drainage lines such as rivers or artificial channels called Pynes. Water supply for an Ahar comes either from natural drainage after rainfall (rainfed ahars) or through pynes where necessary diversion works are carried out.

Water for irrigation is drawn out by opening outlets made at different heights in the embankment. It is this system that made paddy cultivation possible in South Bihar, which is otherwise unsuitable for this crop. In particular, it helped farmers meet the crucial water requirement for paddy during hathia, i.e., the grain-filling stage.

Pynes are constructed by considering various parameters like the slope of the terrain and the location of crops grown. To create a network of pynes well-connected with ahars is a labor-intensive job requiring a considerable amount of work and engineering skills. Ahar and Pyne assist in controlling floods by distributing surplus water into its system. Drought is also managed as it makes water available in the reservoir for a year.

Through this system, one Pyne can irrigate up to 400 acres. For decades, the system is not just used to collect, store, and distribute water but also hold people from various castes and classes together resulting in group action for irrigation operation and maintenance.

Ahar beds were also used to grow a Rabi (winter) crop after draining out the excess water that remained after Kharif (summer) cultivation. While ahars irrigating more than 400ha are not rare, the average area irrigated by an ahar during the early 20th century was said to be 57 ha.

The area irrigated by the ahar pyne systems has witnessed a sharp decline and yet, even today, they constitute nearly three-fourths of the total irrigation facilities in South Bihar. More than sixty percent of these are defunct, and the rest is poorly managed.

These structures not only have relevance for sustainable water management but also have essential socio-economic importance as it allows community participation and distribution of responsibilities simultaneously opening alternative avenues for earning a livelihood for the local population.

Jalsar Ahar, Siur, Nawada, Bihar - Ahars are reservoirs with an embankment on three sides while Pynes are diversion channels laid from the river or the catchment area for impounding water in the Ahars and channels.

Bansi Mohana Pynes, Sakri River, Bihar - Water supply for an ahar comes either from natural drainage after rainfall (rainfedahars) or through pynes, artificial channels constructed to utilise river water in agricultural fields. It is this system that made paddy cultivation possible in South Bihar, which is otherwise unsuited for this crop.

Pyne, Nawada, Bihar - One Pyne can irrigate up to 400 acres. It helps controls flood and drought and acts as a protecting mechanism for the villages. These channels may be of various sizes. The small ones are those found originating in ahars and carrying the water of the ahars to cultivable plots.

Farmers checking Pyne level, Nawada, Bihar - Ahar and Pyne assist in controlling floods by distributing surplus water into its system. The routine upkeep work involves cleaning and desilting of ahar and pyne and maintaining the water conveyance network is done by the cultivators themselves before the onset of monsoon.

Paddy fields, Siur, Nawada, Bihar - All farmers grow the same crop (paddy) all over the irrigation command around the same dates. As a result, agricultural operations undertaken by all cultivators are similar throughout the irrigation command. Since, aharsand pynes have to be used collectively, all farmers have to synchronize their operations.

7. JOHAD OF RAJASTHAN, UTTAR PRADESH AND HARYANA

Johad, a crescent-shaped dam of earth and rocks found in Uttar Pradesh, Haryana and the Thar deserts of Rajasthan, is probably one of the oldest rainwater harvesting systems in India. Archeologists have dated some of these rainwater storage structures in India as far back as 1500 B.C.

The water collected in a Johad during the monsoon is directly used for irrigation, drinking, livestock, and other domestic purposes while recharging the groundwater. During the dry season, when the water gradually recedes, the land inside the Johad is used for cultivation.

Typically, building a Johad involves digging a pit and shaping the excavated earth into a semicircular mud barrier. A stone drain is sometimes set up, allowing excess water to seep into the ground or connecting it with Johads nearby.

When many Johads are built in one area, they have a cumulative effect, resulting in the replenishment of whole aquifers.

The height of the dam varies from one Johad to another, depending on the site, water flow, contours of the land, etc. In some cases, to ease the water pressure, a masonry structure is added for the outlet of excess water. The water storage area varies from 2 ha to 100 ha. The villagers share the expense, supply labor, and materials like stone, sand, and lime.

In the eighties, deforestation, reduced rainfall, depleting groundwater, polluted surface water, and the failure of the modern irrigation and water supply systems brought back attention to the forgotten, decrepit and silted Johads. A mass movement for the revival of traditional methods began in Rajasthan and quickly spread to Haryana and Uttar Pradesh.

In the last twenty years, several innovations have improved the efficiency of the Johads. An initiative by New Delhi based DCAP (Development Centre for Alternative Policies) in the Dhikoli village of Baghpat district of Uttar Pradesh stands out for replication.

In 2001, the Dhikoli block of Baghpat district of Uttar Pradesh was declared dark zones by the Central Ground Water Board due to excessive groundwater exploitation. With no sewage system in place, the ponds in Dhikoli, like other villages in Baghpat, were overflowing with domestic sewage. DCAP's project included an innovative reed- bed system, also known as the bio-filter system for treating wastewater before it reached the ponds.

Seven years later the villagers of Dhikoli are benefitting from the higher water table that ensures round the year water supply in their wells but also are grateful to the unique sewage treatment system that has also dealt with the menace of mosquitoes and malaria making this traditional system, that came into existence decades ago, as relevant today as it was then and perhaps even more given the water crisis and problems like water pollution, scarcity and climate change.

Baba Bhurewala Johad, Dhikoli, Baghpat, Uttar Pradesh - With the involvement of the villagers, DCAP began its intervention with the restoration of an ancient temple pond called Baba Bhurewala johad that had dried up following years of negligence.

Reed bed channel, Dhikoli, Baghpat, Uttar Pradesh - A 650-ft long channel—8ft deep and 10 ft wide—with weirs that had alternating tiny waterfalls and ditches brought the sewage water and rainwater overflow from the village drain to the lower johad that was constructed on the panchayat owned land.

Shamshan Johad, Dhikoli, Baghpat, Uttar Pradesh - Since the project was completed and the three johads have been able to capture around 55 lakh liters of rainwater per annum from the surrounding catchments per year, recharging the groundwater in the process.

Lower Shamshan Johad, Dhikoli, Baghpat, Uttar Pradesh - In addition, every year, 109 lakh litres of treated wastewater goes into the newly made big shamshan johad. Several tube wells downstream of the johads have also reported an increase in the water table.

Johad, Baghpat, Uttar Pradesh - Johads are the main water source for upkeep of domestic cattle and an important water source for wild animals during periods of droughts.

8. BANDHARA PHAD OF MAHARASHTRA

Maharashtra has a unique traditional water-harvesting technique, known as the Bandhara Phad system, whose roots can be traced back over 300 years. During the seventeenth and eighteenth centuries phad system had received patronage in the tenure of Queen Ahillyabai Holkar.

The term Bandhara refers to earthen check dams built across a river from which canals spread out into the fields referred to as a Phad, which comprises of several fields owned by different cultivators. A collection of phads (8 to 40 hectares each) is known as a Thal and can cover an area up to 400 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. Perennial crops in the first Phad, two seasonal crops in the second, annual crops in the third. A fourth crop would be grown depending on the availability of water. The crops are rotated in different Phads in a 4-year cycle. This practice ensures a healthy crop rotation system that maintains soil fertility and reduces the danger of water logging and salinity.

Bandharas were built either to raise the water level, enabling water to be diverted to fields through canals or to impound it to form a large reservoir. Bandharas are constructed with brick masonry or stone masonry. The crest width varies from 1 m to 2 m. and sluices are provided at the bottom of the Bandhara near the head reach of the canal. The canal has field distributaries called Assarang, while the excess water is drained back into the mainstream through Sandwa or the surplus weir.

The Phad system is managed by the Bhagayat committee (farmers' / irrigators' committee) consisting of elected members. The number of members in the committee varies among villages. The membership is not permanent and usually lasts for 2 to 4 years at a time; however, it can be changed depending upon the interests of its members.

Hereditary positions like Hawaldar (supervisor) and Jakleya (watchman) are involved in maintaining the canal system. Patkaris (waterman) oversees the water distribution process by operating the field gates (Sasar) and the Jerai mali community, along with some other communities, are involved in the construction.

It is said that the Bandhara Phad system was originally practiced on three rivers in the Tapi basin – Panjhra, Mosam and Aram – in the Dhule and Nasik district of Maharashtra. The advent of modern irrigation systems may have spelled the death knell for many of these traditional water- harvesting systems.

However, in the face of unprecedented drought and water scarcity, Bandharas are making a come back in Maharashtra and Goa. Hundreds of new Bandharas are being built and the old abandoned ones are being repaired.

Bandhara, Nasik, Maharashtra. **Bandhara, Thane, Maharashtra -** A Bandhara is a low masonry weir of height 1.2 to 4.5m, which is constructed across a small stream for diverting the water of the stream into a small main canal taking off from the upstream side of the Bandhara.

Bandhara reservoir, Palghar, Maharashtra - Bandharas were built either to raise the water level to enable water to be diverted to fields through canals, or to impound it to form a large reservoir.

Bandhara, Palghar, Maharashtra - Bandharas are constructed in a series to arrest the supply downstream. Vanarai Bandharas also help recharge groundwater by replenishing the aquifer below the river bed. These temporary dams are usually built towards the end of the monsoon period and last till the onset of the next monsoon.

Sugarcane fields, Pune, Maharashtra - A uniform cropping pattern is usually followed within the phad in a season, but it could vary across phads and over the years. Because all farmers have some share of land in the main phad, an equitable system of water distribution is maintained..

Bandhara tank, Nasik, Maharashtra - Phad systems have shown its promise in the region in the condition of medium rainfall, of providing low irrigation potential through mainstream surface and groundwater systems, and have been able to mitigate the risk of crop failure and yield reduction substantially.

9. ERI OF TAMILNADU

With no perennial rivers and minimal rainfall, the people of Tamil Nadu have been dependent on a system of community-built tanks and reservoirs called Eri (irrigation tank) for centuries. An Eri is created by building a low bund across a shallow valley that is usually fed by run-offs from streams and rivers through a series of channels. There used to be about 40,000 Eris in Tamil Nadu, some more than a millennium old.

Eris requires very little capital investment; they can capture the run-off of the increasingly unpredictable monsoon rains, augment groundwater resources through sub-surface recharge and be effective flood control measures that prevent soil erosion.

A well-maintained Eri can store water to be used for more than one year. For example, Mamandur Eri in the North Arcot District of Tamil Nadu saves water for fifteen months.

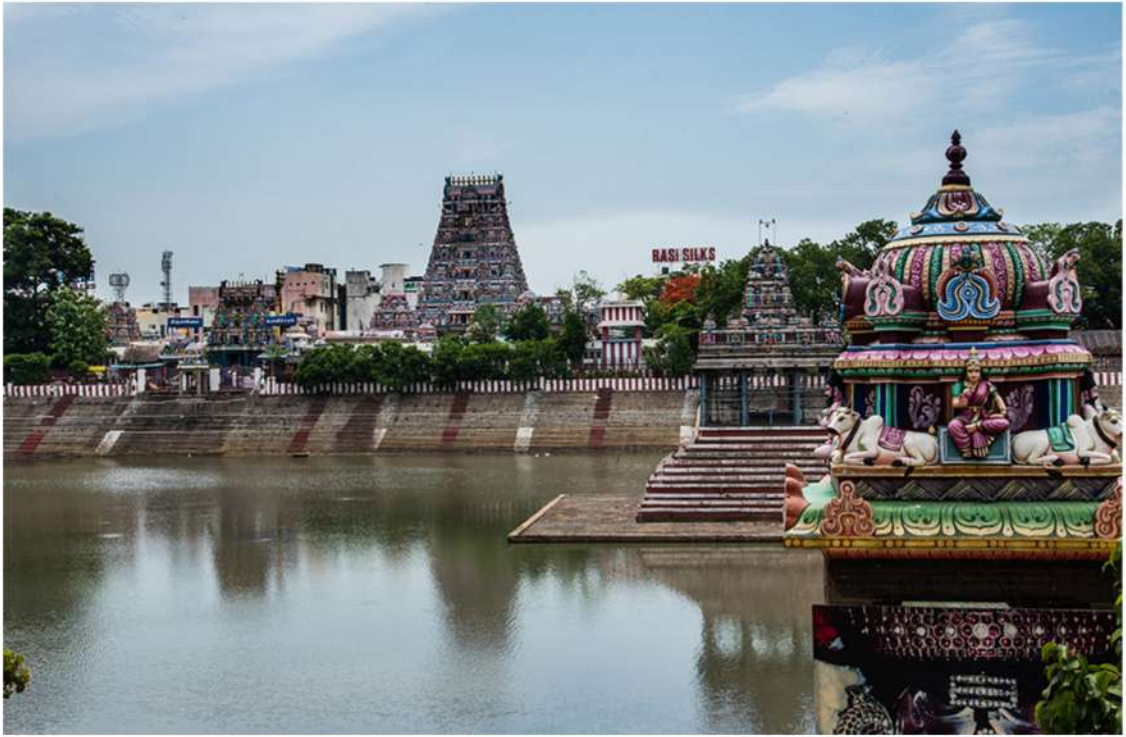
Each Eri is designed to irrigate a certain extent of agricultural land known as the Ayacut of the Eri. The water reaches the fields through sluices known as Madagu in Tamil that is located at different levels to be able to supply water at different elevations. To divert water to nearby villages, the Eris was laid out as a series of cascading tanks. The excess outflow from one Eri would serve as the inflow for the next one in the series.

Eri construction and maintenance used to be sponsored by local rulers, dominant groups, zamindars, and priests with the cooperation of the villagers. During the rule of Chola King Karikalan, certain parts of the Grand Anicut canal system were maintained by the government known as 'Sarkari.' The lower parts of the canal were maintained by farmers known as 'Kudimaramath' (people's maintenance by donated labor).

Water was allocated according to the size of each land, and a Neerkatti (water resource manager) was hired to ensure the right amount of water reached the correct fields at the right time with minimum wastage.

Given the severe water crisis gripping the state, the government has taken urgent steps to revive the traditional water bodies under the Kudimamaramath scheme of strengthening tank bunds, de-silting supply channels, repairing and reconstructing sluices, weirs, and shutters.

Eris area culture-specific response to ecological prerogatives of Tamil Nadu. Not only have they stood the test of time but also satiated local needs in an environmentally friendly manner. These systems emphasized environmental conservation in contrast to over-extraction common to myopic modern systems.



Kapaleeshwarar Temple tank, Chennai, Tamil Nadu - KovilKulams (Temple tanks) are deep ponds outside temples that are protected by an enclosure or wall with steps on all four sides leading to the bottom. KovilKulams served more than ritual needs; they play an important role in recharging and maintaining groundwater level and are a boon for local ecology as well.

Chembarambakkam Eri, Tiruvallur, Tamilnadu - Chembarmbakkam Eri is known to have existed during the Chola period and used to irrigate 168 villages. Today it is one of the two rain-fed reservoirs that supplies water to Chennai City, the other one being the Puzhal Lake. The Adyar River originates from this lake.

Rettai Eri, Chennai, Tamilnadu - Rettai Eri, locally known as Retteri, is a lake in the Kolathur area of Chennai, India. The lake covering 5.42-million sq. meter gets inflows from Red Hills reservoir and Koratturlake. 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.

Oorani, Chennai, Tamilnadu - Ooranis are dug out ponds that are usually smaller and shallower than eris and collect and store rainwater for drinking water purposes. Water from the ooranis remain the most preferred choice for drinking in many villages in Tamilnadu. They have appropriately situated inlets to gather rainwater from surrounding areas and outlets for excess water.

Porur Eri, Chennai, Tamilnadu - Porur Eri is located in south-west Chennai and is a primary water resource for people residing in Chennai. The presence of eris provided an appropriate micro-climate for the local areas. Without eris, paddy cultivation would have been impossible.

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