



Breaking the Barriers: Challenges and Opportunities in Banana Cultivation in Bihar

Saurav Vats¹, *Shubham Gaurav² and Sudeep Barman³

¹Ph.D. Research Scholar, Department of Horticulture (Fruit Science), Bihar Agricultural University, Sabour, Bihar-813210, India

²Ph.D. Research Scholar, Department of Agricultural Extension Education, Bihar Agricultural University, Sabour, Bihar-813210, India

³M.Sc. Research Scholar, Department of Agricultural Extension Education, SHUATS, Prayagraj, UP-211007, India

*Corresponding Author's email: shubhamgaurav048@gmail.com

A Farmer's Story: More Than Just Growing Bananas

Ram Vilas Mahto has grown bananas on his four acres near Bidupur block in Vaishali district for almost twenty years. Every February, when he plants a fresh batch of suckers, he says a small prayer — not for rain, but against it. "Bananas don't fear the sun as much as they fear the water standing around their roots," he explains, pointing to a low patch of his field still marked with the silt line from last year's flood. His day begins before sunrise: checking the drip lines, propping up bunches heavy with fruit using bamboo poles, watching the sky for the kind of dark clouds that bring not rain but wind — the kind that can flatten an entire plot of nearly-ready bananas in twenty minutes. He has taken loans for tissue-culture saplings, spent on fertilizer whose price climbs every season and hired labour that is harder to find every year as young men from his village migrate to Delhi and Punjab for construction work. And yet, when his crop is good, Ram Vilas can earn more from his four acres of bananas than most of his neighbours earn from an equivalent stretch of paddy or wheat. That tension — high risk, high reward; heavy investment, uncertain return — is the story of banana farming not just for one man in Vaishali, but for hundreds of thousands of families across Bihar. It is a crop that has quietly become one of the state's most important economic engines, even as the farmers who grow it continue to battle floods, pests, unpredictable markets and a shortage of the basic infrastructure needed to turn a hard-won harvest into a fair price. This is the story of that crop — its promise, its problems and the path Bihar must walk to fully realise what many agricultural scientists already call its "green gold."

Bihar: India's Banana Powerhouse

Bihar may not always come up first when people talk about India's fruit bowl, but in banana cultivation, the state has quietly built a formidable presence. According to figures from Bihar's agriculture department, the state's banana production has more than tripled over the past two decades — climbing from around 545,000 metric tonnes in 2004–05 to nearly 1.97 million metric tonnes in 2022–23, a rise of over 260 percent. The area under banana cultivation expanded over the same period from roughly 27,200 hectares to about 42,900 hectares, while productivity per hectare more than doubled, from around 20 tonnes to about 45 tonnes. Nationally, this places Bihar among the leading banana-producing states — commonly cited around seventh position by area and production, behind larger producers such as Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu and Gujarat, which together account for roughly two-thirds of India's total banana output. But raw rank understates Bihar's importance to the crop: few states have seen banana transform a regional farm

economy as visibly as it has in the Ganga basin districts of north Bihar. Major banana-growing districts include Vaishali (particularly the Hajipur and Bidupur blocks, home of the famous "Hajipuri Kela"), Muzaffarpur, Samastipur, Khagaria, Katihar, Purnea, Bhagalpur and parts of Saran. Vaishali and Muzaffarpur together account for the largest share of the state's banana area, benefiting from the fertile alluvial soil deposited by the Ganga and Gandak rivers. Banana is also a significant employment generator. From land preparation and planting to irrigation, staking, harvesting, bunch-carrying and roadside sorting, banana cultivation is labour-intensive at nearly every stage, offering rural employment across the calendar year rather than in the short, concentrated bursts typical of cereal crops. For thousands of smallholder families across the Ganga basin, banana is not a side crop — it is the primary source of household income. Bihar is home to the National Research Centre on Banana, based at Goraul village in Vaishali district — a reminder of just how central this crop is to the region's agricultural identity.

Why Banana Is Called the "Green Gold"

Few crops match the banana's combination of nutrition, versatility and market demand — which is why agricultural economists often describe it as a "green gold" for smallholder farmers.

- **Nutritional value:** Bananas are rich in potassium, dietary fibre, vitamin B6 and natural sugars, making them one of the most affordable sources of energy and micronutrients available to Indian households, rural and urban alike. Unlike many fruits, bananas are consumed across every income group and every season.
- **Economic significance:** India is the world's largest banana producer, accounting for roughly a quarter to a little over a quarter of global output — more than double the production of China, the second-largest producer. For a crop this dominant nationally, a state like Bihar with strong natural growing conditions has an outsized opportunity.
- **Multiple uses:** Beyond the ripe fruit, the banana plant offers value at almost every stage — raw bananas are cooked as a vegetable, the flower (mocha) is used in regional cuisine, the leaves serve as an eco-friendly plate and wrapping material and the pseudostem, traditionally discarded, is now increasingly processed into fibre for textiles, paper and handicrafts.
- **Market demand:** Banana enjoys near-universal, year-round consumer demand in India, unlike seasonal fruits whose price collapses during glut periods. This steady demand cushions banana farmers, to some extent, from the sharpest price swings that affect more seasonal produce.
- **Export potential:** India's banana exports have grown dramatically in recent years, crossing roughly USD 300 million in 2023–24, up from a fraction of that just a decade earlier, with major markets in Iraq, Iran and the UAE. Even so, India's export share remains a small fraction of its total output — under 2 percent — showing how much room remains for growth, including for a state like Bihar that has yet to build a meaningful export pipeline of its own.
- **Value-added products:** Banana chips, banana powder, banana fibre and yarn and banana-based flour are all emerging as small but promising value chains — several of which, as we will see later in this article, are now taking root in Bihar itself.

Challenges Before Harvest

For all its promise, banana cultivation in Bihar is not an easy crop to grow. It is capital-intensive, sensitive to weather extremes and vulnerable to a range of pests and diseases that can wipe out months of investment in a matter of days.

- **Lack of quality planting material.** Traditional sucker-based propagation carries a high risk of transmitting soil-borne diseases and produces uneven, genetically variable plants. Tissue-culture plantlets solve this problem — offering disease-free, uniform, high-

yielding material — but they remain out of reach for many smallholders because of cost and limited local availability of certified nurseries.

- **High cost of tissue-culture plants.** A single hectare of tissue-culture banana can cost well over a lakh of rupees to establish, factoring in plantlets, drip irrigation infrastructure and fertigation equipment. Bihar's Fruit Development Scheme currently offers a 50 percent subsidy on this cost — up to about Rs 62,500 per hectare against a unit cost of roughly Rs 1.25 lakh — a meaningful support, but one that still leaves a substantial upfront burden for farmers with limited access to credit.
- **Pest infestation.** The banana rhizome weevil bores into the underground corm, weakening the plant and creating entry points for secondary infections, while the pseudostem borer damages the plant's structural core, sometimes causing the entire plant to collapse under the weight of a maturing bunch. For a farmer like Ram Vilas, a weevil infestation discovered too late can mean losing an entire mat of plants that took a year to mature.
- **Diseases.** Three diseases dominate discussions among banana growers and scientists alike. *Panama wilt* (*Fusarium oxysporum* f. sp. *cubense*) attacks the vascular system, causing yellowing and eventual collapse of the plant and can persist in soil for years, making infected land unusable for banana cultivation without careful management. *Sigatoka leaf spot* reduces the leaf area available for photosynthesis, directly cutting bunch size and fruit quality and spreads fastest in humid, rainy conditions — exactly the climate of the Ganga basin during the monsoon. *Banana Bunchy Top Virus* (BBTV), spread by the banana aphid, causes stunted, bunched growth and renders infected plants permanently unproductive; because no banana variety is fully immune, prevention through virus-free planting material and prompt removal of infected plants remains the only real defence.
- **Climate variability, floods and waterlogging.** Bihar's north Ganga plain districts are among the most flood-prone regions in India. Banana, with its shallow root system, is particularly vulnerable to waterlogging — even a few days of standing water can suffocate roots and topple plants. Farmers in Khagaria, Purnea and parts of Muzaffarpur regularly lose entire plots to the same rivers that make their soil so fertile in the first place.
- **Drought stress and wind damage.** In years with delayed or erratic monsoon rainfall, banana's high-water requirement makes it especially sensitive to dry spells during fruit development. At the other extreme, the broad, sail-like leaves of the banana plant make it highly susceptible to wind — a single pre-monsoon storm ("kalbaisakhi," as it is locally known) can flatten an unstaked plantation overnight.
- **Soil fertility declines and high fertilizer prices.** Continuous banana cultivation on the same plots, often without adequate organic matter replenishment, gradually depletes soil fertility, while the rising cost of urea, DAP and potash squeezes already-thin margins.
- **Labour scarcity and rising cultivation costs.** As rural youth migrate out of Bihar's villages in search of non-farm work, the labour-intensive tasks of staking, de-suckering, bunch-covering and harvesting have become harder and costlier to organise, pushing up overall cultivation costs even before a single bunch reaches the market.
- **Extension Tip:** Farmers should source planting material only from certified, disease-indexed tissue-culture laboratories and avoid replanting banana on the same plot for more than two to three consecutive cycles without a break crop, to reduce the build-up of Panama wilt inoculum in the soil.

Marketing Challenges: Producing Is Easier Than Selling

Ask any experienced banana grower in Vaishali and they will tell you a hard truth: growing a good crop is only half the battle. Selling it well is often harder.

- **Price fluctuations** are a constant source of anxiety. Because bananas cannot be stored for long, farmers are often forced to sell quickly after harvest regardless of the prevailing

price, leaving them exposed to sharp swings driven by local supply gluts, festival demand cycles, or simple market rumour.

- **Dependence on middlemen** remains deeply entrenched. Most smallholders sell their standing crop or freshly harvested bunches to local traders (aratiyas) who control transport, grading and onward sale to distant mandis. This chain of intermediaries typically captures a disproportionate share of the final consumer price, leaving the farmer with a fraction of what the fruit eventually sells for in a city market.
- **Lack of organized markets** compounds the problem. Few districts in Bihar have dedicated wholesale banana markets with transparent price discovery, standardized grading, or auction systems, forcing farmers to negotiate one-on-one with traders who hold most of the information and bargaining power.
- **Poor bargaining power** is a direct consequence of fragmentation: an individual farmer with two or three acres has almost no leverage against a trader who can simply move to the next farmgate if the price offered isn't accepted.
- **Transportation costs** eat further into margins, particularly for farmers in more remote blocks who must pay to move perishable bunches to the nearest functional market before quality deteriorates.
- **Limited market information** means many farmers simply do not know the prevailing price in a neighbouring district or state on a given day, making it difficult to time sales or negotiate confidently.
- **Delayed payments** from traders — sometimes stretching over weeks — create cash-flow stress for farmers who have already spent heavily on inputs and now need funds for the next planting cycle.
- **Weak Farmer Producer Organizations (FPOs)** mean that, in most banana-growing blocks, farmers still lack the collective institutional structure that could allow them to aggregate produce, negotiate bulk sales, invest jointly in grading and packaging, or access formal credit and government schemes as a group rather than as scattered individuals.

Together, these factors mean that even in a good production year, the price a Bihar banana farmer actually receives can lag well behind what the fruit fetches downstream — a gap that organized marketing, not better cultivation alone, is needed to close.

Post-Harvest Challenges

Banana's greatest agronomic strength — its fast growth and heavy yield — is also its greatest post-harvest weakness: it is one of the most perishable fruits grown in India.

- **High perishability** means that once a bunch is harvested, the clock starts ticking almost immediately. Without proper handling, ripe bananas can spoil within a matter of days, especially in Bihar's hot and humid climate.
- **Lack of cold storage** facilities specific to banana (as opposed to potato, which dominates Bihar's existing cold-storage capacity) leaves farmers with almost no way to hold produce back from the market even briefly to wait out a price dip.
- **Poor packaging** — bananas are still commonly transported in loose bunches stacked on open trucks or bullock carts — leads to bruising, pressure damage and accelerated ripening, all of which reduce the price a farmer can command.
- **Absence of ripening chambers** is a particularly significant gap. Controlled, uniform ripening using ethylene chambers allows traders to supply consistently good-quality fruit to distant markets on a predictable schedule; without such infrastructure, ripening happens unevenly and haphazardly, often in open, informal conditions.
- **Limited processing industries** mean that culled or lower-grade fruit — which in a more developed value chain would go into chips, powder, or puree — is frequently simply discarded, representing pure economic loss.
- **Transportation losses and wastage** are the cumulative result of all the above: industry estimates for perishable horticultural produce in India commonly cite post-harvest losses in the range of 15–20 percent and for a highly perishable, poorly packaged crop like

banana in a state with limited cold-chain infrastructure, actual losses for many smallholders can run higher still.

Bananas are climacteric fruits — they continue to ripen after harvest through natural ethylene production. This is exactly why controlled ripening chambers can be so valuable: they let traders manage this natural process deliberately rather than leaving it to chance.

How Agricultural Extension Can Make a Difference

If there is one thread running through nearly every challenge described above, it is this: many of Bihar's banana problems are not questions of unsolved science, but of unspread knowledge and un-adopted practice. This is precisely the gap agricultural extension is built to close.

- **Farmer training and demonstrations**, run through Krishi Vigyan Kendras (KVKs) across banana-growing districts, allow farmers to see improved practices — from tissue-culture planting to drip fertigation — tested on demonstration plots before committing their own limited capital.
- **Scientific cultivation practices**, including correct spacing, timely de-suckering and proper staking to reduce wind damage, are often known to researchers but not yet routine on every farm; extension's job is to close that adoption gap.
- **Integrated Pest Management (IPM)** approaches — combining resistant planting material, field sanitation, biological controls and judicious, targeted pesticide use — can meaningfully reduce losses from rhizome weevil and stem borer without the cost and environmental burden of blanket chemical spraying.
- **Nutrient management**, guided by soil testing rather than blanket fertilizer application, can help farmers get more yield per rupee spent on inputs, directly addressing the problem of rising fertilizer costs.
- **Climate-smart agriculture** advisory — including improved drainage design, raised-bed planting in flood-prone plots and staking techniques suited to high-wind conditions — can help farmers protect their investment against Bihar's increasingly erratic weather.
- **Digital advisory services and mobile apps**, including weather alerts and pest-warning systems, are increasingly reaching even remote blocks, though their effectiveness still depends heavily on farmers receiving not just data but guidance on how to act on it.
- **Farmer field schools**, where groups of growers work through a full cropping cycle together under expert guidance, have proven particularly effective for a crop like banana, where many of the most important decisions (when to stake, when to de-sucker, how to spot early disease symptoms) are best learned through hands-on observation rather than a one-time lecture.
- **Capacity building** for extension workers themselves matters too — as banana cultivation shifts toward tissue culture, drip irrigation and export-oriented quality standards, the KVK and Horticulture Department staff advising farmers need continuous updating on the latest research and market requirements.

Technology: The Future of Banana Cultivation

Bihar's own recent experience shows just how transformative the right technology can be when it reaches the field. The state's shift toward tissue-culture banana is widely credited by the agriculture department as the single biggest driver behind the tripling of banana production over the past two decades, with disease-free, high-yielding G-9, Malbhog and China varieties replacing less reliable traditional sucker-propagated stock.

- **Tissue-culture planting material** offers genetic uniformity, disease-free starts and more predictable maturity — all of which translate into better planning for both farmers and buyers.
- **Drip irrigation and fertigation** allow precise, efficient delivery of both water and nutrients directly to the root zone, reducing water use while improving uptake efficiency — a significant advantage given banana's high water demand and the increasing unpredictability of rainfall.

- **Precision agriculture and drones** are still at an early stage of adoption in Bihar's banana belt but hold real promise for tasks such as aerial monitoring of plantation health, targeted spraying and early detection of stress or disease symptoms across large plots.
- **AI-based disease diagnosis** tools — increasingly available through smartphone apps that let a farmer photograph a leaf and receive an instant assessment — could help address the problem of diseases like Sigatoka and Panama wilt being identified too late, though their accuracy and usefulness still depend on training data relevant to local varieties and conditions.
- **IoT-based irrigation and weather advisory systems** can automate irrigation scheduling based on real soil-moisture and weather data, reducing both water waste and the labour burden of manual irrigation management.
- **Digital marketplaces and mobile advisory applications**, including platforms linked to e-NAM, offer the potential for farmers to access price information from multiple markets before deciding where and when to sell.
- **Benefits and limitations.** The benefits of these technologies are substantial, but so are the barriers to reaching every farmer: cost, digital literacy, patchy rural internet connectivity and — for AI and IoT tools in particular — a continued need for human extension support to interpret and act on the data these systems generate. Technology, in other words, is a powerful accelerant for banana cultivation in Bihar, but only when it arrives alongside the training and support that helps ordinary farmers actually use it.

Government Initiatives Supporting Banana Farmers

Several central and state schemes already touch banana cultivation in Bihar, though gaps remain in how effectively they reach every eligible farmer.

- **Mission for Integrated Development of Horticulture (MIDH)** is the umbrella centrally sponsored scheme supporting area expansion, planting material, protected cultivation and post-harvest infrastructure for horticulture crops, including banana, with the central government typically funding 60 percent of the outlay and the state government the remaining 40 percent (with more generous ratios for hill and North-Eastern states).
- **Rashtriya Krishi Vikas Yojana (RKVY)** provides states flexible funding to support region-specific agricultural priorities, which several states have used to support horticulture infrastructure, including banana-specific interventions.
- **PMKSY (Micro Irrigation)** subsidizes drip and sprinkler irrigation systems, directly supporting the shift toward the drip-fertigation approach that tissue-culture banana cultivation depends on for its full yield potential.
- **PM Fasal Bima Yojana (PMFBY)**, India's crop insurance scheme, in principle offers banana growers protection against losses from floods, storms and other weather extremes — though awareness and enrolment among horticulture farmers, as opposed to cereal growers, remains comparatively low in many districts.
- **Agricultural Infrastructure Fund (AIF)** provides medium- to long-term debt financing for post-harvest infrastructure such as cold storage, ripening chambers and processing units — precisely the kind of investment identified earlier in this article as Bihar's biggest post-harvest gap.
- **e-NAM (National Agriculture Market)** aims to create a unified electronic trading platform linking mandis across the country, offering farmers price transparency and access to buyers beyond their immediate local market — though its usefulness for a highly perishable crop like banana depends heavily on complementary cold-chain and logistics infrastructure being in place.
- **Formation of FPOs**, supported both by the central government's target of forming 10,000 new FPOs nationally and by Bihar-specific institutional platforms such as Jeevika (the Bihar Rural Livelihoods Project), offers a structural solution to the marketing weaknesses described earlier — allowing farmers to aggregate produce, negotiate

collectively and access schemes and credit as a registered group rather than as scattered individuals.

- **Implementation gaps.** Despite this fairly comprehensive policy architecture, the gap between scheme design and ground-level uptake remains real: subsidy disbursement delays, limited awareness among smallholders of what they are eligible for, uneven presence of accredited tissue-culture nurseries close to farmers and insurance products not well tailored to horticulture crops all continue to blunt the full impact of these otherwise well-intentioned programmes.

Success Stories from Bihar

Amid these very real challenges, Bihar's banana sector already offers genuine, replicable success stories worth learning from.

- **Tissue culture adoption at scale** is itself Bihar's biggest success story: under the state's Fruit Development Scheme, thousands of farmers — 3,624 in the 2024–25 financial year alone — have taken up the 50 percent subsidy for tissue-culture banana planting material, directly contributing to the state's dramatic rise in per-hectare productivity.
- **Women entrepreneurs and banana fibre.** In Vaishali district, six rural women came together with support from Jeevika to form Kera Jeevika Mahila Kela Resha Kisan Utpad Company — the state's first Farmer Producer Organisation dedicated to processing banana waste. Working out of a unit provided by the Bihar Industrial Area Development Authority in Hajipur, the group extracts fibre from the pseudostems that would otherwise be discarded after harvest, turning it into yarn used for bags, handicrafts, paper and even sanitary products — creating income from what was previously pure agricultural waste.
- **KVK-led technology demonstration.** Under the Biotech-Kisan Hub initiative run by the Directorate of Extension Education at Bihar Agricultural University, Krishi Vigyan Kendras in aspirational districts including Katihar, Khagaria and Purnea have run structured demonstrations of tissue-culture (G-9) banana alongside other livelihood interventions, helping bring proven technology directly to farmers in some of the state's most resource-constrained districts.
- **Diversified smallholder livelihoods.** Individual farmers across Bihar increasingly combine banana cultivation with allied activities — fish farming, seed production and other horticulture — to spread risk and stabilise household income across seasons, a pattern extension officers increasingly encourage as a hedge against banana's own weather and market volatility.
- **Youth-led agribusiness,** while still an emerging trend rather than a widespread pattern, is visible in a small but growing number of younger farmers and entrepreneurs experimenting with banana chips units, direct-to-consumer sales and social-media-driven marketing of Bihar's distinctive local varieties such as Malbhog and Chinia banana.

Practical Recommendations

- **For farmers:** Prioritise certified, disease-indexed tissue-culture planting material over uncertified suckers; invest in staking and drainage as insurance against wind and waterlogging; diversify income through allied activities where possible; and join or help form an FPO to gain collective bargaining strength.
- **For extension personnel:** Expand farmer field school coverage in under-served blocks, particularly in Purnea, Katihar and Khagaria; build local capacity in early disease identification for Panama wilt, Sigatoka and BBTV; and actively help eligible farmers navigate and apply for existing subsidy schemes rather than leaving awareness to chance.
- **For researchers:** Continue developing and field-testing Panama-wilt-tolerant and BBTV-resistant banana varieties suited to Bihar's specific agro-climatic conditions; and invest in low-cost, locally validated AI disease-diagnosis tools trained on regional varieties and symptoms.

- **For government agencies:** Prioritise investment in ripening chambers and cold-chain infrastructure in major banana belts under AIF; simplify and speed up subsidy disbursement processes; and expand crop insurance products specifically designed for horticulture rather than adapting cereal-crop insurance frameworks.
- **For financial institutions:** Design credit products that match banana's actual cash-flow cycle — heavy upfront investment followed by a delayed, lump-sum return — rather than generic short-term agricultural loan structures.
- **For Farmer Producer Organizations:** Focus early efforts on the two interventions farmers most consistently cite as valuable — collective marketing to reduce dependence on middlemen and shared investment in basic post-harvest infrastructure such as grading and packing sheds.

The Road Ahead

Bihar's banana story over the next decade will likely be shaped by how well the state can connect five threads that are currently only loosely woven together.

- **Sustainable banana cultivation** will require balancing the state's impressive productivity gains with long-term soil health, through crop rotation, organic matter management and continued vigilance against the soil-borne diseases that intensive monoculture can encourage.
- **Climate resilience** must move from being a reactive response to floods and storms toward proactive planning — better drainage infrastructure, flood-tolerant cultivation practices and insurance products that actually reflect banana's real risk profile.
- **Digital agriculture**, from AI-assisted disease diagnosis to e-NAM-linked price discovery, holds real promise, but only if paired with the digital literacy support that ensures ordinary smallholders — not just larger, better-resourced growers — can actually use these tools.
- **Smart extension services**, blending KVK field demonstrations with mobile advisory and farmer field schools, remain the connective tissue that turns research and technology into on-farm results.
- **Youth participation** could reshape the sector if Bihar's agricultural colleges and universities actively encourage young graduates toward agribusiness ventures in banana processing, export and digital marketing, rather than seeing farming purely as something to leave behind.
- **Export opportunities and public-private partnerships** offer perhaps the single largest untapped upside: with India's overall banana exports rising sharply in recent years, a state with Bihar's raw production base has genuine potential to build its own export-oriented supply chain — but only with the cold-chain, quality-certification and logistics partnerships needed to meet international buyer standards.

Conclusion

Ram Vilas Mahto will plant another batch of suckers this February, say his quiet prayer against the rain and once again bet a year's labour and a family's finances on a crop that can be as generous as it is unforgiving. He is not alone: across the fertile plains of Vaishali, Muzaffarpur, Katihar and Purnea, hundreds of thousands of farmers like him have already turned Bihar into one of India's most significant banana-producing states, more than tripling output in twenty years through nothing more complicated than better planting material, a little more water discipline and the willingness to try something new. What Bihar's banana farmers have proven, in other words, is that the crop itself is not the barrier. The barriers are the ones this article has traced — planting material that doesn't always reach the smallholder who needs it, markets that don't always pay a fair price, storage and processing infrastructure that doesn't yet exist at the scale the crop deserves and support systems that don't always find their way to the farmer at the right moment. None of these barriers is insurmountable and several — as Bihar's own tissue-culture story and its Jeevika-supported women's FPOs already show

— are actively being broken down, one field, one training, one institution at a time. If Bihar can extend that same momentum consistently — timely technological support, stronger institutional and financial backing, well-functioning markets and a new generation of young agripreneurs willing to build what the last generation could not — there is little standing between the state and a future where its "green gold" is recognised not just within India, but on the shelves of the world.

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