VISION FOR GREEN AND CLEAN RURAL INDIA

The Sustainable Development Goals (SDGs) are India's roadmap for a sustainable future. The government is dedicated to achieving these goals by 2030, with India's significant contribution in shaping them. The Ministry of Panchayati Raj (MoPR) is actively involving Panchayati Raj Institutions (PRI) to **localize SDGs into nine themes**, fostering engagement and meaningful participation at the grassroots level. These nine themes may be read as follows:

Theme 1 Poverty free and enhanced livelihoods village

Theme 2 Healthy Village

Theme 3 Child Friendly Village

Theme 4 Water Sufficient Village

Theme 5 Clean and Green Village

Theme 6 Self-Sufficient Infrastructure in Village

Theme 7 Socially Secured Village

Theme 8 Village With Good Governance

Theme 9 Women Friendly Village

MOPR drives SDGs through diverse initiatives, partnering with ministries, communities, academia, NGOs, and international agencies.

Key Interventions

Global interest, in the idea of a clean and green society, has grown in response to rising pollution, climate change, environmental degradation, and the need for cost-effective and affordable alternative energy sources. Key Interventions are needed for efficient implementation of the theme of **'Clean and Green Village'** that will require a concentrated effort towards the following:

- Awareness generation amongst the citizens on the importance of reducing waste, ensuring sustainable production and consumption of energy, and reducing the adverse impact on the environment.
- Promotion of measures within the Gram Panchayat (GP) that would reduce environmental pollution, such as reducing the use of plastics within the GP area.
- Taking steps to create an in-depth understanding of the term 'climate change' and its impact among the Gram Sabha, Panchayat committees, and other community volunteers.
- Mapping land use patterns, water bodies, forests, hill slopes, wetlands, and degraded forests within the GP's biodiversity registers.
- Establishing sustainable norms for common resource use, assessing water sources, waste, and setting sanitation goals.
- Selection of appropriate technology for water supply and sanitation in the GP, based on participatory area assessment.
- Maintaining toilets and public spaces, creating an energy program, and pursuing Mission LIFE certification for Panchayats.

Gram Panchayats and Theme 5 - Clean and Green Village

- To achieve Clean and Green Village status, a gram panchayat should focus on conserving water and land, promoting clean energy, managing waste, and ensuring sanitation. The Green Village initiative aims for eco-resilience and community involvement.

- Rural households are equally vulnerable to climate change effects, and Panchayats play a pivotal role in tackling many of the causes and consequences of global warming.
- The Ministry of Panchayati Raj encourages eco-friendly projects, involving panchayats in resource management, waste, and eco-initiatives.

Open Defecation Free (ODF)

- Around, **52% of villages** are ODF Plus villages, i.e., nearly 4,25,691 villages, have sustained its ODF status along with implementing either solid or liquid waste management systems.
- 2,22,637 villages having arrangement of Solid Waste Management and 3,60,103 villages have arrangement of Liquid Waste Management. Various community assets have been created across villages, contributing to the ODF plus status of the GPs.

Gram Urja Swaraj Abhiyaan

- The Ministry of Panchayati Raj, in partnership with the Ministry of New and Renewable Energy, is integrating Gram Panchayats into renewable energy schemes.
- This aims to make Panchayats energy self-sufficient, transitioning from consumers to producers, fostering local revenue sources and youth employment.
- Through the **Gram Urja Swaraj Abhiyaan**, Gram Panchayats are developing unique renewable energy projects in collaboration with state agencies.
  - o Examples include windmills in Odanthurai, biogas plants in Thikekarwadi, and micro-hydel power in Meenvallam. Many Panchayats also embrace solar energy for rooftops, kitchens, street lighting, and high masts.
  - o Under the Gram Urja Swaraj Abhiyaan, as on date, 2080 Gram Panchayats have taken up and implemented Renewable Energy Projects.
- Close to 2020 Gram Panchayats have solar energy systems that are installed and are fully functional. Around 60-70 Gram Panchayats have hydel energy systems and wind energy systems that are installed and there are 106 Gram Panchayats with existing biogas energy systems.

Mission LIFE

- Mission LIFE, introduced at COP26, advocates for global sustainable living. It aims to shift from a disposable model to a circular economy, urging individuals to adopt eco-friendly habits. Panchayats are key to implementing these changes at the grassroots.
- In 2022-23, Mission LIFE's Phase 1 emphasizes "Demand Shift," encouraging 75 eco-actions across seven categories for easy adoption, minimal supply reliance, and economic compatibility, aligning with sustainability goals.
- Panchayats are pivotal for grassroots transformation, promoting eco-friendly practices and community engagement in Mission LIFE. They lead in waste reduction, renewable energy, sustainable agriculture, and incentivizing initiatives.

Capacity Building Initiatives Towards Clean and Green Village

- Capacity Building of PRIs has been one of the major activities of MOPR. The Ministry has been providing technical and institutional support for strengthening of PRIs, including advocacy support for Inter-ministerial and multi-sectoral coordination.
- The revamped Rashtriya Gram Swaraj Abhiyan (RGSA) enhances rural local governance capacities, promotes local development, and encourages thematic training at the Gram Panchayat level.

Convergence

• Achieving Clean and Green Panchayats requires collaboration and support from various government ministries, along with active involvement of NGOs, college students, and youth organizations like Nehru Yuva Kendra volunteers.

• State Panchayati Raj Departments must map activities and resources, integrating government schemes into the Panchayat Action Plan and Gram Panchayat Development Plan.

• Collaborative efforts from all levels of government are vital to safeguard the planet's future. All Gram Panchayats must embrace clean and green principles to achieve LSDGs by 2030 and address climate change challenges.

• India has taken remarkable strides in greening and cleaning rural India, notably with the historic Swachh Bharat movement since 2014. It has made significant improvements in sustainable energy development, maintaining its Paris Climate Change commitments, and reaching 100 GW of installed renewable energy capacity. Rural areas have played a crucial role in this achievement.

Case Studies

MOPR has undertaken concerted efforts at block, district, State/UT, and National Level for integration of the Clean and Green Theme. Panchayats are specially making considerable efforts and some noteworthy examples of their best practices are as follows --

a) **Kundal Gram Panchayat in Palus, Maharashtra** has achieved 100% solid waste management, implemented greywater treatment, and rainwater harvesting. They use LED lights and have a Water Treatment Plant. They've also planted 4,000 trees for afforestation and wildlife preservation.

b) **Syasan Ambagam Gram Panchayat in Hinjilicut, Odisha**, implements daily door-to-door garbage collection, waste segregation, and recycling through Community Composting. Their sanitation committee conducts cleanliness drives and creates assets like compost pits. The GP actively engages in afforestation, wildlife preservation, and employs energy-efficient solar pumps for irrigation. They practice community-based management of natural resources, ensuring biodiversity conservation and ecosystem sustainability.

c) **Meenangadi Gram Panchayat in Kerala's Wayanad district**, a _model for carbon neutrality_, implements innovative schemes like Tree Banking, promoting tree planting with interest-free loans. It has planted 1,58,816 trees and bamboo along riverbanks for soil and water conservation. The Panchayat rejuvenated water bodies conducted waste and energy audits, established a compost park, and a plastic shredding unit. Their efforts earned them the Carbon Neutral Vishesh Panchayat Puraskar under the National Panchayat Awards for 2023 of the Ministry of Panchayati Raj.

d) **Thikekarwadi Gram Panchayat, Junnar Block, Thane, Maharashtra,** was awarded Gram Urja Swaraj Vishesh Panchayat Puraskar under National Panchayati Raj Awards-2023. The Thikekarwadi GP has also come forward to make its effort towards becoming Carbon Neutral Gram Panchayat through convergence of funds.

g) **Hasudi Ausanpur, Gram Panchayat of Siddharthnagar, UP** is yet another Panchayat to have come forward to work towards attaining 'Carbon Neutrality. This Gram Panchayat has already made good progress in afforestation, renewable energy interventions (solar streetlights). installation of a smog tower, etc.

PRESERVING THE GREEN COVER OF INDIAN VILLAGES

Villages are integral to India's identity, representing its primary societal unit. However, urbanization trends are causing villages to emulate urban lifestyles, leading to concretization, expanded courtyards, and increased vehicle use, risking their traditional essence. Preserving their greenery can be a central theme for initiatives, involving stakeholders and communities to revive villages in the vision of **Viksit Bharat** by 2047. The government recognizes this through SDGs, with the **Local Indicator Framework (LIF)** focusing on **'Clean and Green Villages.'** To achieve tangible outcomes, adaptation and motivation are vital. Embracing a 'green' culture rooted in the heritage of living with nature can guide contemporary settlement planning principles. This article explores challenges and pathways to strengthen the village system for future generations.

The Top-down Facilitation

The Ministry of Panchayati Raj interfaces with 278,000 PRIs via **Rashtriya Gram Swaraj Yojana (RGSY)** for UN-recognized SDGs, with budgetary support for meaningful outcomes. LIF covers themes like poverty alleviation, community health, water sufficiency, and more. These indicators are interconnected; for example, green cover supports livelihoods and health. Achieving outcomes is measurable, but the approach is interactive and iterative. Sharing success stories is crucial for learning and adaptation.

Narrative for Engagement with Village Communities

- Trees take time to mature and have a natural cycle of aging, needing timely replacement. Effective afforestation requires consistent, long-term efforts that involve all age groups in village society.
- Children play a vital role in passing on the values, like the Chipko movement, to the next generation.
- As schemes reach grassroots and yield results, structured awareness campaigns should involve village communities in green cover preservation. Culturally significant trees, like the Indian Cedar (Deodar), can enhance preservation efforts, especially when linked to Hindu temples.
- The overlooked medicinal value of trees aligns with the Government's focus on alternative medicine, especially through the Ministry of AYUSH, offering economic opportunities and revitalizing villages. The concept of 'green villages' holds promise for holistic rural development.

Sourcing of Local Material for Construction

- The concept of 'clean and green villages' should consider using environmentally suitable construction materials to align with sustainability goals.
- Transporting materials over long distances contributes to pollution and conflicts with sustainability. Also, employing non-local materials creates environmental burdens without recycling options. In contrast, local materials, like bamboo, are eco-friendly and easily recyclable and can serve as construction and insulation options.
- Innovative architects advocate for clay, mud, stones, grasses, leaves, bamboo, and wood as appropriate alternatives for walls and roofs.
- Locally sourced materials harmonize with topography, geography, and climate. Industrial materials like concrete and masonry absorb heat and require additional energy for comfort, while local materials offer insulation, thermal mass, and indoor comfort.
- In Himachal, **Didi Contractor (a German woman)**, without formal training, pioneered eco-friendly architecture with local materials, inspiring others. **Laurie Baker**, the 'Gandhi of Architecture,' promoted cost-effective buildings and local methods. Dr. G. Shankar continued this legacy, focusing on local materials in mass housing.

Sustainable Architecture

- Sustainable village architecture should embrace 'green' principles and consider the innate competitive aspiration of villagers for urban-style designs.
- Architectural solutions should incorporate local design elements, fostering community empowerment and pride. Sustainable architecture for villages must break the traditional, financially focused model.
- There is a need to reshape the education of professionals to address contemporary village challenges. Proactive architectural interventions are essential to make village environments appealing for future generations and shift away from town-centric architecture.

Minimum Damage to Green Cover

- Construction is vital, but green cover preservation is equally important. There are no guidelines for ensuring healthy tree growth, leading to unnecessary concretization that harms green cover & groundwater recharge.
- Green cover stabilizes rainfall, prevents runoff, and maintains soil health, thus benefiting ecosystems. Traditional groundwater practices offer mineral-rich, clean water. Preserving these practices offers multiple benefits.
- Green cover includes a variety of trees and flora specific to regions. Agriculture must respect this balance, as disturbances, like recent subsistence issues in Himachal and Uttarakhand, can be disastrous. Village life requires careful interventions. Traditional Indian knowledge can offer valuable solutions.

Way Forward

Villages embody 'living with nature,' rooted in Jal-Jangal-Jamin. India's village heritage, with vernacular systems, is diverse and culturally significant. Architecture is crucial for sustainable communities. Villages offer niche tourism with green cover as an attraction. Preserving green cover involves revitalizing biodiversity and revisiting growth principles with a 'green' focus. Educational structures imparting modern and traditional Indian knowledge are vital for community involvement in revitalization efforts.

INTEGRATED SOLAR VILLAGE SCHEME FOR INCLUSIVE DEVELOPMENT

- India's updated NDCs aim for a citizen-centric approach, ensuring sustainable development while combating climate change toward a **2070 net-zero goal**. Rural areas embrace renewable energy, exemplified by solarized villages like Modhera, Dharnai, and Barapitha, enhancing access to reliable power for households and enabling vital institutions like schools and health centres to operate seamlessly.
- Solar energy in rural areas benefits homes and power companies, but "solar villages" must encompass economic development and infrastructure as well.
- **Distributed Renewable Energy (DRE)** technology, with its modular design, enhances power supply in remote areas, fostering community engagement as 'prosumers.' DRE elevates healthcare, education, internet access, livelihoods, and grid resilience. Moreover, it creates numerous jobs, as evidenced by the CEEW study, which projected 2.8 lakh jobs by 2030. Many states are emphasizing DRE in their renewable energy and solar policies, particularly for rural areas. Jharkhand, for instance, offers 100% capital subsidies to households with annual incomes below Rs. 3 lakhs.
- Furthermore, MNRE introduced a framework for integrating decentralized DRE livelihood projects, enhancing productivity, income, and clean energy access. According to CEEW-Villgro estimates, DRE innovations in agriculture and textiles have a USD 50 billion market potential and could benefit 37 million rural livelihoods in India.

- Uttarakhand and Jharkhand have plans to **establish 1,000 solar villages** in their solar policies to ensure affordable, reliable, and clean energy access. Uttarakhand targets hilly regions prone to landslides, addressing extended blackouts with *reliable electricity through DRE*. To turn these visions into reality, policymakers, industry, and developers must work together diligently.
- Governments at various levels actively promote rooftop solar and decentralized livelihood projects. MNRE provided capital subsidies for residential rooftop solar up to 10 KW under the 2019-launched **Grid Connected Rooftop Solar Programme Phase II**, resulting in about 11 GW installed by August 2023. This scheme was extended until 2026 in October 2022.

Rural Economy Needs Energy for Development

While India has made strides in achieving nearly 100% household electrification, the **UNDP's 'Energy Plus'** framework underscores that access alone isn't enough for rural livelihood development. *Reliable electricity* is crucial for households and vital services like healthcare, education, and livelihood opportunities. As of March 2023, approximately 2.86 crore households were electrified, yet the power supply quality remains a challenge.

Current Electricity Supply and Power Quality Situation in Rural Households

The power supply situation has improved over the years in the states, with some progressing towards 24-hour supply, such as Delhi, Kerala, and Gujarat. However, there is significant variation in progress both across states and within states, between rural and urban areas. Rural India faces more power supply outages compared to urban areas, with an average of 20 hours of supply. In addition, power quality issues (such as long blackouts, low voltages, or appliance damage) are experienced more by rural households compared to their urban counterparts due to voltage fluctuations.

Electricity Supply to Healthcare and Educational Institutions

Quality power supply impacts healthcare and education services, with *5% of rural primary health centres lacking electricity, 12% of sub-centres facing similar issues, and 10% of schools remaining unelectrified*, particularly in hilly regions. In areas prone to climate change-induced extreme events like the Kerala floods of August 2018, health infrastructure is significantly disrupted. These statistics make it all the more important to ensure the reach, stability, and access of renewable energy in rural India. It will not only aid the energy transition but also improve lives and livelihoods.

Learning from Past Experiences of Solarisation of Villages

Some states, such as Gujarat, Odisha, and Bihar, have already worked on solarising villages. As states work on their climate action plans and reduce emissions without compromising growth, lessons learned here can be case studies for improving the clean energy potential of other villages. While Gujarat has seen success in the Modhera Solar Village project, Odisha and Bihar have not yet realised the expected result.

Dharnai Village in Bihar

In 2014, a 100 KW solar mini-grid in Dharnai Village, Bihar, powered 400 households, a health centre, two schools, a Kisan training centre, and 50 commercial establishments. Unfortunately, after three years, the grid's battery failed due to inadequate maintenance, rendering the project non-operational. This exemplifies the tragedy of the commons, where the shared system lacked exclusive ownership, leading to maintenance issues.

Barapitha Village in Odisha

In 2015, Barapitha became Odisha's first 100% solar village, with a 1 kW foldable solar system powering street lights, lamps for 61 households, a community center, LED TV, and set-top box for weather warnings. Cyclone Fani damaged the system in 2017, and like Dharni Village, it remains non-functional, leaving villagers reliant on the grid.

Modhera Village in Gujarat

- Modhera solar village is a joint project of the Gujarat and Indian governments, costing INR 81 crore with equal state and central contributions. It includes a 6 MW ground-mounted solar facility with a 15 MWh battery storage system and 1 kW rooftop solar systems on 1,400 households.

- Over 1,700 households in Modhera, Samlanpura, and Sujjanpura receive continuous power via smart meters. Professional maintenance enhances plant usability and efficiency, reducing villagers' grid electricity bills by 60-100% and generating surplus power for additional revenue.

The cases offer three key insights for future projects. Firstly, having a clear vision and value proposition for stakeholders is vital. Modhera, with proper maintenance, supplies free power to villagers and generates additional income by supplying excess power to the grid. Secondly, defining roles and responsibilities is crucial for project success, especially in operation and maintenance. Lastly, exploring solar applications beyond rural households, like in health centers and schools, is essential for maximizing solar's potential.

An 'Integrated Solar Village Development Scheme"

States need to focus on integrated solar village development while formulating the scheme. The schemes should aim at improving the reliability and quality of power supply, boosting rural income, strengthening education and health services, and providing employment opportunities by integrating solar into the rural economy. The major contours of these schemes could be:

1. Demand Assessment - For an integrated scheme, assess the village's electricity demand, including residential, agriculture, and public buildings like schools, health centres, and more. Identify solarization opportunities and various solar applications.

2. Innovative Business Models - To meet the residential demand, there is a need to assess the viability of different business models. Deploying rooftop solar installations is suitable for pucca houses with roof ownership. However, to overcome the barriers of unsuitable rooftop conditions, high upfront costs, or a lack of consumer awareness, community solar models could be explored. It helps aggregate residential demand and set up projects on community premises.

3. Integrating Livelihoods through Decentralised Productive Appliances- This means identifying the potential applications, creating awareness, and incentivising through credit access, among others. The scheme can consider productive appliances in areas such as agriculture (grain milling, food processing, solar pumps), animal husbandry (feeders, cutters, vertical fodder grow units), and other allied activities (cybercafé computers, printing machines, blacksmith, blowers, refrigerators).

4. Integration with Existing Policies and Regulations- The scheme needs to identify its alignment with other existing state solar schemes, such as solar street lights and solar water heater programmes, among others, which can be leveraged to provide overall development in the identified solar villages. The responsible agency should work with other relevant departments to identify and integrate the schemes of other departments.

5. Skill Development and Capacity Building - The scheme should target training youth in these rural areas to become Surya Mitras, enabling solar adoption in the state. There should be a dedicated focus on gender-inclusive capacity building and employment opportunities at the local level to cater to these solar villages.

6. Models for Sustenance -Sustaining solar villages requires well-defined roles for stakeholders, from installation to maintenance. Village-level committees (VLC) should be formed in selected villages, including Gram Panchayat members, women's self-help groups, and youth groups, in collaboration with State Rural Livelihood Mission, Department of Panchayati Raj, and Department of Rural Development. These committees will coordinate with implementing agencies and relevant departments for scheme implementation.

Conclusion

The clean energy transition has favoured urban areas, but rural policies should focus on poverty reduction and clean energy promotion. Both utility-scale and distributed renewable energy (DRE) deployment are vital for a sustainable, people-oriented transition.

CROP RESIDUE MANAGEMENT: CHALLENGES AND OPPORTUNITIES

- Managing India's agricultural waste, known as crop residues (CR), sustainably and safely is a critical challenge. Harvesting and processing crops generate various materials like stubbles, stalks, stover, husk, bran, bagasse, and molasses, which are now recognized as valuable resources rather than mere waste.
- Crop residues (CR) serve multiple purposes, including livestock bedding, animal feed, bio-gas, compost, thatching, and energy production.
- Innovative technology can transform CR into valuable products like paper and boards. Unfortunately, much CR is burned on-farm, harming soil and air quality, and jeopardizing food security.
- Government enforces laws to curb CR burning, promotes tech adoption for recycling, and collaborates with states, NGOs, and institutions to raise awareness and prevent field burning.

Problem and Perspectives

- India produces 683 million tonnes of CRS annually, mostly from cereal crops. While 500 million tonnes are recycled, 178 million tonnes remain unused, with **Punjab, Haryana, and Uttar Pradesh being major culprits**. Rice and wheat contribute most to residues, and cotton dominates among fibre crops.
- On-farm CR burning harms the environment and human health, depleting soil nutrients like nitrogen, phosphorus, potassium, sulphur, and organic carbon. In Punjab, _0.824 million tonnes of NPK_ are lost annually. Retaining CR in the soil enriches it, especially with organic carbon and nitrogen.
- CR burning raises soil temperatures, harming beneficial organisms. Frequent burning depletes soil nitrogen and carbon, crucial for crop root development, impacting fertility and productivity.
- Burning CRS emits greenhouse gases like CO_2, CO, methane, sulphur and nitrogen oxides, plus particulates.
- These pollutants contribute to air pollution, climate change, and health issues, notably in Delhi. Punjab alone emits 22 million tonnes of CO_2, 0.92 million tonnes of CO, and 0.03 million tonnes of SO_2 annually from burning 15 million tonnes of paddy residues.
- CRS particulate emissions are 17 times higher than from vehicles, waste incineration, and industrial waste.
- These emissions pose health risks, especially for those with existing pulmonary and cardiac conditions.
- Additionally, CRS burning endangers livestock and wildlife.

In spite of many long-term damages to soil and human health, farmers in north-western India often opt for the burning of paddy stubbles, mainly due to three factors: -

1. A shortage of farm labour at a critical time of field operation;
2. A very short span or window for the preparation of the field for the next wheat crop; and
3. Large-scale use of a combine harvester for the harvesting of paddy.

Previously, manual labour prevented stubble in fields, but labour shortage led to automated combine harvesters leaving 20-30 cm stubble to manage. Farmers have a limited time of 10 to 20 days to remove stubble before planting wheat. Paddy straw isn't ideal livestock feed due to high silica content. While tools like rotavators and seeders exist, many farmers can't invest or prefer the convenient, cost-effective practice of burning stubble for quick field preparation.

Regulations and Solutions

- The **National Green Tribunal**, on December 10, 2015, prohibited crop residue burning in Delhi, Punjab, Rajasthan, Uttar Pradesh, and Haryana. Persistent defaulters face punitive action, including prosecution. Violators must pay environmental compensation collected by the states. In 2018-19, Punjab, Haryana, and Uttar Pradesh collected Rs.167.58 lakh, 61.72 lakh, and 28.60 lakh, respectively.

- The Supreme Court also takes stubble burning seriously and directs defaulter states to curb it. State Governments have their own regulations for addressing offenders. The Central Government introduced schemes promoting CR management and alternative technologies.

- The central sector scheme offers **50% financial aid to farmers for CRM machinery and 80% to cooperatives, FPOs, and Panchayats** for Custom Hiring Centres. These centres rent out CRM machinery affordably, including straw management systems, seeders, mulchers, crop reapers, balers, and rakes.

- With central support, Punjab, Haryana, Uttar Pradesh, and Delhi distributed 2.07 lakh machines to farmers and established 38,000 Custom Hiring Centres in the past four years.

- The Central Government revised guidelines for off-site crop residue management in four states, aiming to develop a paddy straw supply chain. Pilot projects will be established through agreements between beneficiaries and industries.

- Funding includes 65% from the Central and State Governments, 25% from industry, and 10% from beneficiaries.

- The project plans to create **333 biomass collection depots** in Punjab, Haryana, Uttar Pradesh, and Madhya Pradesh, collecting 1.5 million metric tonnes of surplus paddy straw over three years. This straw will be used for power generation, heat generation, bio-CNG, bio-ethanol production, and more.

- Indian Council of Agricultural Research developed **Pusa Decomposer tech**, in liquid or capsule form, decomposing paddy stubbles, preparing fields for wheat in 25 days, improving soil quality. It is used across 5.7 lakh hectares, equal to 3.5 million tonnes of straw, with 92% success, minimizing burning.

- To promote bio-decomposer technology, scheme guidelines were updated in August 2022, allowing demonstrations on farmers' fields using flexi funds.

- Vermicompost from partially decomposed waste benefits individuals and markets. ICAR's Krishi Vigyan Kendras showcased microbial-based crop residue management and vermicomposting to 22,700 farmers across 900 villages during **Swachhata Special Campaign 2.0** (Oct 2-31, 2022).

- Rice straw's nutritional value for livestock can be improved through physical, chemical, and biological treatments. It's useful as animal bedding, compost, mushroom substrate, biochar, mulch, and for diversifying crops to reduce burning.

Moving Forward

Collaborative efforts by Central and State Governments, along with stakeholders, reduced crop residue burning events, with a 31.5% decrease in 2022. Rs. 3,062 crores allocated for stubble management, leading to the procurement of 1.20 lakh, 72,700, and 7,480 machines and the establishment of 38,400 Custom Hiring Centres. Farm fires' contribution to Delhi's daily PM2.5 levels decreased from 48% (Nov 2021) to 34% (Nov 2022), improving AQI by 56 points. States are implementing action plans and educational campaigns for CRS management.

Crop Residues from Fabrics to Fuel
Banana pseudo stems, often discarded, hold potential as a rich source of natural fibers in major banana-producing states. Technology enables eco-friendly fiber extraction. Banana fibers are biodegradable, shiny, and dye-friendly, blending well with other natural fibers for various products like sarees, cables, ropes, nets, bio-pesticides, paper, sanitary pads, and handicrafts.
In Odisha, a startup is building **electric vehicle batteries using crop residues**. These batteries charge 8 to 10 times faster, offer 20-30% longer battery life and cost 30-40% cheaper than regular batteries. Besides, these are 100% bio-degradable. Every 100 batteries produced can help one farmer earn an additional Rs. 25,000 and prevent burning of crop residue.
Among other bio-energy options, 300 cubic meter bio-gas may be produced by anaerobic digestion of one tonne of rice residue. One tonne of paddy biomass may provide 300 kwh of electric energy through gasification. Rice straw is a potential source for production of bio-ethanol. Production of rice-straw briquettes as fuel in brick kiln and straw pellets for domestic use are also viable options for energy production.

WATER FOR CLEAN AND GREEN VILLAGES

- As discussed above, Ministry of Panchayati Raj aligns SDGs with Gram Panchayats, breaking them into 9 themes – Theme 5 being **"Clean and Green Village,"** for local action.
- Mahatma Gandhi, the father of the nation, once said that "India lives in its villages". "If villages perish, India perishes". Gandhiji had a vision of self-reliant villages; now we call them green villages. Therefore, village ecosystems need a closer study, emphasising the interactions between societal needs and life support systems.
- Clean and green entails holistic wellness encompassing hygiene, climate care, water preservation, and overall village sanitation, encompassing multiple aspects.
- "Clean" implies safe water, sanitation, low pollution, healthier lives. Gram Panchayats aiming for "clean and green" must preserve water, land, and soil health.
- Green refers to a world in which natural resources, including oceans, land, and forests, are sustainably managed and conserved to improve livelihoods and ensure food security, and most importantly, protect the environment for future generations.

Components of A Clean and Green Village

The broad components that constitute a clean & green village are appended below. Each component consists of many elements. Each component vis-a-vis the elements is made of specific action points at the village level.

Action Points at the Village Level

1. Open Defecation Free Village.
2. Clean & Green Schools.
3. Clean & Green Anganwadis.
4. Scientific Management Of Solid Waste.
5. Waste Water Management.
6. Affordable & Clean Energy, including solar & wind energy.
7. Greening Development
8. Promotion of Organic Farming and progressing reduction of chemical fertilisers & pesticides.
9. Celebrate Clean and Green living.

10. Strengthening local committees and enhancing larger participation.

11. Supply of Clean & Safe Drinking water.

12. Improvement of Indoor Air Quality.

13. Energy Conservation.

14. Rainwater Conservation including Rainwater Harvesting.

Government Initiatives for Clean and Green Village

Nine Indian government Secretaries signed an advisory, focusing on SDG localization through PRIs on "Clean & Green Village" theme. The letter, dated March 31, 2022, shows the ministries' commitment to support Gram Panchayats/Villages under their schemes. The government aims to fulfil the saying 'Cleanliness is next to Godliness.' The Ministry of Jal Shakti's Department of Drinking Water and Sanitation is leading this initiative. Other initiatives aimed at achieving Clean and Green Village are –

Swachh Bharat Mission

- The **Swachh Bharat Mission**, launched by the Prime Minister on October 2, 2014, works towards universal sanitation coverage with two sub-missions, rural and urban, targeting a Swachh Bharat (Clean India) by 2019, in honour of Mahatma Gandhi's 150th Birth Anniversary. The mission seeks to improve cleanliness through waste management and make gram panchayats open defecation free, clean, and sanitized.
- Swachh Bharat Mission relies on Behaviour Change Communication (BCC) to promote consistent toilet use, with community action and social norms being vital.
- Inter-Personal Communication (IPC) is crucial for toilet adoption and hygiene behaviour change, complementing infrastructure to achieve desired outcomes.
- By 2019, the campaign built 100 million toilets, benefiting 500 million people in 6,30,000 villages.
- Green villages necessitate addressing ecological, economic, and equity issues via community involvement, regulations, and eco-friendly practices, emphasizing conservation and sustainability.

Jal Jeevan Mission (JJM)

- The PM of India launched the Jal Jeevan Mission on 15 August 2019.
- The mission envisioned providing clean, safe, and adequate drinking water to all rural households, schools, Anganwadi's, and public health centres through functional tap connections **by 2024.**
- Quality water, not just infrastructure, was prioritized. At mission start (Aug 15, 2019), 3.23 crore households had working taps; **by Aug 15, 2023, 12.85 crore (66.8%) households have functional taps**, with *nine states/UTs, 140 districts, and over 1.83 lakh villages achieving Har Ghar Jal.*

Jal Shakti Abhiyan - Catch The Rain (JSA CTR)

- The Government launched Jal Shakti Abhiyan in 2019, engaging states, districts, and millions for water conservation in *1,592 water-stressed blocks across 256 districts*.
- Following the success of Jal Shakti Abhiyan in 2019, the Jal Shakti Abhiyan: Catch The Rain (CTR) campaign was launched in 2021.
- It aimed to create and maintain rainwater conservation structures, emphasizing people's involvement, from March to November 2021, with the theme *'Catch the Rain, where it falls when it falls.'*

The campaign had the following five focused interventions -

(a) Rainwater harvesting & water conservation

(b) Enumerating, geo-tagging & making an inventory of all water bodies; preparation of scientific plans for water conservation.

(c) Setting up Jal Shakti Kendra's in all districts

(d) Intensive afforestation, and

(e) Awareness generation

Building on the success of the 2019 and 2021 Jal Shakti Abhiyans, the 2022 campaign was launched by the Hon'ble President on March 29, 2022, covering all districts (rural and urban areas) with the theme 'Catch the Rain, where it falls, when it falls.' The campaign ran from April 1, 2022, to November 30, 2022, encompassing new interventions beyond the 2021 activities:

(a) Spring Shed Development and Management

(b) Wetland Development and Management

(c) Catchment area protection and development

(d) Amrit Sarovars: Creation/ Rejuvenation of 75 Amrit Sarovars in every district to commemorate Azadi ka Amrit Mahotsav (AKAM)

Reduction in water run-off and rise in water table across the country due to the successful implementation of the Jal Shakti Abhiyan: Catch the Rain' campaign is acknowledged by those who monitor it for their cause.

Convergence of the Ministries/ Departments/NGOS/Institutions

The success of these missions relies on support from various government departments, including Drinking Water & Sanitation, Water Resources, New & Renewable Energy, Environment & Forests, Rural Development, Land Resources, Agriculture, Animal Husbandries, and Panchayati Raj. Additionally, involvement of NGOs, college students, youth organizations like Nehru Yuvak Kendra Volunteers, can expedite the "Clean & Green Village" goal.

Role of Gram Panchayat

If a Green Panchayat resolves to transform itself into a clean and green village, it should focus on:-

- Raising awareness to reduce waste, promote sustainable production, consumption, and minimize environmental impact is crucial.
- Promotion of measures within the GPs that would reduce environmental pollution, such as reducing the use of plastics within the GP area.
- Taking steps to create an in-depth understanding of the term climate change and its impact among the Gram Sabha, Panchayat committees, and other community volunteers.
- Mapping land use patterns, water bodies, forests, hill slopes, wetlands, and degraded forests within the GP.
- Developing appropriate norms for sustainable utilisation of resources from common lands, water bodies, and forests on materials like non-timber forest produce, sand, fish, and water.
- Assessing the water needs, sources, schemes, and solid and liquid waste being generated and preparation of District and Village Water Conservation Plans.
- Setting the water and sanitation goals and targets for the Gram Panchayats.
- Selection of appropriate technology for water supply and sanitation in the GPs, based on participatory and area assessment in markets and GP premises.
- Ensuring maintenance of toilets, public spaces, including those in markets and GP premises.
- Developing a comprehensive energy programme based on need assessment.

Conclusion

- India is leading sustainable village development, inspired by Mahatma Gandhi's 'Clean & Green Village' concept, aiming to enhance rural life and reduce urban migration.

- Cleaning villages presents numerous challenges, but government, NGOs, and public efforts focus on water supply, sanitation, waste management, air quality, and solar energy. Government initiatives like 'National Mission for a Green India', 'Jal Jeevan Mission', 'Swachh Bharat Mission', 'Jal Shakti Abhiyans', 'Amrit Sarovar Yojana', 'Atal Bhujal Yojana', and more aim to create 'Clean and Green' villages.
- Garbage results from human activities, whether physical waste or emotional stress. Like yoga detoxifies the body and meditation purifies the mind; clean surroundings ensure environmental cleanliness.
- Local institutions like Gram Panchayats are vital for water-sufficient, clean and green villages, but varying factors pose challenges. Promoting this vision nationwide is essential. Supporting Gram Panchayats is crucial. Convergent action at all government levels is necessary for global sustainability and climate change mitigation.

LEVERAGING AGRO-ECOLOGICAL APPROACHES FOR CLEAN AND GREEN VILLAGES

Rural India, with 65% of the population and 47% dependent on agriculture, accelerates socio-economic growth, aiding SDG goals, in 6,40,000 villages with 83.3 crore people (MoF, 2023). In a decade, rural population increased from 74.3 crore in 2001 to 83.3 crore in 2011 (Census, 2011). Rural women's workforce participation rose from 19.7% in 2018-19 to 27.7% in 2020-21 (MoF, 2023). Leveraging the demographic dividend, rural areas offer transformative potential to achieve the vision of **"Viksit Bharat by 2047"** outlined by PM Narendra Modi. His emphasis on **"Jan dhan, Van dhan, and Gobar dhan"** underscores the pivotal role in rural economic transformation. The Indian government has launched various initiatives for equitable and inclusive rural development. Agroecology fosters sustainable food systems, preserving resources, mitigating climate change, and enhancing rural conditions. In India, agroecology spans agriculture, forestry, energy, fostering eco-friendly practices, transforming villages, and advancing sustainable development (MOPR, UNEP).

Agroecological Approaches For Clean And Green Villages

- Agroecology combines ecological and social principles to optimize food and agricultural systems for sustainability.
- Agroecological approaches prioritize natural processes, local knowledge, and participatory methods to achieve sustainable agrifood systems.
- Agroecology includes 10 elements like diversity, synergies, and practices such as nutrient cycling, biodiversity conservation, and pest control (FAO, HLPE).
- The Green and Clean Village initiative promotes tree planting, organic farming, ecosystem conservation, renewable energy, and community involvement for a sustainable rural India (MOPR, 2023).
- The agroecological practices, such as natural farming, organic farming, biofuel production, agroforestry, waste recycling, etc. can support in achieving the objectives of green and clean village and the SDG targets.

Organic and Natural Farming for Green Villages

- Organic and natural farming align with agroecological principles, promoting chemical-free agriculture, enhancing soil health, and fostering clean, green villages.
- India encourages organic farming via schemes like Paramparagat Krishi Vikas Yojana **(PKVY)** and Mission Organic Value Chain Development for North East Region **(MOVCDNER),** benefiting farmers.
- The government aims to **convert 6.00 lakh ha of land to organic farming via PKVY** from 2022-23 to 2025-26.MOVCDNER achieved 1.73 lakh ha of organic farming, benefiting 1.89 lakh farmers, with 379 FPOS and FPCs, 205 collection units, 190 custom hiring centres, and 123 processing units.

- Natural farming has been promoted under **Bhartiya Prakratik Krishi Paddhati (BPKP)**, a sub-scheme under PKVY, since 2019-20. Under BPKP, 4.09 lakhs ha area has been brought under natural farming.
- The Ministry of Chemicals and Fertilizers launched the **PM-PRANAM (**Prime Minister Programme for Restoration, Awareness, Nourishment, and Amelioration of Mother Earth**)** in June 2023 to promote sustainable fertilization, organic farming, and resource conservation.
- States saving 50% of fertiliser subsidy through reduced chemical fertilizer use will receive a grant.
- MGNREGS promotes waste management through soak pits, vermicomposting, and recycling, contributing to rural cleanliness.
- Agroforestry boosts green coverage, offering economic and environmental advantages to farmers.

Waste to Wealth: Towards Clean Villages

- Biogas and organic manure harness waste into energy and agri-inputs, aiding energy needs, reducing emissions, and enhancing waste management.
- The **Gobardhan program**, part of Swachh Bharat Mission, converts organic waste into biogas and bio-slurry, promoting clean villages and circular economy. Financial aid supports community biogas plants.
- This initiative offers eco-friendly energy, improved soil quality, reduced reliance on chemical fertilizers, sanitation, health benefits, reduced GHG emissions, economic savings, local employment, farmer income, entrepreneurship, and green energy investments.
- MNRE supports biogas plant installation for cooking, while **Sustainable Alternative Towards Affordable Transportation** (SATAT) initiative ensures that Compressed Bio Gas (CBG) is available as automotive fuel through Oil Marketing Companies.
- Union Budget 2023-24 plans 200 CBG plants, including 75 in urban areas, and 300 community or cluster-based plants for circular economy promotion.
- Organic fertilizers from biogas slurry will receive market development assistance under Fertilizer Control Order (1985).

Rural Industries

- Agroecological practices enhance rural industries, including biogas, manure production, processing, marketing, and waste management, supporting livestock integration.
- Biogas is a labour-intensive renewable energy industry in India, meeting rural energy needs while producing valuable organic waste. Its use boosts agricultural productivity, with successful examples being Maharashtra, Gujarat, and Andhra Pradesh.
- Over 1200 Biogas Plants exist in 450 districts nationwide.
- The biogas sector generates 55,000 skilled, 200,000 semi-skilled, 10,000 highly skilled, and 150,000 unskilled jobs (IBA, 2023).
- Organic and natural farming enhance rural livelihoods, value chains, exports, with plans for bio-input resource centres to support **National Mission on Natural Farming**, benefiting 1 crore farmers

Conclusion

Clean and Green Village objectives can be expedited by scaling up agroecology-based programmes and schemes and their implementation at the grassroots level with support from panchayats, cooperatives, Self- Help Groups (SHG), and women-SHGs.

India faces significant environmental issues, impacting both urban and rural areas, with rural regions bearing a heavier burden due to agriculture and closer nature connection. Rural India grapples with environmental challenges like poor waste disposal, deforestation, air and water pollution, soil degradation, and over-cultivation due to population growth and agricultural practices. Legislation like Forest Conservation Act, Air and Water Pollution Control Acts, and initiatives like National Action Plan on Climate Change and Green India Mission aim to address environmental issues. Challenges in implementation, like infrastructure and resources, can be addressed through technology, enhancing enforcement and awareness. Leveraging emerging technologies can bolster environmental protection efforts in rural India.

Role of Digital Technology

- Technology, deeply embedded in society, presents a potent opportunity for greener, sustainable urban and rural futures. Villages, increasingly connected, surpass urban areas in internet usage.
- Digital technologies can be a catalyst for environmental change, raising awareness and promoting sustainability, enabling remote farming insights, ecological monitoring, and knowledge dissemination in rural areas.
- India utilizes digital initiatives for sustainable agriculture, water conservation, waste management, and rural connectivity, emphasizing its commitment to sustainability and connectivity.

The Government's Approach

- India employs digital tech for holistic environmental protection. Social media educates about policies and initiatives. Apps inform citizens, and digital data tracks progress for better resource allocation.
- The Government engages citizens in environmental protection using online platforms, gathering feedback, promoting ideas, and mobilizing participation, fostering a sustainable and informed society.

Considering the fabric of our rural society, such initiatives don't go without facing their share of challenges.

Some of these challenges are:

- Lack of Awareness: Insufficient environmental awareness in India hinders engagement and conservation initiatives.
- The Digital Divide: Digital exclusion in rural areas due to device scarcity, connectivity issues, power interruptions, and low digital literacy hinders progress.
- Lack of Resources: Resource constraints in a vast country necessitate prioritizing critical environmental protection and awareness initiatives effectively.
- Lack of Coordination: Lack of coordination among stakeholders, including government bodies, NGOs, rural entities, and private sector, may cause inefficiencies.

Nevertheless, the Government perseveres, using digital tech to promote rural environmental awareness and protection. These examples illustrate its commitment and impact.

Use Of Social Media

- The Ministry of Environment, Forest, and Climate Change (MoEFCC) utilizes social media and a multilingual website to educate villagers on environmental issues and share success stories. Workshops reinforce environmental awareness and action in villages.
- The Ministry aids villagers in eco-projects but faces challenges like limited internet access and illiteracy. Still, MOEFCC strives for rural sustainability.

The Namami Gange Project

- Namami Gange uses digital tech to revive the Ganga River, monitoring progress, identifying pollution, and engaging citizens in restoration.
- Satellite imagery tracks Ganga River pollution, guides cleanup priorities, and geospatial tech maps the river's course for effective planning.
- Namami Gange project also leverages social media for engagement, using Facebook, Twitter, and other platforms to inform, gather feedback, and mobilize citizens.
- Namami Gange illustrates the transformative potential of digital tech in environmental protection, showing how it can change the Ganga River's condition.

The Watershed Organisation Trust

- WOTR, established in 1993, is a respected nonprofit and think tank, addressing rural challenges in India through **water and food security, livelihoods, and biodiversity preservation**.
- WOTR utilizes digital technologies including geospatial tools, ICTs, and social media to advance environmental sustainability in villages, mapping resources, facilitating communication, and fostering awareness. They empower communities for sustainable resource management.

The Centre for Environment Education (CEE)

- CEE, a nonprofit organisation since 1984, promotes **environmental education and sustainable development** in India through a vast network of partners.
- CEE, a national institution, advances environmental awareness through innovative programs, educational materials, and capacity-building in Education for Sustainable Development (ESD).
- CEE uses social media effectively in rural India, with a Facebook page for information sharing, educational initiatives, and community connections. Twitter highlights environmental messages, successes, and conversations. Their YouTube channel stores environmental videos and success stories.

The Digital Green Initiative

- Digital Green enhances small land holding farmers' lives through digital technology and local partnerships in countries like India, Ethiopia, and Afghanistan.
- They promote sustainable farming, food security, and provide agricultural information, market connections, and financial services.
- Digital Green emphasizes environmental protection, partnering with farmers for sustainable practices and employing digital tech for monitoring soil, water, and deforestation.

STRENGTHENING RURAL ECONOMY WITH CLEAN AND GREEN INITIATIVES

Our environment, a vital legacy, must be safeguarded for future generations. India's diverse landscapes require sustained clean and green efforts. The World Bank's 2019 report highlights critical issues: 940 million lack electricity, 663 million lack clean water, and 2.4 billion lack sanitation. Green development and technology adoption are crucial, as many depend on forests and nature for their livelihoods and basic necessities.

Need for Green and Clean Technologies

- India must prioritize a low-carbon, inclusive village-level green economy. Global clean energy access is crucial, given **3.8 million yearly premature deaths due to indoor air pollution**, mainly in poor countries.
- Switching to bottled cooking gas in India, praised by WHO, saves countless lives, especially vulnerable women and children exposed to toxic indoor smoke during chores.

- Clean and green initiatives are crucial for enhancing the human development index and sustainable growth.
- Access to safe water and sanitation is vital, with 1.4 million annual deaths related to water, sanitation, and hygiene (WHO 2022).
- Nearly 3.6 billion people globally lack safe sanitation (WHO/UNICEF 2021). Ensuring safe drinking water for all households in India could prevent 400,000 deaths and 14 million Disability Adjusted Life Years (DALYs), saving up to $101 billion.
- India's Har Ghar Jal program has significantly improved rural tap water connections, reducing 13.8 million DALYs and boosting the human development index from 16.64% in 2019 to 62.84% in 2023.

Potential of Renewable Energy Generation- Vision and Mission

- Renewable energy is crucial for sustainable development and energy security in India. The National Solar Mission aims to make India a global solar energy leader, with a cumulative **renewable capacity of 179.322 GW by July 2023**. Solar energy dominates with 67.07 GW, followed by wind energy at 42.8 GW.
- India's ambitious goal is **500 GW of renewable energy capacity and five million tonnes of green hydrogen production by 2030.**
- This will be supported by 125 GW of renewable energy capacity, for which 57 solar parks with an aggregate capacity of 39.28 GW have been approved.
- India prioritizes renewable energy for economic growth, energy security, and climate mitigation. Abundant sunshine and coastal wind offer strategic advantages, with hydropower potential exceeding 100,000 MW.
- This positions India as a leader in green energy production, benefiting rural areas like Modhera village, Gujarat, powered by solar energy. Such initiatives extend across states, including Himachal Pradesh's aim to become a green energy state with 500 MW of solar installation in 2023-24 and the development of green Panchayats.
- Focused green development in rural areas combats environmental degradation, bolsters economies, creates jobs, and strengthens climate resilience. India's renewable energy ambitions aim to **generate 3.4 million jobs**, with existing training programs already certifying thousands.

Government Policies and Initiatives

- The 2023 Union Budget emphasizes a green energy shift, allocating Rs. 35,000 crores for energy transition and Net Zero goals. Rs. 10,222 crores have been allocated to the Ministry of New and Renewable Energy to promote clean energy adoption.
- Additionally, the solar sector receives Rs. 5,331.5 crore, and Rs. 20,700 crore is designated for inter-state transmission lines for 13 GW of renewable energy from Ladakh.
- India's National Action Plan on Climate Change features eight missions, emphasizing clean tech for energy independence by 2047, bolstered by 'Make in India.'
- Foreign investors are keen on battery storage, EVs, and green hydrogen. The government allows **100% FDI in renewables**, promoting decarbonization.
- Waiving inter-state transmission charges and setting renewable purchase obligations promote green energy. **Ultra-mega renewable energy parks** expedite solar projects.
- **PM-PRANAM** encourages nationwide adoption of eco-friendly fertilizers, enhancing farming practices and safeguarding health and the environment.
- Green hydrogen can cut 3.6 Gt of CO_2 emissions by 2050 and reduce coal imports by 95%. The **National Green Hydrogen Mission** aims to establish India as a global hub. New energy trading platforms, Green Term

Ahead Market **(GTAM)** and Green Day Ahead Market **(GDAM),** offer renewable power without long-term PPAs.

- The **UJALA LED bulb campaign** lowers emissions by 40 Mt yearly. Skills Council for Green Jobs integrates environmental awareness in job training with 'Green National Occupation Standards.'

Role of Self-Help Groups

- Self-Help Groups (SHGs) are pivotal in development. Engaging India's 1.2 crore SHGs, mainly rural and 88% women-led, in green initiatives is essential.
- Swachh Bharat Mission Grameen (SBM-G) focuses on Open Defecation-Free status, solid/liquid waste management, bio-degradable waste, non-biodegradable waste, greywater, and faecal sludge management.
- Women's leadership, including 'Swachhagrahis,' and elected women representatives, proved crucial in its success, highlighting their vital role in SBM-G.

Emerging Opportunities with Green Development Initiatives

- Clean energy innovations in the farm sector offer a USD 40 billion market for tasks like spraying, transplanting, and harvesting.
- Clean energy innovations could transform enterprises engaged in activities such as custom tailoring, food processing, poultry, and livestock rearing among others.
- Decentralized renewable energy (DRE) powers various rural appliances, reducing crop production costs, thanks to government incentives.

Focus Areas to Accelerate Use of Renewable Energy

- Rural appliances rely on unreliable electricity, requiring efficient equipment powered by renewable energy sources.
- There is a need for reduction in battery costs and development of cost-effective, super-efficient, small-sized motors, which could significantly improve the economic viability of DRE.
- Expanding the market for smaller livelihood solutions may require numerous small and medium enterprises to participate.
- Farmers in rural areas need initial financial support to overcome barriers in adopting clean energy solutions for livelihood.

Challenges for Shift to Green Technologies

Global renewable energy investment requires $4 trillion annually until 2030 for net-zero emissions by 2050. This investment could save $4.2 trillion annually by 2030. Low-carbon technologies could create an $80 billion market in India by 2030. International support from organizations like the World Bank and developed nations is crucial for India's low-carbon transition. To achieve net-zero emissions by 2070, the IEA estimates $160 billion annually until 2030. India saw a record-high $14.5 billion investment in renewable energy in 2022, set to attract over $20 billion in 2023. Access to low-cost long-term capital is essential for achieving net zero.