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ALTERNATIVES DEVELOPMENT

Monthly newsletter on issues of sustainable development

Reducing the drudgery of potter families through selective mechanisation in Dhubri, Assam

Celebrating National Technology Day

Contents

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The Paradigm of Technology: Innovate or Incubate

India is home to some of the earliest and greatest inventions in the world, which started and flourished under the Indus Valley Civilisation. Among the greatest innovations were the technologies for producing pottery and burnt building materials in Mohenjo-Daro, efficient water harvesting and conservation systems in Dholavira, and other tools and techniques that improved the quality of life. During that time, the Indus Valley Civilisation introduced pubic litter bins at street junctions for garbage disposal as well as inscription-based signboards. Over the centuries, these innovations evolved into technologies for agricultural products, construction, and civil engineering, including architecture, textiles, medicines, and machinery. All of these advancements contributed to leading a healthy and dignified life.

Thus, we have a 'little bit of technology in everybody's life'. Without technology, progress would be nearly impossible. From space technology and satellites that improve communication to mobile phones that help us stay connected, and superfast trains and aircraft that facilitate travel, we cannot envision a world without technology and innovation. India is home to some of the largest education and innovation ecosystems in the world, with many of our universities and institutes engaged in cutting-edge developments. Despite being at the forefront of innovations, we still find that the Nobel Prize in chemistry, physics, or even medicine continues to elude us. This merits an important question: are we innovating, or are we more into science for application?

At Development Alternatives, we believe that innovation is the profitable implementation of creative ideas – the essence and foundation of technologies. To us, technology is not merely developing a new product, but the process of developing the product. We believe that through technology, we can create a change that introduces a new dimension of performance in products, techniques, services, or even business practices. It is not only the material part of it, but the processes and ecosystem that drive the change.

In recent years, we have adopted technologies that have helped us create a difference in people's lives, particularly in the areas of water, building materials, waste utilisation technologies, and data science. Our technology for purifying contaminated water and making it accessible to rural India has helped people to improve their health and well-being. The technology of using fuel-efficient cook stoves has helped reduce the mortality of infants. The technology of producing fibres and liquid fertilisers from banana pseudo-stem has enhanced the value of these materials, which were otherwise left to rot in the villages.

Our integration of selective mechanisation in terracotta pottery production has helped reduce the drudgery of work and improve productivity without compromising the traditional knowledge and skills of potter families in remote villages of the Northeast. Similarly, our technology of valorisation of biomass waste and turning it into green briquettes and pellets has helped reduce carbon emissions from brick firing and foundry units. There is now a growing interest amongst thermal power plants to use these biomass

Access to clean and safe drinking water - a step towards a healthier life

pellets in reducing coal consumption in thermal power plants. Technologies have also been developed to reduce wastewater generation in villages and promote its productive use. The principal idea is to bring in the virtues of cities and towns to villages and make the villages a healthy and liveable habitat.

While these may not be space technologies or cutting-edge defence systems, they are the backbone to a resurgent India and Viksit Bharat. ❐

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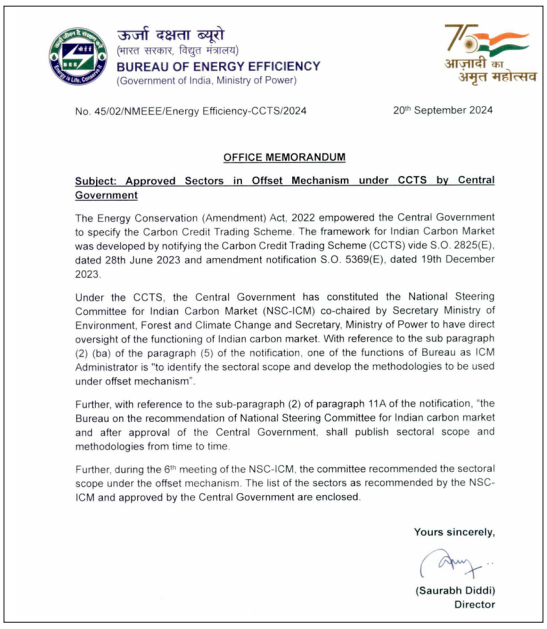
Driving Decarbonisation through Innovation: India's Offset Mechanism and the Future of Sustainable Construction

On this Technology Day, we highlight a significant advancement in India's journey towards a low-carbon future: the Offset Mechanism under the **Carbon Credit Trading Scheme (CCTS)**. This initiative, developed by the Bureau of Energy Efficiency (BEE), lays a robust, transparent, and scientifically grounded foundation for generating and trading Carbon Credit Certificates (CCCs). Designed specifically for non-obligated entities, the mechanism empowers industries to develop projects that reduce or remove greenhouse gas (GHG) emissions while aligning with the United Nations Sustainable Development Goals (SDGs).

The Offset Mechanism operates under principles that prioritise transparency, independent third-party validation, and alignment with both national and global sustainability goals. Project activities are classified under ten sectors, including energy, industry, waste management, agriculture, and notably, **construction**—a dominant sector critical to India's economic growth and climate action.



ऊर्जा दक्षता ब्यूरो
(भारत सरकार, विद्युत मंत्रालय)
BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

आज़ादी का अमृत महोत्सव

No. 45/02/NMEEE/Energy Efficiency-CCTS/2024 — 20th September 2024

OFFICE MEMORANDUM

Subject: Approved Sectors in Offset Mechanism under CCTS by Central Government

The Energy Conservation (Amendment) Act, 2022 empowered the Central Government to specify the Carbon Credit Trading Scheme. The framework for Indian Carbon Market was developed by notifying the Carbon Credit Trading Scheme (CCTS) vide S.O. 2825(E), dated 28th June 2023 and amendment notification S.O. 5369(E), dated 19th December 2023.

Under the CCTS, the Central Government has constituted the National Steering Committee for Indian Carbon Market (NSC-ICM) co-chaired by Secretary Ministry of Environment, Forest and Climate Change and Secretary, Ministry of Power to have direct oversight of the functioning of Indian carbon market. With reference to the sub paragraph (2) (ba) of the paragraph (5) of the notification, one of the functions of Bureau as ICM Administrator is "to identify the sectoral scope and develop the methodologies to be used under offset mechanism".

Further, with reference to the sub-paragraph (2) of paragraph 11A of the notification, "the Bureau on the recommendation of National Steering Committee for Indian carbon market and after approval of the Central Government, shall publish sectoral scope and methodologies from time to time.

Further, during the 6th meeting of the NSC-ICM, the committee recommended the sectoral scope under the offset mechanism. The list of the sectors as recommended by the NSC-ICM and approved by the Central Government are enclosed.

Yours sincerely,

(Saurabh Diddi)
Director

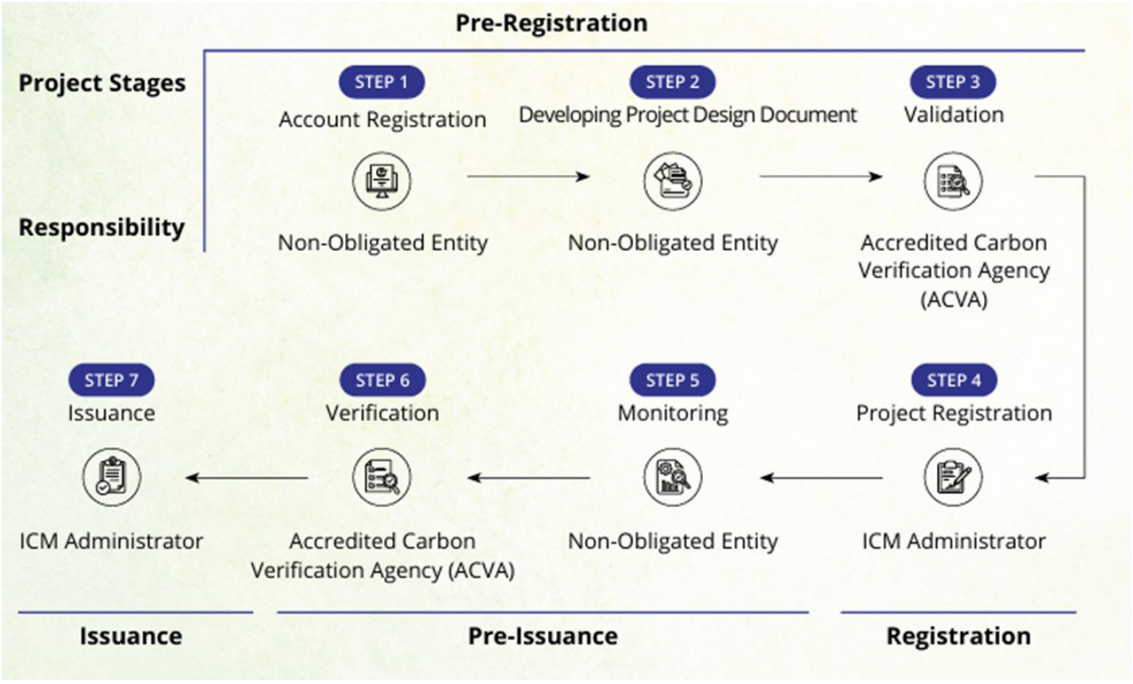
The Bureau of Energy Efficiency has released an official memorandum which has approved LC^3 under the Carbon Credit Trading Scheme

Decarbonising through innovation

With buildings accounting for a significant share of global emissions, the CCTS offers a transformative opportunity for India's construction industry. From promoting energy-efficient design and low-carbon materials to encouraging on-site renewable energy systems, the framework incentivises innovative technologies and sustainable practices. Projects that meet the stringent validation criteria can earn CCCs, opening new financial avenues for developers while pushing the envelope on green innovation.

A prime example of such innovation is the **LC^3 (Limestone Calcined Clay Cement)** technology, championed by the TARA Applied Research Centre. With a lower clinker factor and reduced thermal energy requirement, LC^3 emits up to 40% less CO_2 compared to Ordinary Portland Cement (OPC). These environmental advantages, paired with India's abundant supply of raw materials like limestone and calcined clay, make LC^3 a game-changer in the race to decarbonise construction.

The adoption of LC^3 is further supported by the **2023 Bureau of Indian Standards**



(Source: BEE March 2025)

2023 Bureau of Indian Standards (BIS) regulation IS 18189

(BIS) regulation IS 18189, which outlines comprehensive guidelines for its production and performance. This regulatory clarity, combined with increasing demand from public infrastructure and green certification bodies like LEED, is solidifying LC^3's position in India's sustainable construction narrative. Additionally, LC^3 now included as an illustrative technology under the recently published memorandum of the CCTS.

As industry experts highlight, decarbonisation in cement is not only a technological challenge but also a market-driven one. The successful adoption of low-carbon alternatives, such as LC^3, hinges on consumer awareness and demand. The offset mechanism offers a crucial push in this direction by integrating climate performance into economic incentives.

The CCTS provides a **step-by-step project cycle**—from drafting project design documents to third-party validation and CCC issuance—ensuring accountability at every stage. This framework supports innovation while maintaining scientific rigor through both stakeholder-led bottom-up approaches and administrator-led top-down methodology development.

For methodologies to qualify, they must be credible, cost-effective, and scalable. They should define realistic Business-As-Usual (BAU) baselines and accommodate region-specific factors, adhering to IPCC and global best practices. The fast-track approval process even enables quicker adoption of methodologies that have been validated under international frameworks, such as CDM and Article 6.4 of the Paris Agreement.

As India accelerates its climate commitments under the Paris Accord, the CCTS Offset Mechanism serves as a beacon of technological and policy innovation. It not only empowers industries to contribute to national emissions reduction targets but also strengthens India's position as a climate leader—where sustainable development meets economic growth.

This Technology Day, let us celebrate not only technological advancements but also the frameworks that ensure they translate into real-world climate action.

Explore the full CCTS Offset Mechanism Report by BEE India (March 2025). ❐

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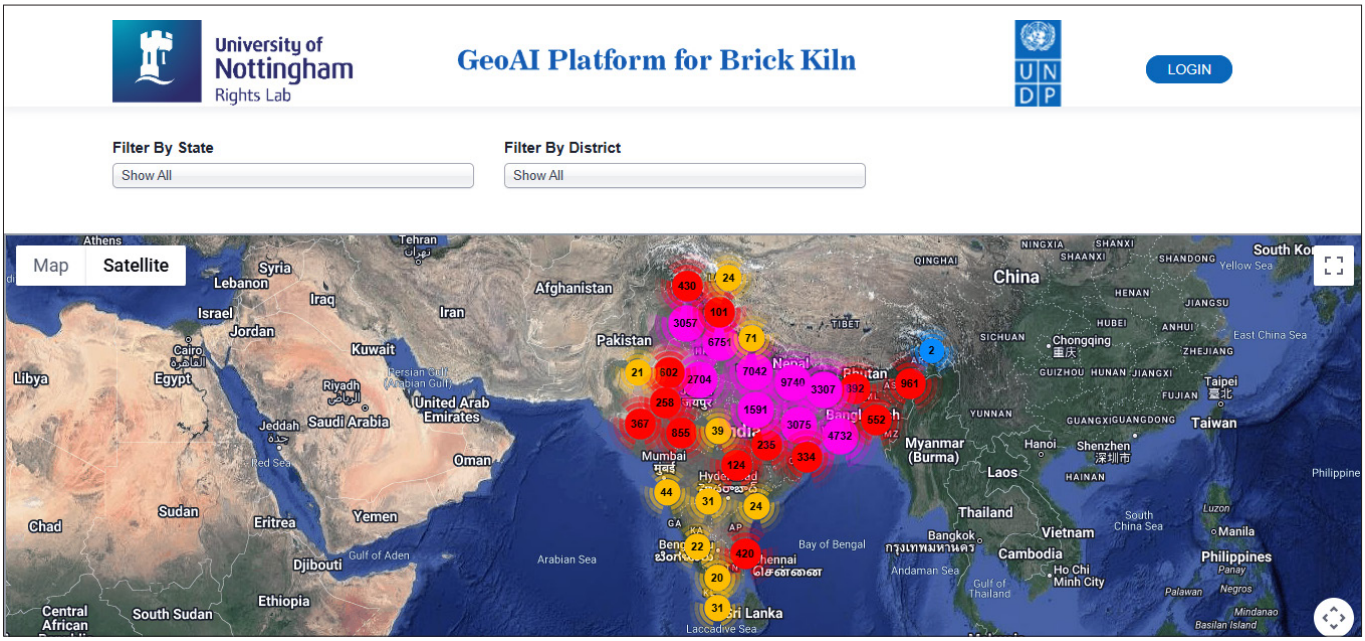
Empowering Brick Kiln Workers through GeoAI Training for Labour Inspectors in Chhattisgarh



GEO AI Dashboard: An interactive satellite-based mapping tool showcasing the concentration of brick kilns

India is the second-largest brick producer in the world, following China, with over 1.4 lakh brick kilns that collectively produce over 250 billion bricks annually [1]. However, brick kilns are major pollution hotspots—contributing to 9% of total black carbon in India (Centre for Science & Environment) [2]. They account for 8 to 14% of air pollution across the Indo-Gangetic plain, an area identified as India's 'Brick Belt' (UNDP) [3]. The sector is largely unorganised, comprising small-scale units and employing over 10 million workers, making regulation and enforcement extremely difficult.

To address these issues, GeoAI is a pioneering initiative created by the Rights Lab of UNDP India and the University of Nottingham. The application of GeoAI in India, particularly across Bihar, Chhattisgarh, and Odisha, seeks to address these systematic challenges by improving data-driven regulatory oversight. In Chhattisgarh alone, GeoAI mapped 364 brick kilns, mostly located in the districts of Raipur, Surguja, Bilaspur, and Durg.

Alongside focusing on air quality and emissions reductions, it is also very important to emphasise the working conditions of labourers. Many workers come from marginalised communities, specifically the Scheduled Castes, the Scheduled Tribes, and certain groups within the Other Backward Castes. They often migrate from within and outside the state in search of employment opportunities. When making systematic comparison between Chhattisgarh and India, it is evident that Chhattisgarh has higher migration rates in every aspect than the migration of India [4]. For example, in Gujarat, 54% of labourers who migrated came from Chhattisgarh, making it the largest source of migrant workers [5]. In Chhattisgarh, these workers often face precarious conditions, including low wages, poor working conditions, inadequate living conditions, gender pay disparities, and the absence of formal social protections. Based on the gravity model, the migration rate is directly correlated with household size and inversely proportional to origin and destination regions. Chhattisgarh

'Brick kilns are SDG Objects of Intersectionality where extreme poverty meets extreme environmental degradation'. [6]

ranks highest with a 1.9%, followed by Odisha at 1.3%, and Jharkhand at 0.8%. Empirical analysis shows that in both cases of inter-state and intra-state migration, the percentage of females is higher than that of males [7].

To address these issues, Development Alternatives, with the support of the Chhattisgarh Labour Department, initiated a pioneering programme recognising the potential of technology to transform regulatory practices. A series of targeted training programmes were conducted to capacitate 117 labour inspectors across 33 districts of Chhattisgarh to equip them with data collection and monitoring of the brick kilns, ensuring compliance with labour laws, safety standards, and the welfare of workers. The three-day training covered important aspects of GeoAI application, including data collection techniques and a comprehensive understanding of questionnaires that address environmental, site-specific, and labour welfare data. Building on these foundational efforts, the state will be better equipped with the tools to shape visionary and transformative policies that can address deep-rooted structural issues in the brick kiln sector.

With the availability of on-ground and real-time data, policymakers will be able to implement wage enhancement and standardisation measures. Currently, wages remain low, ranging approximately. ₹650 for producing 1000 bricks per day, and is often paid irregularly. Hence, the Labour Department, with the help of precise GeoAI-based inspections, can enforce fair wage regulations, linking pay to minimum wage standards and introduce performance-linked incentives to ensure workers receive just compensation for their work.

Gender-based pay disparities are prevalent in the brick kiln Industry, capturing the disaggregated data based on wage pattern and workers demographics. By using GeoAI, a forward policy mandate can be curated to ensure equal pay for equal work as enshrined in Article 39(d) of our Constitution, thereby empowering women and promoting workplace equity.

Data on site conditions assist in the enforcement of the mandatory provision of safe drinking water and basic amenities at worksites. Accessibility to clean drinking water is not a matter of welfare but a fundamental human right, essential for well-being and dignified living. GeoAI mapping of brick kiln infrastructure can aid inspectors to categorise violations and facilitate compliance, thereby improving the lives of brick kiln workers.

Through GeoAI protection, formalisation of migrant labour can be ensured. Migration from Chhattisgarh to states like Gujarat, Jammu and Kashmir, Andhra Pradesh, etc. is largely driven due to poverty and lack of opportunity in their home state, often leading them into unprotected, informal employment settings. By tracking workers' movements and documenting their employment patterns, the state can initiate policies to mandate registration of migrant workers and enable social security inclusion into formal employment opportunities.

GeoAI, is not merely a technological upgrade; it can bring catalytic policy changes that can form the cornerstone for systematic change. It provides the critical evidence needed to design, implement, and monitor labour reforms with accuracy. Thus, it empowers officials and policymakers to shift from reactive enforcement to proactive governance, ensuring that rights, welfare, and dignity of every brick kiln worker are upheld. ❐

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Enhancing Public Health in Khagaria through Technological Solutions for Arsenic Mitigation

Arsenic removal filters installed in the village

Arsenic contamination in groundwater poses a serious public health challenge, especially in regions where groundwater is the primary source of drinking water. In India, states like Bihar are experiencing alarming levels of arsenic, with the Khagaria district being one of the worst affected. The World Health Organisation (WHO) and Bureau of Indian Standards have set the permissible limit for arsenic in drinking water at 10 parts per billion (ppb). Exposure to arsenic levels beyond this limit is associated with severe health issues, including skin disorders, cancers, cardiovascular diseases, and developmental and reproductive disorders.

In an effort to tackle this crisis, a targeted intervention was implemented in the Khagaria district to not only assess the scale of contamination but also bring sustainable and community-driven solutions to the ground.

The initiative began with extensive door-to-door household surveys conducted in ten villages within the district, which captured key socio-economic and health indicators. The survey revealed that nearly 44.8% of the people had visible skin lesions or pigmentation, while 50.2% had experienced some form of skin-related ailment in the past six months—clear indicators of chronic

Outreach program being carried out at Mahda

arsenic exposure. Additionally, the surveys indicated that 24.6% of the population had never attended school, and the average annual household income stood at Rs 1,08,322, reflecting both economic and educational vulnerabilities that could hinder awareness and mitigation efforts. Furthermore, water quality testing in all ten villages showed that 84% of the samples had arsenic levels exceeding the permissible limit, confirming the urgent need for intervention.

Responding to this critical situation, a significant breakthrough was achieved with the development and installation of community-based arsenic removal filters in two villages—Mahda and Mohangadhi Kabir Math Banni. These filters were customised to suit the local groundwater quality and were designed for ease of operation and maintenance in rural environments. As a result, over 250 households of these two villages now have access to safe, arsenic-free drinking water. This intervention paves the way for a safer and healthier future by preventing continued exposure to arsenic, particularly among vulnerable populations such as children and the elderly, who are more susceptible to the long-term health effects of contaminated water.

In addition to the technical deployment, the project facilitated focused group discussions (FGDs) in all ten villages. These discussions encouraged open conversations about the health impacts of arsenic, the importance of clean water, and the community's preferences for water treatment solutions. This engagement played a crucial role in building trust and participation, which ultimately increased the acceptance and effectiveness of the intervention.

Overall, this initiative has brought about a significant shift in the public health landscape of Khagaria. It has not only reduced direct exposure to toxic arsenic levels but also enhanced community resilience through awareness, training, and participation. The success of Mahda and Mohangadhi Kabir Math Banni now serves as a replicable model, demonstrating how technological solutions rooted in community engagement can lead to lasting health improvements in vulnerable rural regions. ❐

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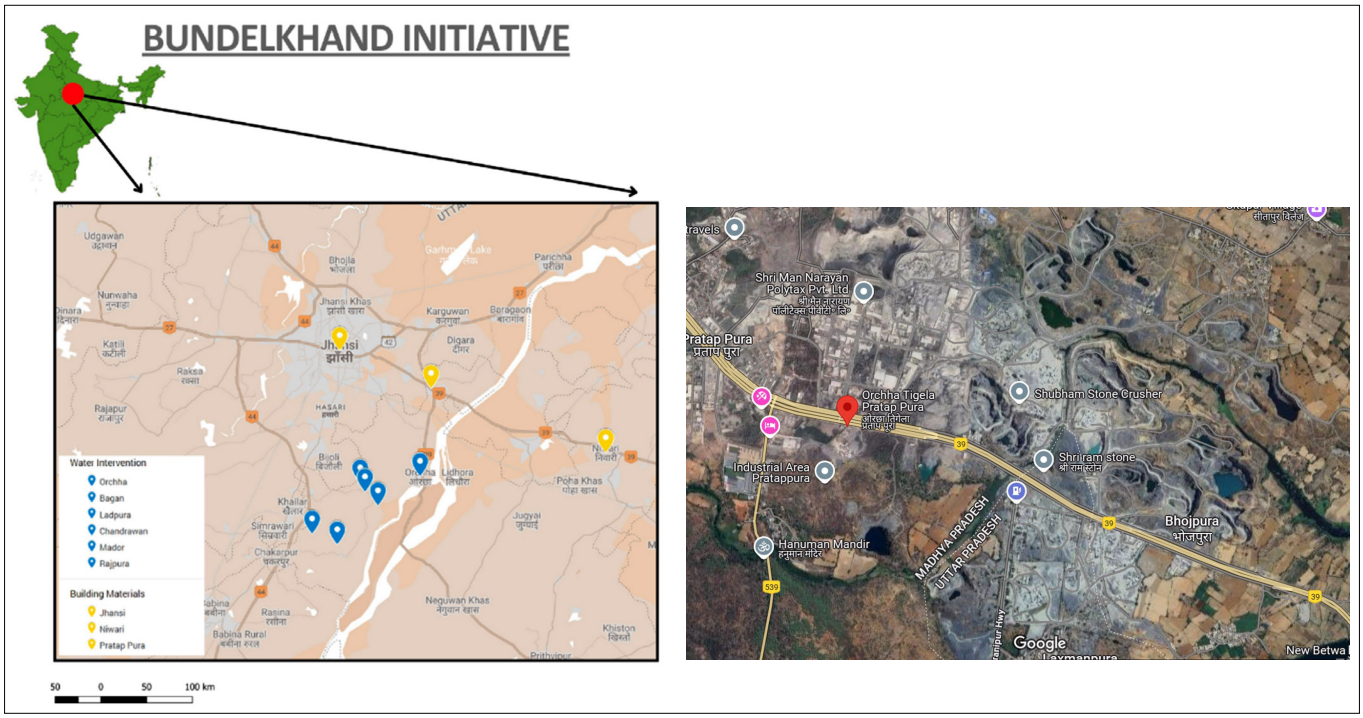
Mitigating Air Pollution through Technology and Livelihood Solutions in Bundelkhand



A regional map highlighting the areas in Bundelkhand where interventions have been carried out

Bundelkhand is a semi-arid region located at the crossroads of Uttar Pradesh and Madhya Pradesh, known for its naturally rich resources, including granite, sand, and diasporas. This resource abundance has led to the proliferation of the stone crushing industry, particularly around Orchha. However, activities like blasting, loading, transportation, and crushing have become major contributors to particulate air pollution.

The Problem

During the period of 2016–17, the levels of respirable suspended particulate matter (RSPM) and suspended particulate matter (SPM) ranged between 1400–250 µg/m³ and 3000–500 µg/m³, respectively. These values far exceed the Central Pollution Control Board's (CPCB) limits of 150–100 µg/m³ for RSPM and 500–200 µg/m³ for SPM[1].

This level of pollution poses serious occupational health hazards to workers and nearby residents, with reported cases of respiratory illnesses, skin disorders, high blood pressure, and silicosis[2].

The Solution: Technology Intervention

Development Alternatives (DA) has addressed this issue by researching the reuse of stone crusher dust as manufacturing sand (M-sand). After conducting extensive trials, DA developed a method to replace 30–40% of natural sand in building materials, including fly ash bricks, paving blocks, and MCR tiles. The complete process—sourcing raw materials, integrating M-sand, and ensuring quality—has been finalised and commercialised.

Enterprise Development

After the successful implementation of the technology, DA facilitated the establishment of local enterprises to manufacture these building materials. Over 25 enterprises have been set up in Tikamgarh, Niwari, Pratappura, and Orchha, providing skill training and creating livelihood opportunities. This initiative also helps in reducing crusher dust waste at its source.

The process of reusing stone crusher dust as manufacturing sand

Impact

- Over 300 local jobs have been created
- Significant reduction in dust-related air pollution through waste utilisation

Way Forward

1. Expand enterprise development
2. Achieve 100% utilisation of crusher dust
3. Further reduce pollution levels
4. Ensure affordable, eco-friendly building materials

This initiative is a significant step towards sustainable development in Bundelkhand, balancing environmental restoration with economic empowerment. ❐

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