



By **Fen Montaigne** Photographs by **Peter Essick**

How can such a wet planet be so short on clean fresh water? The latest installment in the "Challenges for Humanity" series plumbs the problem.

Rajendra Singh came to the village, bringing with him the promise of water. If ever a place needed moisture, this hamlet in the desiccated Indian state of Rajasthan was it. Always a dry spot, Rajasthan had suffered several years of drought, leaving remote villages like Goratalai with barely enough water to quench the thirst of their inhabitants. Farm plots had shriveled, and men had fled to the cities seeking work, leaving those behind to subsist on roti, corn, and chili paste. Desperate villagers appealed to a local aristocratic family, who in turn contacted Singh, a man renowned across western India for his ability to use traditional methods of capturing monsoon rains to supply water year-round.

Singh arrived in Goratalai on a warm February morning. The sky was robin's egg blue, the same color it had been since August when, everyone recalled, the last rains had fallen. He was greeted by a group of about 50 people waiting in a dirt square under a banyan tree. The men wore loose-fitting cotton pantaloons and turbans of orange, maroon, and white. They were rail-thin, their faces burnished by the sun and distinguished by great mustaches that swept across hollow cheeks. The women were covered from head to toe in vivid orange, gold, and pink clothing, a counterpoint to the parched dun terrain of rock and scrub.

Singh smiled and addressed the villagers.

"How many households do you have?"

"Eighty."

"It's been four years without much rain," interjected a woman. "And we don't have a proper dam to catch the water."

"Do you have any spots where a dam could go?" asked Singh, 43, who has a full head of black hair and a thick beard, both flecked with gray.

"Yes, two spots."

"Will the whole village be willing to work there?"

"Yes," they replied in chorus. The villagers, nearly all of them illiterate, had submitted a petition to Singh

asking for help, their names represented by violet thumbprints on a smudged piece of paper.

"I would like to help you," Singh told them, "but the work has to be done by you. You will have to provide one-third of the project through your labor, and the remaining two-thirds I will arrange."

The villagers clapped, the women broke into song, and the group hiked across the rock-studded hills to a ravine, the women's silver

ankle bracelets jangling as they walked. After a few minutes Singh—dressed in a light-golden blouse that fell to his knees and white pants—directed villagers to place stones in a 75-yard (68-meter) line between two hills. "This is an ideal site," he announced. His organization, Tarun Bharat Sangh, would provide the engineering advice and materials. The villagers would supply the sweat equity. The 30-foot-high (9-meter-high) earthen dam and reservoir, known as a johad, could be finished in three months, before the start of the monsoon. If the rains were plentiful, the reservoir would not only provide surface water for drinking and irrigation but would also recharge dry wells as water seeped into the ground.

"You shouldn't get disheartened," Singh told the villagers. "You will not see the results immediately. But soon the dam will begin to raise the water level in your wells."

Ninety minutes after he arrived, Singh was gone, heading to a nearby village that had also requested help building a johad. In recent years Singh's johads have sprung up all over Rajasthan—an estimated 4,500 dams in about 1,000 villages, all built using local labor and native materials. His movement has caught on, he told me, because it puts control over water in the hands of villagers. "If they feel a johad is their own, they will maintain it," said Singh.

"This is a very sustainable, self-reliant system. I can say confidently that if we can manage rain in India in traditional ways, there will be sufficient water for our growing population."

Among the environmental specters confronting humanity in the 21st century—global warming, the destruction of rain forests, overfishing of the oceans—a

shortage of fresh water is at the top of the list, particularly in the developing world. Hardly a month passes without a new study making another alarming prediction, further deepening concern over what a World Bank expert calls the "grim arithmetic of water." Recently the United Nations said that 2.7 billion people would face severe water shortages by 2025 if consumption continues at current rates. Fears about a parched future arise from a projected growth of world population from more than six billion today to an estimated nine billion in 2050. Yet the amount of fresh water on Earth is not increasing. Nearly 97 percent of the planet's water is salt water in seas and oceans. Close to 2 percent of Earth's water is frozen in polar ice sheets and glaciers, and a fraction of one percent is available for drinking, irrigation, and industrial use.

Gloomy water news, however, is not just a thing of the future: Today an estimated 1.2 billion people drink unclean water, and about 2.5 billion lack proper toilets or sewerage systems. More than five million people die each year from water-related diseases such as cholera and dysentery. All over the globe farmers and municipalities are pumping water out of the ground faster than it can be replenished.

Still, as I discovered on a two-month trip to Africa, India, and Spain, a host of individuals, organizations, and businesses are working to solve water's dismal arithmetic. Some are reviving ancient techniques such as rainwater harvesting, and others are using 21st-century technology. But all have two things in common: a desire to obtain maximum efficiency from every drop of water and a belief in using local solutions and free market incentives in their conservation campaigns.

That the planet's fresh water is consumed profligately is beyond doubt, particularly in agriculture, which accounts for 70 percent of all water use. Getting more out of each drop of water is imperative, for as the world's population increases and the demand for food soars, unchecked irrigation poses a serious threat to rivers, wetlands, and lakes. China's Yellow River, siphoned off by farmers and cities, has failed to reach the sea most years during the past decade. In North America not only does the Colorado River barely make it to the Gulf of California, but last year even the Rio Grande dried up before it merged with the Gulf of Mexico. In Central Asia the Aral Sea shrank by half after the Soviets began diverting water for cotton and other crops. Elsewhere, countless small rivers have gone dry.

Two decades ago, as an idealistic young man intent on helping India's rural poor, Rajendra Singh traveled to northwestern Rajasthan, which was suffering water shortages from excessive groundwater extraction. Shortly after he arrived in the impoverished Alwar district, two things became clear to Singh. The first was that managing water wisely was the key to helping drought-prone villages in the region. The second was that farmers were pumping far too much groundwater.

"If you replenish water, that is a green revolution," Singh told me. "But if you destroy your water capital, what kind of green revolution is that?"

An old villager showed Singh the numerous earthen dams in the district that had fallen into disrepair, their reservoirs filled with silt. They were remnants of a rainwater collection tradition that dated back 5,000 years in India, a system that used the natural terrain to channel and store the brief monsoon downpours for year-round use. But

community rainwater collection schemes fell out of favor during British rule and after independence in 1947; their neglect, coupled with overpumping of groundwater, led to a crisis in villages throughout western India. Singh became consumed with the idea of building johads, gradually helping villagers erect the earthen and stone structures all over Rajasthan.

Today he is perhaps the best known of a large group of people who have revived India's ancient rainwater harvesting techniques, which use not only dams but also underground storage tanks and large concretelined reservoirs. Singh's organization—financed by the Ford Foundation, among others—has 45 full-time employees and 230 part-time workers. He spends eight months a year on the road, rarely seeing his wife and son and often sleeping in the backseat of his chauffeur-driven car at night, no small hardship given India's chaotic, treacherous, and polluted highways.

I joined Singh for two days, traveling to a handful of villages where johads had spurred an economic revival. The success of his movement owes much to his personality, which has inspired villagers to follow his lead during the arduous process of building dams, often with their bare hands. His manner is gentle and unflappable, and he spends hours listening to villagers, sometimes sleeping in their huts and eating their food. In the hamlet of Johdi Ki Dhani, where Singh initiated the construction of three johads, the headman said Singh's quiet, persistent ways overcame the residents' initial skepticism.

"Rajendra Singh used to come as a very simple person," said Suraj Mal Gujur, 45. "He would sit among us and not act like a

big shot. He eventually established a very close relationship with us."

One of the villages Singh and I visited was Neemi, situated in dry hills about 20 miles from Rajasthan's capital, Jaipur. Neemi's farmers had pumped many of their wells dry, and some were abandoning the land for work in nearby cities. Singh helped them build several large dams, and by the end of the 1990s the reservoirs began recharging depleted groundwater, catalyzing what villagers describe as a remarkable turnaround in Neemi's fortunes.

Today Neemi is a thriving village in a fertile valley, its fields green with wheat, vegetables, watermelons, and flowers. Not only has migration to the cities stopped, but more than 400 farmworkers have also poured into Neemi to cultivate its fruit and vegetables. With more water and fodder available, the number of cattle among Neemi's 122 dairy farmers has increased sharply, quadrupling the village's milk production.

"We knew johads could have an impact," said Radhu Patel, an elderly farmer who was one of Singh's earliest supporters. "But when you're in a car and there's no driver, you can't move the vehicle. Mr. Singh was our driver. Because of his presence we have accomplished all the development you see here."

Singh attributes the growing success of his movement to a basic fact: It encourages local people to build smaller dams and reservoirs in their own backyards, rather than relying on large government-built dams, which often displace residents and transfer water far away.

"This work fulfills the need of the selfreliance of local people," said Singh. "In

a small project everyone can participate in decision-making. That's the only real way to improve a community. The community gets employment and has a feeling of ownership and control."

Sunita Narain, director of the nonprofit Center for Science and Environment in New Delhi, said rainwater harvesting is not a panacea and needs to be coupled with conservation measures and, on occasion, the big public works projects Singh abhors. Still, the work of Singh and others has had a profound impact in India, she said, and is proof of an axiom in the developing world: "Managing water well," said Narain, "is the first step in alleviating poverty."