

Innovation

Frontline

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Madhuvan Gajar - A Farmer's Wisdom Turned Innovation



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India's ancient wisdom of shared ownership, decentralised governance, and ecological stewardship predates the modern economic theory by centuries, and the National Cooperation Policy (NCP) 2025, unveiled on July 24, 2025, explicitly builds on this ancient Indian lineage. Village-wide functional associations like the *Bāra Balutedār* (twelve professionals) of Maharashtra organised 12 hereditary crafts and services on a village-as-a-whole basis, and paid in kind from the harvest, which was an embedded risk-sharing and mutual-service arrangement that kept settlements self-sufficient. Moreover, the traditional village socio-economic governance systems, like gram sabhas, community-managed irrigation systems, tribal forest-produce enterprises, weaving guilds, trust-based banking, etc., operated on principles of collective ownership and shared decision-making that economists would later formalise as cooperative economics. The National Cooperative Policy builds upon these established foundations, systematising and scaling institutional mechanisms. This historical continuity provides the policy with social legitimacy and cultural compatibility that purely imported models often lack.

The statistical significance of India's cooperative sector reveals the scale of this institutional bedrock. India currently operates nearly 9 lakh cooperatives across agriculture, dairy, credit & banking, housing, marketing, fisheries, handicrafts, etc., representing 27% of the world's total cooperative institutions. With 21% of India's population participating in cooperative structures, compared to the global average of 12%, the country has created the world's largest distributed economic democracy. These numbers reflect not only institutional proliferation but the systematic organisation of collective economic action across the nation. Since 2021, there has been an addition of 7,768 new Primary Agricultural Credit Societies, demonstrating accelerating momentum in cooperative formation at the grassroots level. This expansion connects directly to patterns of grassroots innovation that emerge from collaborative community engagements. Through structured interventions over the past 25 years, NIF has been spearheading local and village-level entrepreneurship by recognising, scaling, commercialising, and diffusing grassroots technologies for various Self-Help Groups (SHGs) and local collectives.

These institutional pathways become particularly relevant when examined against successful cooperative models that have already demonstrated transformative potential. Gujarat's dairy cooperatives, Kerala's rubber cooperatives, Maharashtra's sugar cooperatives etc., have converted millions of village folks into entrepreneurs through integrated supply chain management, value addition, and brand development. Studies suggest that cooperative expansion could address several structural challenges in India's development trajectory. With 85% of Indian farmers operating holdings smaller than two hectares, individual market participation remains economically inefficient. Cooperative aggregation can achieve economies of scale in input procurement, technology adoption, and market access without requiring land consolidation that might displace vulnerable populations. Moreover, the global context adds urgency to the national cooperative renaissance. As traditional business and commerce grapple with environmental degradation, inequality, tariffs etc., alternative economic models exhibit intellectual credibility and practical relevance.

As India moves towards *Viksit Bharat*, cooperatives represent not only economic institutions but a civilizational strategy that aligns development goals with cultural values. In this pursuit, NIF's grassroots innovation support architecture complements the policy's target of creating institutional infrastructure for democratic economic participation that involves active engagement by members and communities at large.

By combining traditional cooperative wisdom with contemporary management practices and digital technologies, India is creating a development model that offers viable alternatives to lopsided economic systems. The success of this approach will depend on maintaining robust governance structures while achieving operational efficiency and enabling system-wide coordination, and adapting to technological change, at the same time protecting vulnerable participants. If these challenges are navigated effectively, India's cooperative renaissance could demonstrate that ancient wisdom about collective prosperity remains relevant and resilient for addressing contemporary global challenges and ensuring *Sahkar Se Samridhi*, meaning, prosperity through collective cooperation. ■

Dr. Arvind C. Ranade

Madhuvan Gajar

- A Farmer's Wisdom Turned Innovation

Parthkumar P. Dave, Hardev Choudhary, Arvind Marvaniya

In a remarkable stride towards addressing malnutrition and enhancing agricultural prosperity in India, the *Madhuvan Gajar*-a biofortified carrot variety developed by the late farmer-breeder Shri Vallabhbhai Vasrambhai Marvaniya from Junagadh district, Gujarat-is transforming both livelihoods and nutritional outcomes for thousands of farmers. This improved variety exemplifies the power of grassroots innovation in driving sustainable agricultural development.

It is often said that a single sentence can alter the course of destiny. Shri Vallabhbhai Vasrambhai Marvaniya, born into a modest family in Moti Marad village under the royal territory of Gondal (then ruled by Maharaja Shri Bhagvatsinhji), proved this true. His journey began with inspiration drawn from a line on page 191 of Shri Aryabhishek (Samvat 1982, Sixth edition, published by Sastu Sahitya Vardhak Karyalay - around the year 1925, according to Gregorian calendar): "The carrots grown near Delhi are of superior quality." Vallabhbhai wondered-why not in Saurashtra? This spark ignited a

revolutionary journey in carrot cultivation during the year 1939.

At that time, local carrots, known as lodar, were short, thick, and primarily used as cattle feed. Vallabhbhai observed that hard soil conditions restricted root growth. Through persistent experimentation and keen observation, he improved the soil conditions to support deeper and longer roots. Year after year, he carefully selected the healthiest roots for seed production, eventually succeeding in cultivating long, sweet, and high-quality carrots that matched-if not surpassed-those grown near Delhi.

Recalling the nutritional benefits of carrots highlighted in Aryabhishek, Vallabhbhai began questioning why such a nutrient-rich crop should remain limited to animal fodder. In 1943, he attempted to introduce his improved carrots for human consumption in the market. Initially, he faced ridicule and was dismissed as "foolish." Yet, this criticism only strengthened his resolve. Determined to prove their value, he introduced a carrot variety rich in both taste and



Shri Arvindbhai receiving National Grassroots Innovation Award on behalf of his father Vallabhbhai

nutrition. It quickly gained popularity-not only for human consumption but also as cattle fodder, owing to its sweetness and high biomass yield. By the 1950s and 1960s, he had expanded its cultivation to a much larger scale.

On his carrot farm, Vallabhbhai often observed a significant presence of *Madhu* (honey bees). A devoted follower of Lord Krishna, he drew inspiration from the sacred forest of Madhuvan associated with Krishna, naming the new variety "Madhuvan Gajar".

By the 1970s, he began sharing seeds with neighboring farmers. As demand and popularity grew, he formally



Shri Vallabhbhai Vasrambhai Marvaniya was conferred with Padma Shri in the year 2019

began selling high-quality seeds in 1983. His dedication to selective cultivation and seed production established Madhuvan Gajar as a premium brand, recognized by farmers and consumers alike across India.

Vallabhbhai's son, Shri Arvindbhai V. Marvaniya, who had been actively involved in farming since childhood, continues this legacy. Through innovations in farming practices such as drip irrigation, he achieved higher yields with lower input costs and superior root quality. Today, the third generation, represented by Shri Prashantbhai Arvindbhai V. Marvaniya, has also joined wholeheartedly after completing his graduation, ensuring the continuation and expansion of this remarkable family enterprise.



The National Innovation Foundation - India (NIF) played a pivotal role in validating Madhuvan Gajar. The variety, developed through meticulous selection, underwent trials at the Rajasthan Agricultural Research Institute (RARI), Jaipur, during 2016-2017. Results demonstrated its significantly higher root yield of 74.2

NIF conducted on-farm trials across 50 hectares in Gujarat, Maharashtra, Rajasthan, Assam, Haryana, Punjab, and West Bengal, involving over 100 farmers to assess performance and suitability in new regions

t/ha and a plant biomass of 275 g/plant, outperforming other check varieties.

Biochemical analysis at the CALF Lab (National Dairy Development Board, Anand), facilitated by NIF, highlighted the variety's superior nutritional profile: β -carotene content of 277.75 mg/kg and iron content of 276.7 mg/kg (dry basis). Such exceptional nutritional qualities make Madhuvan Gajar highly suitable for value-added products, including carrot chips, juices, and pickles.

In addition, NIF conducted on-farm trials across 50 hectares in Gujarat, Maharashtra, Rajasthan, Assam, Haryana, Punjab, and West Bengal, involving over 100 farmers to assess adaptability in new regions. The variety consistently delivered strong performance in yield and desirable agronomic traits.

Shri Vallabhbhai's contributions received national recognition. He was conferred the National Award by the President of India at Rashtrapati Bhavan, New Delhi, during the Festival of Innovation (FOIN) 2017. In 2019, his extraordinary achievements in developing Madhuvan Gajar in the non-conventional carrot-growing region of Saurashtra were further honored with the prestigious Padma Shri Award.



The economic impact of Madhuvan Gajar is equally impressive. Annual seed sales average around 120 quintals, supported by over 100 local suppliers nationwide. Cultivation spans more than 300 hectares in Junagadh and neighboring districts of Gujarat, with an average yield of 50 t/ha, forming a crucial income source for local farmers. Over the past three years, its cultivation area has expanded beyond 1,000 hectares across Gujarat, Maharashtra, Rajasthan, West Bengal, and Uttar Pradesh, reflecting its adaptability and widespread acceptance.

The journey of Shri Vallabhbhai Vasrambhai Marvaniya—from a spark of inspiration in a book to the sweet revolution of Madhuvan Gajar—is a shining example of grassroots innovation. It demonstrates how traditional wisdom, combined with scientific validation, can drive nutritional security, enhance rural livelihoods, empower farmers, and catalyze agri-entrepreneurship and social transformation across India. ■

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Shri Arvindbhai V. Marvaniya, legal heir of Innovator

From Ancestral Wisdom to Modern Solutions

- An experience from Shodh Camp in Jaintia Hills, Meghalaya

Rajiv Mili, Sayed Abdul Hai, Vivek Kumar

Introduction

Amid the picturesque green landscapes of Meghalaya lie the Jaintia Hills, renowned not only for their breathtaking beauty but also for their vibrant cultural heritage and strong community ethos. Comprising the East and West Jaintia Hills districts, this region is home to hardworking farmers, skilled artisans, and guardians of age-old traditions. Here, innovation is not confined to the boundaries of research institutions; it flourishes in paddy fields, village workshops, and communal gatherings. It takes root where necessity intersects with ingenuity, shaped by the lived realities of rural life. For generations, the people of the Jaintia Hills have displayed exceptional creativity - crafting unique tools, evolving sustainable agricultural practices, and devising contextually suited solutions using available local resources. This innovation is seamlessly woven into everyday life, merging traditional wisdom with contemporary needs.

Recognising this untapped potential, initiatives such as the Shodh Camp, spearheaded by the National Innovation Foundation - India (NIF), have worked to document and promote grassroots innovations and traditional knowledge (TK) systems. Such efforts highlight the Jaintia Hills as more than a scenic landscape - they are a living repository of human ingenuity, a genuine "land of creativity" where frugal, locally relevant solutions are born.



Secondary forest regeneration on the hill top after using as shifting agricultural field in Jaintia hills

Shodh Camp: Bringing Innovation to the Grassroots

Innovation often emerges in unexpected places - in a farmer's makeshift tool, a homemaker's fuel-efficient stove, or a student's inventive gadget. To spotlight such ingenuity, NIF has been consistently scouting and documenting grassroots innovations and practices. Between 25 July and 1 August 2025, a Shodh Camp was organised across the Jaintia Hills to identify unsung innovators - farmers, artisans, and community problem-solvers - while also capturing unmet local needs that could inspire new technological interventions.



The camp extended across 13 villages and towns: six in West Jaintia Hills (including Jowai, Mulieh, Dawki, and Thadmuthodlong) and seven in East Jaintia Hills (including Khliehriat, Myndihati, Lumshnong, and Donaskur). The choice of this region was deliberate, as several marginalised farming communities here remain beyond the reach of mainstream innovation networks.

The camp was guided by two key objectives:

1. Document locally developed solutions.
2. Inspire a culture of innovation among youth and local institutions.

Over the course of eight days, six interactive meetings were convened in colleges, villages, and community halls. Participants shared their ideas, demonstrated devices, and described traditional practices that had withstood generations. Local

challenges were also discussed to identify areas where innovative solutions could be designed.

The results were noteworthy:

- 5 grassroots innovations were documented.
- 30 traditional knowledge practices were recorded, covering domains such as agriculture, household energy, and resource use.

For grassroots innovations to bring meaningful change, dissemination alone is insufficient. Continuous monitoring and evaluation are essential to assess how these solutions improve livelihoods, enhance efficiency, and protect the environment.

The camp also showcased tried-and-tested rural technologies, including the Arecanut Polishing Machine, Mitticool products, fruit nipper, BamHum (bamboo-based musical instrument), ZenRelax (herbal roll-on for muscle pain), Siramide Plus, and the She Innovates platform. Exhibitions on 25 Years of NIF and Innovation Frontline further underscored how grassroots ideas can be refined, scaled, and disseminated for broader impact.

Why These Innovations Matter

The innovations emerging from the Jaintia Hills are not abstract



Arecanut cultivation is one of the livelihood option in Jaintia hills

experiments but practical responses to pressing realities. Farmers often cultivate steep terraced fields where conventional machinery is unsuitable. Women invest long hours in crop processing and fuel collection, necessitating tools that save time and reduce effort. The community's ecological knowledge ensures that many solutions rely on renewable materials, conserve resources, and blend seamlessly with cultural practices.



By documenting these grassroots innovations, the Shodh Camp has safeguarded them for future generations while also creating opportunities for scientific refinement, validation, and scaling. This approach ensures that practical, sustainable solutions rooted in tradition can be carried forward into the future.

Current Gaps and Challenges

Despite their potential, grassroots innovations in the Jaintia Hills face several barriers that limit their wider application.

- **Documentation:** Many innovations lack detailed engineering designs, specifications, or fabrication manuals, hindering replication.
- **Validation:** There is limited systematic testing for safety, efficiency, durability, or compliance with standards.
- **Manufacturing:** Most innovations are crafted in informal workshops without standardised tools or quality control processes, restricting consistent production.
- **Market Access:** Innovators

often lack knowledge of pricing, distribution, after-sales services, and intellectual property protection.

- **Gender Gap:** Women innovators contribute significantly, especially in agriculture, food processing, and herbal products, yet face barriers in finance, technology, training, and recognition.

Addressing these gaps will require targeted interventions in technical validation, skill development, market linkages, and inclusive innovation policies - enabling local solutions to transition into scalable, sustainable technologies with regional and national relevance.

Monitoring for Impact

For grassroots innovations to bring meaningful change, dissemination alone is insufficient. Continuous monitoring and evaluation are essential to assess how these solutions improve livelihoods, enhance efficiency, and protect the environment.

Key dimensions include:

- **Adoption and satisfaction:** Tracking how widely innovations are adopted and measuring user satisfaction through surveys and participatory feedback.
- **Productivity and time savings:** Evaluating how tools reduce labour intensity, improve efficiency, or enhance output quality.
- **Safety and well-being:** Comparing pre- and post-adoption data on accidents, injuries, or exposure to hazardous





Kiang Nongbah Govt. College_Jowai_West Jaintia Hills

processes.

- **Income enhancement:** Analysing direct and indirect economic benefits, from higher yields and lower costs to new market opportunities and microenterprise growth.

- **Environmental impact:** Documenting savings in fuel, reduced emissions, and conservation of resources to strengthen arguments for climate resilience.

A participatory, transparent, and adaptive monitoring framework is essential. By involving communities in defining success, trust is built, and innovations can be refined in line with real-world needs.

Conclusion: From Hills to Horizons

The innovations highlighted during the Shodh Camp exemplify how necessity, when coupled with

ecological wisdom, can generate practical and sustainable solutions. These range from simple mechanical devices to complex ecological practices, each rooted in adaptive knowledge passed down through generations.

The Shodh Camp has shown that with the right balance of scientific engagement, community participation, and institutional support, the Jaintia Hills can evolve into a vibrant hub of rural creativity

Yet without structured documentation and rigorous validation, such valuable practices risk fading into obscurity. The next steps - scientific testing, ethical scaling, and fair benefit-sharing - will

ensure these innovations achieve broader relevance while maintaining community ownership and cultural authenticity.

A collaborative approach is critical, bringing together local communities, scientific institutions, and policymakers. Ensuring gender equity - through recognition, finance, and technology access - is equally important.

If nurtured effectively, the Jaintia Hills can serve as a model for innovation-led rural development in India. They demonstrate that innovation is not confined to high-tech laboratories but is equally vibrant in fields, kitchens, workshops, and forests - anywhere people respond resourcefully to daily challenges.

The Shodh Camp has shown that with the right balance of scientific engagement, community participation, and institutional support, the Jaintia Hills can evolve into a vibrant hub of rural creativity - enhancing livelihoods, strengthening resilience, and safeguarding heritage for generations. ■

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A comparative analysis

- India's performance in most recent Global Innovation Index (GII) vis-à-vis Ease of Doing Business (EoDB) ranking

Tushar Garg

The Global Innovation Index (GII)¹ is an annual ranking that assesses the innovation capacity and performance of countries worldwide. It takes into account multiple dimensions, including the policy environment, education, infrastructure, and knowledge creation within each economy. The Index is published by the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations with a unique mandate to support innovators and creators, ensuring their ideas are protected, reach the market, and ultimately improve lives across the globe. In the 2024 edition, India was ranked 39th.

The Ease of Doing Business (EoDB) ranking, published by the World Bank Group, was last reported in 2020 (reflecting data from 2019)². This index primarily assessed the regulatory environment of a country and its conduciveness to the establishment and operation of local enterprises. While EoDB has been discontinued, a new initiative Business Ready (B-READY)³ was taken as an international benchmarking project by the World Bank Group starting the year 2024 of which India will become a part from 2026 onwards. Having said that, for the purpose of analysis, the erstwhile EoDB, of which India

remained an integral part with a rank of 63 in its latest and last edition, is referred. As a disclaimer, a comparative analysis of GII and EoDB 2020 i.e. both ranking for same year would have been equally appropriate. Nonetheless, to incorporate the most recent and relevant parameters - which provide a more updated reflection of current frameworks - this study draws upon the latest available editions of each index.

It is often said that an innovation that does not scale remains a hobby. In essence, for an innovation to create real impact, it must eventually translate into a viable enterprise. Viewed through this lens, India's position in the Global Innovation Index (GII) - ranked 39 among 133 participating nations - and in the Ease of Doing Business (EoDB) - ranked 63 among 191 participating nations - offers meaningful insights. These rankings indicate that 38 countries performed better than India in terms of innovation ecosystem readiness, while 62 countries fared better in enabling ease of doing business. Notably, all 133 economies assessed in the GII also featured in the last EoDB assessment, and two additional economies - Taiwan and Kosovo - though not part of the GII, were positioned ahead of India

in the EoDB rankings.

While being good as a country in terms of innovation is different from being good in doing business, it is observed that countries which score high on both of these, are today the hallmark of innovation fueled economies simply because their innovations also transformed into businesses, though with varying level of success. For example, the United States of America (USA) which ranks #3 in GII and #6 in EoDB, represent the likes of BigTech and others which are renowned for both i.e. (a) Widely accepted innovative technologies and (b) Highly successful commercial dissemination.

For an innovation to create real impact, it must eventually translate into a viable enterprise

It isn't surprising that USA is world's no. 1 economy for a significant long time with a GDP of USD 30.5 trillion⁴, which accounts for 25% of Global economy. It's closest competitor is China, world's 2nd largest economy, with a GDP of USD 19.3 trillion and it ranks #11 in terms of GII and #31 in terms of EoDB. However, with tech

1. <https://www.wipo.int/en/web/global-innovation-index>

2. <https://www.worldbank.org/en/news/press-release/2019/10/24/doing-business-india-top-10-improver-business-climate-ranking>

3. <https://www.worldbank.org/en/businessready>

4. <https://www.forbesindia.com/article/explainers/top-10-largest-economies-in-the-world/86159/1>

innovations like DeepSeek and many others in the field of AI, during last one year, China has emerged as an innovation powerhouse, significantly superior to rest of the world and with close competition from the likes of US, India etc., so in all likelihood China may be able to secure an improved GII rank in 2025 in comparison with 2024. India is keeping pace with the best in the world, and focused more on innovative enterprises which maintain a parallel focus on being a marketplace and job creation simultaneously.

Drawing upon the comparison further, the word “better” has a huge significance primarily because we are talking about a relative performance and not an absolute performance structure per se. If we did “Good” and others did “Better”, we’ll still discover our rank is getting demoted. If we did “Bad” and others did “Worse”, we may still find our rank getting promoted. That’s an obvious conduct in a ranking set up where it’s not just about our own performance, rather our performance

vis-à-vis everyone’ else.

If we take a holistic view of these parameters i.e. both GII and EoDB, we’ll realize that they are very appropriately chosen as every economy would have something relevant to offer in them.

‘It is not necessary that an economy which has over performed on GII, is also an over performer in EoDB and vice versa’

It is not necessary that an economy which has over performed on GII, is also an over performer in EoDB and vice versa. Let’s analyze few economies, especially those which have an equally good eco - system for both innovation and doing business i.e. entrepreneurship or the other way round.

While on one side we have economies like USA, UK, Korea, Singapore which does well in both GII and EoDB by securing a rank < 10 in both, we also witness

others like Namibia, Niger, Tajikistan, Côte d’Ivoire, Trinidad and Tobago which does not perform well in either of these with a rank > 100 in both GII and EoDB. These instances help us infer that right prioritization can do wonders and a poor prioritization can adversely impact nations as far as their economic growth is concerned.

We also witness nations which could prioritize only one and not both of these i.e. either they did well in GII or in EoDB, but not both and instead failed miserably in getting the other right. Brazil for instance lead in this category where its GII rank is 50 and EoDB rank is 124, which can be inferred to believe that it focused on innovation much more than doing business. Perhaps, the reason for this could be, country’s ability to introduce reforms in case of promoting an innovation eco - system and on the contrary an inability to meet the same treatment to doing business reforms. While Reserve Bank of India (RBI), country’s Central Bank was contemplating a mobile banking

Table

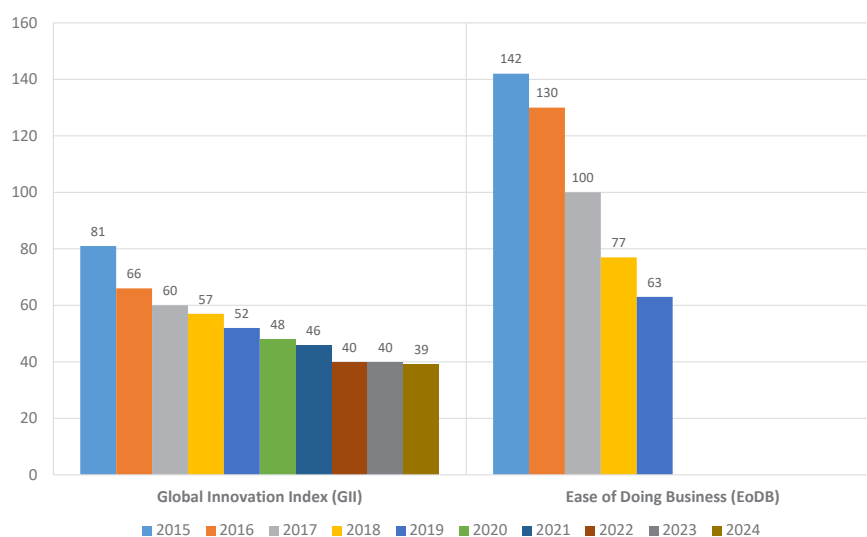
Extrapolating this further to GII and EoDB, the overall rank that gets assigned to a particular country is a function of its performance in specific parameters.

Parameters - GII	Parameters - EoDB
Institutions	Starting a business
Human Capital and Research	Dealing with construction permits
Infrastructure	Getting electricity
Market sophistication	Registering property
Business sophistication	Getting credit
Knowledge and Technology outputs	Protecting minority investors
Creative Outputs	Paying taxes
	Trading across borders
	Enforcing contracts
	Resolving insolvency

policy and constituted a Technical Committee on Mobile Banking⁵, the Committee in its report observed “Lei Do Bem (Law of the Goods) enacted by Brazil in Oct 2013 which mandates that smart phones give visibility to Brazilian made apps by either pre - loading phones with these homegrown apps or providing a dedicated marketplace on smart phones to display them. Similar intervention in India can support and incentivize the relevant stakeholders to either ‘pre burn’ common mobile banking application on mobile handsets / SIM cards or send ‘over the air’ using dynamic STK to facilitate financial transactions. This is a “build-it-they-will-come” approach.” This establishes that the country i.e. Brazil can be a model for the world, but it has restricted itself to innovation and yet to graduate as far as ease of doing business is concerned. On the other hand, we have Rwanda which ranks #104 in GII and only #38 in EoDB, thereby establishing its flair for business more than innovation where it needs a significant catch up with rest of the world.

Based on the available facts, the following inference can be drawn: a nation’s performance in innovation and ease of doing business is ultimately shaped by its priorities. If the objectives include generating greater employment opportunities, improving livelihoods, enhancing ease of living, and boosting exports,

India’s parallel rise towards being Innovative and Business friendly from the year 2015 onwards



then both the Global Innovation Index (GII) and Ease of Doing Business (EoDB) must feature prominently on the national agenda. The experiences of countries like the United States and Singapore demonstrate this clearly. Today, these economies may be net importers of talent, intellectual property, and investment, but sustaining such growth and eventually becoming net exporters of knowledge and innovation requires the right mix of reforms, forward - looking policies, robust legal frameworks, and above all, the collective will to drive change.

In India, we are witnessing a parallel strengthening of both innovation and ease of doing business, as reflected in the

steady improvement in the nation’s GII and EoDB rankings over the past decade.⁶ A combination of political will, economic reforms, progressive policies, a young and talented workforce, and a frugal yet sustainable approach to execution are collectively driving this progress. India has set its sights on becoming the world’s second - largest economy by 2075 . Along this journey, the milestone year 2047 - marking 100 years of independence - has been envisioned as the point by which India will emerge as a developed nation under the vision of Viksit Bharat @ 2047.⁷ Achieving this aspiration will significantly depend on continued progress and performance in both innovation and ease of doing business. ■

5. <https://m.rbi.org.in/scripts/PublicationReportDetails.aspx?UrlPage=&ID=760>

6. <https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=1557863>

7. <https://www.goldmansachs.com/insights/articles/how-india-could-rise-to-the-worlds-second-biggest-economy>

Innovation in Bloom

- A Flower Tying Assistive Aid

Mamata Nayaka, Mr. Manjunath Reddy

Flower garlands, with colorful blooms and sweet fragrance, are part of Indian culture. These chains of flowers, leaves, and foliage are not merely decorative; they hold spiritual significance. Whether offered in temples, used in household rituals, or presented during public ceremonies, garlands form a vital element of Hindu worship, with the word puja itself evoking the act of “flower offering.”

Traditionally, garland making is a manual craft, requiring patience, precision, and physical stamina. The process involves carefully selecting flowers, arranging them in sequence, and tying them one by one with thread. For those who make garlands in large numbers, this repetitive motion causes significant strain, especially on the hands and back, making the work labor-intensive and exhausting.

This was the everyday reality for Late Mr. Muniveera Reddy and his son, Mr. Manjunath, residents of Karnataka. Engaged in flower binding for years, the duo understood firsthand the physical toll of garland making. Faced with the constant fatigue and slow output, they began to think differently.

Late Mr. Muniveera Reddy envisioned a tool that could ease this burden, a simple device that would speed up the process, reduce the strain, and improve consistency. Although he passed away before realizing this dream fully, his son Manjunath took his vision forward. Today, Manjunath is not only keeping his father’s legacy alive but also transforming the lives of hundreds of garland makers across the region.

The Flower Tying Assistive Aid: A Simple Solution

Manjunath’s innovation is a mechanical device designed with accessibility, affordability, and efficiency in mind. Built using commonly available materials, the machine features:

- A 12V DC motor that powers the rotation.
- PVC pipes and connectors to create a supportive frame.
- Two S-shaped hooks to hold the thread.
- A switch and regulator to control the motor speed.

The device is designed to be placed on a stable surface (eg. Wall or any vertical support structure). The thread is wound between the two hooks. When the motor is turned on, one of the hooks rotates, twisting the thread. The garland maker simply inserts flowers between the twisted threads.

The strand can be flipped over and flowers inserted from the other side to complete the garland. A speed controller allows the user to adjust the motor’s pace based on the type of flower and the desired tightness of the garland. Once finished, the garland is cut to size.

Transforming the Garland - Making Process

This innovative device addresses many challenges faced in traditional garland making :





Flower tying machine

Image Reference :- <https://www.facebook.com/muniveerareddy/>

1. **Reduced physical strain:** The automated twisting eliminates repetitive stress on the hands and back, preventing long-term health issues.
2. **Enhanced productivity:** With the machine, a skilled artisan can produce up to 25 feet of garland in an hour, significantly faster than manual methods.
3. **Economic empowerment:** Increased productivity leads to higher earnings, providing artisans with improved financial stability.
4. **Inclusive and accessible:** The simple operation makes the device usable by people of various ages and physical abilities, including women and those with disabilities.
5. **Preservation of tradition:** By making the craft easier and more

sustainable, the machine encourages the continuation of garland making among newer generations.

A Blooming Success

Priced affordably, starting at just ₹2500, Manjunath has already sold over 700 units of the flower tying device. The overwhelming response from the garland - making community is a testament to its impact. This grassroots innovation is not only preserving a cultural tradition but also empowering artisans with the tools to improve their craft and their livelihoods.

By honoring the past and embracing innovation, the Flower Tying Machine beautifully symbolizes the spirit of creativity and practical ingenuity, turning a simple idea into a blooming success. ■

This grassroots innovation is not only preserving a cultural tradition but also empowering artisans with the tools to improve their craft and their livelihoods

Source : NIF database

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Phone: 09743784416,

E-mail: manjunathmreddym@gmail.com

Interested readers may go through the following websites to know more.

1. <https://gaatha.org/Craft-of-India/madurai-garland-making-craft/>
2. <https://garlandmag.com/article/mala-the-floral-garlands-of-india/#:~:text=Garlands%20serve%20as%20offerings%20to,flowers%20in%20the%20religious%20context.>
3. <https://www.youtube.com/watch?v=3pb7j-vCILQ>
<https://www.youtube.com/watch?v=53qVG5MC094>
4. <https://www.pexels.com/photo/baskets-with-rose-petals-16153512/>

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Shri Manjunath Reddy, a grassroots innovator, and his late father, Muniveera ji, crafted floral garlands from roses grown in their own garden to sell in their neighborhood. To simplify and speed up this process, Manjunath developed this unique garland-making mechanism.

Rural Innovation Landscape in India

- From margins to mainstream

Poonam Singh, Shubhamika Jha

India has long been described as a land of villages, with nearly 65% of its population residing in rural areas. Despite impressive strides in urban economic growth, the gap between rural and urban India persists - not only in infrastructure and economic opportunities but also in how knowledge, innovation, and capabilities are perceived and valued.

In this context, rural and grassroots innovations - rooted in the wisdom, resilience, and ingenuity of local communities - assume critical importance. They address core issues such as affordability, employment generation, distress migration, economic self-reliance, and the preservation of indigenous knowledge systems that have sustained ecosystems and economies for centuries. India's challenge is not merely to replicate urban models in rural contexts, but to craft a development paradigm where local knowledge and creativity serve as the foundation for sustainable and inclusive growth.

Imperatives of Rural Innovations

According to the Periodic Labour Force Survey (PLFS) 2024, the rural unemployment rate is reported at 4.2% (for persons aged 15 and above), compared to 6.1% in urban areas. However, this statistic masks deeper challenges - large segments of the rural workforce are engaged in low-productivity, informal, and seasonal employment, particularly in agriculture. Agriculture continues to employ over 45% of India's workforce while contributing less than 18% to GDP.

In this scenario, rural innovation - particularly grassroots-led innovation - can play a transformative role. Low-cost farm tools, improved crop varieties, irrigation solutions, soil health management techniques, and herbal remedies can significantly improve productivity and create sustainable livelihood opportunities.

The Government of India has over the years launched several targeted schemes and initiatives to mainstream rural innovations

Equally pressing is the issue of distress migration. Over 30% of India's population is estimated to be migrants, many from states such as Bihar, Jharkhand, Odisha, and Uttar Pradesh. Migration is often seasonal and distress-driven, straining urban infrastructure while leaving rural economies depleted of human resources. The COVID-19 pandemic exposed these vulnerabilities starkly, as millions of migrant workers returned to villages without economic security.

Strengthening rural innovation ecosystems - through Fabrication Labs, Rural Technology Parks, and Livelihood Centres - can provide local youth with exposure to design, digital fabrication, and entrepreneurship. When aligned with the National Rural Livelihood Mission (NRLM),

grassroots innovation platforms can generate sustainable livelihood opportunities at scale.

Energy innovation is another key area. Affordable solutions such as solar pumps, solar dryers, and biogas-based cooking technologies are already transforming rural energy access. The International Energy Agency estimates that decentralized solar solutions could bridge up to 70% of the rural energy access gap by 2030 if innovation and financing are scaled effectively.

Government Initiatives Supporting Rural Innovations

The Government of India has over the years launched several targeted schemes and initiatives to mainstream rural innovations. In this section we will explore some major institutional mechanisms, flagship programs, financial supports, and integrative platforms through which India promotes rural innovations.

National Innovation Foundation (NIF) - India: The Flag-bearer of Grassroots Innovation

राष्ट्रीय नवप्रवर्तन प्रतिष्ठान — भारत
विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार का स्वायत्तशासी संस्थान
National Innovation Foundation - India
Autonomous Institute of the Department of Science and Technology, Govt. of India

At the heart of India's grassroots innovation architecture is the National Innovation Foundation (NIF) - India. Grassroots innovations originate from diverse groups, including tribes, farmers, artisans, school dropouts, and rural women. These are the individuals who lack institutional

support from formal science and technology infrastructure. The institute has built a substantial repository of technological ideas, innovations, and traditional knowledge practices from nearly 600 districts across the country. From low - cost agricultural tools to Farmers' developed crop varieties, herbal human and veterinary medicines, from water-conservation and agricultural techniques to eco-friendly machines, NIF support rural innovators with R&D interventions, Intellectual Property Rights (IPR) protection, incubation (through its own in-house Technology Business Incubator), commercialization, entrepreneurship development and dissemination. Another unique aspect is NIF led DST INSPIRE - MANAK (Million Minds Augmenting National Aspiration and Knowledge) scheme, which garners lakhs of students annually to propose original science and innovation - based ideas, many from far flung hinterlands.

Unnat Bharat Abhiyan (UBA): Academic Institutions Meeting Rural Needs



उन्नत भारत अभियान
UNNAT BHARAT ABHIYAN

The Unnat Bharat Abhiyan, launched by the Ministry of Education, aims to connect academic institutions, especially technical and higher education institutions like IITs and central universities, with rural India to address developmental challenges through appropriate technologies and community engagement. Under this scheme, each participating institute adopts a cluster of villages and undertakes needs assessments, surveys, and interventions.

Many national-level initiatives under the Ministry of Science and Technology have introduced special rural innovation windows

Support from National and State R&D Missions

Many national-level initiatives under the Ministry of Science and Technology have introduced special rural innovation windows. Programs like Technology Development Board (TDB) and National Science and Technology Entrepreneurship Development Board (NSTEDB) support affordable, scalable rural technologies by co-funding their development and pilot testing. The programme SUNIL (Strengthening, Upscaling & Nurturing Local Innovations for Livelihood) aims to empower India's Economically Weaker Sections (EWS) by supporting the deployment of S&T-based solutions that address local community needs. It aims to boost technology adoption, foster adaptive skill development, enhance S&T knowledge, and promote social enterprise models to improve livelihoods and local entrepreneurship, ensuring that grassroots innovations deliver long - term socio - economic benefits to marginalised populations.

On the state level, various programs, e.g., *Mukhyamantri Abhinav Krushi Jantrapati Samman Yojana* by the Government of Odisha; Innovation Awards and Grassroots Innovation Internship Scheme by Higher and Technical Education Department of Govt of Jharkhand; State Innovation Awards by the State Innovation Council of Govt of Rajasthan, Grassroots innovators of Punjab, by Punjab state council of science and

technology, NERCORMP North Eastern Region Community Resource Management Project under Ministry of Development of North Eastern Region (DoNER), etc., have been initiated under different departments for the promotion of local innovations and traditional knowledge holders.

Atal Innovation Mission (AIM) and Atal Tinkering Labs (ATLs)



ATAL INNOVATION MISSION

Atal Innovation Mission, as a flagship innovation program by NITI Aayog, has made concerted efforts to include rural India. Under its Atal Tinkering Labs (ATLs) scheme, thousands of schools have been provided 3D printers, robotics kits, and science learning equipment. Additionally, Atal Incubation Centres (AICs) and Community Innovation Centres (CICs) are being promoted in Tier II and Tier III areas. The CICs, a newer initiative, directly seek to support rural entrepreneurs and innovators by providing lab access, training, and mentorship.

Start-Up India and Rural Enterprise Promotion

#startupindia

Start-ups India has been striving to build a strong ecosystem for nurturing innovation and startups across various sectors, and, consequently, India has become the world's third-largest innovation ecosystem. In addition, several state governments have launched Rural Innovation and Entrepreneurship Programs in tandem with the Start-Up India ecosystem. In parallel, Pradhan Mantri Mudra Yojana (PMMY) has opened up

institutional credit for non-corporate, rural entrepreneurs, especially those who develop innovative microenterprises in food processing, repair, handicrafts, and local transport.

National Rural Livelihoods Mission (NRLM): Innovation Through Self-Help Groups



The Deendayal Antyodaya Yojana - National Rural Livelihoods Mission (DAY-NRLM), under the Ministry of Rural Development, focuses on building community-based institutions (SHGs and federations) that can foster entrepreneurship and micro-enterprise. Many of these SHGs are today involved in innovative value chains - such as turning farm waste into packaging, developing millet-based ready-to-eat products, or crafting herbal health and beauty products.

Initiatives like Start-up Village Entrepreneurship Programme (SVEP) and Aajeevika Grameen Express Yojana within NRLM allow experimentation and incubation of grassroots ideas by rural youth and women in non-farm sectors. Innovations emerging from these groups are often frugal, sustainable, and women-led.

Traditional Knowledge Digital Library (TKDL) and AYUSH Integration



India's grassroots innovations are deeply rooted in its traditional knowledge systems, from herbal medicine to agricultural techniques. To protect these, the TKDL, a joint initiative of CSIR and AYUSH Ministry, documents traditional practices in multiple languages, preventing biopiracy and facilitating recognition of community innovations.

The AYUSH Ministry also promotes innovation by supporting rural healers and herbalists through schemes for clinical validation, drug standardization, and setting up AYUSH Health and Wellness Centres in tribal and remote areas.

e-GramSwaraj, Digital India, and Tech Platforms for Rural Innovators



With the Digital India Mission, access to digital infrastructure in rural areas has expanded. Platforms like e-GramSwaraj, Common Service Centres (CSCs), and MyGov Innovate serve as vehicles for citizen engagement, digital skilling, and innovation challenges. For instance, CSCs in various remote areas are

offering digital services as well as training rural youth in skill-based programs including electrical repair, assistant motor mechanic, welding, mobile repair, and cybersecurity etc.

ASPIRE (A Scheme for Promotion of Innovation, Rural Industries and Entrepreneurship)

The objective is to establish a network of Livelihood Business Incubators (LBIs) primarily in rural and underserved areas to foster innovation and accelerate entrepreneurship. This initiative aims to generate employment opportunities by enabling the creation of formal, scalable micro-enterprises within the agro-rural sector. Additionally, it focuses on skilling, upskilling, and reskilling unemployed individuals, self-employed persons, and wage earners in emerging technologies relevant to the agro - rural domain. By providing a skilled workforce to nearby industrial clusters, the program seeks to promote innovation and enhance the competitiveness of Micro, Small, and Medium Enterprises (MSMEs) in these regions.

Outcomes and Opportunities for Strengthening India's Rural Innovation Ecosystem

Over the past two decades, India has launched a diverse range of initiatives to democratize and decentralize innovations, particularly in underserved rural regions. While these measures have undeniably boosted awareness and participation among grassroots innovators, challenges persist in scaling, equity, infrastructure, and commercialization.

Evolving Innovation Ecosystem

Multiple initiatives through NIF, AIM, RKVY (Rashtriya Krishi Vikas Yojana), PMGDISHA (Pradhan Mantri Gramin Digital Saksharta Abhiyan), and Startup India are now in place

by ministries and organizations, offering innovators support at different stages-from ideation to incubation. While this has led to vibrant activity across the country, the ecosystem still offers scope for greater synergy and coordination among stakeholders. Strengthening institutional integration can ensure that innovators receive seamless support across their entire journey, maximizing efficiency and impact.

Expanding Investment in R&D

India is steadily increasing its investment in R&D, currently at around 0.64–0.7% of GDP. This reflects a solid foundation upon which a more ambitious research-driven economy can be built. An encouraging trend is the growing involvement of the private sector, which now contributes over one-third of total R&D spending. With further encouragement, especially in frugal and grassroots innovations, India has the opportunity to balance high-tech advancements with inclusive, rural-focused solutions - unlocking a vast market and amplifying social impact.

Strengthening Industry - Academia Partnerships

India's academia and industries are increasingly recognizing the value of collaboration. As shown in the Global Innovation Index, there is already a measurable presence of university - industry R&D engagement. Expanding this linkage presents immense potential for commercialization, particularly if more institutions establish dedicated industry liaison and technology transfer offices. With greater private

participation and targeted financing for Intellectual property - led startups, the innovation pipeline from lab to market can be accelerated.

Encouraging Intellectual Property Awareness and Use

The Indian government has introduced several supportive schemes to promote intellectual property (IP) creation. For example, the Startup India program offers up to 80% rebate on patent filing fees, 50% on trademark registration, and special concessions for MSMEs under the IPR awareness mission. The next opportunity lies in widening awareness and access, especially in Tier II, Tier III, and rural regions. By simplifying procedures, enhancing local facilitation, and embedding IP experts within universities and incubators, grassroots innovators will be able to better protect and scale their ideas. This expanded IP culture can serve as a multiplier for entrepreneurship across the country.

Enhancing Outcome-Oriented Tracking

Currently, a wealth of data is collected on participation and initial achievements such as idea submissions and prototype creation. Building on this, India has the opportunity to evolve towards deeper longitudinal tracking - focusing on commercialization success, market entry, and income generation. Such outcome-based evaluation would create a powerful feedback loop, helping policymakers, funders, and incubators to replicate successes, fine - tune support systems, and sustain innovations over the long term.

Conclusion

India's commitment to grassroots innovation is both ambitious and inspiring. National and state-level programmes have expanded participation and democratized access to innovation platforms. However, the next phase must focus on deeper integration, sustainable financing, IP protection, and commercialization pathways. Regional IP hubs, rural incubation clusters, and academia - industry collaborations can convert rural creativity into scalable enterprises. By embedding outcome-based evaluation and recognising intangible assets such as traditional knowledge, India can ensure grassroots innovation translates into tangible social and economic transformation. With the right support ecosystem, rural innovation can emerge as a powerful engine of equitable growth - strengthening self - reliance from the bottom up and playing a pivotal role in realising the vision of Atmanirbhar Bharat and *Viksit Bharat@2047*. ■

References:

1. <https://nif.org.in/>
2. <https://unnatbharatabhiyan.gov.in/>
3. <https://aim.gov.in/>
4. <https://www.startupindia.gov.in/>
5. <https://aajeevika.gov.in/>
6. <https://www.tkd.res.in/tkd/langdefault/common/Home.asp?GL=Eng>
7. <https://egramswaraj.gov.in/>
8. <https://www.digitalindia.gov.in/>
9. <https://www.mygov.in/>

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Silkworm Net Folding Device

- A Grassroots Innovation Transforming Sericulture

Neha Tavker, Sunil Shinde

In many rural communities where farming and silkworm rearing form an integral part of daily life, even seemingly small challenges can have significant consequences. One such challenge is the repetitive task of folding and storing nets used for rearing silkworms. Though routine, this process demands time, effort, and precision - factors that directly impact cocoon formation and, ultimately, farmers' incomes.

From Problem to Possibility

Shri Sunil Shinde, a grassroots innovator from a joint farming family actively engaged in sericulture, faced this difficulty firsthand. After every rearing cycle, hundreds of V-shaped nets - used as the base on which silkworms spin their cocoons - had to be folded and tied for reuse. The process was painstaking: improper folding often distorted the nets, affecting their usability in future cycles.

With over a thousand nets to manage, and only two skilled workers available, productivity remained low. On average, a full day's effort yielded just 200 neatly folded nets. The process was not only time-consuming but also physically draining, delaying subsequent rearing cycles.

Determined to address this bottleneck, Sunil designed a simple yet effective tool - the Silkworm Net Folding Device.

A Simple Solution to a Persistent Challenge

The device exemplifies how frugal engineering can resolve real-world

rural problems. Constructed from lightweight square metal pipes, it features three main components:

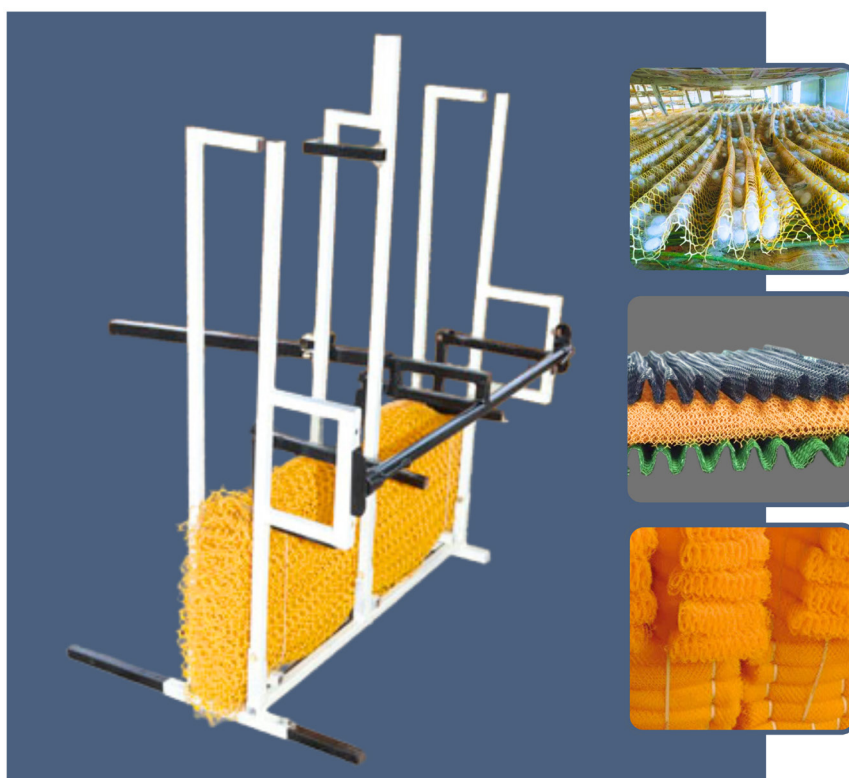
- **Base Platform:** Where nets are placed initially.
- **Main Frame:** A vertical structure guiding the folding process.
- **Pressing Lever:** A horizontal bar that applies uniform pressure on the nets.

To operate, nets are stacked onto the hinged base platform, which is then raised into the frame. By applying pressure with the lever, the stack is compressed into a compact bundle. The nets are tied securely with ropes, after which the locks are released, leaving a neat, reusable package.

Portable at just 16 kilograms, the device can be handled easily, even by individuals with limited physical strength. Most importantly, it cuts down folding time dramatically - transforming a day-long effort into a matter of minutes.

Boosting Productivity and Reducing Dependence on Labor

Since its introduction, the Silkworm Net Folding Device has revolutionized net management in Sunil's community. What once required two people an entire day - folding 200 nets - can now be scaled up to 3,000 nets per day, marking a tenfold increase in productivity.



The Silkworm Net Folding Device is a reminder that transformative technologies do not always emerge from research laboratories or large corporations. Sometimes, they arise from the lived experiences of individuals who identify challenges, imagine solutions, and act on them

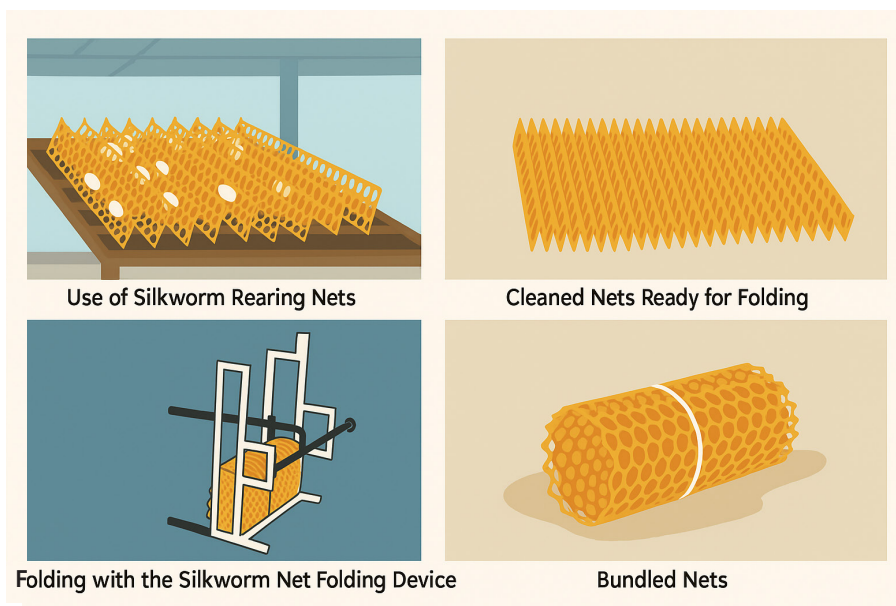
Beyond efficiency, the device offers several critical benefits:

- Maintains net integrity, ensuring longer usability and consistent cocoon formation.
- Reduces physical strain, making sericulture more accessible and less exhausting.
- Speeds up rearing cycles, enabling higher yields across the year.
- Decreases reliance on skilled labor, fostering greater self-reliance among farmers.

For small-scale farmers, particularly those supplementing their livelihoods through sericulture, these improvements translate into more stable incomes and reduced risks during peak seasons.

The Science Behind the Innovation

The device operates on the principle of mechanical advantage. The lever mechanism multiplies the user's input force, allowing them to compress multiple nets with minimal effort. The frame ensures even pressure, resulting in uniform folding and compact



AI-Generated & Modified Image

bundles that are easier to store and transport.

This not only saves space but also minimizes damage and tangling - common problems with manually folded nets.

Broader Implications for Rural Innovation

The Silkworm Net Folding Device is more than a mechanical tool - it represents the spirit of grassroots innovation. Developed out of necessity, it showcases how local knowledge and ingenuity can create impactful, low-cost solutions that transform lives.

Such innovations:

- Save time, allowing farmers to engage in other productive activities.
- Enhance income stability by ensuring uninterrupted rearing cycles.
- Generate opportunities for local fabrication, repair, and entrepreneurship.

At a time when rural labor shortages are increasing, and efficiency in farming practices is critical,

innovations like Sunil Shinde's device highlight the power of community-driven problem solving.

The Silkworm Net Folding Device is a reminder that transformative technologies do not always emerge from research laboratories or large corporations. Sometimes, they arise from the lived experiences of individuals who identify challenges, imagine solutions, and act on them.

By combining simplicity with effectiveness, Sunil Shinde has not only eased the burden of sericulture for his community but also set an example of how rural India's creativity can drive progress - literally folding innovation into everyday life.

When a simple act like folding a net becomes a daily hurdle, it's not just about lost time- it's about lost potential. This silkworm net folding device reminds us that innovation doesn't always wear a lab coat. Sometimes, it wears dust-covered shoes, watches patterns in routines, and builds solutions with bare hands. Every fold saved here folds open a new opportunity turning tools of burden into tools of change.

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Shri Sunil Shinde is a grassroots innovator from Maharashtra, developed this silkworm net folding device based on his own experience in sericulture, offering a practical solution that bridges rural challenges with hands-on ingenuity

Rethinking Science Education

- From Rote Learning to Real-World Applications

Govinda Bhattacharjee

Science is driven by curiosity and inquiry. One of my abiding memories of learning science in school was when our teacher had taken the entire class to an outing near a beautiful stream strewn with pebbles and stones of various sizes and colours. We were told to pick up a few stones each, and then identify and classify them into various rock types we had learnt from our textbooks. I have not forgotten that lesson even after more than five decades. It reminds me of the old adage - tell me and I forget, show me and I remember, involve me and I learn.

Science prepares our youth to navigate the complex challenges that life will present to them, but our current model of science education based on memorisation and overreliance on rote learning is totally inadequate for that purpose. It remains tethered to outdated paradigms while across the world today, pioneering initiatives are redefining how to teach science - not just as a body of knowledge, but as a way of thinking and acting. We rely too much on memory with too little meaning and application, and so we have students who can recite textbooks but cannot explain real-world phenomena. The Annual Status of Education Report (ASER) in 2021 found that fewer than 40% of rural Indian youth could interpret simple science data, and many had never conducted basic experiments. The Aspiring Minds 2019 survey of over 170,000 Indian engineering students found that only 3.84% had no employable, practical engineering skills. Our hyper-competitive coaching industry, which engages students for 14 hours a day on how to crack the JEE, destroys whatever

curiosity they have. As a Kota student recalled, he cracked the exam by memorising formulas while losing all interest in learning. Bugged with outdated curricula that time forgot, teachers who teach mostly through lectures, national board exams that are heavily fact-based and favour parrot learning with little to foster creativity, innovation and application, it is a moribund system in which test preparation consumes most of the time for both teachers and students rather than learning. Standardized texts often not revised for 10 years and standardised exams dominate this educational system and this “*teaching to the test*” model in schools that discourages curiosity, inquiry and exploration is in an advanced state of decay.

Science prepares our youth to navigate the complex challenges that life will present to them

Many countries have implemented key reforms that transformed their landscape of science teaching. One pioneer is Finland that shows of what a reimagined science education can do by replacing rigid subject silos with flexible, interdisciplinary and project-based or “*Phenomenon-Based Learning*” (PBL) from early years. A typical science unit in the school might blend biology, geography and ethics as students explore the real - world implications of climate change, urban planning, impact of technology, etc. It prioritizes autonomy, creativity, critical thinking and team-work, supported ably by a highly qualified teaching fraternity. OECD’s “*Programme for International Student Assessment*” (PISA) assesses scientific literacy of 15-year-old students

worldwide - in 2018, Finnish students scored well above the global average in science literacy with high levels of engagement and confidence in scientific reasoning. USA’s Project Lead the Way (PLTW) are reshaping STEM education through hands - on, problem-based learning. In PLTW classrooms, students are encouraged to think like scientists and engineers - the focus is on creativity and problem solving. Similarly,, Ontario’s science curriculum in Canada also emphasizes inquiry-based learning, indigenous knowledge and STEM skills. A 2023 evaluation by the Ontario Institute for Studies in Education showed a 15% increase in student confidence in science after this updated curricular reform. Closer home, Singapore has moved from rote-focused teaching to the “Science as Practice” model, emphasizing critical thinking, inquiry, and societal relevance. Its National Science Curriculum includes real-world applications, digital literacy and sustainability themes. Singapore has topped the PISA science scores several times; its students rank among the world’s best in problem-solving and scientific reasoning. A 2020 Ministry of Education survey reported that 75% of students felt confident applying science to everyday issues.

Even low-income countries are reinventing and reimagining science education - Rwanda is demonstrating that technology can rapidly level the playing field and reduce gender achievement gaps in science learning. Its “*Smart Classroom*” initiative has equipped schools with digital tools and interactive software, giving students access to virtual labs and multimedia science modules in areas lacking traditional lab equipment. A 2021 study by the Rwanda Education

Board showed that students using digital science content performed 25% better on exams than their peers who relied solely on textbooks.

India doesn't need more students who can recite the periodic tables. It needs thinkers and innovators who can use science to change the world. Even in India, there are many exemplary initiatives launched both by the government and private sector that need to be replicated and scaled up. The Government-launched Atal Innovation Mission, established more than 10,000 "Atal Tinkering Labs" (ATL) in schools nationwide to provide students with tools to experiment with robotics, electronics, and AI. An NCERT impact study in 2022 found that students in 75% of the schools equipped with the labs have developed a positive attitude towards STEM subjects, while 69% of schools reported that more students were pursuing science for higher studies after accessing ATLs.

India doesn't need more students who can recite the periodic tables. It needs thinkers and innovators who can use science to change the world

Agastya International Foundation, a non-profit organisation based in Bengaluru, runs a network of Mobile Science Labs and hands-on science centres for rural children. By 2023, they had reached over 15 million children and 250,000 teachers across India, using open-ended exploration, real-world problem-solving and community-led learning to ignite curiosity in young minds. A government-led initiative, the Raman Science Centre at Nagpur, engages students in interactive science learning through exhibits, planetarium shows, and innovation



AI-Generated Image

competitions, which the local teachers use as a supplement to regular curriculum, especially for explaining physics and chemistry concepts through real-life simulations. Vidya Vanam tribal school in Tamil Nadu integrates local knowledge systems with modern science education. Students learn biology through farming, environmental science through water conservation, and physics through traditional architecture. The school fosters inquiry by grounding scientific concepts in the learners' own communities. At the college level, IIT Gandhinagar has pioneered an innovative "Foundation Programme" to foster critical thinking, hands-on tinkering, and interdisciplinary

science exploration.

Like the rest of our educational landscape, our science education is also splintered into two separate fragments, one a broken system that traps students in mindless rote learning that kills inquiry, and the other, a set of bold, innovative experiments that awaken curiosity and purpose. In an age of climate crises and disruptive AI revolutions that are reshaping our society and jobs like never before, rethinking and reimagining science education is no longer a pedagogical option - it's a practical and strategic imperative. We owe it to our students and to the nation. The stakes are too high to keep continuing with our old meaningless ways. ■

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Wheels of Change

- The Journey of the Swachhata Cart

Merin Dayana, Devendra Tiwari, Javed Pathan, Sikanto Mandal

In the historic city of Mathura, Uttar Pradesh, a young student named Sikanto Mandal noticed what most people overlooked—the daily struggles of sanitation workers. While his peers shied away from waste collection tasks, Sikanto paid attention to the relentless bending, lifting, and straining endured by street sweepers, whose outdated tools left them vulnerable to fatigue and injury.

Across the world, and particularly in developing countries like India, manual waste collection remains a public necessity but comes at a steep human cost. Workers sweeping with long-handled brooms, bending to gather trash, and hauling heavy wheelbarrows often develop musculoskeletal disorders (MSDs) affecting their back, neck, shoulders, and knees. Exposure to waste also causes respiratory problems, skin diseases, and eye irritation. For Sikanto, these observations sparked a life-changing idea: *What if garbage could be collected in a way that was quicker, safer, and less physically demanding?*

This simple yet powerful thought gave birth to the concept of a Hand-Driven Waste Picking and Dumping Cart—a device that would eventually evolve into the innovative Swachhata Cart.

From Idea to Innovation

Sikanto's journey began with the INSPIRE - MANAK competition, a platform for young innovators. His initial prototype, though basic, caught attention and set him on an extraordinary path. Progressing through district, state, and national levels, Sikanto's idea gained

recognition and support.

The National Innovation Foundation (NIF) - India stepped in to mentor him, helping refine his concept into a practical innovation. What started as a sketch gradually transformed through multiple prototypes, each iteration tackling flaws from the previous version.

Prototypes and Refinement

The path to the final design, the Swachhata Cart, involved several rounds of meticulous redesign and testing to address a number of flaws.

1. Prototype 1 – A proof-of-concept made from waste wood. It featured a foldable dustpan and pulley mechanism but was complicated to operate and impractical for real-world use.
2. Prototype 2 – Built with iron and a 40 kg capacity, this model included a dustbin with a sliding surface and compartments for sanitation tools. Aesthetic yet inefficient, it struggled with smooth waste collection.
3. Prototype 3 – Created with the help of an entrepreneur, it integrated iron, plastic, and rubber parts. A fixed dustpan, improved wiper, and relocated storage made it more usable, though maneuverability remained poor.
4. Prototype 4 – Increased capacity to 100 kg and improved collection, but its two-tire design made it heavy and difficult to move.

After multiple refinements, the



Sikanto Mandal

Final Prototype emerged as a breakthrough design—ergonomic, durable, and efficient.

The Swachhata Cart : Thoughtful Engineering

Crafted from CRC sheets and MS tubes, the Swachhata Cart achieved a carrying capacity of 220 kg, including a waste bin of 150 kg. More importantly, its design prioritized worker health and efficiency:

- Contactless Picking Mechanism – Allowed waste collection without direct contact, reducing health hazards.
- Efficient Dumping System – Streamlined disposal, saving time and effort.
- Integrated Storage – Dedicated compartments for protective gear, tools, and even a water bottle, reflecting a deep empathy for sanitation workers' daily needs.

A Lasting Impact

The Swachhata Cart is not just a product—it represents social innovation with real impact. NIF filed a patent (520049) in Sikanto's name

and facilitated a licensing agreement with Sarjan Innovation Pvt. Ltd., ensuring both recognition and financial reward.

Today, the cart is listed on the Government e-Marketplace (GeM) and has been adopted by municipal corporations in Ahmedabad, Patan, Mehsana, and other cities. Over 250 carts are already in use, significantly reducing physical strain and health risks for sanitation workers.

‘The Swachhata Cart is more than an engineering solution - it is a human-centered innovation. It bridges the gap between grassroots ideas and practical technologies that uplift communities’

For Sikanto, the cart is a symbol of change, but for the workers, it has become a tool of dignity and safety.

Recognition and Milestones

Sikanto’s journey demonstrates how observation, empathy, and perseverance can drive meaningful innovation. His achievements include:

- Recognition at district, state, and national levels under INSPIRE – MANAK.
- Selection for the In-Residence program at Rashtrapati Bhavan (2019), where he showcased his Swachhata Cart.
- Participation in the Japan-India Youth Exchange Programme

(2019), fostering international collaboration in science and technology.

- Invitation to the Innovation Conclave (2018), where he shared the stage with grassroots innovators and interacted with the cast of *Padman*.

INSPIRE – MANAK : Nurturing Young Innovators

The INSPIRE – MANAK (Million Minds Augmenting National Aspiration and Knowledge) scheme, jointly implemented by the Department of Science and Technology (DST) and NIF – India, supports creative school students (classes 6-12).

Schools nominate promising ideas, and shortlisted students receive funding to build prototypes. Top innovators progress through district, state, and national levels, gaining mentorship from premier institutes such as IITs, NITs, and IISc. The most impactful innovations are incubated, patented, and commercialized—turning young thinkers into change-makers.

Conclusion

The Swachhata Cart is more than an engineering solution - it is a human-centered innovation. It bridges the gap between grassroots ideas and practical technologies that uplift communities. Sikanto’s journey reminds us that great change often begins with small observations, and with the right support, those ideas can transform lives.



Sanitation workers are using the Swachhata Cart during their daily routine work for the municipal corporation.

In his story lies a powerful message: innovation is not only about technology—it is about empathy, persistence, and the courage to see problems as opportunities for change.■

References:

1. <https://www.thebetterindia.com/11371/tbi-invisible-heroes-of-everyday-the-street-cleaner-women/>
2. https://cdn.downtoearth.org.in/library/small/2016-05-30/0.08295700_1464611343_42-1-20160615-dte.jpg
3. <https://design-altruism-project.org/2012/03/07/brushin-up-bgalore/>
4. <https://5.imimg.com/data5/OH/CJ/MY-3952687/hand-cart-500x500.jpg>
5. https://www.thebetterindia.com/11371/tbi-invisible-heroes-of-everyday-the-street-cleaner-women/img_0928-800x493/
6. <https://www.bbc.com/news/world-asia-india-18394914>

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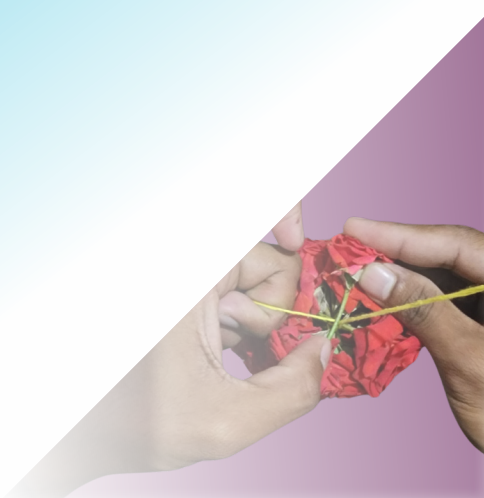
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Sikanto Mandal, is a young innovator from Mathura whose manually-operated Swachhta cart was born out of simple school chores and is now set for mass production thanks to NIF.



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