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Innovation-led transformation of agriculture and rural development in India

Editor-in-Chief
Dr. Arvind C. Ranade

Editor
Dr. Rintu Nath

Publication Committee:
Dr. Vivek Kumar
Dr. R K Ravikumar
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Er. Rakesh Maheshwari
Shri Hardev Choudhary
Dr. Satya Singh

Design
Ms. Bhavya Singh

Address for correspondence
National Innovation Foundation - India
Grambharti, Amrapur, Gandhinagar,
Gujarat- 382650

Tel: +91-02764-261131, 32

email
newsletter@nifindia.org

website
https://www nif.org.in

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Editorial

India is navigating a complex hydrological situation. Official data reveals that nearly 600 million citizens face acute water stress, with per capita availability dropping toward international scarcity thresholds of 1000 cubic meters per person. Dynamic Groundwater Resources Assessments, conducted by the Central Ground Water Board and State Ground Water Departments, indicate that over 12% of the nation's assessment units are critical or over-exploited, particularly across northwestern and southern aquifers. As rural agriculture consumes 80% to 85% of India's freshwater withdrawals, securing the nation's hydrological future depends not on urban conservation alone, but also on fundamentally transforming farming practices. To reverse aquifer collapse, India must transition from water intensive cultivation to a regenerative, climate-resilient agriculture that bridges public infrastructure with traditional ecological wisdom.

For decades, agricultural incentives favored water-guzzling crops like flood-irrigated paddy and sugarcane in semi-arid and ecologically unsuitable regions. This structural mismatch has drained deep aquifers and trapped marginal farmers in a cycle of rising pumping costs and climate vulnerability. Reversing this trajectory requires redefining agricultural success, which means shifting the core assessment metric from yield per hectare to nutritional density and economic revenue per liter of water. Transitioning from conventional flood irrigation (chaalu pani) to precision pressurized micro-irrigation, such as drip and sprinkler systems, can cut farm-level water consumption by up to 50% while boosting yields by 30%. However, hardware adoption alone is insufficient, and infrastructure must be matched with cropping patterns tailored to regional agro-climate.

Long before modern hydrological accounting, Indian communities perfected decentralized, rainfed agricultural systems. Central to this heritage are Shree Anna, which are native millets like Bajra, Jowar, and Ragi. Unlike standard paddy, which consumes up to 5,000 liters of water per kilogram, millets require under 600 liters. They flourish in nutrient-poor rainfed soils without synthetic fertilizers, withstand extreme thermal shifts, and offer better nutritional value. Complementing these low-water crops is the revival of traditional community water-harvesting architecture. Hyper-local systems, such as Rajasthan's Johads, South Bihar's Ahar-Pynes, Himalayan Kuls, Tamil Nadu's Eris, etc., provide essential buffer storage against monsoon volatility. Combined with modern contour bunding and organic mulching, these grassroots structures capture runoff in situ and actively recharge local water tables.

Targeted national initiatives are already establishing the institutional scaffolding required for nationwide agrarian resilience. The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) champions the 'Per Drop More Crop' mandate by subsidizing micro-irrigation across millions of hectares. Simultaneously, the Atal Bhujal Yojana empowers Gram Panchayats to manage local groundwater budgets using transparent hydrogeological data. In addition, programs like the Paramparagat Krishi Vikas Yojana (PKVY) are promoting natural farming to rebuild soil organic carbon, transforming farmland into a biological sponge that maximizes rainfall retention.

While India has established a strong foundation for agrarian climate resilience through PMKSY, PM-KUSUM, and the push for Farmer Producer Organizations (FPOs), the success will be decided by its utilization at the grassroots level. The vital remaining task for rural cooperatives is equipping every village-level FPO with on-site processing and packaging machinery, allowing communities to transform drought-resilient crops like millets into shelf-stable goods right at the farm gate rather than selling raw grain at volatile market rates. Various regional state-level pilot schemes provide direct incentives to farmers who voluntarily switch from water-guzzling crops to low-water alternatives. Expanding this into a national framework will ensure that preservation of ecology as a dependable and profitable livelihood across rural India.■

Dr. Arvind C. Ranade

Innovation-led transformation of agriculture and rural development in India

Ankita Singla and Vipin Kumar

India's goal towards becoming a developed country by the year 2047 depends on its ability to generate productive employment, increase rural income and accelerate sustainable economic growth. Despite the fact that almost half of the workforce in India is employed in the agriculture sector and related activities, a significant number of rural households are engaged in low-value economic activities (Economic Survey, 2024; NABARD, 2024). Stagnation of this sort is best countered by the type of entrepreneurship that is reliant on innovation and can successfully address local issues on a daily basis and establish new businesses that employ people (NITI Aayog, 2023).

Affordable grassroots innovations and traditional knowledge systems tend to offer practical and sustainable solutions to local problems. Throughout the year, rural inventors, mechanics, farmers and artisans develop unique designs of tools for agriculture, process and conserve water, manage livestock and farm renewable energy, food process and more. Even with their brilliance, many local innovations remain underexploited as inventors often lack the technical support to upgrade the innovations, the business acumen to mass-produce them and the adequate access to be able to sell them to local markets (Gupta, 2016)

A complete framework is required to be able to realise the full potential of local innovations. This framework may integrate innovation, skill development and commercialization. The process of such an innovative framework comprises recognizing local innovations that meet the practical and optimal requirements of local communities and adjusting them to work in other regional climates and varied socio-economic conditions. As evidence suggests, such innovations and tools are better adapted and can achieve a high level of impact across different regions of the country if they focus on local customization and modification centered around the end user (DST, 2024; OECD, 2023).

Rural farmers, rural youth, local artisans and women's self-help groups will be the focus of this capacity building and economic transformation initiative. These groups, in particular are the target demographic for this capacity-building initiative, which will include the development of technical and business skills. First, they should receive training about strengthening their technical and entrepreneurial capabilities, quality control, financial literacy, digital marketing and how to access markets, which they can use to develop and sell their products. Additionally, to help them overcome the operational challenges associated with initiating a new business, these first-generation entrepreneurs will require ongoing support and mentorship (ILO, 2024; IFAD, 2023).

The National Innovation Foundation's (NIF) methodologies, showcased through massive nationwide outreach, builds on the concept of problem-innovation fit. This seeks to eliminate the process of finding a market for an unknown technology or innovation and instead focuses on identifying local challenges and providing grassroots innovations to alleviate them. This process optimizes the use of technology and improves the effectiveness of several capacity development initiatives. NIF, through its technology business incubator NIFientreC provides avenues for the raw and the novel ideas of rural innovators and allowing them to establish small ventures for socioeconomic impact.

Once the technology and the local innovators are ready, unabridged structuring of business incubation aligns the creation of micro and small

enterprises. These enterprises can crystallize as a plethora of ideas like, decentralized food processing machinery, rural agricultural machinery, renewable energy enterprises, farming, livestock and utility service ventures. To ensure the first few months of business operation extend into the future, the enterprise is underpinned by a resilient business model. This model outlines the revenue streams and market and supply chain linkages. To achieve this, continuous surveys and research are essential to design low- risk, high-reward business models and frameworks that leverage local resources (IFAD, 2023).

The employment strategy promotes a shift in farming from growing crops for sale to processing the crops and selling the value added products. These new business opportunities diversify the local economy and keep the profits in the village rather than the profits escaping to cities (FAO, 2023; Ministry of Agriculture & Farmers Welfare, 2025). This shift from selling raw material to value added products greatly reduces the need of rural community members to migrate to find employment.

To implement such an innovation-based business model requires the use of many strategies with a focus on research-based interventions. The early stages of this model need to prioritize the research-based interventions of initial assessment and sectoral research to identify the most appropriate technology for active business incubation. The policies need to include integrated market strategies and innovative work performed in several adjacent regions. This model of research based interventions for tracking the effects on employment, business opportunities and improved income for households in rural communities need to be there in future policies. The model expands self-reliant rural communities by incorporating informal sectors into formal value chains, and makes rural commerce competitive (UNDP, 2024).

Fig 1. Adding value to local food produces using innovative tools developed by grassroots innovators Dharmabir Kamboj, Haryana and Mushtaq Ahmad Dar, J&K. The purpose of this framework is to develop new, sustainable employment opportunities and to propagate new levels of wealth throughout rural communities. Employment opportunities create a ripple effect and expand into many business networks. These include secondary supply chains and logistics, maintenance services and business marketing. There is less availability of employment for the rural youth and women. However, motivation based businesses create self-employment and expand job opportunities (ILO, 2024).

Fig 2. Reducing drudgery and enhancing efficiencies in rural micro industries (loom design making by weft insertion developed by Shri Dipak Bharali, Assam and parboiled paddy and oil seed turner developed by Shri R Ravi, Tamil Nadu)

The model of using innovative tools for enterprise and job creation will act as a powerful engine for agriculture and rural transformation as it would shift selling of farm produce as raw to value added products, hence, more incentives to the farmers. Supporting these enterprises shall contribute directly to agricultural modernisation and balanced

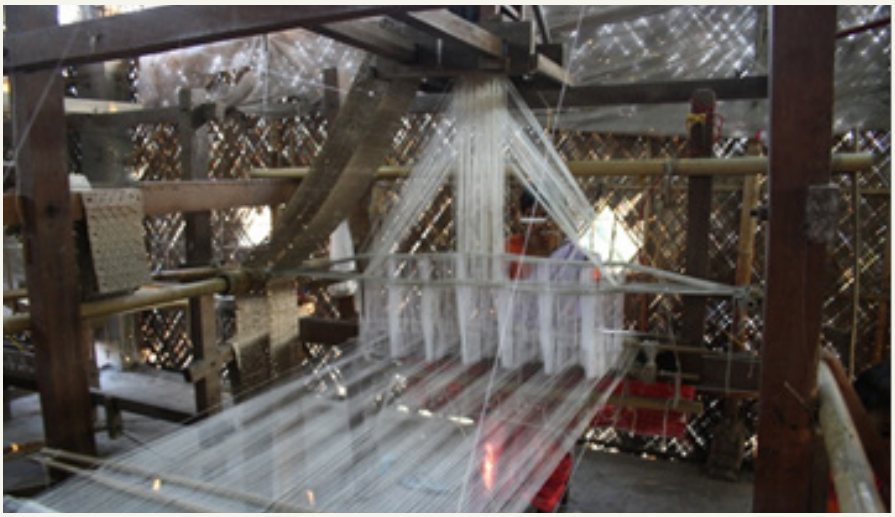

Fig 2. Reducing drudgery and enhancing efficiencies in rural micro industries (loom design making by weft insertion developed by Shri Dipak Bharali, Assam and parboiled paddy and oil seed turner developed by Shri R Ravi, Tamil Nadu)

economic growth. Such self-sustaining models complement ongoing national livelihood and skill development initiatives by reducing people's reliance on government subsidies and replacing it with sustainable economic independence rooted in local ingenuity (DAY-NRLM, 2025). ■

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Ms. Ankita Singla is Junior Fellow at National Innovation Foundation – India (NIF). She holds a M.Tech in Agricultural Systems and Management and at present associated with Business Development division.
Email: ankitas@nifindia.org

Dr. Vipin Kumar is Chief Scientist and Former Director at the National Innovation Foundation – India (NIF). His research and interest areas are incubation and promotion of innovations by value addition, intellectual property protection, and commercialization. He leads the Business Development team.
Email: vipin@nifindia.org

From Banana Wastes to Global Market: The Quiet Revolution of P.M. Murugesan

Akshita Mundra

350+ Women Employed	Rs. 1.5 Crore Annual Revenue	500 Tonnes Waste Processed/ Year	EXPORTS UK, France Singapore, Malaysia

Global context & india's position

The world is at crossroads on sustainability. Deloitte's 2025 Global C-Suite Survey of over 2,100 leaders confirms that sustainability is overtaking cost and digital transformation as the

PM Murugesan

single most pressing business priority globally. Meanwhile, conventional rope materials made of polypropylene, nylon, polyester release micro plastics into ecosystems, persisting for centuries. The world needs a natural, biodegradable alternative at large scale in order to protect the mother Earth.

India's Position: Ranked #38 on the WIPO Global Innovation Index 2025, India is officially classified as an "overperformer" signifying the consistent growth for achieving innovation outcomes beyond what its economic tier would predict. This is not the innovation of billion-dollar labs. It is the innovation of fields, villages, and open sheds.

The innovator — P.M. Murugesan

P.M. Murugesan hails from Melakkal Village, Madurai District, Tamil Nadu, where he is a cultivator and entrepreneur. While he did not complete his studies past the 8th standard, he has been working alongside his father in cultivation for decades He cultivates 2 acres of coconut and banana plantation, and leases 4 acres Vaigai river basin, which is the most productive region of Tamil Nadu in the cultivation of bananas.

His wife, Malarkodi, who did her education till the 10th standard, is equally involved in this endeavor since the very start, making valuable contributions on her own. Together, they set up an enterprise, which has come to be known as M S Banana Rope Production Center, a company that exports their environmentally friendly products.

The spark — from garland to revolution

Harvesting season marks an eerie catastrophe in the banana plantations of the Vaigai region. Post the harvest, the massive banana pseudostem, which is fibrous, high, and hard in nature, is left to decay into nothingness. The farmers either burn or bury the plant, or leave it to rot, thus, resulting in millions of tons of this plant going up in smoke and into soil through the years. It was in 1998, during a KVK (Krishi Vigyan Kendra) programme in Madurai, where Murugesan first came to know about processing of banana waste to ropes.

Along with Malarkodi, he started manually extracting the fiber to make just 200 metres a day fiber. Finally in 2002, tired of the laborious process of extracting the fiber manually, he finally decided to stop if mechanization was not possible. Another observation in

the flower market led him to his next big decision. At the flower market, he found that the very banana fiber he was letting to decay in his field was used to string flowers garlands. He adopted the coconut husk rope machine design

for making banana fiber rope.

Five machines — one vision

Over the next twenty years, Murugesan designed and refined five versions of his banana fiber rope-making machine. Iterative modifications driven by failures and feedback at each stage, enabling him to secure patents for three machines. The innovations span from manual to fully automatic, covering rope diameters from 1mm to 10mm:.

"The next trillion-dollar industry won't be made from oil, steel, or silicon. It will be made on the stuff we throw away."

— On Grassroots Circular Economy & Sustainable Innovation

Crucially, the designs are simple enough to be constructed by an average welder working at a local workshop, cost-effective enough to be afforded by small farmers, and efficient enough to compete with synthetic rope manufacturing on an industrial scale. Indeed, Murugesan has developed not only a fiber separator, a rope twiner, and a device that counts the length of the rope but also improvised the efficiency of the fiber separator, invented by his wife Malarkodi, which involved designing an alternative hair comb.

Nature, ecology & circular economy

M S Banana Rope Production Center, a unit by Murugesan does not just provide alternatives to the artificial varieties; their offerings amount to an ecological solution. The business utilizes around 500 tons of banana psuedostem waste annually. Otherwise, this waste would be either burned (resulting in emissions of CO_2), buried (emitting methane), or simply thrown away into rivers where it would eventually disintegrate. Natural processes have been employing zero-waste production since Earth's inception 3.8 billion years ago. Everything produced naturally finds itself as an input in other processes. Such is the case with the banana plant: its fruits sustain people, fibers make rope, leaves wrap food, and finally, the stem goes back into soil. Murugesan hasn't invented this process chain himself; he industrialized it.

His products made from banana fibers such as ropes, mats, baskets, bags, and lampshades are completely biodegradable and compostable. These materials compete with polypropylene and nylon ropes that contaminate both land and water by releasing micro-plastics in these ecosystems for hundreds of years to come. Raw material expenses are negligible. The ecological balance is positive.

Sustainable industry & women's empowerment

From Murugesan's beginning with only two people, himself and his wife, to what he now has is more than 150 women working for M S Banana Rope Production Centre in two shifts per day, from 7 a.m. to 3 p.m. and from 3 p.m. to 11 p.m. Every design feature of his machine takes into consideration the welfare of those working for him. The spring-loaded hook where one can stop her work without disrupting everyone else; the winder where he has spared his women a walk of 20 kilometers; and finally the automatic length counter where he saves his women workforce from doing the tedious work.

Awards and recognition

2008 Citibank Entrepreneur Award — ₹2 Lakhs. National recognition for grassroots business creation and sustainable entrepreneurship.

2010 ICAR Farmer Scientist Award — ₹5 Lakhs. Awarded by the Indian Council of Agricultural Research for farmer-led innovation in agro-waste utilisation.

2013 Tamil Nadu Government Handicraft Award (Poompuhar) — ₹50,000. State-level recognition for natural fibre handcraft innovation. 2016 MSME Micro Enterprise Award. National recognition for contribution to micro-manufacturing and rural employment generation.

Version	Machine Type	Output (per day)	Cost
Version I	Manual rope-making wheel (6-hook)	2,000–2,500 m	₹20,000
Version II. a	*Semi-automatic (without winder)*	15,000–20,000 m	₹60,000
Version II. b	*Semi-automatic (with integrated winder)*	25,000 m	₹65,000
Version III	*Automatic machine — thick fiber (1–5 mm)*	30,000–35,000 m	₹2,00,000
Version IV	Semi-auto heavy-rope machine (3–10 mm)	4,500–5,000 m	₹55,000
Barnyard	*Echinochloa frumentacea Link*	Phenolics, dietary fiber	Anticancer potential, diabetes management, inhibition of glycation
Little	*Panicum sumatrense Roth*	Polyphenols, dietary fiber	Prevention of metabolic disorders, digestive health

2025 Jamnalal Bajaj Award — India's most prestigious award for Application of Science and Technology for Rural Development. The highest institutional validation of a lifetime of grassroots work.

Conclusion— the economy that grows from waste

P.M. Murugesan has his production shed in a village in facility which he has constructed with borrowed money from the bank. He did not complete formal schooling beyond secondary school level. And still, he holds patents, ships products to four countries, supports 350 people economically, and earned accolades from the most prestigious scientific and governmental bodies in India.

While CEOs of multinational corporations have started focusing on sustainability as a priority issue and policymakers look desperately for practical circular economy systems, Murugesan has been implementing one silently for decades in a village that is not even marked on most maps. His equipment runs on half horsepower motors. There are no imported parts needed in his equipment. He does not generate any waste in his operations, instead he has destined the journey of waste in such a way that he turned into gems for himself in all the ways and by promoting the sustainability he has gifted it to mother nature. ■

"He looked at agricultural waste and didn't ask 'how to dispose it,' but 'how to give it purpose."
P.M. Murugesan | M S Banana Rope Production Centre | Melakkal, Madurai | Tamil Nadu

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Akshita Mundra is Project Associate with National Innovation Foundation -India
Email: akshitam@nifindia.org

Sowing Hope with Seed Balls

Prajna Ritaparna and Hari Pangi

Global warming and climate change are the biggest threats to biodiversity. Changing rainfall patterns, rising temperatures, and frequent weather events are affecting the ecosystems where these plants grow naturally. When these habitats are destroyed or fragmented, their population shrink, genetic diversity decreases, and the chances of local extinction increase. As a result, these species become more vulnerable to environmental change, ultimately leading to the loss of forest cover and the depletion of medicinal plants.

The importance of medicinal plants extends beyond biodiversity conservation. The global demand for herbal medicines and natural health products is growing rapidly. One of the most effective approaches to protect these plants is in situ conservation, which focuses on protecting plants within their natural habitats. The success of such efforts depends greatly on the active participation of local communities, indigenous groups, and other stakeholders. Their involvement creates a sense of ownership and commitment to conservation. Traditional healers and indigenous communities hold generations of knowledge about medicinal plants, including where they grow, how they are used, and the conditions required for their survival. Recognizing and integrating this knowledge can significantly strengthen conservation efforts while also respecting local cultural traditions and rights.

There are inspiring examples of this approach from around the world. In Brazil's Cerrado ecosystem, researchers collaborated with the Xavante community to protect native biodiversity. In Nepal, the government worked with local communities and non-governmental organizations to regulate the controlled collection and marketing of valuable medicinal plants through certification programs. Similarly, in India, the Tribal Health Initiative (THI) has been helping local communities adopt sustainable harvesting and cultivation of medicinal plants in the Nilgiri Biosphere Reserve. These efforts have not only helped conserve biodiversity but have also improved healthcare access for marginalized populations.

In Odisha, a similar story is unfolding: a single individual has taken on the challenge of conserving the medicinal plant of the Eastern Ghats in Koraput district, Odisha. Hari Pangi, a traditional herbal healer from the Kandha tribe who lives in the foothills of Deomali, has spent years serving his community through his knowledge of herbal medicine. During his regular

Hari Pangi with volunteers dispersing seed balls across the orest landscape

visits to nearby forests to collect medicinal plants, he noticed a gradual decline in the availability of several important species of trees, herbs and shrubs. Concerned about this, he began collecting and preserving seeds of these plants to prevent their disappearance. However, he soon realized that simply storing seeds was not enough. Conservation requires increasing the population of medicinal plants in their natural habitats. This realization inspired him to start sowing seeds directly in forest areas at the beginning of the monsoon. Yet, he understood that seed survival would remain a challenge. While searching for better solutions, he came across the concept of seed ball technology and adapted it for plant conservation.

Seed ball technology is an ancient and cost-effective method of ecosystem restoration. It involves enclosing seeds within a mixture of clay and organic materials, creating a protective coating around them. One major advantage of this method is the development of stronger root systems. Unlike nursery-raised saplings grown in restricted containers, seeds germinate directly in the soil and develop natural root structures. The clay coating protects the seeds from predators, moisture loss, and other environmental stresses while providing a favorable environment for germination. TheseW are easy to prepare, store, transport, and distribute over large areas. Literature also reveals that germination rates range from 87% to 98% within a few days under suitable conditions. However, in some cases by adjusting the composition of the seed balls, survival rates have reached nearly 100%.

Globally, seed ball technology has demonstrated impressive results. The Haitian Aerial Reforestation Project (HARP) and similar initiatives in Kenya have successfully used aerial seed dispersal to restore degraded landscapes. In India, several organizations and government programs have adopted this approach. In 2021, Banas Dairy in Gujarat distributed two lakh seed balls containing six lakh seeds in the Aravalli-Jessore region. The Mahbubnagar district administration in Telangana prepared two crore seed balls through women's Self-Help

Groups under the Haritha Haram initiative. In Uttarakhand, joint efforts by NGOs, students, and government agencies achieved survival rates of up to 80% in hilly terrains. Similarly, Self-Help Groups in Dhanbad, Jharkhand, produced 2.5 lakh seed balls to restore vegetation in open-cast coal mining areas. The technique has also been adopted through community-driven plantation campaigns. In 2019, nearly 200 volunteers dispersed one lakh seed balls in the Rajokri–Ghitorni forest area in just six hours to restoring large tracts of degraded land. Seed ball initiatives have also engaged young minds in conservation. Students of Rajagiri

Woman participation in seed ball campaign

Higher Secondary School in Kerala participated in a global school program by dispersing seed balls in the Malayattoor Forest, contributing to ecosystem restoration while supporting the Sustainable Development Goal (SDG) 15: Life on Land.

Despite these successes, the use of seed balls for medicinal plant conservation remains relatively limited. Recognizing this gap, Hari Pangi saw an opportunity to apply this powerful technique specifically for the conservation of medicinal flora in the Eastern Ghats. Seed balls are now widely recognized as a simple, innovative, and low-cost tool for restoring degraded ecosystems. They are particularly useful in difficult terrains such as rocky hills, steep slopes, deserts, saline lands, and areas prone to landslides where conventional planting methods are difficult to implement. Like any technology, seed balls also have limitations. Delayed rainfall can reduce germination rates and affect uniform plant establishment. However, Pangi has addressed many of these challenges through careful planning and community participation. With the experimentation, he himself prepared a formulation/ mixture for the seeds balls which is favourable/ conducive to the environment, giving the higher chances of germination. He trains volunteers to prepare and distribute seed balls at the right time and incorporates locally available materials that improve soil fertility, aeration, moisture retention, and natural pest resistance. Inspired by his efforts, concerned individuals from neighbouring states such as Bihar, Chhattisgarh, and Jharkhand obtained seed balls from him and initiated similar conservation activities in their localities.

As the world searches for solutions to climate change and biodiversity loss, initiatives like this offer valuable lessons. Reforestation and medicinal plant conservation are not separate goals; they complement each other in building healthier ecosystems for future generations. The efforts of Hari Pangi demonstrate how one individual's vision and dedication can create a meaningful impact on both nature and society. To strengthen such initiatives, greater support from institutions, universities, government departments, and civil society organizations are essential. Students can contribute through internships, field projects, and programs such as NSS. Research institutions can develop innovative approaches and provide technical support. Most importantly, communities and institutions must work together to create a sustainable ecosystem for conservation.

Acknowledgement

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Ms. Prajna Ritaparna is a Senior Fellow at National Innovation Foundation – India (NIF). She holds a M.Sc. in Biotechnology and at presently associated with Scouting Documentation and Database management department.
Email: prajnar@nifindia.org

Mr. Hari Pangi is a traditional herbal healer and grassroots innovator from the Koraput district, Odisha. He has dedicated his life to serving people through herbal medicine while preserving indigenous knowledge and conserving the region's rich medicinal plant heritage.

Millets in India: Nutritional significance, health benefits, ecological importance and strategies for revival

Moumita Sahoo and Vivek Kumar

Introduction

Millets are among the earliest domesticated cereal crops and have been cultivated in India for centuries as staple foods in dry and semi-arid regions. Traditionally consumed by rural communities, these grains are now gaining renewed global attention because of their nutritional richness, climate resilience, and role in sustainable agriculture. In recent decades, dependence on rice and wheat has overshadowed millet cultivation and consumption, resulting in a substantial decline in their dietary importance. However, rising concerns regarding malnutrition, lifestyle disorders, climate change, and food insecurity have revived scientific and public interest in millets. The declaration of 2023 as the International Year of Millets by the United Nations further highlighted their significance in achieving sustainable food systems and nutritional security. India is one of the leading producers of millets worldwide and cultivates a diverse range of species including sorghum (*jowar*), pearl millet (*bajra*), finger millet (*ragi*), foxtail millet, little millet, barnyard millet, kodo millet, proso millet, and browntop millet. These crops are highly adaptable to harsh environmental conditions and can thrive in regions with poor soil fertility, low rainfall, and minimal agricultural inputs. Their resilience makes them especially important under present climate change scenarios where conventional cereal crops are increasingly vulnerable to drought and temperature stress. Millets therefore represent not only a nutritional resource but also a sustainable agricultural solution for the future.

Nutritional importance of millets

Millets are often referred to as "nutri-cereals" because of their superior nutritional profile compared with refined cereals such as rice and wheat. They are rich sources of carbohydrates, proteins, dietary fiber, essential amino acids, vitamins, minerals, and bioactive compounds. Several millet varieties contain significantly higher quantities of calcium, iron, zinc, magnesium, phosphorus, and potassium than conventional cereals. Finger millet is particularly recognized for its exceptionally high calcium content, which supports bone growth and skeletal health. Pearl millet and barnyard millet contain considerable amounts of iron and are therefore beneficial in combating anemia. Foxtail millet and little millet provide substantial dietary fiber and micronutrients that improve digestion and metabolic functioning. Millets also contain appreciable quantities of sulfur-containing amino acids such as methionine and cysteine, which are comparatively limited in rice and wheat. Another important nutritional feature of millets is their gluten-free nature. This makes them suitable for individuals suffering from celiac disease or gluten intolerance. Their slow starch digestibility and high fiber content contribute to a lower glycemic index, making millet-based foods beneficial for diabetic individuals and those at risk of obesity and cardiovascular disorders. Additionally, millet grains contain B-complex vitamins such as niacin, thiamine, riboflavin, and folic acid, which play essential roles in energy metabolism and nervous system functioning. Millet flour generally exhibits a relatively short shelf life under ambient storage conditions because of its higher lipid content, which makes it more susceptible to oxidative rancidity and enzymatic deterioration during storage. Under normal room temperature conditions, millet flour is best consumed within 10–15 days to maintain optimal quality and freshness. In contrast, storage under refrigerated or frozen conditions considerably prolongs its stability by slowing lipid oxidation and microbial activity. Refrigeration can extend the shelf life of millet flour for approximately 3–6 months, while freezing may preserve its quality for up to one year. Spoilage is commonly indicated by the development of sour, fermented, or musty odors resulting from rancidity. Several approaches have been recommended to enhance storage stability, including heat

treatment of grains prior to milling, which helps reduce enzymatic activity and delay oxidation. Packaging also plays a critical role, and airtight containers or High-Density Polyethylene (HDPE) packaging materials are considered effective in minimizing moisture absorption and exposure to oxygen. Additionally, millet flour should always be stored in cool, dry environments away from direct heat and light to preserve its nutritional and sensory quality. Although intact millet grains can remain stable for one to two years under suitable conditions, milling significantly reduces shelf stability due to increased surface area and exposure of lipids to oxidative reactions.

Health benefits and phytochemical profile

Millets possess numerous health-promoting properties due to the presence of phytochemicals including polyphenols, flavonoids, tannins, phytosterols, and phenolic acids. These compounds exhibit antioxidant, anti-inflammatory, antidiabetic, anticancer, and cholesterol-lowering activities. Antioxidants present in millets help neutralize reactive oxygen species and reduce oxidative stress, thereby minimizing the risk of chronic diseases. Different millet species possess distinct therapeutic properties. Foxtail millet has shown potential in lowering cholesterol levels, regulating blood glucose, and protecting liver tissues. Finger millet contributes to cardiovascular protection and supports tissue healing due to its mineral-rich composition. Kodo millet demonstrates antioxidant and anti-diabetic activities, while barnyard millet has shown potential in preventing colorectal cancer and reducing glycation associated with diabetes.Browntop millet has recently emerged as an important functional grain due to its high concentration of bioactive compounds such as luteolin, kaempferol, vanillin, and other polyphenols. These phytochemicals contribute to strong antioxidant activity and may help prevent chronic diseases including diabetes, obesity, cardiovascular disorders, and certain forms of cancer. Experimental findings have also indicated anti-proliferative effects against breast and colorectal cancer cell lines, highlighting its nutraceutical potential.

Role of millets in food security and livelihoods

Millets are extremely important in ensuring food and nutritional security, especially in drought-prone and resource-poor regions. Since they can be cultivated under low-input conditions, they provide stable yields even under unfavorable climatic situations. Their short crop duration and resistance to pests and diseases make them reliable crops for small and marginal farmers. In addition to serving as staple food grains, millets are valuable fodder crops. Sorghum and pearl millet are widely used as livestock feed because of their high biomass production and nutritional quality. Thus, millet-based farming systems support both human nutrition and animal husbandry, contributing to rural livelihoods and economic stability.

Millets are also economically beneficial because they require comparatively lower expenditure on irrigation, fertilizers, and pesticides. This makes them more accessible and sustainable for low-income farmers. Promotion of millet cultivation can therefore improve income generation, strengthen agricultural resilience, and reduce dependence on expensive agricultural inputs.

Ecological and environmental significance

Millets are environmentally sustainable crops and are increasingly considered climate-smart cereals. Compared with rice and wheat, millets consume significantly less water and can tolerate drought, salinity, and high temperatures. Their low water requirement is particularly important in India where groundwater depletion is becoming a major concern. Millet cultivation also contributes to biodiversity conservation because many traditional millet farming systems involve mixed cropping and indigenous landraces. Since millets require fewer chemical fertilizers and pesticides, they reduce environmental pollution and preserve soil health. Their deep root systems improve soil structure and minimize erosion. Consequently, millets play a significant role in maintaining ecological balance and promoting sustainable agricultural ecosystems.

Decline in millet consumption

Despite their nutritional and ecological advantages, millet cultivation and consumption declined considerably after the Green revolution. Agricultural policies strongly favored rice and wheat through subsidies, irrigation facilities, procurement support, and public distribution systems. As a result, farmers shifted toward high-yielding cereal crops while millets gradually lost economic importance. Urbanization and

Table: Health benefits of different millets and associated phytochemicals

Millets	Scientific name	Major phytochemicals/ bioactive compounds	Key health benefits	Reference
Sorghum	*Sorghum bicolor* L. Moench	Tannins, phenolic acids, flavonoids	Antioxidant activity, cholesterol reduction, improved gut health, weight management	Sharma et al. (2021); Ambati & Sucharitha (2019)
Pearl	*Cenchrus americanus* L. Morrone	Polyphenols, phytosterols, dietary fiber	Anti-diabetic effect,improved immunity,anemia prevention	Sabuz et al. (2023); Sharma et al. (2021)
Finger	*Eleusine coracana* L. Gaertn.	Polyphenols, tannins, calcium, methionine	Bone health, cardiovascular protection, antiaging properties,tissue repair	Sabuz et al. (2023); Singh et al. (2024)
Foxtail	*Setaria italica L. P. Beauv.*	Flavonoids, phenolic compounds	Antidiabetic, antiobesity, cholesterol lowering, liver protection	Sabuz et al. (2023); Ambati & Sucharitha (2019)
Kodo	*Paspalum scrobiculatum* L.	Polyphenols, antioxidants, dietary fiber	Glycemic control,antioxidant activity,metabolic regulation	Sabuz et al. (2023); Singh et al. (2024)
Barnyard	*Echinochloa frumentacea* Link	Phenolics, dietary fiber	Anticancer potential, diabetes management, inhibition of glycation	Sabuz et al. (2023)
Little	*Panicum sumatrense* Roth	Polyphenols, dietary fiber	Prevention of metabolic disorders, digestive health	Sabuz et al. (2023); Sharma et al. (2021)

changing dietary habits further accelerated the decline. Refined rice and wheat products became associated with modernization and higher social status, whereas millets came to be perceived as "coarse grains" or "poor man's food". Limited processing facilities, lack of attractive millet-based products, and inadequate consumer awareness also contributed to reduced millet consumption.

Research gaps and challenges

Although millets have gained scientific attention in recent years, several research gaps remain unresolved. Many studies regarding millet health benefits are based on laboratory experiments or animal models, while long-term clinical studies involving human subjects are still limited. More research is required to validate the therapeutic effects of millet consumption under practical dietary conditions.

Another challenge involves the presence of anti-nutritional compounds such as phytates and tannins, which can reduce mineral bioavailability. However, processing techniques including germination, fermentation, soaking, malting, and decortication have shown promise in improving nutrient absorption and digestibility.

Further research is also needed in crop improvement programs aimed at enhancing yield, disease resistance, nutritional quality, and climate resilience. Development of modern processing technologies and ready-to-eat millet products is equally important to improve consumer acceptability and commercial viability.

Strategies for revival of millets in india

1.Revival of millets requires coordinated efforts involving government agencies, researchers, industries, and consumers. Public awareness campaigns should emphasize the nutritional and therapeutic advantages of millets through educational programs, media outreach, and community-based initiatives.

2.Inclusion of millet-based foods in school feeding programs, hospitals, and public distribution systems can significantly increase consumption. Government support for millet farmers through subsidies, procurement policies, and market infrastructure is also necessary to encourage cultivation.

3.The food industry has an imortant role in developing

innovative millet-based products such as pasta, noodles, biscuits, breakfast cereals, bakery items, and health snacks. Attractive packaging, improved taste, and convenient processing can help integrate millets into modern urban diets.

4.Research institutions should focus on interdisciplinary studies related to phytochemistry, food technology, nutrition, genomics, and sustainable agriculture. Strengthening millet value chains and supporting millet entrepreneurship can further contribute to rural development and economic growth.

Government initiatives and institutional support for millet promotion in india

Recognizing the nutritional, ecological, and economic importance of millets, the Government of India has introduced several initiatives to promote these crops under the broader vision of "Shree Anna". Major policy interventions have focused on increasing millet production, improving farmer income, encouraging domestic consumption, and expanding export opportunities. One of the most significant initiatives is the Sub-Mission on Nutri-Cereals under the National Food Security Mission (NFSM), which supports the cultivation of millets such as sorghum, pearl millet, and finger millet through improved seed distribution, advanced production technologies, and better agronomic practices. In addition, the government has substantially enhanced the Minimum Support Price (MSP) for millet crops to encourage farmers to adopt these climate-resilient cereals. Millets are also being incorporated into welfare schemes including the Public Distribution System (PDS), Mid-day meal programs, and Anganwadi nutrition services to address malnutrition and improve dietary diversity among vulnerable populations. Support for millet-based Farmer Producer Organizations (FPOs), establishment of incubation centers under the PM Formalization of Micro Food Processing Enterprises (PMFME) Scheme, and initiatives such as millet museums, millet parks, and high-yielding seed distribution programs further demonstrate the government's commitment to strengthening the millet value chain and positioning India as a global millet hub.

At the state level, Odisha has emerged as a model for millet revival through the Odisha Millet Mission launched in 2017. The program was designed primarily to revive traditional millet cultivation, especially finger millet, in tribal and rainfed regions of the state. Unlike conventional agricultural schemes, the mission addresses the entire millet value chain including production, processing, marketing, consumption, and integration into public nutrition systems. The program provides conditional cash incentives to farmers, promotes decentralized processing, and supports community-based marketing initiatives. Nutritional interventions under the mission include the introduction of ragi laddoos in Anganwadi centres for preschool children and the establishment of Millet Shakti Cafés that popularize millet-based foods among urban consumers. These initiatives have significantly improved millet awareness, farmer participation, and local consumption patterns in Odisha.

India's millet research ecosystem is supported by several premier research institutions dedicated to crop improvement, climate resilience, nutritional enhancement, and value-added product development. The ICAR–Indian Institute of Millets Research (IIMR), Hyderabad, serves as the leading national institute for millet research and coordinates the All India Coordinated Research Project on Millets (AICRP-Millets) through multiple regional centers across the country. Other important institutions include the ICAR–Central Arid Zone Research Institute (CAZRI), Jodhpur; the ICAR–Indian Agricultural Research Institute (IARI), New Delhi; and several State Agricultural Universities such as Tamil Nadu Agricultural University (TNAU), University of Agricultural Sciences (UAS), and Mahatma Phule Krishi Vidyapeeth (MPKV). Internationally, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad, plays a crucial role in global research on dryland cereals including millets. Collectively, these institutions contribute toward developing improved millet varieties, strengthening drought tolerance, enhancing nutritional quality, and promoting millet-based food innovations for sustainable agriculture and food security.

The National Innovation Foundation–India (NIF-India) has played a significant role in documenting and preserving grassroots knowledge related to millets from various parts of the country. The organization has compiled extensive records of traditional practices associated with the nutritional recipes, therapeutic applications, and health-promoting properties of different millet species traditionally utilized by rural

and tribal communities across India. These efforts highlight the important contribution of NIF-India towards the revival, and sustainable utilization of millets through awareness generation, value addition, innovation support, and dissemination of indigenous knowledge systems. The organization has also made these documented repositories publicly accessible, thereby facilitating wider understanding and promotion of the nutritional, medicinal, ecological, and socio-economic significance of millets among researchers, farmers, policymakers, and consumers.

Conclusion

Millets represent a valuable solution to many contemporary challenges related to nutrition, food security, environmental sustainability, and climate resilience. Their exceptional nutritional composition, rich phytochemical profile, adaptability to harsh environments, and multiple health benefits make them highly important crops for the future. Although millet cultivation and consumption declined due to changing agricultural priorities and dietary preferences, increasing scientific evidence and global recognition has renewed interest in these traditional grains.

Promoting millets in India can contribute substantially to reducing malnutrition, combating lifestyle diseases, conserving natural resources, and strengthening sustainable agriculture. Through improved research, policy support, public awareness, and product innovation, millets can regain their rightful place in Indian diets and agricultural systems.■

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Dr.Moumita Sahoo is a principal associate at National Innovation Foundation-India. She is associated with NIF-India at the Bhubaneswar cell since 2018, and currently holds the position of Research Associate-III
Email: moumitas@nifindia.org

Dr. Vivek Kumar is Scientist-F at National Innovation Foundation-India. He has more than twenty years of experience in Grassroots Innovation and Ethnobotanical explorations across the country. Dr. Vivek Kumar leads the Scouting Documentation and Database Management

Bridging Tradition and Technology: Scouting Grassroots Innovations and Traditional Knowledge in Chhattisgarh's Rice Bowl

Subhankar Naskar, Rahul Prakash and Vivek Kumar

Introduction

When traditional wisdom meets modern science, the results can be transformative; for instance, in March 2026, National Innovation Foundation (NIF) team conducted a three-day scouting and documentation activity through Chhattisgarh's rice heartland in the Mahasamund and Dhamtari districts. Team scouted various grassroots innovation and traditional knowledge including manual seed drills, natural pest sprays brewed from local plants, indigenous crop varieties, and herbal remedies passed down through generations—which, though hidden in remote villages, hold the potential for wider application and diffusion across rural India.

The setting: Chhattisgarh's rice bowl

Chhattisgarh's central plains are often called the "Rice Bowl of Central India." Yet behind this abundance lies a harder reality. The state is home to approximately 40 lakh farming families, of which over 82 percent are small and marginal farmers. Nearly a third belong to Scheduled Tribes, and 12 percent to Scheduled Castes—communities that have long relied on traditional knowledge to navigate difficult growing conditions (1). In Mahasamund, lateritic acidic soils and undulating terrain make farming especially challenging. Despite ample rainfall, the uneven topography causes rapid runoff, and irrigation covers barely 20 percent of the cultivated land. This traps most farmers in a cycle of rain-dependent, single-crop rice farming—a pattern locally known as "rice-fallow" (2).

Conditions in Dhamtari are somewhat better. Irrigation reaches over 1.2 lakh hectares during the Kharif season, and the district has over 1.34 lakh registered farmers (3). Yet mechanisation remains limited, input costs keep rising, and farmers continue to wrestle with stubborn pests. These challenges exist against a broader backdrop of national progress: India's ranking in the Global Innovation Index has climbed from 66th in 2019 to 38th in 2025, and the agriculture sector has averaged 4.45 percent annual growth over the past five years (4), (5). However, excessive use of chemical pesticides continues to cause environmental pollution, ecological imbalances, and serious health hazards across rural India (6). It is precisely in this gap—between national progress and ground-level hardship—that grassroots innovations, born from necessity and nurtured by experience, become critically important.

Farmers and district officials met at the Dhamtari Zila Panchayat, Dhamtari

Sensitisation and scouting: the approach

Recognising this potential, the NIF team conducted systematic sensitisation and scouting activities in March, 2026. Instead of arriving with clipboards and lectures, they adopted a hands-on, "listening-first" approach—sitting with 120 farmers across villages such as Atharagudi and Laxmipur, learning about everyday struggles and the knowledge rich workarounds farmers had innovated to overcome them.

Picking the Right Spots: The team focused on Lakahgarh

(Mahasamund) and Dhamtari, identifying them as hubs where traditional rice farming meets grassroots engineering. Experienced farmers here have long blended time-tested methods with low-cost mechanical tweaks—from pedal-operated threshers to custom tractor attachments. These regions also preserve the GI-tagged Nagri Dubraj rice and practise water-saving SRI techniques, making them living laboratories of decentralised agricultural innovation and biological conservation.

Showing What's Possible: Building on these conversations, the team used posters and live demonstrations to show how simple "backyard tools" can be turned into professional, high-quality machines—like paddy threshers and seed drills. This helped farmers see how their own ideas could be improved, legally protected through patents, and eventually sold as real products in the market.

Walking the Fields: The team then moved from conversations to first-hand documentation, walking through farms to document unique local plants and record traditional herbal formulations used for both health and agriculture. By interviewing practitioners and village elders, they were able to bridge the gap between age-old wisdom and modern research, ensuring that these vital traditional remedies are formally preserved for future generations.

Technological interventions and sensitisation

To address the drudgery in sowing, harvesting, and transporting operations during farming, the NIF team sensitised farmers about several grassroots technological innovations such Paddy transplanter, Paddy Threshers, Jute Seed Drills, and Head Loaders that have been scouted, validated, and supported by NIF over the years.

In the area of post-harvest technology, Dal Mills and Cotton Wick Machines were demonstrated through hands-on training sessions. Dal Mills enable farmers to process pulses locally rather than selling raw produce at lower prices, thereby improving their returns. Cotton Wick Machines allow rural households to produce wicks for sale, creating an additional income stream. These post-harvest technologies help reduce dependence on intermediaries and add value to farm produce at the village level.

Beyond farming, the team also sensitised communities about Mastirak Gel for livestock health management, which addresses mastitis in cattle—a common condition affecting milk yield. Sanitary Napkin Machines were introduced to help local women's self-help groups start small manufacturing units, contributing to both hygiene and livelihood generation. Additionally, the team shared information about NIF-supported innovations in areas such as herbal pest management, energy-efficient biomass stoves, and floor-cleaning machines, which address everyday needs of rural households.

What the team found

These field visits and interactions revealed three major friction points that make farming difficult in the region. Hard manual labour remains the norm—while agricultural machinery in Chhattisgarh supports rice, pulses, and oilseed cultivation, the high cost of advanced implements keeps them out of reach for most small and marginal farmers. A very small proportion have adopted efficient tools like hydraulic reversible ploughs or tractor-mounted boom sprayers; the majority remain restricted by fragmented landholdings and lack of capital. Pest attacks and soil degradation compound the problem: farmers face heavy crop losses from pests like the Brown Planthopper (*Nilaparvata*

Empowering women farmers through interactive dialogue and knowledge sharing

lugens), Yellow Stem Borer (*Scirpophaga incertulas*), and Rice Bug (*Leptocorisa acuta*), while diseases such as Blast and Blight ravage rice and Wilt attacks pulses. Making matters worse, many farmers misuse chemical pesticides—sometimes burning their own crops through over dosage (7). Livestock diseases add a third layer of vulnerability: ailments like Foot-and-Mouth Disease and PPR act as devastating financial shocks, draining scarce savings on veterinary costs while simultaneously cutting daily income from milk and manure. Yet alongside these challenges, the team documented several ingenious home-grown solutions.

An innovative Single Seed Driller machine, essential for maximising yields in Chhattisgarh's diverse agricultural landscape. Various indigenous plant varieties—Turmeric (*Curcuma longa*), Long Beans (*Phaseolus vulgaris*), Bottle Gourd (*Lagenaria siceraria*), Gram (*Cicer arietinum*), and Okra (*Abelmoschus esculentus*)—were found to have naturally adapted to thrive in local weather conditions. Botanical bio-pesticide formulations, made entirely from local plants, offer affordable and safer alternatives to chemical pesticides. Ethno-medicinal practices (ITK) documented from the community address conditions ranging from arthritis and kidney stones to diabetes, typhoid, and haemorrhoids.

The Way Forward

Taken together, these findings indicate that the villages of Chhattisgarh hold a considerable repository of grassroots innovations and traditional knowledge. Over generations, farmers have developed and refined seeds, tools, and herbal practices—but without formal documentation, validation, or intellectual property protection, many of these innovations remain localised. NIF's Value Addition, and Research & development (VARD) framework supports the scientific validation and value addition of such grassroots technologies through collaboration with universities, and other R&D institutions. Through this process, NIF facilitates intellectual property protection in the name of innovators and traditional knowledge holders, and works towards wider dissemination of validated technologies through commercial and non-commercial channels.

NIF is already working with the various district administration to deploy grassroots technologies suited to regional needs. Innovations such as innovative leaf plate making machine, maize shellers, solar-powered rice puff machines, and paddy straw cutters have been identified and deployed to reduce drudgery and support rural livelihoods. NIF has recently signed a Memorandum of Understanding (MoU) with Startup Chhattisgarh to strengthen the linkage between grassroots innovators and the state's emerging startup ecosystem. This collaboration aims to provide incubation support, mentoring, and market access to grassroots innovators, aligning with the state's Chhattisgarh Innovation and Startup Promotion Policy 2025–30. Through such partnerships among NIF, academia, industry, and government agencies, grassroots innovations from the region can be taken forward for wider application and contribute to rural development. ■

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Mr. Subhankar Naskar is a Senior Project Associate in the Scouting, Documentation, and Database Management (SDDM) department at the National Innovation Foundation-India.
Email: subhankarn@nifindia.org

Dr. Rahul Prakash is a Principal Associate in National Innovation Foundation-India. He holds PhD in Management, and is currently associated with the Dissemination and Social Diffusion Department (DSD) at the National Innovation Foundation-India.
Email: rahulp@nifindia.org

Dr. Vivek Kumar is Scientist-F at National Innovation Foundation-India. He has more than twenty years of experience in Grassroots Innovation and Ethnobotanical explorations across the country. Dr. Vivek Kumar leads the Scouting Documentation and Database Management (SDDM) department team.
Email: vivekkumar@nifindia.org

From Local Selections to Living Laboratories: How On-Farm Trials Validate and Diffuse Grassroots Crop Varieties

Parthkumar P. Dave and Hardev chaudhary

Introduction

Developing a distinct, high-yielding plant variety is an intensive, multi-layered journey. For grassroots innovators across India, this path begins with a sharp observation in their own fields, which is then backed by comprehensive institutional incubation support. At the National Innovation Foundation (NIF) – India, this handholding is rigorous—encompassing primary field verification, on station testing & validation, value addition, and Intellectual Property Management (IPM) to secure the innovator's legal rights.

Yet, while intellectual property protection and controlled on-station trials (conducted within pristine institutional research plots) are foundational to verify Distinctness, Uniformity, and Stability (DUS), they represent an idealized environment. Real agriculture doesn't happen in a protective bubble; it happens in fields with unpredictable rainfall, varying soil conditions, and resource constraints.

To bring these breakthroughs to need-based farmers and vulnerable agro-climatic pockets, the true potential of an innovative grassroots crop variety cannot be fully realized until it leaves the research station. To bridge the gap between experimental science and field realities, proper outstation trials in actual field conditions are indispensable.

Creating living laboratories: the strategic purpose of ofts

On-Farm Trials (OFTs) serve as a crucial bridge between agricultural research, native of variety and real-world farming conditions. While a new variety or technology might perform exceptionally well in a highly controlled research station, on-farm trials test whether those results actually hold up in a farmer's actual field.

NIF implements systematically designed, participatory ***On-Farm Trials (OFTs)*** to transform actual farmer fields into living laboratories. By involving farmers directly as active researchers rather than passive recipients, NIF ensures that grassroots agricultural innovations are robust, practical, and risk-mitigated for widespread adoption.

[Scouting of variety] » [On-site verification and detailed scientific documentation] » Station Institutional Testing/Validation] » [Value Addition] » [IPM] »[Participatory On-Farm Trials] » [Large-Scale Dissemination & Adaptation]

These systematically executed trials serve several critical institutional objectives:

- ***Verifying Real-World Performance:*** Evaluating how a potential variety stands up to regional pests, indigenous disease pressures, erratic local weather, and varied soil types.
- ***Securing Direct End-User Feedback:*** While scientists look closely at raw data sheets, farmers evaluate practicality. OFTs allow NIF to collect invaluable feedback regarding crop management, yield architecture, ease of harvest, marketability, taste, and vital secondary traits like fodder quality.
- ***Building Trust & Accelerating***

Glimpse of On-Farm Trials implemented through farmers' participation:

Adoption: Farmers are naturally cautious about changing long-standing practices. When they see a new variety or method succeeding in their own village or a neighbor's plot, the barrier of skepticism drops. It serves as a living demonstration, vastly speeding up extension work and regional adoption.

•***Paving the Way for Social Diffusion:*** Generating the definitive data required to plan sustainable, large-scale dissemination across the country. Localized proof of success helps eliminate skepticism and streamlines the future regional expansion of the crop.

Transforming regional ecosystems: motivation & market impact

The impact of an On-Farm Trial extends far beyond agronomic data sheets. The interactive Field Days organized at trial sites act as catalyst events for local agricultural communities.

The Ripple Effect of Field Days

Seeing is believing. When neighboring farmers observe the performance of an improved variety flourishing in a local plot, it drives rapid adaptation, reduces the perceived risk of switching varieties, and ultimately boosts market profitability at the regional level. More importantly, these live demonstrations inspire visiting farmers to engage in their own need-based selections. Witnessing a fellow farmer's variety being validated at a national scale empowers rural communities to develop localized solutions to regional agricultural challenges.

A collaborative network for precise deliverables

The successful execution of OFTs across fragmented agro-climatic zones demands a highly integrated institutional framework. NIF works in close contact with a diverse array of stakeholders to implement these trials with scientific precision and ensure accurate data outputs.

For the identification of hosting farmers and the precise implementation of trials, NIF leverages a collaborative, participatory matrix consisting of Institutes & Universities, KVKs, Central & State Government Authorities, Grassroots & Community like innovators, FPOs (Farmer Producer Organizations), Farmers & Community Groups, NGOs, SHGsThrough this collaborative network, On-Farm Trials remain the absolute key to linking formal research with actual end-users. By blending scientific rigor with the traditional wisdom of local farmers, NIF ensures that grassroots innovations do not remain confined to scientific journals, but actively transform into proven, reliable assets that drive rural prosperity and resilience across Indian agriculture.

Recent activity: participatory on-farm trials on sk-4 turmeric variety

A premier example of NIF's robust OFT framework is currently unfolding with SK-4 (PPV&FRA: REG/2023/0029), a highly promising turmeric variety developed through years of dedicated selection by a grassroots innovator, Sachin Karmakar Karekar from Ratnagiri, Maharashtra. He was conferred 2nd National award in 11th Biennial National Grassroots Innovation and Outstanding Traditional Knowledge Awards of NIF by the Honorable President of India, Smt. Droupadi Murmu at Rashtrapati Bhavan, New Delhi on April 10, 2023. While SK-4 showed exceptional promise in its home tract Ratnagiri and revealed promising result for its biometric and biochemical parameters during the field testing of the variety was carried out at Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (Maharashtra), unlocking its nationwide potential required understanding how it adapts beyond its origin. To comprehensively map its multi-location suitability, yield stability, reaction to regional biotic and abiotic stresses and market preference NIF deployed the SK-4 variety across distinct agro-climatic zones of five major states: Maharashtra, Karnataka, Tamil Nadu, Telangana and Madhya Pradesh by rigorously tracking performance across these vastly different geographical regions, this multi-state study provide the scientific foundation necessary for future commercial expansion, targeted scaling, and official regional recommendations. ■

Dr Parthkumar P. Dave, Principal Associate, VARD & IPM-Agriculture, National Innovation Foundation – India, Gandhinagar, Gujarat.
Email: parthkumard@nifindia.org

Shri Hardev Choudhary, Scientist E & Head, VRAD & IPM Agriculture, National Innovation Foundation –India, Gandhinagar, Gujarat.
Email: hardev@nifindia.org

Activities Undertaken for Observance of World Blood Donor Day 2026

National Innovation Foundation (NIF) - India observed World Blood Donor Day 2026 in accordance with the directions and guidelines issued by the Ministry of Health and Family Welfare, Government of India, with the objective of promoting awareness about voluntary blood donation and encouraging greater public participation in this noble and life-saving cause. The observance aimed to highlight the critical importance of ensuring an adequate and safe blood supply for patients requiring emergency medical care, surgeries, maternal healthcare, and treatment of various life-threatening conditions.

As part of the observance, NIF-India, in collaboration with the GMERS Civil Hospital, Gandhinagar, organised a Voluntary Blood Donation Camp at its Headquarters in Gandhinagar. The camp received enthusiastic participation from NIF officials, staff members, and volunteers, reflecting their strong sense of social responsibility and commitment towards humanitarian service. The initiative provided an opportunity for individuals to contribute directly to saving lives and supporting the healthcare system through voluntary blood donation.

To further amplify the message of World Blood Donor Day 2026, themed "One Drop of Humanity. Give Blood. Save Lives.", NIF conducted a comprehensive awareness campaign through its official social media platforms by sharing informative posts, awareness messages, and creative posters highlighting the significance of regular voluntary blood donation. The campaign emphasised the role of blood donors as lifesavers and encouraged citizens to make blood donation a regular practice.

The observance was also prominently featured on the official NIF website to ensure wider outreach and public engagement. In addition, specially designed awareness posters were developed and translated into various regional languages to maximise accessibility and outreach. These posters were circulated to all NIF Camp Offices and displayed prominently at their respective premises, enabling the dissemination of key messages among local communities in their native languages and fostering greater awareness at the grassroots level.

Through these activities, NIF-India contributed significantly to raising awareness about the importance of voluntary, safe, and regular blood donation. NIF-India reaffirms its commitment to supporting national public health initiatives, promoting community welfare, and encouraging citizen participation in activities that contribute to the well-being of society.■

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

National Innovation Foundation (NIF) - India
Headquarters: Grambharti, Amrapur, Gandhinagar-Mahudi Road, Gandhinagar, Gujarat, India – 382650
Camp Offices : Bhubaneswar (Odisha), Guwahati (Assam), Noida (Uttar Pradesh), Srinagar (Jammu & Kashmir).
Phone : Tel: +91-02764-261131, 32 | **Email :** newsletter@nifindia.org | **Website :** www.nif.org.in