Water as infrastructure: Lessons from ancient Indian hydraulics for contemporary water security



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A stepwell in Patan. A stone barrage across the Kaveri still shaping irrigation nearly two millennia after it was built. These are reminders that India's water history is not only a history of structures, but also of systems for storing, sharing and maintaining water. India's contemporary water challenges are therefore not simply questions of supply and extraction. They are also questions of how water is stored, governed, maintained and shared.

India has about 18 per cent of the world's population but around 4 per cent of its freshwater resources. NITI Aayog's 2018 *Composite Water Management Index* warned of a potentially severe gap between demand and supply by 2030 if prevailing trends continued. More recent data from the Central Ground Water Board indicate some improvement: the proportion of assessed groundwater units classified as over-exploited declined from 17.24 per cent in 2017 to 11.13 per cent in 2024, while the share classified as safe increased from 62.6 to 73.4 per cent. Recharge from tanks, ponds and water-conservation structures also increased from 13.98 to 25.34 billion cubic metres. These figures point to the contribution that distributed water infrastructure can make to groundwater recharge.

"O Waters, You Are the Source of Vigour"

The reverence for water in Indian thought begins in verse. The *Rigveda's Apah Suktam* (RV 10.9.1) opens: *apo hi stha mayobhuvas ta na urje dadhatana* "O Waters, you are beneficent; grant us nourishment and strength." The following verse invokes the waters' auspicious essence "like loving mothers": *usatir iva matarah*. Water thus appears not merely as a physical resource but as a source of nourishment and well-being. Later *Dharmashastra* traditions prescribe against water pollution, reflecting the ethical and social obligations associated with its protection.

Water management in the Indian subcontinent has a much longer history, as demonstrated by the reservoirs and water-harvesting systems of the Harappan civilisation, particularly at Dholavira. A later example is Sringaverapura, near present-day Prayagraj, where excavations revealed tanks and a canal drawing floodwaters from the Ganga, with arrangements for sedimentation and storage before excess water returned to the river.

Although associated with Rama's crossing of the Ganga in the *Ramayana* tradition, the archaeological evidence independently demonstrates how floodwater could be captured and stored rather than treated merely as a hazard.

Today, this approach highlights the value of integrating flood management, rainwater harvesting and groundwater recharge to strengthen water security.

Kautilya's Economics of Water

The *Arthashastra*, generally associated with Kautilya, links water management to public administration and economic incentives. It prescribes tax remissions on lands associated with new waterworks, repairs and improvements, while also assigning maintenance obligations and penalties for neglect. Its significance lies in the questions it raises about financing, responsibility and accountability across the life of an infrastructure asset.

Beyond construction, the *Arthashastra* assigns responsibilities to irrigation beneficiaries and regulates water distribution between waterworks, including higher and lower tanks. It thus links water management with benefits, obligations, maintenance and penalties. Rather than assuming uniform implementation, its significance lies in the administrative principles it articulates: who builds infrastructure, who benefits, who maintains it and who is accountable for neglect.

When Water Infrastructure Met Local Institutions

The Kaveri delta illustrates durability through adaptation. The Kallanai, or Grand Anicut, traditionally attributed to the Chola ruler Karikala and dated to the early centuries CE, continues to shape irrigation in the delta. Captain Caldwell repaired and reinforced it in 1804, followed by further improvements by Arthur Cotton, who drew on its foundations when designing irrigation works on the Godavari and Krishna rivers. Its history demonstrates the importance of maintaining and adapting existing infrastructure.

The Uttaramerur inscriptions of 919-921 CE offer an institutional example. They describe village committees, including an *eri-variyam,* or tank committee, responsible for maintaining irrigation tanks (*eri*). Members were selected through the *kudavolai* system from among qualified candidates. Although Uttaramerur was a *Brahmadeya* settlement with restrictive eligibility, the inscriptions specify selection procedures, tenure and disqualification, placing tank management within the village's administrative structure.

These examples show that durable water infrastructure requires not only sound engineering but also institutional continuity, local participation and sustained maintenance. It reveals four interconnected layers of water infrastructure: knowledge of rainfall, terrain and hydrology; physical systems designed to hold, move and recharge water; institutions given defined responsibilities; and incentives or obligations that make maintenance someone's responsibility rather than a general expectation.

What the Data Suggests Today: Lessons for Contemporary Water Security

The first lesson is that construction must be accompanied by maintenance. The *Arthashastra's* attention to incentives, obligations and penalties and the long history of Kallanai both demonstrate that infrastructure cannot be treated as a one-time investment. Contemporary water programmes therefore require clear responsibility for operation, maintenance, rehabilitation and accountability after construction.

The second lesson is that groundwater recharge and surface-water management should be understood as connected systems. Sringaverapura demonstrates how capture, sedimentation and storage could be integrated within a single hydraulic system. Contemporary planning can similarly connect tanks, ponds, recharge structures and catchments with groundwater management rather than treating them as isolated interventions.

The third lesson is that local institutions matter. The Uttaramerur example shows that irrigation infrastructure could be placed within a defined institutional structure. The Atal Bhujal Yojana offers a contemporary example of this institutional approach, combining community participation with local groundwater budgeting. Government assessments report improvement in groundwater levels in 180 of the programme's 229 blocks and approximately 81,700 water-conservation and recharge structures created or restored by March 2026.

The fourth lesson is that water security requires an ethical commitment to stewardship and protection, not merely technical access. Just as ancient ethical traditions treated water protection as a social obligation, it is important for modern policy to foster public duty around preventing pollution, conserving water and safeguarding catchments alongside infrastructure. The Jal Jeevan Mission has expanded rural household tap-water coverage from 16.7 per cent in 2019 to 81.71 per cent as of March 2026. Yet providing a connection is only one part of water security. Sustaining the source, preventing degradation and ensuring long-term operation and maintenance remain equally important.

Water security is not created by infrastructure alone. It emerges when knowledge, infrastructure, institutions and responsibility work together. The most useful lesson from India's hydraulic heritage, therefore, is not simply how earlier societies built water systems, but how they embedded those systems within social, administrative and ecological relationships. For a water-stressed future, the durability of a water system will depend not only on how well it is built, but on how well a society takes responsibility for keeping it alive.

Fable with Moral

Sant Eknath and the Thief



Sant Eknath was a revered 16th-century saint from Maharashtra, renowned for his kindness and his ability to see the divine in every living being. He lived a life of extreme simplicity, possessing no material wealth.

One cold winter night, a thief broke into Eknath's humble home. The intruder searched every corner, hoping to find gold or jewels, but found nothing of value. Desperate not to leave empty-handed, he gathered a few old brass vessels and a worn-out blanket, clumsily wrapping them into a bundle.

As the thief tried to slip away into the shadows, Eknath woke up. Instead of raising an alarm or attacking the intruder, the saint felt a wave of profound compassion. He did not see a criminal; he saw a desperate soul compelled by abject poverty.

In the dim light, Eknath noticed the thief struggling to tie the knot on his stolen bundle. Moving quietly so as not to scare him, the saint walked up and gently helped the startled man tie the knot securely. Before the bewildered thief could run, Eknath removed his own warm shawl and draped it over the man's trembling shoulders.

With a serene smile, Eknath said, "My friend, you broke into my house in the dead of night and worked so hard, yet you found so little. Please take this shawl as well. The night is bitter cold and your comfort matters more than these objects."

The thief stood frozen, completely stunned by this unexpected form of kindness. He had prepared himself for anger, beatings, or imprisonment, but he had not anticipated such unconditional love. Bursting into tears, the thief dropped the bundle at Eknath's feet. He fell to the ground, begged for forgiveness and renounced his life of crime that very night, choosing instead to become a lifelong disciple of the saint.

MORAL OF THE FABLE: Unwavering kindness redeems the wrongdoer.

Did you know?

Long before the advent of modern meteorological instruments and agricultural forecasting systems, Indian scholars closely observed the natural world, particularly the flowering and fruiting of trees, to understand seasonal rhythms and anticipate agricultural conditions.

An intriguing example appears in the *Brhatsamhita*, the sixth-century CE encyclopaedic work of Varahamihira. Chapter 29, entitled *Kusumalata* (on Flowers and Plants), describes how the growth of flowers and fruits was believed to indicate the likely abundance of different crops. According to the text, the flourishing of the banyan tree (*nyagrodha*) signalled favourable prospects for barley, while the flowering and fruiting of the *jambu* tree were associated with the abundance of sesame and black gram. Similarly, the growth of the *madhuka* (mahua) tree was considered an indicator of wheat production. These associations reveal an attempt to interpret agricultural prospects through changes observed in the surrounding vegetation.



In modern environmental science, the study of recurring seasonal events such as flowering, fruiting, and leaf emergence is known as *phenology*. Scientists today examine these changes to understand plant responses to variations in temperature, rainfall, and climate. Although the predictive associations recorded in ancient texts should not be equated with scientifically validated forecasting methods, they offer valuable evidence of historical environmental observation.

Wisdom Word Search

A	G	N	N	E	E	R	M	O	P	K	L	S
N	R	A	L	I	K	L	W	Q	R	A	P	C
G	L	U	Q	L	K	A	D	A	L	P	E	H
A	U	A	V	A	O	L	A	I	I	K	R	V
K	P	M	D	I	Y	A	R	K	A	I	U	A
A	A	A	S	S	T	Q	F	N	K	O	J	E
A	O	Z	V	E	A	G	M	A	L	A	I	R
D	J	H	W	A	L	I	A	S	A	L	U	S
U	K	A	N	G	R	H	N	K	R	L	Y	E
T	P	I	R	U	L	A	N	O	A	D	N	L
I	W	J	S	H	N	S	V	B	N	U	G	G
S	C	H	V	A	A	N	A	M	O	I	W	X

WORDS TO FIND
Aruvi, Iyarkai, Kaadu, Kadal, Malai, Mann, Mazhai, Neer, Vaanam, Vaer

THE WISDOM LEXICON

ARUVI: Waterfall / Cascade
IYARKAI: Nature / The natural order of the world
KAADU: Forest / Jungle / Wilderness
KADAL: Sea / Ocean
MALAI: Mountain / Hill
MANN: Soil / Earth / Ground
MAZHAI: Rain / Precipitation
NEER: Water (pure flowing water)
VAANAM: Sky / Firmament (also Vaan)
VAER: Root of a plant or tree

Note: These terms come from Tamil, one of India's 22 Scheduled Languages.

Marvels of India

ASHOKA'S GREEN INFRASTRUCTURE



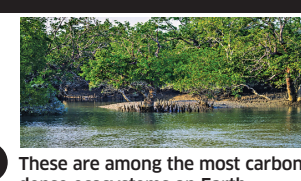
Roads with Shade and Water
Emperor Ashoka (third century BCE, Mauryan dynasty) chronicled his public works in his rock and pillar edicts. Pillar Edict VII records that he planted banyan trees along roads to shade people and animals, established mango groves, dug wells and built resthouses and water reservoirs. Rock Edict II, likewise, mentions roadside wells and trees. The combination of shade, water and resting facilities made routes more hospitable to humans and animals.

Medicine from the Land
Rock Edict II also states that when medicinal herbs for humans or animals were unavailable, they were imported and planted, making health care part of public welfare.

Protecting Forests and Wildlife
Pillar Edict V lists animals that were not to be killed and forbids setting forests on fire. Some protections applied on specified days.

Why It Is a Marvel
These measures treated shade, water, medicine and wildlife as public goods, grounded in *Dhamma* and compassion for all beings. Scholars see here an early link between environmental ethics and state policy or state-supported ecological care. Because the evidence comes from his own inscriptions, the claim rests on primary historical sources rather than legend or oral narratives.

QUIZ Environment & Sustainability

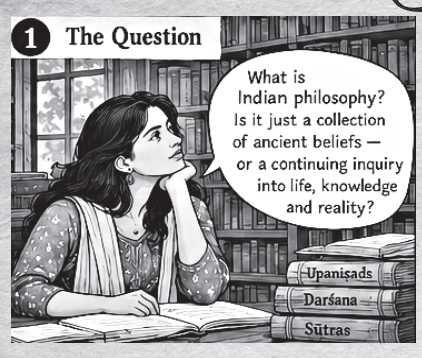
	Questions	Option A	Option B	Option C	Option D
1	 These are among the most carbon-dense ecosystems on Earth, storing more carbon per hectare than the terrestrial tropical rainforests. What are they?	Coconut Palms	Whistling Pines	Indian Tulips	Mangroves
2	Which is the traditional agro-aquaculture system practised along the coast of Karnataka that plays a key role in blue carbon sequestration?	Gazani	Pokkali	Bheries	Khazan
3	The Banni Grasslands, found along the southern edge of the Rann of Kutch in Gujarat, represent one of Asia's largest and finest tropical arid grassland ecosystems. Which tribe is found here?	Bishnoi	Maldhari	Kukna	Warli
4	What is special about the Lakshadweep Islands?	Coral Islands	Volcanic Islands	Metallic Islands	Mud Islands

Answers: 1 - D, 2 - A, 3 - B, 4 - A

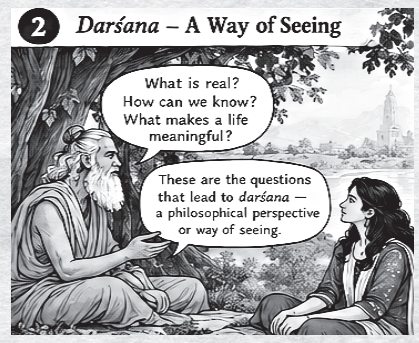
bharatiya darshan

The many paths of inquiry

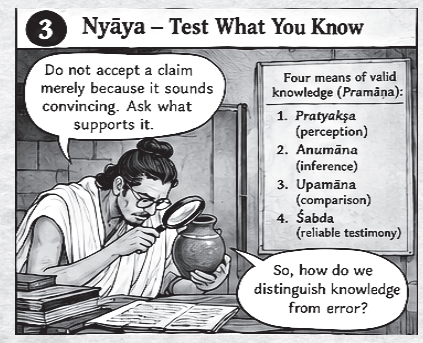
From logic and consciousness to non-violence and materialism



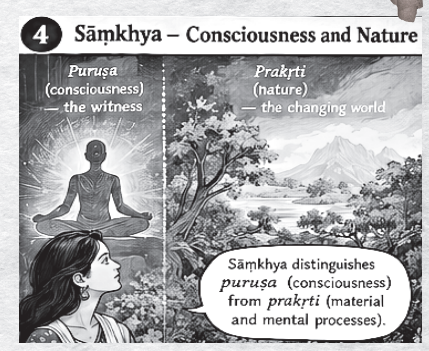
Indian philosophy is a diverse tradition of reasoning, debate, and practice. It asks fundamental questions about what exists, how we know, and how we should live.



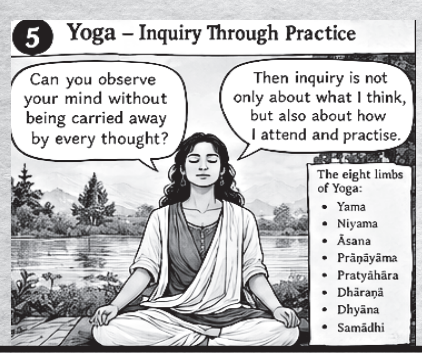
Indian philosophical traditions explore three enduring questions: What is real? What can we know? How should we live? Different schools offer different answers.



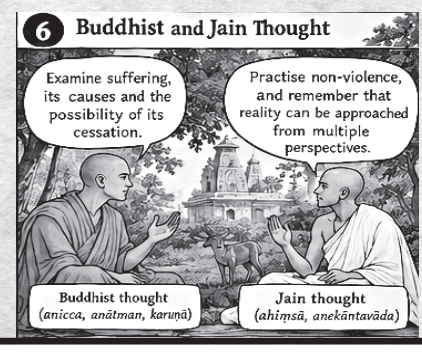
Nyaya develops logic and critical reasoning. Its tools - observation, inference, comparison and testimony - are still relevant in evaluating information, even in the digital age.



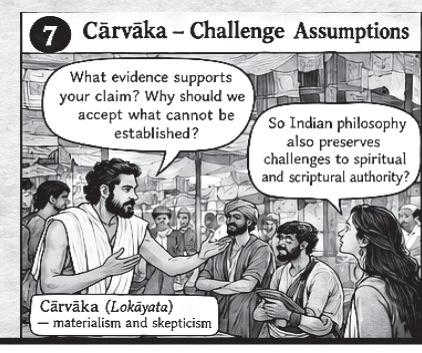
It offers a profound analysis of the self, consciousness and the material world.



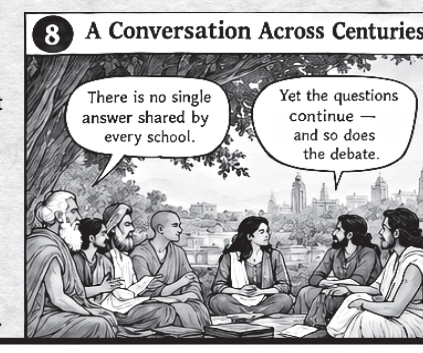
Yoga is a philosophical and practical discipline that cultivates attention, ethics and liberation. It is more than physical postures.



Buddhist philosophy explores suffering, impermanence, and the absence of a permanent self in many of its traditions. Jain philosophy emphasises non-violence and many-sidedness.



The Carvaka tradition questions unsupported claims and focuses on what can be known through experience. Its teachings are known mainly through later accounts, so we must be cautious and not assume every detail is clear.



MORAL OF THE STORY: Different paths. Rigorous questions. A living intellectual heritage.