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पर्यावरण और स्वास्थ्य पर मासिक

HEAL

SOLUTIONS FOR A HEALTHY PLANET

आशा की किरण

‘आशा दीदी’ बन शीला चौहान गाँव के
हर घर पहुँचा रही स्वास्थ्य सेवाएं

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Why a solutions webzine on planetary health?

OUR HEALTH is not separate from the nature around us. The air we breathe, the water we drink, and the soil that grows our food, directly decide how healthy we are. Today, humanity is pushing our planet to its limits—overusing natural resources and changing the climate. These environmental shifts directly affect the health of our families and communities at large.

Yet, turn on the news or open a daily newspaper, and health is almost always presented in a silo. We read endlessly about disease outbreaks, climate disasters, and contaminated food and water as disconnected crises. This unrelenting, problem-focused media coverage breeds eco-anxiety and quiet resignation, leaving citizens feeling overwhelmed rather than empowered.

At the same time, critical scientific evidence remains locked behind expensive, English-only academic paywalls, far out of reach for rural communicators, local policymakers, and common citizens. Crucial traditional ecological knowledge of indigenous communities is fading because it is rarely integrated with modern scientific validation.

To bridge the divide among policy, science, and on-the-ground action, we are launching *HEAL* (Health, Environment, Action & Learning), India's first bilingual solutions webzine dedicated to environmental health, under the CARE Project of IISER Pune. CARE is pioneering a solutions-focused approach that unites scientific rigor

with lived experience and community action—making this webzine a vital tool for that mission.

HEAL is built around the One Health concept—a holistic framework that is gaining momentum globally and across India. Today, as policy discussions increasingly recognise that human, animal, and ecosystem health are inextricably linked, *HEAL* aims to embed this approach into mainstream public consciousness. It refuses to dwell merely on what is broken. Instead, we insist on documenting who is fixing it and how.

HEAL is collaborative journalism in action. Guided by a strong editorial vision and working hand-in-hand with grassroots reporters, *HEAL* documents solution stories from media-dark corners of the country to build ground evidence that can directly inform public health and environmental health policies. While legacy media often reports on the crises in isolation, *HEAL* convenes researchers, practitioners, and communities around their actionable insights so that the response to environmental change is not just informed, but effective.

HEAL is a public platform for solutions journalism and a live engine for the action research behind it. We firmly believe along with status and warnings of a broken environment, we need simple, clear steps to thrive together.

Above all, *HEAL* is for you, our readers, to bring forward the stories that matter to your daily life. We warmly welcome your feedback and ideas. □

THE APATANI ALGORITHM

An ancient tribe's water engineering in Ziro Valley offers a masterclass in climate resilience

□ NIDHI JAMWAL

IT WAS ON a misty winter morning, in November 2022, that 33-year-old Tri-dipa Biswas, a geographer and a remote sensing & GIS analyst, first set foot in Ziro Valley in Arunachal Pradesh. Biswas, a scientist with GB Pant National Institute of Himalayan Environment, in Itanagar, had come there to assess mountain spring ecosystems and build climate-smart communities.

Located in the Lower Subansiri district, Ziro Valley was merely meant to be a pre-decided

pilot site on a research project. Yet, as Biswas walked through its pine hills and terraced rice fields and met members of the indigenous Apatani tribe, she realised she was standing inside a living laboratory of traditional ecological knowledge centred around water, which modern science now calls climate resilience.

“What captivated me was not just how the Apatani people managed water, but how their existence was woven around it,” Biswas told *HEAL*. “Their water-management system reflects an intricate and interconnected relationship between water, agriculture, ecology, and community institutions.”



In Ziro Valley, the borang system utilises bamboo pipes of varying diameters to transport water across different elevations and distances.

Over the next four years, Biswas conducted field surveys in eight representative villages of Ziro Valley—Kalung, Hari, Hija, Hong, Bamin Michi, Reru, Lempia, and Mudang Tage. She spent hours chatting with community members, young and old, and local water-management practitioners. She collected field-level data and documented irrigation channels, bamboo water-conveyance systems, agricultural terraces, storage structures and drain-age networks in Ziro Valley.

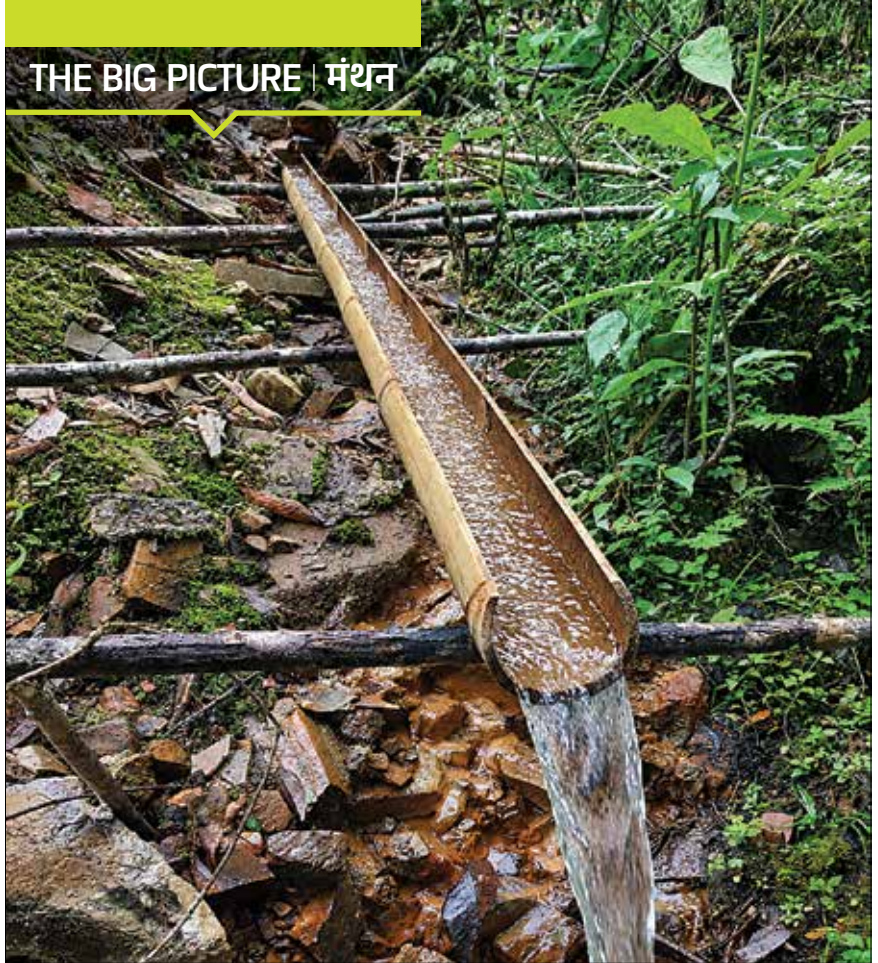
Her exhaustive research study—*‘Indigenous water resource management systems of the Apatani tribe: Bridging traditional practices with modern solutions in the Indian Himalayan Region’*—was recently published as a chapter in Volume 15 of the *Advances in Chemical Pollution, Environmental Management and Protection* (2026), an international peer-reviewed book series published by Elsevier.

Other researchers have also documented the valley’s wet-rice system, rice–fish cultivation and irrigation networks, but Biswas has filled a gap. Bringing together traditional water management, agro-hydrological integration, low-carbon infrastructure, and community governance, her research has interpreted these ancient practices through a contemporary scientific lens of climate resilience and long-term water security.

“One of the important findings of my research is that several characteristics of the Apatani system align closely with principles that are now central to the ecosystem-based adaptation approach,” Biswas told *HEAL*, who is also a member of the Brahmaputra Board for Springshed Management in the North Eastern Region under the Ministry of Jal Shakti.

“Their terraced fields and

THE BIG PICTURE | मंथन



Borang, the bamboo irrigation system in Ziro Valley. PHOTOS: TRIDIPA BISWAS

interconnected channels facilitate water distribution and management; the rice–fish system enables multiple outputs from the same water resource; bamboo and gravity-based irrigation reduce dependence on external energy; wetlands and springs provide important ecological functions; and community institutions support collective maintenance, water allocation and conflict management,” she pointed out. “This perspective is particularly relevant to India’s climate adaptation agenda.”

Apatani’s Ancient Adaptation

Centuries ago, when the Apatani tribe migrated from Tibet to Ziro Valley, its people inherited a terrain made up of steep mountain slopes and seasonal deluge. The Kille River meandered through it. Community members realised that to settle down in a bowl-shaped valley surrounded by hills required innovative water management solutions for survival. Rather than fighting the water, they learnt to live with it.

They developed a basic system of water channelling using locally available bamboo and wood, which gradually evolved into the more sophisticated

farming and irrigation system seen in Ziro Valley today. The community has maintained social cohesion around water management. Traditional institutions have evolved but retained their core principles of equity, sustainability, and community participation.

“The community has adapted agriculture to its local landscape, water availability and ecological conditions over generations. Water management is closely interconnected with agriculture, ecosystems and community institutions,” said Biswas.

She went on to narrate that water is stored, transported, distributed and reused within an interconnected system that supports rice cultivation, fish production and ecosystem functions, while its distribution and maintenance are governed through community institutions.

“The gravity-fed *bogo* channels and bamboo-based *borang* irrigation systems use natural topography and local resources/materials rather than relying on energy-intensive pumping and costly materials. At the field level, the *aji-ngyii* (fish farming) system allows the same water resource to support both crop and fish production,” explained Biswas.



Kele, the traditional wetlands in Ziro Valley; Aji-ngyii, the paddy-cum-fish cultivation system of the Apatani tribe.

Equally important is the social dimension. The *Bulyang* system provides a community-based framework for water allocation, collective maintenance and conflict management. “The effectiveness of the water management system of the Apatani tribe depends not only on the physical infrastructure but also on the institutions and collective responsibilities that support it,” the scientist said.

Borang and Bogo

The *borang* system utilises bamboo pipes of varying diameters to transport water across different elevations and distances. These are carefully selected and treated to ensure durability, with joints sealed using local materials.

There are primary distribution pipes (*danth*) and secondary distribution ones (*siiri*) that deliver water directly to the crops. This gravity-based system is labour intensive, highly efficient and has minimal environmental impact.

Apart from the bamboo network, there is the *bogo* system—a hierarchical canal network that diverts water from upland natural streams fed by springs

in the Kille River catchment. Primary channels feed secondary canals, which in turn branch into tertiary field ditches.

Aji-Ngyii: The Symbiotic Field

The Apatani tribe practises an innovative integrated farming system combining wet rice cultivation with fish farming, or *aji-ngyii*. This involves cultivating two varieties of rice (*mipy* and *emoh*) and fish (*ngyii*) in the same field. It optimises use of water by cultivating the rice in waterlogged fields while simultaneously rearing fish. This provides an additional source of nutrition and income to the local farmers.

The paddy fields have strong bunds (*agher*) and deep water channels (*khele*) around the perimeter to retain water and prevent fish from escaping during floods. These water channels, typically 30-45 centimetres (cm) deep, run through the terraced fields and provide habitat for fish, facilitate water circulation, and create microenvironments that enhance both rice and fish production, as explained in Biswas’ research.

It is a symbiotic phenomenon displaying remarkable water efficiency.

The fish feed on insects and weeds, naturally controlling the pests, while their movements aerate the soil and their excreta fertilise the paddy fields.

According to a 2018 study, this traditional system achieves impressive productivity—3-5 tons rice/ha/year and 200-500 kg fish/ha/year—without chemical inputs through natural nutrient management, including the integration of Azolla and Lemna (duckweed) as nitrogen fixers. Azolla and Lemna are small, fast-growing floating aquatic plants that support sustainable agriculture, animal feed, and wastewater treatment.

Further, water quality tests conducted across the fields in Ziro Valley found favourable parameters—dissolved oxygen (8.11 ± 0.13), pH (6.2–7.1), and controlled nutrient levels (ammonium <0.01 mg/l, nitrate 3.8 ± 0.3 mg/l)—which supported rice cultivation and aquaculture.

Customary Governance

In Apatani society, as per the principles of *bulyang*, water is not treated as a private commodity to be hoarded, nor



“The community has adapted agriculture to its local landscape, water availability and ecological conditions over generations. Water management is closely interconnected with agriculture, ecosystems and community institutions.”

TRIDIPA BISWAS, Scientist, GB Pant National Institute of Himalayan Environment, Itanagar

an unregulated free-for-all resource. It is a communal trust managed by the traditional village council of elders and representatives.

Equity and resource sharing are the pillars of *bulyang*. Water rights are tied to land parcels, but distribution timing is regulated according to crop cycles and terrain elevation. Upper terraces receive water first, but strict discharge quotas ensure that lower fields receive their required volume without delay or contamination.

Maintenance of the primary *bogo* canals is a shared community duty. Before the onset of the spring planting, villagers desilt the channels, repair worn bamboo conduits, and reinforce field bunds. Failure to participate results in social sanctions or temporary loss of water diversion rights.

Water disputes between households or neighbouring villages are brought directly before the *bulyang*. Decisions are focused on restorative fairness rather than punitive exclusion.

During dry spells or delayed monsoons, the *bulyang* activates emergency allocation schedules. Water access shifts from continuous flow to rotational turns, ensuring that fields at the tail end of the channel network receive sufficient moisture to prevent crop failure.

The Apatani hydro-agro ecosystem extends beyond the cultivated paddy terraces. It relies on a carefully managed upland catchment network that buffers the valley against climate extremes (see box: *Siirpi, Dlong, and Kele*).

However, despite its historical resilience, the Apatani water management system faces modern pressures. Monsoonal patterns in the Eastern Himalaya are becoming unpredictable. Intense short-duration rainfall events cause flash floods and landslides that threaten to breach the earthen bunds, while extended dry spells test the gravity-fed channels.

Another challenge is the migration of young community members out of the valley to pursue education and employment. The labour-intensive upkeep of the *borang* and *bogo* networks therefore is becoming difficult. In some sectors, traditional bamboo pipes are being replaced by PVC conduits—a



Bogo, the traditional irrigation channels in Ziro Valley.

SIIRPI, DLONG, AND KELE

MOUNTAIN SPRINGS or *siirpi* are considered sacred. They are managed through traditional conservation practices. The tribe has developed specific protocols for spring protection, including maintaining vegetation cover in catchment areas and regulating water extraction. Each spring has designated caretakers who ensure its sustainable use and protection.

Dlong is a traditional water harvesting reservoir that captures and stores rainwater and spring water for use during dry periods. The tribal community also maintains sacred pools called *bhubin* that serve both religious and water conservation purposes.

Kele are natural wetlands that maintain ecosystem services while supporting agricultural activities. These wetlands act as natural water purification systems and help in flood control.

short-term fix that lacks the low-carbon, biodegradable harmony of the original system. Influence of modern agriculture and synthetic fertilisers may threaten to disrupt the delicate balance of the *aji-ngyii* ecosystem.

Way Forward

According to Biswas, traditional ecological knowledge should neither be idealised as automatically sustainable nor dismissed as unscientific. “It should be treated as a knowledge system that contains hypotheses, observations, practices, ecological understanding and community institutions that can be scientifically examined, validated and improved where appropriate,” she said.

Research can provide an important bridge between traditional ecological knowledge and contemporary climate science. She said, “Scientists can work with communities to document local practices, understand the ecological principles behind them, assess their effectiveness using scientific methods, and identify which elements remain relevant under present and future climate conditions.”

“For Viksit Bharat 2047, the goal should be a knowledge partnership between traditional wisdom and modern science. We should combine satellite observations with community observations, hydrological models with local understanding of springs and streams, scientific climate projections with farmers’ experience of seasonal change, and modern institutions with effective community governance,” Biswas pointed out.

“The future of climate adaptation in India should be about co-producing solutions with communities, rather than designing solutions for them,” she concluded. □



PHOTOS: VIRENDRA SINGH

उत्तर प्रदेश में बाराबंकी ज़िले के ग्राम मतुवा की शीला देवी चौहान एक आशा कार्यकर्ता हैं।

अपने पहले बच्चे को खोने का ग़म बना ताकत; 'आशा दीदी' बन शीला चौहान अब अपने गाँव के हर घर पहुँचा रहीं स्वास्थ्य सेवाएं

□ वीरेंद्र सिंह

बाराबंकी, उत्तर प्रदेश

देश के ग्रामीण इलाकों में आज भी स्वास्थ्य सेवाओं की पहुँच हर गाँव और हर परिवार तक नहीं है। कई गाँवों में अस्पताल और प्रशिक्षित स्वास्थ्यकर्मी नहीं हैं, तो कहीं स्वास्थ्य को लेकर ज़रूरी जानकारी, समय पर जाँच, दवाओं और संसाधनों की कमी है।

ऐसे में 'आशा' कार्यकर्ता ग्रामीण परिवारों को औपचारिक स्वास्थ्य सेवाओं से जोड़ने में अहम भूमिका निभाती हैं। गर्भवती महिलाओं की पहचान और उनकी जाँच से लेकर संस्थागत प्रसव, बच्चों के टीकाकरण और विभिन्न सरकारी स्वास्थ्य अभियानों को घर-घर तक पहुँचाने में उनका बड़ा योगदान है। केन्द्रीय स्वास्थ्य एवं परिवार कल्याण मंत्रालय की 2024-25 की वार्षिक रिपोर्ट के अनुसार देश में 10.29 लाख आशा महिलाएं कार्यरत हैं।

उत्तर प्रदेश में बाराबंकी ज़िले के ग्राम मतुवा की

शीला देवी चौहान भी ऐसी ही एक आशा कार्यकर्ता हैं।

इनके ज़िम्मे 314 घर और 1,300 से अधिक लोगों की आबादी है। करीब डेढ़ दशक पहले अपने पहले बच्चे को कोख में खोने के बाद उन्होंने आशा कार्यकर्ता बनने का फैसला किया। उनका मानना है कि जिस जानकारी की कमी के कारण उन्हें अपनी पहली गर्भावस्था में मुश्किलों का सामना करना पड़ा, वैसी स्थिति किसी दूसरी महिला के सामने न आए।

“हमें कुछ पता ही नहीं था। बच्चा पेट में उल्टा था। घर वाले झोलाछाप डॉक्टर के पास ले जाते रहे। समय निकलता गया,” 38 वर्षीय शीला कहती हैं। “और मेरा बच्चा पेट में ही खत्म हो गया। मृत पैदा हुआ...”

इस घटना के बाद शीला को लगा कि ग्रामीण महिलाओं के लिए स्वास्थ्य संबंधी सही जानकारी और समय पर इलाज कितना ज़रूरी है।

“मैं सोचती थी कि मेरे साथ जो हुआ, वह जानकारी के अभाव में हुआ। अगर गाँव में कोई आशा होती, जो मुझे बताती कि उल्टा बच्चा होने पर तुरंत बड़े अस्पताल जाना चाहिए, तो आज मेरा पहला

बच्चा मेरे साथ होता। तभी मैंने तय किया कि अब मैं खुद वह आशा बनूँगी,” शीला कहती हैं।

दो साल बाद, 2012 में, उन्होंने आशा कार्यकर्ता के तौर पर काम शुरू किया।

ग्रामीण महिलाओं की आशा

शीला घर-घर जाकर महिलाओं को संस्थागत प्रसव के लिए प्रेरित करती हैं। उनके मुताबिक, गाँव में स्वास्थ्य सेवाओं को लेकर लोगों में पहले की तुलना में काफ़ी जानकारी आई है।

“एक गर्भवती महिला का पता चलते ही हमारी ज़िम्मेदारी शुरू हो जाती है। उसकी चार बार जाँच, हीमोग्लोबिन, वज़न, टीटी के टीके, आयरन की गोलियाँ, संस्थागत प्रसव के लिए प्रेरित करना, फिर बच्चे के जन्म के बाद 5 साल तक उसका टीकाकरण—बीसीजी, पोलियो, खसरा—सब कुछ देखना होता है,” शीला बताती हैं।

आशा कार्यकर्ता के तौर पर काम करते हुए शीला के सामने कई आपात स्थितियाँ आई हैं। पर उन्होंने हिम्मत नहीं हारी और हर मुश्किल का डट कर सामना किया। “एक बार हम एक गर्भवती महिला को लेकर डिलीवरी के लिए जा रहे थे कि रास्ते में ही उसे तेज प्रसव पीड़ा शुरू हो गई। सीएचसी अभी दूर था। हालात बिगड़ रहे थे। हमें रास्ते में ही उसका प्रसव



शीला घर-घर जाकर महिलाओं को संस्थागत प्रसव के लिए प्रेरित करती हैं।

कराना पड़ा। आज जच्चा-बच्चा दोनों स्वस्थ हैं। ईश्वर ने हमारी लाज रख ली,” वह कहती हैं।

शीला गाँव में कुपोषित बच्चों की पहचान करती हैं और टीबी, कुष्ठ रोग, फ़ाइलेरिया जैसे रोगों के संभावित मरीज़ों की जानकारी स्वास्थ्य विभाग तक पहुँचाती हैं। पल्स पोलियो, दस्तक और परिवार नियोजन जैसे सरकारी कार्यक्रमों को भी घर-घर तक पहुँचाने में उनकी भूमिका रहती है।

शीला के मुताबिक, उनके काम का कोई निश्चित समय नहीं है। किसी गर्भवती महिला को सुबह चार बजे प्रसव पीड़ा हो सकती है तो किसी को रात के दो बजे। ऐसे में उन्हें किसी भी समय अस्पताल जाना पड़ सकता है। उनके घर से सामुदायिक स्वास्थ्य केंद्र करीब 16 किलोमीटर दूर है।

ग्राम प्रधान मगरौड़ा के मुताबिक शीला के आने के बाद गाँव में संस्थागत प्रसव को लेकर जागरूकता बढ़ी है। उनका कहना है कि पहले कई महिलाएँ घर पर दाई की मदद से प्रसव कराती थीं, जबकि अब अधिकतर महिलाएँ अस्पताल जाती हैं।

आज मतुवा गाँव का हर परिवार उनको इज़्ज़त की नज़र से देखता है, पर पहले ऐसा नहीं था। आशा कार्यकर्ता बनने के शुरुआती दिनों में शीला को सामाजिक विरोध का भी सामना करना पड़ा। नई बहू का घर-घर जाकर काम करना गाँव के कुछ लोगों को पसंद नहीं था। शीला बताती हैं कि शुरुआत में उन्हें सुनना पड़ा, “घर की नई बहुरिया घर-घर घूम रही है।”

इस दौरान उनके पति नंदलाल चौहान ने उनका साथ दिया। शीला के मुताबिक, पति के सहयोग से ही वह बिना झिझक अपना काम कर पाईं।

बचपन का संघर्ष

शीला का जन्म बाराबंकी के अकनपुर गाँव में 1988 में हुआ। उनके पिता के पास चार बीघे ज़मीन थी और परिवार में चार बच्चे थे। इसी ज़मीन से परिवार के छह लोगों का गुज़ारा होता था। गाँव में स्कूल नहीं था। घर की सबसे बड़ी बेटी होने के कारण शीला पर परिवार की ज़िम्मेदारियाँ थीं, लेकिन पढ़ाई के प्रति उनका लगाव बना रहा।

तीन प्रमुख माँगें

- आशा कार्यकर्ताओं को राज्य कर्मचारी का दर्जा दिया जाए
- आने-जाने के लिए इलेक्ट्रिक स्कूटी
- ब्लॉक अस्पतालों में आशा कार्यकर्ताओं के लिए कमरा



शीला गाँव में कुपोषित बच्चों की पहचान करती हैं और संभावित मरीज़ों की जानकारी स्वास्थ्य विभाग तक पहुँचाती हैं। पल्स पोलियो, दस्तक और परिवार नियोजन जैसे सरकारी कार्यक्रमों को भी घर-घर तक पहुँचाने में उनकी भूमिका रहती है।

शीला बताती हैं, “गाँव में पढ़ाई का माहौल ही नहीं था। लड़कियाँ तो स्कूल जाती ही नहीं थीं। लेकिन मेरा मन हमेशा किताबों में लगता था। पिताजी ने मेरे जुनून को देखा और मुझे मेरे नाना के गाँव भेज दिया, क्योंकि वहाँ प्राथमिक विद्यालय था।”

नाना के गाँव मेड़िया में उन्होंने कक्षा पाँच तक पढ़ाई की। इसके बाद छठी कक्षा के लिए उन्हें रोज़ सात किलोमीटर पैदल जाना पड़ता था। रास्ते में एक बड़ा तालाब पड़ता था, जिस पर पुलिया नहीं थी। “पिताजी रोज़ मुझे कंधे पर बिठाकर तालाब पार कराते थे। छुट्टी के समय वह फिर तालाब किनारे खड़े मिलते थे। कई बार मेरे भाई-बहन भी साथ होते थे,” शीला बताती हैं।

आर्थिक स्थिति ऐसी थी कि पढ़ाई के साथ सभी भाई-बहनों को मज़दूरी भी करनी पड़ती थी। खेत में काम करने के बाद शाम को ढिबरी की रोशनी में पढ़ाई होती थी। इसके बावजूद शीला ने पढ़ाई जारी रखी। बीए के अंतिम वर्ष में 2008 में उनकी शादी तय हुई। शादी के बाद वह ससुराल के मतुवा गाँव आ गईं और वहीं रहते हुए एमए तक की पढ़ाई पूरी की।

आशा की मांगें

शीला आशा संगिनी संगठन से भी जुड़ी हैं। वह आशा कार्यकर्ताओं की समस्याओं और उनकी मांगों को सरकार तक पहुँचाने की कोशिश करती हैं।

शीला बताती हैं कि आशा कार्यकर्ताओं को साल भर में करीब 74 अलग-अलग मदों के तहत प्रोत्साहन राशि मिलती है। हालांकि, इन सभी मदों पर हर महीने काम नहीं होता। करीब आठ मद ऐसी हैं, जिनसे हर महीने काम जुड़ा होता है और उनसे उन्हें लगभग 2,000 रुपये मिलते हैं। बाकी मदें अलग-अलग स्वास्थ्य अभियानों और कार्यक्रमों से जुड़ी होती हैं, जो समय-समय पर चलते हैं और इनके लिए अलग से प्रोत्साहन राशि मिलती है। शीला की शिकायत है कि यह भुगतान भी समय पर नहीं मिलता।

ज़िला सामुदायिक प्रक्रिया प्रबंधक सुरेंद्र कुमार के मुताबिक, आशा कार्यकर्ता ग्रामीण स्वास्थ्य व्यवस्था में महत्वपूर्ण भूमिका निभाती हैं। बाराबंकी ज़िले में इस समय 3,387 आशा कार्यकर्ता हैं। उन्हें अलग-अलग गतिविधियों के लिए करीब 74 मदों में समय-समय पर प्रोत्साहन राशि दी जाती है। परंतु आशाओं को कोई निश्चित मासिक वेतन नहीं मिलता। □



Sarat Chandra Dehuri is a *Prakriti Guru* and has vast knowledge of the flora of his forest.

PHOTO: NIDHI JAMWAL

SALT OF THE EARTH

Sarat Chandra Dehuri of the Bhumij tribe is ensuring that the ecological wisdom of his ancestors lives on

■ NIDHI JAMWAL
Dhenkanal, Odisha

SARAT CHANDRA Dehuri may not know his exact age, but he knows everything about the trees, tubers, flowers, and wild berries in the forest where he lives. Dehuri is from the Bhumij (meaning born from the soil) tribe and he lives at Kantol village with 150 adivasi families in Kankadahad block in Dhenkanal district of Odisha.

People refer to Dehuri as *Prakriti Guru*, or Jungle Master. He holds in his head encyclopaedic knowledge about the flora of the forests. It is accumulated wisdom of tribal communities,

who have always lived in the jungles.

“Forests are our home. Because our forefathers always lived deep inside jungles, they didn’t have access to modern medicines and all treatment was natural. The same knowledge has been passed on to us,” Dehuri told *HEAL*.

For three years now, Dehuri has been on a mission to pass on his ancestral ecological learnings to the younger people in his tribe. As a Jungle Master, he takes youngsters from his village into the forests to give them a tutorial on the bounty of nature.

“On school holidays, I take 10-15 children into the forest. Together, we identify and collect leaves, twigs, fruits, berries and tubers. I tell them the medicinal and health benefits of each of the collected items. This knowledge is our heritage,” said Dehuri, who is also the president of the Kantol Village Development Committee.

Dehuri is one of the 152 Jungle Masters across 72 villages in four districts

of Odisha who are documenting biodiversity in their forests by creating village-level ecological registers. They lead guided walks into the forests to do this. Foundation for Ecological Security, a non-profit, is coordinating their efforts.

Traditional Ecological Knowledge

This ancient wisdom of tribal communities is now globally acknowledged as traditional ecological knowledge (TEK). TEK is a cumulative body of observations, oral traditions, cultural beliefs, and resource-management practices refined over millennia and passed down generations.

Unlike modern industrial approaches that often view nature as a resource for extraction, TEK approaches ecosystems holistically. Lived experiences, long-term observational data, understanding micro-climates, tracking species behaviour, preserving medicinal plants, and practising nature-based



“The bark of the sal tree is a natural antiseptic. We dry it, turn it into powder and apply it on a wound to heal it. The seeds are also powdered and consumed to treat stomach infection.”

SARAT CHANDRA DEHURI, Jungle Master

adaptive techniques, are some of its tenets.

TEK has emerged as a subject of interest and research for the scientific community especially in the context of climate change, biodiversity loss, and food security challenges.

Bounties Of The Forest

Giving an example of the Sal tree (*Shorea robusta*, a native Indian forest tree found in central and eastern India), Dehuri said: “Our forest is full of sal trees and every part of it has medicinal properties. The bark is a natural antiseptic. We dry it, turn it into powder and apply it on a wound to heal it. The seeds are also powdered and consumed by both humans and cattle to treat stomach infection [diarrhoea and dysentery].”

Oil is extracted from the sal seeds and used for cooking. It is also used as a mosquito repellent. “The twigs are used as *datun* (toothbrush) and the leaves are stitched together to make plates. The sal tree’s strong fibrous roots are used to make sturdy ropes,” he continued.

The tribal families in Kantol need not look outside for anything. Forest resources meet almost all their needs through the year, Dehuri pointed out. Besides collecting forest produce, the villagers cultivate paddy in the *kharif* (monsoon) season and vegetables like brinjal and beans in the *rabi* (winter) season. “At the most, we buy *moong* [lentil] from the market,” he said.

This intimate knowledge of the forests helps the tribal communities survive difficult times. “Whenever there is a shortage of food, we pray to the local *solopo* tree [*Caryota urens*] before felling it. Parts of the tree are distributed to all the families in the village who dry it and make a powder out of it that resembles rice flour. We make a cake out of it to eat and no one goes hungry,” Dehuri said.

Indigenous wisdom keeps hunger away. If there is a shortage of rice, families collect mango kernels, first dry them and then soak them for a day. These are then ground into a paste and turned into *pitha*, a kind of pancake.

“There are at least 10-12 types of wild potato that we eat. In July and August, we eat *pita alu* [*Dioscorea bulbifera*, or the air potato]. In September, we consume *pani alu* also called Pichhuli, which has a high moisture content. In May and June, we eat *tunga aru* [*Dioscorea*],” explained Dehuri.

To ensure that the wild tubers are not poisonous or contaminated, tribal people have a unique practice of washing these tubers. “We first rub tubers on a tree and then cut them into pieces. These cut tubers are kept in running water for 24 hours. Thereafter, we boil and eat them,” said Dehuri.

Healing With Nature

The forest is a source of medicines to the communities living in its protection. The root of *agnijwala* (*Woodfordia fruticosa*, commonly known as the fire-flame bush or Dhataki) is made into a paste with water and fed to someone afflicted with a stomach infection and in a day, the patient feels better, said Dehuri.

He knows as this is what he treated his father with. “His infection was so severe he could not even get out of bed. I brought the root of *agnijwala* and my wife and daughters made it into a paste for my father who had it and within a day he was walking around,” recalled Dehuri.

There are trees and other plants in the forests that are also sources of water. As a Jungle Master, Dehuri teaches his young wards to identify them so that those trees could be tapped for drinking water in times of need.

“If you make a small cut in the *Atundi*

(*Combretum roxburghii*) climber at a height of five feet, you can get a glass of water. Go up another five feet and you can get another glass of water,” he said.

A 2023 research study, titled *Atundi* (*Combretum roxburghii* Spreng.): a medicinal climber with ecological & pharmacological significance, has recorded the ethnomedicinal values of the *Atundi*. Based on detailed interviews of tribal communities, the researchers have documented that its bark paste is applied externally to reduce inflammation by the Sabar community.

The mature leaf paste is used against skin infection by the Bathudi community in Mayurbhanj. The Khadia community in Sundargarh crush its young white leaves and make juice, which is consumed to treat diarrhoea. This joint research study was led by the Department of Life Sciences, Rama Devi Women’s University, Bhubaneswar, Odisha.

Predicting Weather

The indigenous people make good weather forecasters, said Dehuri. “If in early mornings, there are water drops falling from either the *arjun* or *asan* tree, we know it is going to rain heavily in the next 10-15 days. We can also predict weather from the sound of the winds.” The *Arjuna* tree (*Terminalia arjuna*) and the *Asan* tree (*Terminalia elliptica*, syn. *Terminalia tomentosa*) are closely related large deciduous trees.

Traditional indigenous forecasting also relies on bio-indicators like insect behaviour. “If black ants start to climb up the trees along with their eggs, it means that it will rain in the next few days. But, if a *naati puk* insect climbs up trees and starts eating its leaves, then there won’t be any rainfall,” said Dehuri. *Naati puk* is an edible stink bug belonging to the genus *Coridius* and is also called *Gandhi Puk*. □

“Large windows, sunlight, and open spaces have healing power, and must be integrated into hospital design”

DR ANKIT THAKKER, Managing Director and CEO of Jupiter Lifeline Hospitals, Pune speaks to PANKAJA SRINIVASAN about the importance of ecologically sustainable hospitals. Jupiter Hospitals recently won the H.E.L.P Sustainability Excellence Award 2026

● **Jupiter Hospital has received recognition for its sustainable building design and eco-friendly infrastructure. Tell us more about it.**

Our approach started at the design table, not after construction. We sought the Indian Green Building Council Platinum certification from day one. This meant energy, water and waste weren't afterthoughts—they were central to decision making.

On the energy front, we prioritised high-efficiency HVAC (Heating Ventilation and Air Conditioning) and chiller systems along with an AI-based on-site chiller plant optimiser, the first of its kind installation in the country.

For water, we have designed a zero-discharge building with builtin sewage treatment plant (STP). Treated water is recycled for flushing and landscaping, rainwater harvesting, and low-flow fixtures across patient and staff areas. Segregation of waste is engineered into the workflow—biomedical, general, and e-waste—are all segregated and disposed of by licensed agencies.

● **Sustainability is a continuous process rather than a static achievement. How are these practices being embedded into the hospital's daily routine?**

We've built sustainability metrics into our regular operational reviews the same way we track infection rates: daily energy consumption per department, water use per day, waste segregation compliance along with periodic monitoring of the energy performance index. Housekeeping, biomedical engineering, and facilities teams are trained on these as standard operating procedure,



Ankit Thakker informs that Jupiter Hospital has a solar and wind energy portfolio of about 12 MW.

not a one-time induction.

We're working toward deeper energy self-sufficiency: expanding renewable capacity to the maximum permissible limits. We already have a solar and wind energy portfolio of about 12 MW that generates the majority of our energy needs. We will keep adding to this as our bed strength increases. We are pushing efficiency further in high-consumption areas like operation theatres, ICUs, and diagnostics.

● **From your perspective as a healthcare leader, why is**

sustainability no longer just an optional CSR initiative, but an operational and ethical necessity for modern hospitals?

A hospital consumes enormous energy and water while also producing significant waste. While we understand that this is a necessary consequence of protecting human life, we must also protect environmental health. And increasingly, its financial logic too—energy and water efficiency initiatives, while higher on initial capital expenditure, help in lowering operating expenses, and insulating against inflation in power costs.

● **How does environmental stewardship intersect directly with clinical outcomes and patient care?**

We strongly believe that besides clean air and water quality, one of the most underrated elements in hospital design is access to fresh, un-tinted daylight. Large windows, natural sunlight and open spaces have huge healing power and these must be integrated into hospital design. This is a common feature across all the Jupiter Hospitals.

● **For hospital administrators across India who are just starting out on this green transformation: what is your single key message to inspire industry-wide action?**

One must be intrinsically motivated. It is just responsible behaviour. Green initiatives are much easier to implement if they're integrated into the design from the planning and building stage. It is much harder to retrofit. So, I would urge everyone, who is in the process of designing a new one, to do it right the first time. □



PHOTOS: GOPAL MS

The Rocket Stove Makers of Palghar

Building their own energy efficient mudstoves has improved both lives and livelihoods of tribal women in north Maharashtra

■ NITISHA AGRAWAL

Palghar, Maharashtra

IN ANWIR VILLAGE in Palghar district of north Maharashtra, Navshi Kamlesh Vartha Tai is putting the finishing touches to the meal she is cooking. Pointing to a *chulha* on which she is making her *bhakris* (a local flatbread), the 35-year-old said how the 'rocket stove' had cut down her time in her kitchen.

Not just that, the indigenous woman from the Warli tribe now handcrafts the very same energy-efficient stove for others in her village and community. Her *chulha* uses less firewood and emits very little smoke.

"I want to be able to make these 'rocket stoves' for all the women in my village. Not only do these *chulha* reduce

the drudgery of firewood collection, these stoves also release less smoke and protect women's health," Navshi Tai told *HEAL*. "I made eight *chulhas* so far in my village and I earned Rs 1,600," she added with pride.

A rocket stove is a clean-burning, efficient burner that runs on biomass, twigs, or small pieces of wood. It is designed in such a way so as to draw more air into the fire which helps the wood burn better, leading to less use of firewood. It also cuts down the smoke generation by nearly half of that of the traditional firewood stove (*see box: Rocket Stove Technology*).

In the remote *padas* (hamlets) of Palghar, 10 Adivasi women and two men were trained by a Mumbai-based non-profit Smokeless Cookstove Foundation (SCF) to make these rocket stoves using locally available materials of mud, straw, rice puff, and cow dung. Navshi Tai is one of them. This is helping tribal women earn a side income in a region notorious for

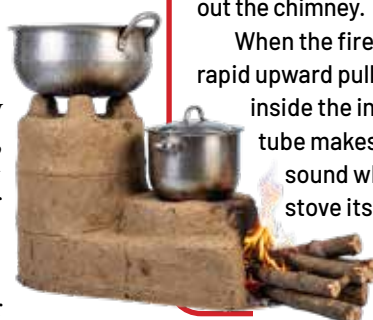
ROCKET STOVE TECHNOLOGY

A ROCKET STOVE is a clean-burning heating and cooking device that uses small biomass fuel like twigs, sticks, or agricultural waste. Its core design features an insulated L-shaped or J-shaped combustion chamber that forces a powerful upward draft, creating complete combustion and intense heat with minimal smoke.

When wood is burned it releases volatile compounds commonly known as smoke or soot. In a rocket stove, these compounds are sucked into the insulated and very hot 'burn tunnel' of the unit where they combust, releasing even more heat energy to drive the rocket process, unlike a normal fire where they are blown out the chimney.

When the fire gets hot, the rapid upward pull of air and gases inside the insulated vertical tube makes a deep, rushing sound which gives the stove its name.

Source: Smokeless Cookstove Foundation



malnutrition and migration.

Naina Tai from Anwir claims the new twin-burner *chulha* has transformed her kitchen. “I can make *dal* or *subzi* on one side and make *bhakis* at the same time on the other. The rocket *chulha* saves time and I use less firewood too,” she beamed.

“A household of about six people that typically used 12-15 kilos of firewood a day, now needs only 6-8 kilos. This has cut our daily consumption by half, even during the colder months when we need more hot water,” said Naina Tai, who is also trained in building the rocket stove.

SCF has done surveys in various blocks of Palghar to record fuelwood usage in tribal households pre and post introduction of rocket stoves. Most families have reported a 50 per cent reduction in their daily firewood consumption.

Training The Trainers

The smokeless *chulha* was not just handed over to the rural women as a dole. They were also trained to make their own rocket stove and improvise on its design. The aim was two-fold—better health, and an additional source of income (see box: *DIY Rocket Chulha*).

But before launching the training programme, a feasibility survey was conducted by SCF across Talasari and Mokhada blocks of Palghar, between December 2023 and February 2024. The survey found Anwir village’s firewood consumption was high across most households (12 to 15 kgs a day per family). The non-profit partnered with a local self-help group and held several community meetings at the village community centre, temple and the local school, before the training was initiated.

In 2024, SCF conducted a five-day training programme to teach the community members to build the rocket *chulha* from scratch, using locally available natural materials. Once trained, the 12 community members in Anwir village handcrafted and installed 40 stoves in tribal households within two months.

“During the training, we learnt that it took a lot more than technical dimensions for the rocket stove to work,” Ajay Sharma, Lead Trainer SCF, told *HEAL*. “The women’s inputs on height, pot



Tribal women in Palghar have been trained to make rocket stoves using locally available materials.

DIY ROCKET CHULHA

ONE ROCKET STOVE needs approximately 40 kgs of mud, 10 kgs of cut grass, 1-2 kgs of rice puffs, 2-3 kg of fresh cow dung, and 6 to 8 bricks.

Mixing and curing is the most labour-intensive stage of the process. It relies on techniques already familiar to tribal communities who build their home using mud.

Once cured, the mixture is shaped into doughnut-shaped blocks using SCF’s metal moulds, with a few bricks creating the fuel path.

These blocks are left to dry for 3-4 days, after which it is installed. The doughnuts are stacked to construct the burn chamber and construct a fuel tunnel. The stove once built and installed has to dry for at least five days before it can be used.

support, firewood opening and cooking practices made the stove work for their everyday lives. When women build and adapt the stove themselves, they become its real technology owners,” Sharma said.

A critical part of the training is learning the stove’s combustion design. An additional air inlet is made at the base and a fuel tunnel is cut at a 45-degree angle to increase airflow and create a fire vortex inside the burn chamber. This enables more heat and a more efficient burn.

Rocket stoves can be built in sizes varying between five and seven in diameter, and can be customised to accommodate the everyday cooking practices, including the size of the *tava* used for *bhakis*.

Apart from providing an additional source of livelihood, rocket stoves have improved the quality of life of tribal

women in Palghar. Sitaram Vartha Tai, who lives in Dablipada *pada*, recalled how once her day began at the break of dawn as she made her way into the nearby forests with other women to collect firewood to cook.

“The excursion into the forest and back took us anything between three to five hours. I do have an LPG cylinder, but that has been empty for many months now,” she said. Vartha Tai now cooks on a rocket stove that has saved her the long walk into the forest.

SCF has conducted rocket stove training programmes in 15 Indian states since 2017, especially in hard to access and marginalised communities. While the initial training and installations of rocket stoves were completed in Palghar, limited funding has constrained wider scale-up. □



PHOTOS: BRIJENDRA DUBEY

खेत के कचरे से हाइड्रोजन

क्या मिर्जापुर का नया प्रयोग भारत को देगा
प्रदूषण-मुक्त 'ग्रीन स्टील'?

□ बृजेंद्र दुबे

मिर्जापुर, उत्तर प्रदेश

साथीय राजधानी दिल्ली से करीब 700 किलोमीटर दूर मिर्जापुर के एक छोटे से गाँव में फसलों के अवशेष और कारपेंटरी के कचरे से हाइड्रोजन गैस बनाने का सफल ट्रायल हुआ है। अब इस हाइड्रोजन से 'ग्रीन स्टील' बनाने की तैयारी भी चल रही है।

भारतीय प्रौद्योगिकी संस्थान-काशी हिंदू विश्वविद्यालय (आईआईटी-बीएचयू) के सिरामिक इंजीनियरिंग विभाग के एसोसिएट प्रोफेसर प्रीतम सिंह की अगुआई में चल रहे इस प्रयोग का मकसद हाइड्रोजन का इस्तेमाल करके खदानों से मिलने वाले कच्चे लोहे (आयरन ओर) को प्रोसेस कर प्रदूषण-मुक्त 'ग्रीन स्टील' बनाना है। 'ग्रीन स्टील' का मतलब



वर्तमान में हाइड्रोजन प्लांट की उत्पादन क्षमता 200 किलोग्राम प्रतिदिन है।

है बिना कोयले या जीवाश्म ईंधन का इस्तेमाल किए लोहा या इस्पात बनाना, ताकि पारंपरिक तरीके से होने वाले भारी प्रदूषण और कार्बन उत्सर्जन को कम किया जा सके।

“हमारा मुख्य उद्देश्य उस कचरे को ऊर्जा में बदलना है जिसे लोग आमतौर पर बेकार समझकर छोड़ देते हैं या जला देते हैं,” एसोसिएट प्रोफेसर सिंह ने HEAL से विशेष बातचीत में बताया। “अगर हम कृषि और लकड़ी के इस अवशेष को सीधे उसी जगह हाइड्रोजन में बदलकर इस्तेमाल कर सकें जहाँ इसकी ज़रूरत है, जैसे कि स्टील प्लांट में, तो यह देश की ऊर्जा सुरक्षा और जलवायु परिवर्तन की लड़ाई में गेम-चेंजर साबित होगा,” सिंह ने कहा, जो वर्तमान में मिर्जापुर की 'बीजल ग्रीन एनर्जी' कंपनी (Biezel Green Energy Pvt Ltd) में वैज्ञानिक सलाहकार के रूप में इस पायलट प्रोजेक्ट को संभाल रहे हैं।

नवीन एवं नवीकरणीय ऊर्जा मंत्रालय (MNRE) के मुताबिक, भारत में हर साल औसतन 50 करोड़ टन फसल का कचरा यानी पराली और डंठल पैदा होता है। इसमें से ज़्यादातर हिस्से का इस्तेमाल पशुओं के चारे और घरों व फैक्ट्रियों में ईंधन के रूप में हो जाता है। इसके बावजूद, हर साल लगभग 14 करोड़ टन फसल का कचरा बच जाता है, जिसमें से करीब 9.2 करोड़ टन कचरे को खेतों में ही जला दिया जाता है, जिससे प्रदूषण फैलता है। वहीं दूसरी तरफ आरा मिलों और कारपेंट्री के काम से भारी मात्रा में लकड़ी का कचरा निकलता है।

क्या ऐसे कचरे के सही प्रबंधन से वायु प्रदूषण और जलवायु परिवर्तन को रोका जा सकता है?

“अगर हम बायोमास से बनी इस हाइड्रोजन का इस्तेमाल लौह अयस्क से ऑक्सीजन अलग करने में

करते हैं, तो स्पंज आयरन बनाने की प्रक्रिया में धुँएँ और प्रदूषण की जगह सिर्फ पानी की भाप निकलेगी। यही सच्चा 'ग्रीन स्टील' है," सिंह समझाते हैं।

कचरे से हाइड्रोजन की पूरी प्रक्रिया

मिर्जापुर की चुनार तहसील के रामपुर गाँव में चल रहे इस अनोखे प्रयोग के तहत एसोसिएट प्रोफेसर सिंह और बीजल ग्रीन एनर्जी की टीम ने मिलकर एक खास 'टीएडी रिएक्टर' (Thermally Accelerated Anaerobic Decomposition Reactor) बनाया। इसमें बिजली और विशेष कैटलिस्ट यानी उत्प्रेरक का इस्तेमाल होता है। एक बार में इसमें अधिकतम 2,700 किलोग्राम कृषि कचरा या कारपेंट्री का कचरा डाला जा सकता है। 2018 से लेकर अब तक इसके परीक्षण में लगभग 7.50 करोड़ रुपये का निवेश किया जा चुका है।

सिंह के मुताबिक, वर्तमान में प्लांट की हाइड्रोजन उत्पादन क्षमता 200 किलोग्राम प्रतिदिन है। औसतन 25 से 30 किलोग्राम बायोमास से 1 किलोग्राम हाइड्रोजन बनती है। यदि बायोमास में लकड़ी का कचरा ज्यादा हो, तो 25 किलोग्राम बायोमास से 1 किलोग्राम हाइड्रोजन बनती है, जबकि धान की भूसी जैसी चीजें ज्यादा होने पर करीब 30 किलोग्राम बायोमास की ज़रूरत पड़ती है।

इस प्रक्रिया की सबसे विशेष बात यह है कि इसमें कचरे को जलाया नहीं जाता इसलिए ज़हरीला धुआँ भी नहीं बनता। सबसे पहले रिएक्टर में बिजली और विशेष कैटलिस्ट की मौजूदगी में कचरा अपनी मूल संरचना छोड़कर कार्बन मोनोऑक्साइड (CO), जलवाष्प, मीथेन और कार्बन डाइऑक्साइड (CO₂) जैसी गैसों में विभाजित हो जाता है।

इसके बाद कार्बन मोनोऑक्साइड पानी के साथ रिएक्शन करती है और हाइड्रोजन में बदल जाती है। गैसों के इस मिश्रण में से पहले कार्बन डाइऑक्साइड को अलग किया जाता है। इसके बाद क्रायो-सेपरेटर तकनीक, यानी बहुत कम तापमान पर गैसों को ठंडा करने का तरीका, इससे मीथेन को अलग करके शुद्ध हाइड्रोजन प्राप्त की जाती है।

इस प्रक्रिया में केवल हाइड्रोजन ही नहीं बनती, बल्कि उप-उत्पाद (by-products) के रूप में कम धुँएँ वाला कोयला और मीथेन (LNG) भी मिलती है। वैज्ञानिक टीम पिछले कुछ सालों में बनारस के ढाबों और अंगीठियों में 35 रुपये प्रति किलो के भाव से बायोचार बेचकर लगभग 10 लाख रुपये कमा चुकी है। इसी कमाई से हाइड्रोजन की शुद्ध लागत घट जाती है, सिंह कहते हैं।

सबसे बड़ी चुनौती

वैज्ञानिकों की शुरुआती योजना थी कि इस हाइड्रोजन को सिलेंडरों में भरकर मॉडर्न हाइड्रोजन कारों में इस्तेमाल किया जाए। लेकिन यहीं पर भंडारण की दिक्कत खड़ी हो गई। "सामान्य स्टील सिलेंडर में 200 बार दबाव पर 50 किलो के सिलेंडर में सिर्फ 500 ग्राम हाइड्रोजन ही समा पाती है। 800 बार दबाव वाले महंगे कार्बन-फाइबर सिलेंडरों के लिए बेहद हाई-टेक कंप्रेसर की ज़रूरत होती है, जिसकी कीमत करीब 50 करोड़ रुपये तक जा सकती



इस प्रक्रिया में केवल हाइड्रोजन ही नहीं बनती, बल्कि उप-उत्पाद के रूप में कम धुँएँ वाला कोयला भी मिलती है।

है," सिंह समझाते हैं।

"स्वदेशी 45 लाख रुपये के कंप्रेसर का परीक्षण किया गया, लेकिन उसके ऑयल पंप की वजह से हाइड्रोजन में खराबी आ गई। चीन से 2.5 करोड़ रुपये का कंप्रेसर मंगाने की बात हुई, पर डॉलर महंगा होने से कंप्रेसर के परिवहन पर करीब 1 करोड़ रुपए खर्च होने का अनुमान है," वह आगे बताते हैं।

जब हाइड्रोजन को एक जगह से दूसरी जगह ले जाना बहुत महंगा साबित हुआ, तो सिंह ने अपनी रणनीति बदल दी। अब विचार यह है कि हाइड्रोजन को गाड़ियों में भरकर दूर भेजने के बजाय उसी जगह (on-site) बनाया और इस्तेमाल किया जाए जहाँ इसकी ज़रूरत है जैसे कि स्टील प्लांट में।

'ग्रीन स्टील' की ओर कदम

पारंपरिक तरीके से जब लोहे के अयस्क से लोहा या स्टील बनाया जाता है, तो कोयले का भारी मात्रा में इस्तेमाल होता है, जिससे भयंकर कार्बन उत्सर्जन होता है। कोयले के खनन के लिए जंगलों को साफ़ किया जाता है और इससे खूब प्रदूषण फैलता है और पर्यावरण को नुकसान भी पहुँचता है।

सिंह कहते हैं कि मिर्जापुर प्लांट की नई योजना के तहत ओडिशा, छत्तीसगढ़ या महाराष्ट्र जैसे राज्यों में जहाँ स्टील प्लांट हैं, वहीं आसपास के कृषि-कचरे से ऑनसाइट हाइड्रोजन बनाई जाएगी। इस हाइड्रोजन का उपयोग आयरन ओर से ऑक्सीजन को अलग करने में किया जाएगा। इस प्रक्रिया से स्पंज आयरन

बनेगा और धुँएँ या प्रदूषण की जगह केवल पानी की भाप बाहर निकलेगी। सिंह का कहना है कि वैज्ञानिकों की टीम 50 किलोग्राम आयरन ओर तैयार करके इस दिशा में शुरुआती सफल परीक्षण कर चुकी है।

उनके मुताबिक, वर्तमान में हाइड्रोजन बनाने की तकनीक और उत्पादन मशीनरी पूरी तरह तैयार है, लेकिन व्यावसायिक बिक्री और खरीद न होने के कारण नियमित उत्पादन रुका हुआ है।

एक सख्त नियम

इस प्रयोग में कच्चे माल का सवाल भी महत्वपूर्ण है। अक्सर यह डर रहता है कि कहीं हाइड्रोजन बनाने के लिए जो बायोमास चाहिए होता है उसके चलते जंगलों से लकड़ी को न काटा जाए। या फिर पशुओं का चारा प्लांट का कच्चा माल न बन जाए।

सिंह के मुताबिक, 'फॉरेस्ट वेस्ट' का मतलब जंगलों को काटकर लकड़ी हासिल करना नहीं है। इसके लिए मेरठ की क्रिकेट बैट इंडस्ट्री, कारपेंट्री और पैकेजिंग उद्योग से निकलने वाली बेकार लकड़ी का इस्तेमाल किया जा सकता है। इसी तरह चीनी उद्योग का बगास और प्रेसमड, राइस मिलों की धान की भूसी, कपास, मक्का, बाजरा, सरसों और सूरजमुखी के तने जैसे कृषि अवशेष भी संभावित कच्चे माल हैं।

सिंह बताते हैं कि प्लांट के शुरुआती टेस्ट के लिए अमेरिका से अमेरिकन पाइन का लकड़ी का कचरा मंगवाया गया था, पर अब पूर्वी यूपी (गोरखपुर, प्रतापगढ़) की आरा मिलों के कचरे का उपयोग हो रहा है। कारपेंट्री के कचरे के अलावा अरहर और सरसों के डंठल तथा धान की भूसी का भी इस्तेमाल किया जा रहा है।

मिर्जापुर का यह पायलट प्रोजेक्ट साबित करता है कि बायोमास से ग्रीन हाइड्रोजन बनाना तकनीकी रूप से मुमकिन है। अगर ऑनसाइट मॉडल के ज़रिये इसे स्टील और सीमेंट जैसे भारी उद्योगों से जोड़ दिया जाए, तो यह न केवल भारत के कार्बन उत्सर्जन को कम करेगा, बल्कि किसानों के खेत के कचरे को भी एक कीमती संसाधन में बदल देगा। फिलहाल तकनीक पूरी तरह तैयार है, बस इंडस्ट्री के साथ व्यावसायिक तालमेल और ऑनसाइट स्पंज आयरन प्लांट शुरू होने का इंतजार है! □

यदि बायोमास में लकड़ी का कचरा ज्यादा हो, तो 25 किलोग्राम बायोमास से 1 किलोग्राम हाइड्रोजन बनती है, जबकि धान की भूसी जैसी चीजें ज्यादा होने पर करीब 30 किलोग्राम बायोमास की ज़रूरत पड़ती है।

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