



# राष्ट्रपुत्र वैचार

विज्ञान धारा

From the Office of PSA

May 2024

## FRUGAL INNOVATION



Foreword By:

**Dr. Parvinder Maini**

*Scientific Secretary,  
Office of the Principal Scientific Adviser to  
the Government of India (OPSA)*

Page 3



### IN CONVERSATION

Demystifying Frugal  
Innovations in India: Bridging  
Technology and Accessibility

Page 5

### FEATURE STORY



Frugal Innovation in  
Horticulture: Empowering  
Farmers with Tools for  
Precision Farming

Page 8



Aravind Eye Care Systems:  
Leading the Path for Inclusive  
Eye Care

Page 11

### OPSA INITIATIVES FOSTERING FRUGAL INNOVATIONS

RUTAG: A MODEL FOR FRUGAL INNOVATION  
ECOSYSTEMS

Page 15

#### AGNII

Empowering Climate Adaptive Livelihoods in  
Uttarakhand through User-Centric Frugal and Emerging  
Technologies

Page 23

#### WASTE TO WEALTH MISSION

Frugal Innovations: Student-led Solutions for a  
Sustainable Future

Page 26

#### SCIENCE AND TECHNOLOGY CLUSTERS

◆ Empowering Communities: JCKIF's Frugal Tech  
Journey

Page 29

◆ Empowering Odisha- Frugal Innovations Shaping  
Healthcare, Technology and Sustainability

Page 33

Comic: Don't forget to explore the adventures  
of Dadu, Mitti and Samosa at

Page 36



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**Dr. Parvinder Maini**

Scientific Secretary,  
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Government of India (OPSA)

*In this edition of Vigyan Dhara, Dr. Parvinder Maini, Scientific Secretary delves into the importance of frugal innovations.*

## ●●● FOREWORD

Today as the world is working towards a sustainable future, frugal innovations are gaining significance. Innovation is often imagined only with grand research facilities, significant investments and futuristic products and services. However, the concept of frugality in innovation is what we require for a sustainable living. India's approach towards innovation has primarily been people-centric and deeply grounded in the concept of sustainability and resource efficiency. Infact, India's journey in frugal innovation is a testament to the power of creativity, resilience, and resourcefulness in driving meaningful change. From grassroots initiative to global innovations, India has emerged as a hotbed for sustainable innovations. This edition of Vigyan Dhara celebrates the remarkable achievements and transformative impact of Indian ingenuity in

addressing complex challenges with simple yet effective solutions.

At the heart of India's frugal innovation lies a fundamental principle: the ability to harness constraints as catalysts for creativity. Whether it's scarcity of financial resources, infrastructural limitations, or societal disparities, Indian innovators have adeptly navigated these challenges to develop solutions that are not only affordable but also scalable and sustainable. With its rich history, diverse culture, language and unique socio-economic landscape, India's success in transforming frugal innovation towards societal prosperity is a testament to the entire development world.

One of the hallmarks of India's frugal innovation is its focus on empowering communities. Instead of imposing top-down solutions, Indian innovators actively engage with local stakeholders to understand their unique needs and co-create solutions that are culturally relevant and socially impactful. This bottom-up approach not only fosters ownership and sustainability but also ensures that innovations are tailored to the needs of the population they aim to serve.

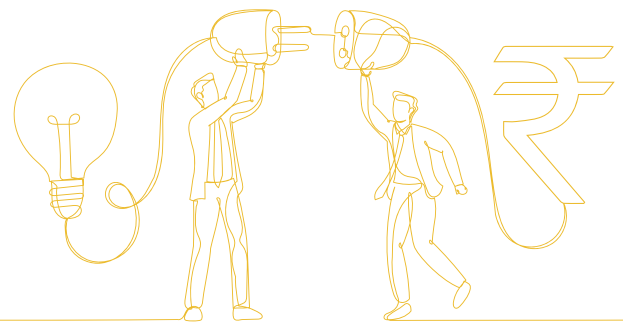
It is essential to understand that frugal innovation is not about compromising on quality or effectiveness but rather about finding innovative ways to achieve desired outcomes without extravagant spending or excessive use of resources. At its core, frugal innovation is characterised by the key principles of simplicity, affordability, adaptability, sustainability and inclusivity. Indian innovations in healthcare, agriculture, education, and energy have garnered international recognition for their effectiveness, affordability, and scalability. Whether it's low-cost medical devices, innovative farming techniques, or digital platforms for financial inclusion, India's frugal innovations are reshaping industries and transforming lives worldwide. This global influence underscores India's leadership in driving change that transcends borders and inspires collaboration on a global scale.

The Government of India has always been demonstrating its firm support for frugal innovation through institutional and governance mechanisms, policy instruments, and dedicated programs. The National Innovation Foundation (NIF) works closely with communities across the country and empowers them with various interventions. Since its inception in the year 2000, the NIF has scouted and documented 3,00,000 innovations - many of which have been taken up for adoption and upscaling. The Atal Innovation Mission (AIM) is Government of India's flagship initiative to create and promote a culture of innovation and entrepreneurship across the length and breadth of the country. At the advanced level of innovation value chain, to further the progress of innovations towards successful entrepreneurship, the Startup India is working at the ecosystem level. This has resulted in the number of startups in the country reaching 137,209 as of May 2024.

The sectoral targeted innovation programs such as, Biotechnology Industry Research Assistance Council (BIRAC) for biotech, Innovation for Defense Excellence (iDEX) for Defense and Indian National Space Promotion and Authorisation Centre (IN-SPACe) for Space, etc are also promoting frugal innovations within domain specific application areas. Many of the successful demonstrations through these programs are being scaled up for increased impact. The Rural Technologies Action Group (RuTAG), an initiative of the office of the Principal Scientific Advisor to the Government of India, through its constant interventions, has been contributing to the nation's efforts of creating and promoting frugal innovations for strengthening rural economies. The national mission on waste-to-wealth also has a significant component of imbibing frugality in environmental sustainability related innovations.

In this edition of Vigyan Dhara, as we explore the diverse facets of India's frugal innovation ecosystem, from the grassroots innovations that

empower local communities to the cutting-edge technologies that are revolutionising industries worldwide, we also attempt to capture some of the successful anecdotes that Indian initiatives and innovators have lived through. The Indian experiences and philosophy in innovation aims to set an example for leaderships across the board that is rooted in empathy, collaboration, and inclusivity.



## IN CONVERSATION

### Demystifying Frugal Innovations in India: Bridging Technology and Accessibility

— By Sanchita Jain



**Dr. Monoranjan Mohanty**  
Adviser/Scientist 'G', OPISA

Necessity is the mother of invention. This adage is particularly true for every small, simple, or incremental innovation that has emerged to address challenges and transform problem-solving, especially in resource-limited settings like India. Frugal innovation utilizes simple and creative ways to address pressing real-world issues and create affordable solutions for unmet needs. Besides creating new solutions, frugal innovations also focus on enhancing the utility of existing technologies to meet real-world needs effectively and affordably.

The concept of frugal innovation, deeply rooted in the Indian ethos of "grassroots" or "bottom of pyramid" innovation is about more than mere cost-cutting; it embodies a strategic reinvention of technology application for broader accessibility and impact. Frugal innovation demonstrates how

innovation development can best be achieved within specific social contexts, particularly in constrained environments with institutional voids. It plays a significant role in inclusive innovation and has become increasingly important for social empowerment at the grassroots level. It aims to reduce technological complexity to provide customers value in resource-scarce environments. India is at the forefront of the frugal innovation phenomenon, which differs from conventional innovation in terms of novelty, target market, and business model.

#### What is the philosophy behind Frugal Innovations?

Dr. Monoranjan Mohanty, Adviser/Scientist 'G', OPISA, explains frugal innovation: "We often get excited about the 'next big thing,' but what if real progress isn't just about new technologies, but how we use the ones we already have?" This challenges the usual approach to technological progress, which often focuses on expensive, feature-rich innovations for wealthy markets. Instead, frugal innovation focuses on simplicity, efficiency, and using available resources wisely. "Frugal innovation is about strong solutions that don't need much—a big difference from the traditional way of doing things," says Dr. Mohanty.

#### Why Conventional R&D is Non-Inclusive?

Traditional scientific research has undeniably fueled remarkable technological advancements, yet it faces inherent challenges that perpetuate inequality and exclusion. Prof. Sangeeta Kohli, Department of Mechanical Engineering, IIT Delhi addresses the challenges posed by traditional



**Prof. Sangeeta Kohli**  
*Department of Mechanical Engineering, IIT Delhi*

scientific research, which often leads to a mismatch between developed technologies and the actual needs of diverse populations. She explains, "Technologies developed from Western perspectives have almost become the benchmark for the urban population and the relatively upper stratum of the developing nations." Therefore, a 'one size fits all' approach cannot be the basis of technology development." This gap has historically led to technologies that are either irrelevant or unaffordable for large segments of the population.

The challenges are further compounded by other factors. Firstly, there's a notable lack of funding available to support frugal research initiatives. Additionally, there's a shortage of established avenues and research labs for individuals interested in contributing to frugal innovations. This lack of infrastructure and support limits the potential impact of trained professionals seeking to make a difference. Combined with a general lack of awareness and limited opportunities, these conditions hinder the development of technological solutions tailored to the needs of marginalized communities. Moreover, the absence of sustainable commercial models further impedes the widespread adoption of frugal technologies. As a result, many segments of society that could benefit from these innovations often remain underserved.

**Frugal Innovations- A Sustainable & Inclusive Solution**

Frugal innovations emerge as a response to these systemic shortcomings, offering a paradigm shift towards technology that is accessible, sustainable, and tailored to diverse socio-economic contexts. Prof. Kohli shares an enlightening example from Chhattisgarh, where artisans sought a viable alternative to inefficient traditional furnaces. Commercial solutions proved unaffordable, prompting her team to intervene. "More than ten years ago, when we happened to be in Chhattisgarh related to another project, the artisans asked us to provide a low-cost gas furnace for them. They had been earlier approached by a commercial venture for installation of a gas-based furnace but the cost of that was too high for them to afford it. This led to our efforts to design a low-cost furnace for their requirement starting from the drawing board."



*IIT Delhi developed and tested natural-draft LPG-fired metal-melting and mould-heating furnaces (Image Credits: IIT Delhi)*

Further, unlike conventional technology development, which often prioritizes comfort and automation without considering hidden environmental and societal costs, frugal innovations focus on reducing inputs to lower overall costs. This shift in focus reflects a concern for both the lower segments of society and the environment, driving the development of low-cost technologies that address real needs while minimizing negative impacts. By prioritizing sustainability and inclusivity, frugal technologies

offer a pathway to more equitable and environmentally conscious innovation.

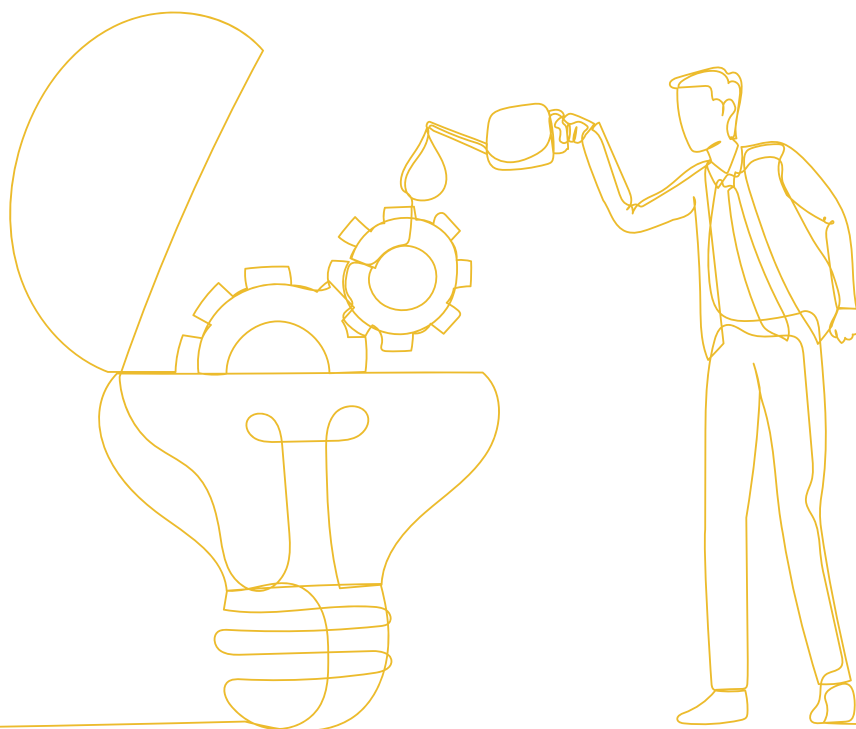
## Policy Interventions to Foster Frugal Innovation

Dr. Mohanty suggests targeted policy interventions are essential to support and scale frugal innovations. He believes that "targeted incentives for affordable, impactful solutions alongside public-private partnerships can bridge the gap between research and application." Dedicated incubation centers, promoting local manufacturing, streamlined regulations, and knowledge-sharing platforms are key strategies that Dr. Mohanty advocates for to accelerate progress in frugal innovation. Prof. Kohli proposes several strategies to overcome these challenges, including encouraging professionals to engage with rural communities with a long-term perspective and not just for superficial project completions. She emphasizes the need for

"creation of funding sources focused on taking lab-level work to the field" and "providing special incentives to entrepreneurs in this sector focused on low-cost manufacturing."

Frugal innovations offer a sustainable and inclusive path forward in technological development, emphasizing practical solutions that cater to the needs of a diverse population. Frugal innovations provide the grounds for building on more advanced versions of a product, solution, or service for a particular need or problem. Therefore creating an end-to-end vision that promotes the culture of frugal innovation, assumes significance. By adopting policies that encourage deeper engagement with underserved communities and fostering an environment conducive to frugal creativity, India can lead by example in the global arena of innovation with an equitable and sustainable future.

*(Sanchita Jain is the Communications Specialist at OPSA)*

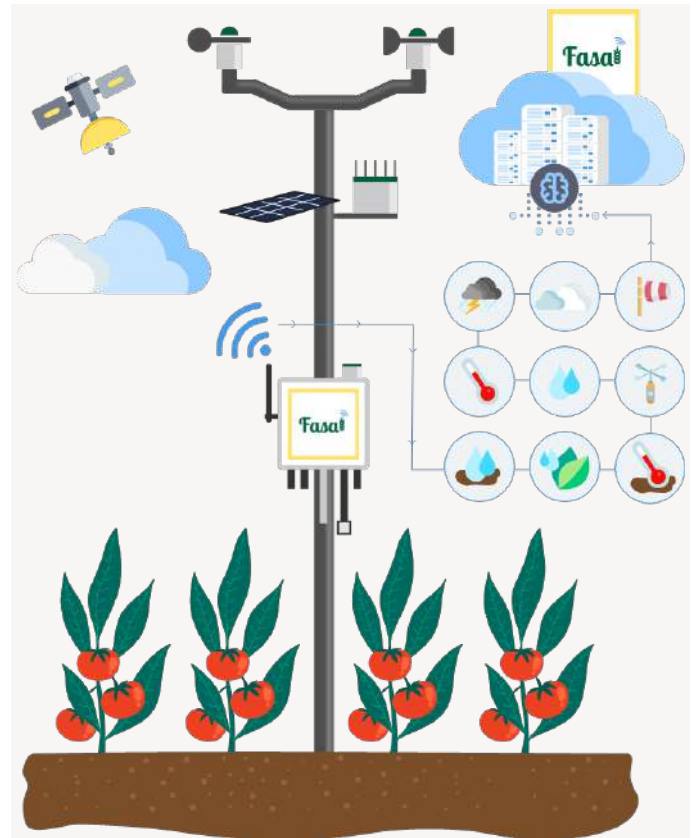


# FEATURE STORY

## Frugal Innovation in Horticulture: Empowering Farmers with Tools for Precision Farming

— By Dr. Madhura Panse and Dr. Lekha Bandopadhyay

New-age start-ups are revamping India's agriculture ecosystem using technology-based solutions. As of 2023, there are over 6000 agriculture start-ups in India. FASAL- an agritech start-up founded by Mr. Shailendra Tiwari and Mr. Ananda Verma in 2018 is one of them, which focuses on empowering Indian horticulturists, specifically- the small-holding fruit farmers, with frugal innovative tools for precision farming.



FASAL Device (Image Credit: FASAL)

The first four years were dedicated towards conducting extensive research in order to gather data at the farm level, through field trials across multiple agro-climatic zones and for a variety of crops; leading to the development of the necessary hardware and software. The FASAL system uses frontier technologies including advanced crop science research, Artificial Intelligence (AI) and the Internet of Things (IoT) to provide real-time information to the farmers about crop growth parameters as well as weather and soil conditions, guiding them towards applying precision farming techniques. The device can be installed directly on the farm, and translates the data collected on the farm into notifications/alerts which can be accessed by the farmers via an app

*"Although both me and Ananda are from farming families, we never planned to be in agriculture. However, life had different plans for us! In 2016-17, while we were carrying out our internal research, we realized that India, with its 120 million hectares of farmland, and a huge variety of soils and hydroclimatic zones has a significantly lower amount of agricultural produce, than its developed counterparts who have much less geographical area for farming, and an even lesser variation in climate and soil. So, either they are too good, or we are too bad at farming- or most likely, it's a mixture of both!"*



**Mr. Shailendra Tiwari**  
CEO, FASAL

This realization peaked their curiosity and encouraged them to dive deeper into the nuances of Indian horticulture. Although fundamentally a science, farming in India is also guided by years of cultural and inherited wisdom. They realized that while it was essential to preserve the wisdom, it was also necessary to provide farmers with scientific data-driven solutions. Towards this goal, FASAL has created a system that guides the farmers in applying appropriate farming techniques enabling them to get the maximum produce from their farms.



on their smartphones. With a team of around 150 people, FASAL currently has operations across 12 districts within India, and also exports their system to Indonesia, Thailand and Malaysia. It is a fairly research-heavy organization, with research spanning across the fields of crop science, human pathology and biology, as well as technological hardware and software. Each operational district hosts a pod, or a mini team of 4-5 people, including a customer manager and agriculture researcher.

Besides developing reliable technology, the main challenge for the founders was to keep the production cost low, in order to maintain the frugal nature and to make it affordable for small-holding farmers. Currently, the production cost for the FASAL device is almost 10 times lower

than the cost of similar devices available in the market, underscoring the hard work and dedication of the team in making the innovation truly accessible to all sections of the society.



FASAL Device installed in farm (Image Credit: FASAL)

Paresh Annasaheb Wable, a pomegranate farmer from Pimpri village of Ahmednagar district in Maharashtra, who has installed the FASAL device



FASAL Ecosystem (Image Credit: FASAL)

on his 3-acre land talks about how the system works in real-time, "The device is a pole attached with sensors and transmitters stuck in the field. Besides checking the climatic parameters, it also tracks the soil moisture below the ground and the conditions above-ground. It thus helps me to calculate exactly when and how much water is required for my field and alerts me about the amount of moisture present in the soil. As the system also forecasts the possibility of upcoming weather conditions like wind speed or direction or rainfall, I have also been able to save my crop from being washed out! Following the alerts given by the system, I have been able to harvest 7 tonnes of fruits in first picking, 12 tonnes in second and expect to collect 20 tonnes in the third one."



▶ INTERACTIVE IMAGE

*Listen more from Paresh Wable here  
(Scan the image using Overly App to watch the full video)*

Due to the precise and efficient irrigation facilitated by the FASAL device, Wable was also able to see a reduction in plant stress, along with a reduction in premature dropping of fruits or flowers, while providing him with high-quality pomegranate produce. Dr. Shashikant Bharatrao Shinde from the same district cultivating pomegranates, oranges and apples on 16 acres of land also uses the FASAL system and saves almost 40% of water which he utilizes to grow more crops in this water-scarce region. Shinde notes that accurate irrigation and optimal humidity level have also reduced pest attacks and disease incidences, thus reducing the cost of spraying fairly.

*(Dr. Madhura Panse is Project Manager (Communications) at Pune Knowledge Cluster, OPSC and Dr. Lekha Bandopadhyay is a freelance science writer)*



▶ INTERACTIVE IMAGE

*To listen to the rest of the Dr. Shinde's testimonial  
(Scan the image using Overly App to watch the full video)*

Having worked in the innovation sector for the past eight years, Mr. Tiwari is quite optimistic about the untapped potential of Indian agriculture:

*"We have people, we have land and we have all different kinds of agroclimatic zones. But, what is missing for agriculture to springboard is the specific knowledge about a particular crop which will enable farmers to work at their fullest potential. Using our system, farmers today can have an almost 50% increase in their produce. Additionally, through efficient irrigation management, we have saved roughly 82 billion litres of water in these farms within the last two years. If we wake up to an India where all farmers together decide to reduce the water they use by even a mere 30%, the country's entire output will increase and many problems will be resolved. Thus, I do not view FASAL as merely a profit-making organization, but rather an agency of change."*

- Mr. Shailendra Tiwari



▶ INTERACTIVE IMAGE

*Listen more from Mr. Shailendra Tiwari here  
(Scan the image using Overly App to watch the full video)*

## FEATURE STORY

### Aravind Eye Care Systems- Leading the Path for Inclusive Eye Care

— By Sanchita Jain and Tanya Gupta

*“Today, we organize 3000 camps on average every year. In over 40 years of service, we have been able to eliminate information barriers, access barriers, and affordability barriers. Thus, our model of working is truly inclusive of the whole community.”*



**Mr. Thulasiraj Ravilla**  
Executive Director, LAICO

The pressing need for eye surgeries in India highlights the crucial issues of affordability and accessibility. According to the Health Ministry Survey 2019, untreated cataracts (66.2%) are the primary cause of blindness in India, affecting middle-aged and elderly individuals, those between 50 and 90 years old. This is largely treatable, yet many sufferers cannot afford the necessary cataract surgery due to financial constraints, emphasizing the necessity for accessible and affordable healthcare nationwide.

In rural areas, the absence of structured healthcare infrastructure for timely treatment exacerbates vision impairments within local communities, depriving individuals of their livelihoods. Financial limitations, coupled with poor logistics and a lack of awareness about available solutions, perpetuate untreated vision issues, leading to reduced quality of life and in some instances potentially irreversible consequences.

Balancing cost-effectiveness with well-designed medical solutions, Dr. Venkataswamy's unwavering commitment to improving eye care led to the establishment of Aravind Eye Care System (AECS).

Serving as a model for revolutionizing eye care facilities in India and other developing countries, Aravind Eye Hospitals prioritize high-quality and affordable eye care, with frugality at its core, empowering thousands to achieve optimal eye health. AECS, with its mission to ‘eliminate needless blindness’, was started in 1976 as an 11-bed hospital by Dr. G. Venkataswamy, as a part of GOVEL Trust with a “design” that integrates frugal innovation through subsidized, financially sustainable sight treatments to the masses.

#### Innovation 1: Community Outreach Camps

As early as the 1960s, when Dr. Venkataswamy launched the outreach initiatives in Tamilnadu, he ensured the involvement of the local community as a partner in rural areas. Fostering community ownership in outreach continues to remain a core principle in Aravind’s community work of taking eye care to the doorstep of the needy through 2,500 eye camps each year. Cataract surgeries through such eye camps, contribute to about 30% of the total cataract surgeries performed. Screening people in the community and referring those needing eye surgery to the hospitals has proven to be cost-effective and efficient<sup>1</sup>. Such work in the community has increased awareness, resulting in more and more people seeking care at the hospital, rather than waiting for an eye camp. Furthermore, streamlining the surgical processes and implementing surgical techniques like manual small-incision cataract surgery, Phaco emulsification, etc., by expert doctors, assisted well-trained staff, and state-of-the-art equipment, enable Aravind Hospitals to currently perform more than 4.5 lakh cataract surgeries a year<sup>2</sup>.

<sup>1</sup> <https://aravind.org/wp-content/uploads/2019/04/The-Story-of-Innovation-at-Aravind-Eye-Care-System.pdf>

<sup>2</sup> <https://aravind.org/clinics/cataract/#1550037329360-6f860328-d4b2>



Screening Eye Camps (Image Credit: AECS)

### Innovation 2: Operational and Clinical Efficiency

Adopting an assembly line approach and efficiently managing the bottlenecks has helped enhance thoroughness in surgery and outpatient services. Aravind's service delivery Model systematically eliminates all the administrative work of doctors as well as routine repetitive tasks so as to maximize their productivity without overworking them. Upskilling and training the clinical support staff to perform routine tasks, including handling expensive, sophisticated equipment like ultrasound, retinal imaging cameras, etc for diagnostics has enabled the doctors to concentrate on the more complex aspects of their work while ensuring the high-quality eye care services to patients at lower costs. Compared to an average Indian ophthalmologist, an AECS doctor performs four to five times more surgeries a year. Overall, this innovative process improves productivity, the quality of treatment, while significantly reducing cost of care, thus showcasing frugality in action.



Aravind Model at work (Image Credit: AECS)

### Innovation 3: : Aurolab

In the late 1980s, implanting an Intraocular lens (IOL) in place of the opaque lens that is removed in cataract surgery, became the standard of care in

the West. The quality of vision received was far superior to the traditional surgery which required wearing high-power +11D glasses to be able to see anything. Without glasses, the person was left largely sightless even after a successful cataract surgery. However, the high cost of over US\$ 100 per IOL limited its adoption in India and other developing countries. Appreciating the benefits of IOL, especially for the rural poor, AECS ventured to bring down the cost of the IOL through indigenous manufacturing. Aurolabs was established for this purpose. Through technology partnership, Aurolab licensed the technology, procured required equipment, trained the staff, and was able to manufacture the IOL of the same quality as in the West, and yet sell at a mere cost of US\$ 10. This enabled Aravind and eye care providers in all developing countries to offer "modern" cataract surgery at affordable cost to their communities. Backward integration via its manufacturing division- Aurolab, supplies high-quality ophthalmic consumables to developing countries at affordable prices. This strategy aligns with the value of providing equitable and quality eye treatment regardless of the economic status of the patients. Mr. Ravilla recognizes that due to the high import value of lenses being passed on to patients in developing countries like India, the adoption of this kind of indigenous manufacturing became essential to bring down the costs for surgeries for underserved communities, to align with the value system of equitable and quality eye treatment for



Eye Surgery taking place (Image Credit: AECS)

all. Today, Aurolab exports lenses to 130 countries, capturing a global market share of 10% by volume of IOLs.

#### Innovation 4: Capacity Building

AECS optimizes the use of a surgeon's time to ensure high productivity. However, this requires well-trained clinical support staff. Since the country had an acute shortage of nurses, who also needed further training in ophthalmic techniques, Aravind decided to create its own supply. This training programme has evolved over the four decades. Now, each year, Aravind selects approximately 600+ young women (18 years old), who have passed 12th standard, from the nearby villages to provide them with a two-year training free of charge. All of them are employed on successful completion of the training. These women then make up about 60% of Aravind's total workforce. The emphasis of the training lies in mastering ophthalmic techniques and delivering patient-centric treatment. This has not only resulted in offering a livelihood to young women in the region but has also helped in staffing the vision centres, as well as achieving high clinical efficiency.



Capacity Building Programme led by LAICO  
(Image Credit: AECS)

#### Innovation 5: : Lions Aravind Institute of Community Ophthalmology (LAICO)

Aravind Eye Hospitals' effective approach in Tamil Nadu garnered global recognition, prompting the establishment of Lions Aravind Institute of Community Ophthalmology (LAICO). With a 100% external focus, LAICO partners with eye care providers and governments worldwide, aiding hospitals in countries like Malawi and Bangladesh through leadership development, organizational transformation, and supply chain management.

This commitment to high-quality, frugally innovative eye care has positioned Aravind as an international leader in the field. Mr. Ravilla explains how the LAICO model works in the following video



Interview with Mr. Thulasiraj Ravilla  
(Scan the image using Overly App to watch the full video)

#### Innovation 6: Vision Centres

Aravind Eye Hospitals' network of over 110 Vision Centres reaches a population of over one crore, providing primary eye care services in rural areas. With more than 90% of patients treated on-site, at a consulting fee of Rs. 20 valid for three visits, these centres significantly reduce the need for costly trips to hospitals in cities. Through innovative use of technology, including AI applications for early detection of diabetic retinopathy, Aravind's Vision Centres ensures timely and affordable eye care, covering over 90% of those in need within four years.



Eye check up at Vision Centres (Image Credit: AECS)

## Financial Sustainability and Frugal Innovation

Aravind achieved their financial sustainability through the implementation of a cross subsidization system. The 45-50% of paying patients are subsidizing the 50-55% of non-paying patients, while the quality of treatment stays the same. In conclusion, AECS managed to develop a unique and innovative system that allowed for inexpensive, high-quality treatment in a financially sustainable manner. The instances of the Aravind

Model in eye care or Narayana in cardiology and orthopaedics showcase India's potential to rise to the leadership role in the global healthcare landscape as a whole. With less than a 4% share in global carbon emissions, India focuses on sustainable and affordable healthcare practices. Considering the cost-effectiveness of healthcare that India offers vis-à-vis the healthcare cost spiralling in countries like the UK and the USA, this necessitates streamlining the government policies to enable more collaborations on the global platforms.

*(Sanchita Jain is the Communications Specialist at OPSA and Tanya Gupta is a technical content writer)*



# OPSA INITIATIVES FOSTERING FRUGAL INNOVATIONS

## RUTAG: A MODEL FOR FRUGAL INNOVATION ECOSYSTEMS

— By Dr. Monoranjan Mohanty and Dibojit Pathak



Sustainable rural development faces a constant struggle: balancing profit, social good, and environmental responsibility (the triple-bottom-line). This article delves into how RuTAG - an initiative of the OPSA, since 2004, is leveraging frugal innovation to overcome these challenges and fostering a new paradigm for rural development in India. By prioritizing local needs and utilizing indigenous knowledge, RuTAG serves as a model for harnessing frugal innovations that are not only cost-effective

but also culturally relevant and environmentally responsible- paving the way for a more sustainable & resilient future for rural India.

RuTAG's commitment to sustainable development is evident in its impressive portfolio of frugal innovations that demonstrate how even simple and low-cost solutions can have a significant positive impact on people's lives and the environment.

## Water Storage Tanks Using Natural Fibers

*"Regions of rural Maharashtra face severe water scarcity, leading to unreliable crop yields and farmer suicides"*

*- Prof. S. Agnihotri, PI, RuTAG IIT Bombay*

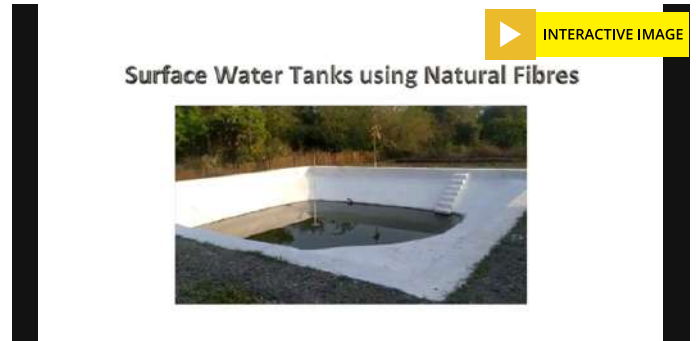
To address this, RuTAG IIT Bombay and NGO Jalvardhini developed a cost-effective water storage solution. By replacing steel with natural



*Water Storage Tanks Using Natural Fibers  
(Image Credit: RuTAG)*

fibers for reinforcement, the cost of constructing water tanks is reduced to Rs 3-4 per litre of capacity, compared to Rs 10 for traditional concrete tanks. This innovation provides farmers a reliable and affordable way to store rainwater, enhancing agricultural productivity and economic growth.

The construction process involves placing a natural fiber mesh between two layers of wet concrete mix after excavation. Local masons can be trained to build these tanks within days, making the technology accessible even in remote areas with limited resources. The impact on rural communities has been significant. In Beed district, known for droughts and farmer suicides, RuTAG IIT Bombay has built natural fiber tanks for 18 marginal farmers. The stored rainwater has allowed them to irrigate crops during dry spells and grow additional crops, substantially increasing their income. Bharat Kale, a farmer in Beed shares the impact of this frugal technology.

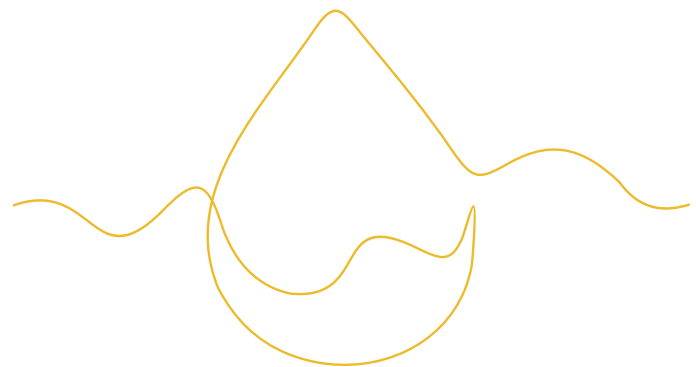


*Water Storage Tank Using Natural Fibers  
(Scan the image using Overly App to watch the full video)*

A natural fiber tank built on his farm in 2022 captured monsoon rains, securing his kharif crop during a dry period and providing extra water for the rabi crop. This led to higher yields and an increase in income.

*"This technology exemplifies resourcefulness and affordability. By using natural fibers, we're reducing our reliance on steel and contributing to a greener future."*

*- Prof. A.B. Rao, Co-PI, RuTAG IIT Bombay*





## Modified Bageshwari Wool Charkha

Spinning wool with the traditional charkha has been strenuous and time-consuming. The modified Bageshwari Wool Charkha, developed by RuTAG IIT Roorkee, retains the familiar foot pedal mechanism but adds a solar-powered motor with variable speed control. This allows spinners to adjust yarn coarseness and fineness.

*"Our team identified issues with traditional charkhas in Uttarakhand like uneven bobbin filling and inconsistent yarn thickness,"*

*- Prof. S.K. Singal, PI, RuTAG IIT Roorkee*

Dr. Sonal, Co-PI, RuTAG IIT Roorkee, noted, "A large community of artisans faced low productivity and uneven yarn quality." The team's modifications include a variable-speed motor and gearbox for uniform yarn filling, and a solar panel for sustainable operation, enhancing both efficiency and environmental friendliness. The improvements are profound. Spinners can now produce nearly 1.5 kg of yarn daily, tripling their output from traditional methods. This boosts their daily income by up to 2-3 times. The charkha's versatility is another advantage, as it can operate on solar, grid power, or manually, allowing artisans to work with various wool types and ensuring continuous operation.



Modified Bageshwari Wool Charkha  
(Image Credit: RuTAG)

Mr. JP Maithani, Chairman of AAGAAS Federation, has seen success in adopting the modified charkha among rural artisans associated with his organisation. "It's a boon to local artisans, increasing their daily income," he reports. The charkha has proved effective with different fibers, including nettle and hemp, making it a pivotal tool for rural economic growth.



Modified Bageshwari Wool Charkha  
(Scan the image using Overly App to watch the full video)



## Sabjikothi for Street Vendors

*"While the focus is often on large-scale agriculture, challenges faced by street vendors selling fresh produce from carts are significant. These fruits and vegetables are constantly exposed to harsh elements, leading to spoilage and lost income,"*

*- Prof. J. Ramkumar, PI, RuTAG IIT Kanpur*

New technologies are reducing trade costs, allowing rural products to reach distant markets more efficiently. Previously, vendors had to discard unsold produce due to spoilage from environmental exposure and temperature changes.

*"Countless street vendors across the country struggle with perishable goods spoiling, impacting their income and contributing to food waste."*

*- Dr. Amandeep Singh, Co-PI, RuTAG IIT Kanpur*

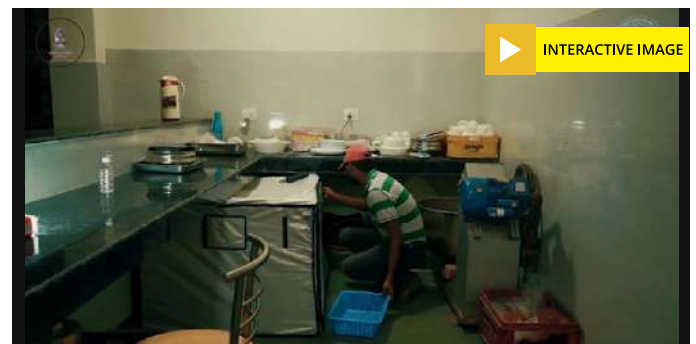


Sabjikothi for Street Vendors (Image Credits: RuTAG)

Addressing this issue, RuTAG IIT Kanpur, in collaboration with agritech startup Saptkrishi, developed the Sabjikothi. This low-cost,

IoT-enabled storage extends the shelf life of fruits and vegetables from three to 40 days, depending on the crop. Portable and wheel-mountable, the Sabjikothi can be used at home, in the field, or on a terrace, storing up to 200 kgs of produce. It automatically adjusts its internal temperature based on the stored quantity and does not rely on chemicals or cooling.

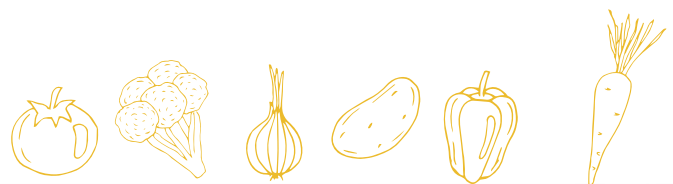
The Sabjikothi features a three-layered insulated wall, ultrasonic atomization for humidity control, UV light, and negative ions to eliminate bacteria. An innovative electric corona discharge technology oxidizes ethylene gas, slowing down the ripening process. The system is controlled and monitored via a user-friendly app.



▶ INTERACTIVE IMAGE

Sabjikothi for home  
(Scan the image using Overly App to watch the full video)

The launch of Sabjikothi has had a positive impact. By reducing spoilage, it empowers street vendors, especially women in urban and semi-urban areas, by increasing their income by 50%, reducing losses, and fetching better prices due to the longer shelf life of their produce. Food waste is also reduced by over 30%. Sabjikothi exemplifies how frugal innovation can create a sustainable and profitable future for vendors and farmers.



### Multi-Nutrient Feed Block Machines for Yak & Mithun Rearers

Yak and mithun rearing are essential livelihoods in the high-altitude regions of North Eastern India, where winter snow cover on grasslands challenges animal sustenance, impacting health and milk production. Prof. S.K. Kakoty, PI at RuTAG IIT Guwahati, highlights the problem: traditional bulky feed block machines are hard to transport and often require electricity, which is unreliable in these areas.

RuTAG IIT Guwahati has innovated a solution with a multi-nutrient compressed feed block machine that is mechanically operated, eliminating the need for electricity and making it ideal for remote locations. The machine is compact, portable, and built from locally available materials, reducing costs significantly. This innovation has been a boon for local farmers.



Multi-Nutrient Feed Block Machines (Image Credits: RuTAG)

The machine produces multi-nutrient feed blocks that improve animal health, leading to higher milk yields and reduced mortality rates. The economic benefits are substantial, as farmers can generate additional income by selling milk and other dairy products. Both hydraulic and manual versions of the machine have been successfully disseminated to institutes like NRC Yak in Arunachal Pradesh and NRC Mithun in Nagaland, as well as various cattle farmers in Nagaland, Manipur, and Mizoram under the STINER project.

These farmers have found the machine incredibly useful, not only for developing cattle feed blocks but also for producing piggery feed blocks. The accessibility and affordability of the feed block machine enhance its value, improving the economic condition of farmers in the region.



Multi-Nutrient Feed Block Machines  
(Scan the image using Overlay App to watch the full video)

*"This machine directly addresses the critical winter feed scarcity for yak and mithun rearers. By allowing farmers to produce nutritious feed blocks, it ensures the survival and health of their animals during harsh conditions and eliminates electricity costs, further enhancing its affordability."*

- Dr. S. Singha, Co-PI, RuTAG IIT Guwahati



### Tulsi Mala Bead Making Device

Rural India's tradition of handicrafts, such as Tulsi mala making in Jait village, Mathura district, faces modern challenges.

*Prof. Saha, PI, RuTAG IIT Delhi*, notes the traditional hand-operated lathe used for making Tulsi mala beads was labour-intensive and caused physical strain, limiting the variety of products artisans could make, especially larger beads over 25mm in diameter, thereby reducing their earning potential.



Tulsi Mala Bead Making Device (Image Credits: RuTAG)

Around 2000 artisans in Jait village and other small clusters across India traditionally used these lathes. Recognizing the challenge, RuTAG IIT Delhi introduced mechanized devices powered by electric motors to automate the bead-making process. These devices come in three versions: a low-power DC motor for smaller beads, a higher-power AC motor for larger beads, and a

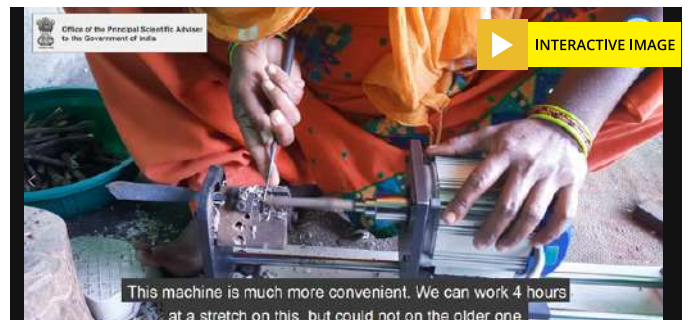
servo motor with variable speed control, all designed to preserve the tradition while enhancing productivity, exemplifying the philosophy of frugal innovations.

The mechanization significantly reduces physical strain and allows for the production of larger beads, expanding the artisans' product range and potential earnings. Over 400 devices have been disseminated, benefiting traditional artisans, craft cooperatives, and commercial manufacturers. These devices have transformed lives in Jait village, enabling families to work together, with women and children participating in bead-making, thus creating a shared income source. Artisans no longer suffer from back and shoulder pain and can work comfortably for longer hours, leading to increased productivity and earnings up to ₹30,000 per month—a substantial increase from the previous ₹5,000.

*"The traditional methods held cultural significance but limited the economic potential of this craft. Through frugal innovation, we've developed solutions that are not only affordable and accessible but also empower rural communities and ensure the sustainability of their traditional practices."*

*- Prof. M. Ravi, Co-PI, RuTAG IIT Delhi*

This approach has secured the future of Tulsi mala making in Jait village, affirming its role as a leading producer and preserving the craft for future generations.



Tulsi Mala Bead Making Device  
(Scan the image using Overly App to watch the full video)

## Automatic Coir Spinning Machine

The coir industry in India, particularly in Kerala, heavily relies on coconuts and the extraction of coir fiber from their husks. However, traditional methods of processing coir lack efficiency and versatility, hindering the industry's growth and competitiveness. To address these challenges, RuTAG IIT Madras collaborated with the Kerala State Coir Machinery Manufacturing Company (KSCMMC) to enhance the Automatic Coir Spinning Machine (ACSM).

*"Recognizing this need," adds Prof. Abhijit, PI, RuTAG IIT Madras, "we emphasized the importance of frugal innovation."*



Automatic Coir Spinning Machine (Image Credits: RuTAG)

*"Previously, the ACSM could only produce two-ply ropes at a limited rate, constraining the industry's ability to meet diverse market demands," says Prof. Varun, PI, RuTAG IIT Madras. "By collaborating with KSCMMC, we aimed to improve the ACSM using cost-effective technologies."*

Through frugal innovation, RuTAG IIT Madras integrated cost-effective technologies into the ACSM, including a Programmable Logic Controller (PLC) system and five independent motor drives. These modifications significantly improved the machine's efficiency and versatility.

"With the upgraded ACSM, production speed increased by 35%, enabling coir producers to meet higher demands and generate more income," highlights Prof. Varun. "Moreover, the machine can now produce five distinct coir twists, catering to a wider range of applications and customer needs."



Automatic Coir Spinning Machine  
(Scan the image using Overlay App to watch the full video)

This not only expands market opportunities but also promotes sustainable coir production by minimizing waste.

KSCMMC has replicated the upgraded ACSM design, making it accessible to coir societies across Kerala. This technology enhances the industry's efficiency, competitiveness, and sustainability, thereby fostering economic growth in rural communities dependent on coir production.

## Sabai Grass Rope Making Machine

Rural artisans, especially those engaged in traditional crafts like rope-making, encounter numerous challenges. Manual processes are labor-intensive, time-consuming, and yield low productivity and income. Inconsistent product quality limits market access, while a lack of technical skills hampers diversification and value addition.

*"Our aim is to create technologies that empower rural communities. The Sabai Grass Rope Making Machine exemplifies this approach. It addresses the specific needs of artisans while ensuring sustainability and affordability,"*

*- Prof. Rintu Banerjee, PI, RuTAG IIT Kharagpur*

The Sabai Grass Rope Making Machine employs a straightforward mechanism. Sabai grass leaves pass through two cone-shaped feeders, where rotating vanes twist them inside tubes. These twisted strands converge inside another rotating pipe, forming a single rope. The finished rope is automatically wound onto a bobbin as the machine continuously pulls in new leaves,



Sabai Grass Rope Making Machine (Image Credits: RuTAG)

eliminating manual labor and significantly increasing production compared to traditional methods.

The machine has transformed the lives of rural artisans. Previously, hand-making rope was arduous, producing only a few kilograms per day. However, the machine, operated by a single person, boosts productivity to 600-700 grams of rope per hour. This results in higher daily wages, improved working conditions, and a better standard of living for their families. The machine's affordability and low energy consumption make it a sustainable solution for these communities. SHGs and NGOs in Suchetana, Kharika, Jhargram, DHAN Foundation, Centre for World Solidarity, and others have reported improved income and overall satisfaction with the developed machine.



Sabai Grass Rope Making Machine  
(Scan the image using Overly App to watch the full video)



All 34 technologies from RuTAG Phase-1 can be accessed [here](#).



(Dr. Monoranjan Mohanty is Adviser/Scientist 'G' at OPSA and Dibojit Pathak is a Young Professional at OPSA)

# OPSA INITIATIVES FOSTERING FRUGAL INNOVATIONS

## AGNi

*"The true measure of innovation lies not in the complexity of the technology, but in its ability to keep communities at the centre of the innovation cycle. When this is achieved, a fine balance of emerging and frugal technology is visible in the most promising solutions especially for critical areas like climate change."*



**Dr. Preeti Banzal**  
Adviser/Scientist 'G', OPSA

## Empowering Climate Adaptive Livelihoods in Uttarakhand through User-Centric Frugal and Emerging Technologies

— By Shubham Tomar and Garima Raj

### Introduction

In a unique collaboration, the Accelerating Growth of New India's initiatives (AGNi), Mission of the OPSA and the Uttarakhand State Council for Science and Technology (UCOST) embarked on a transformative project to harness the power of user-centric frugal and emerging technologies to safeguard and enhance the livelihoods of communities in the Indian Himalayan Region. With a focus on the Champawat Kumaon Division, which aligns with the state's vision of developing it as an Adarsh Zila, the project aimed to address the pressing challenges posed by climate change and empower the local communities to adapt and thrive.

### Challenges Faced by Local Communities

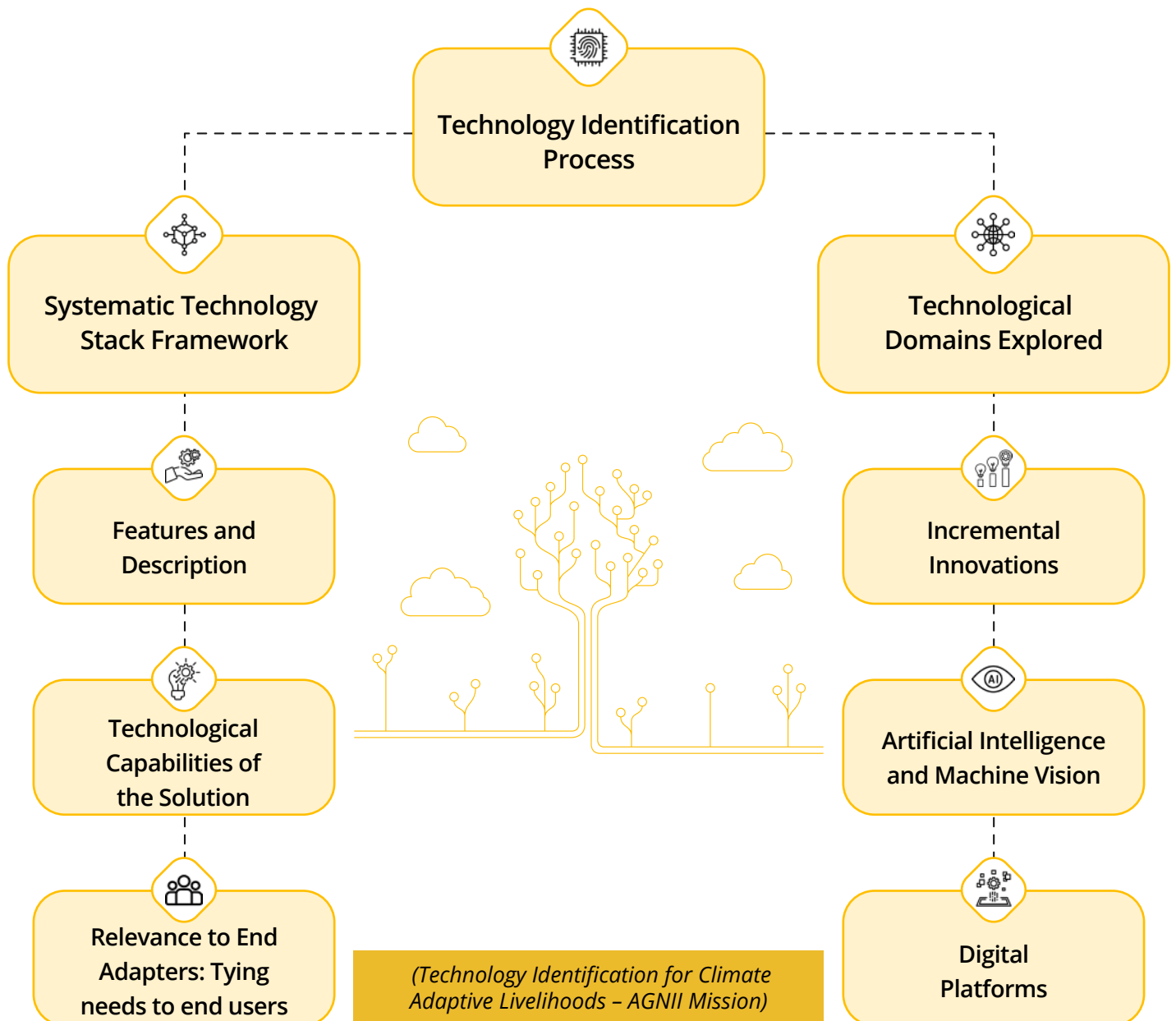
The Indian Himalayan Region, home to diverse communities and rich ecosystems, faces significant

threats from the ongoing climate crisis. The changing climate has disrupted traditional practices, altered resource availability, and compelled communities to adapt to new realities. Recognizing the urgent need for action, the project adopted a user-centric approach to identify and address the specific challenges faced by forest-dependent communities, livestock farmers, and women in the region. For forest-dependent communities, the shifting vegetation zones, heightened vulnerability to pests and diseases, and disrupted collection of forest produce have had profound impacts on their livelihoods. Livestock farmers grapple with the susceptibility of indigenous livestock to environmental stresses, diseases, and nutritional deficiencies, while water scarcity threatens the availability of fodder and water. Women, who play pivotal roles in these communities, often face a lack of decision-making authority and bear the brunt of increased workloads due to climate change.

**Technology Stack Framework and Identification of Technologies**

To tackle these challenges head-on, the project developed a systematic technology stack framework that prioritized user-centricity and struck a balance between frugal and emerging technologies. The framework focused on four key technological domains: incremental and frugal innovations, artificial intelligence and machine vision, digital platforms, and blockchain. Frugal innovations like the briquetting machine, which converts agricultural and forest waste into high-quality biomass briquettes, and the solar-powered silk reeling

machine, which revolutionizes traditional silk reeling, took centre stage. These affordable, resource-efficient solutions were complemented by emerging technologies such as artificial intelligence and machine vision for cow detection and real-time monitoring in the dairy sector. Digital platforms, designed with user-friendliness in mind, provided tools for dairy finance management and agriculture, while blockchain technology enhanced traceability, quality assurance, and trust in dairy and apiary management. The technology identification process has been depicted in below figure.





## Demonstration of technologies

The showcased technological solutions were a testament to the project's commitment to user-centricity and the strategic balance between frugal and emerging technologies. From solar-powered silk reeling machines that revolutionize traditional silk reeling to active packaging sachets that extend the shelf life of fruits and vegetables, each innovation was carefully designed to address the unique needs and challenges of the local communities. Pelletizer and briquetting machines, which convert agricultural and forest waste into high-quality biomass pellets and briquettes, offered a sustainable energy solution while creating income opportunities.

*Some emerging technology solutions scouted and showcased were as follows:*

- ♦ Facial recognition for cow detection using machine vision enabled camera
- ♦ Blockchain in dairy management for ensuring enhanced transparency, quality assurance, traceability of milk supplied, data integrity.

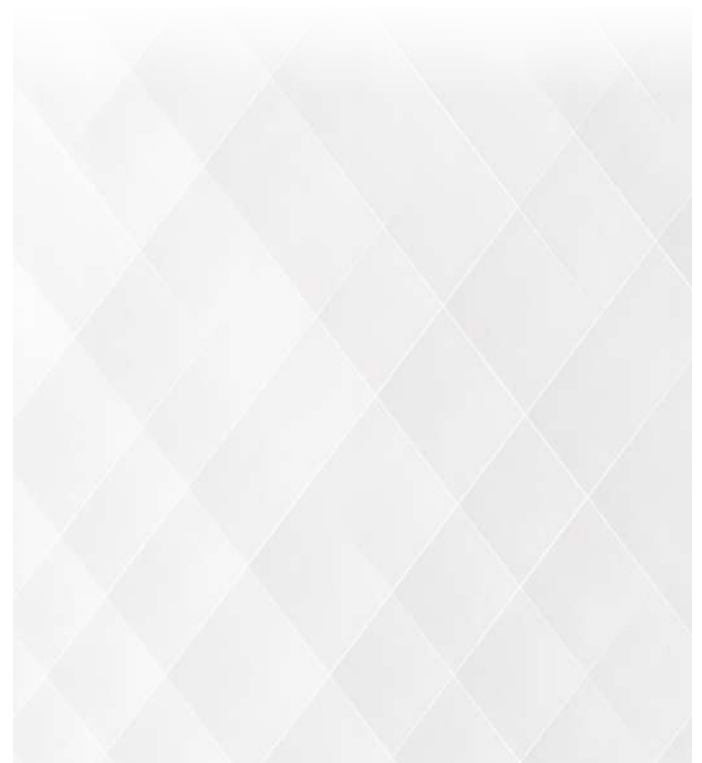
## Success Story

The user-centric approach and the strategic balance between frugal and emerging technologies adopted in this project played a pivotal role in the successful procurement and piloting of the pelletizer and briquetting machine, as well as the solar-powered silk reeling machine, by the Champawat district administration. By actively involving end-users throughout the process, from ideation to demonstration, and leveraging a mix of affordable, resource-efficient solutions and cutting-edge innovations, the technologies met their specific requirements and preferences. The pelletizer and briquetting machine, for instance, was designed to utilize locally available agricultural and forest waste, ensuring a reliable and cost-effective supply of

feedstock. Similarly, the solar-powered silk reeling machine's compact and ergonomic design was tailored to the needs of local artisans, many of whom had limited technical expertise.

The success of this initiative has inspired the district administration of Champawat and UCOST to develop a more ambitious and comprehensive project called "Adarsh Champawat." Building upon the exemplary work done by the mission, this expanded initiative aims to incorporate capacity building and test bed creation for the entire district. This ambitious undertaking not only validates the effectiveness of the approach adopted by the mission but also highlights the potential for such initiatives to drive sustainable development and build resilience in rural communities across the region. The project's success in Champawat exemplifies the transformative potential of user-centric, frugal, and emerging technologies in addressing the challenges posed by climate change on rural livelihoods.

*(Shubham Tomar and Garima Raj are members of Team AGNI, OPSA.)*



# OPSA INITIATIVES FOSTERING FRUGAL INNOVATIONS

## Waste to Wealth Mission

### Frugal Innovations: Student-led Solutions for a Sustainable Future

— By Surbhi Awasthi

In the realm of sustainable development, innovation plays a pivotal role in addressing pressing environmental challenges. Recognizing the importance of fostering such ingenuity, the Swachhta Saarthi Fellowship under the aegis of the Waste to Wealth Mission, 'a mission under OPSA', has emerged as a catalyst for student-led innovations aimed at promoting frugal technologies. Through this initiative, students across India are harnessing their creativity and passion to develop solutions that not only address environmental issues but also contribute to societal well-being.



Biochar Tile Sample  
(Image Credit: W2W Mission)

*Anas Ibni Ali Wani (Srinagar, Jammu & Kashmir): Revolutionizing Construction with Biochar Tiles*

*"I recognized the urgent need to address the detrimental impact of agricultural residue burning on our environment. That's when I conceptualized biochar tiles as a sustainable alternative to conventional building materials," says Anas.*

Anas Ibni Ali Wani's innovative solution tackles the dual challenge of air pollution and waste management caused by agricultural residue burning. His biochar tiles, crafted from organic waste like agricultural residues or woody biomass, offer a promising alternative to traditional building materials. Not only do these tiles reduce carbon emissions, but they also promote sustainable waste management and enhance energy efficiency in construction.



Notebooks made from Water Hyacinth  
(Image Credit: W2W Mission)

**Nivedita Singh (Guwahati, Assam): Transforming Water Hyacinth into Eco-friendly Paper**

*"Witnessing the ecological threat posed by water hyacinth inspired me to find a sustainable solution. By transforming this invasive plant into eco-friendly paper, we're not only mitigating its impact but also promoting sustainable livelihoods for local communities," says Nivedita.*

Nivedita Singh's initiative addresses the ecological menace posed by water hyacinth through innovative recycling. By collaborating with wetland-dependent communities, she transforms this invasive plant into handmade, chemical-free paper and paper products. Her endeavour not only contributes to environmental conservation but also empowers communities through sustainable livelihoods.



Water Pollution Testing  
(Image Credit: W2W Mission)

**Dr. Aviraj Kuldeep (Kolhapur, Maharashtra): Harnessing Nanotechnology for Water Pollution Control**

*"Water pollution poses a grave threat to both ecosystems and human health. Through the utilization of coconut husk fibers and semiconductor photocatalysts, we're developing a sustainable solution to combat water pollution and safeguard our natural resources," says Aviraj.*

Dr. Aviraj Kuldeep's research endeavors focus on harnessing nanotechnology for water pollution control. By leveraging coconut husk fibers and semiconductor photocatalysts, his innovative approach offers a sustainable and cost-effective solution to mitigate water pollution. Through his work, he aims to protect vital water resources and promote environmental sustainability.



Depiction of Corn cob-based device for Mosquito Control  
(Image Credit: W2W Mission)

*Jeevitha D (Javalli, Karnataka): Corn-cob Based Device for Mosquito Control*

*"By repurposing local agricultural waste, we're addressing the dual challenge of waste management and mosquito-borne diseases. Our corn-cob based device not only offers an effective solution for mosquito control but also promotes environmental sustainability," says Jeevitha.*

Jeevitha D's innovative approach to mosquito control demonstrates the potential of utilizing agricultural waste for sustainable solutions. Her corn-cob based device not only addresses public health concerns but also contributes to waste management and environmental conservation.

The testimonies of these Swachhta Saarthi Fellows underscore the transformative potential of frugal innovations in addressing environmental challenges. From sustainable construction materials to waste repurposing initiatives, these student-led projects exemplify the spirit of innovation and environmental stewardship. As we continue to harness the power of creativity and ingenuity, we can pave the way for a more sustainable and prosperous future for generations to come.

*(Surbhi Awasthi is a member of Team Waste to Wealth Mission, OPSCA.)*

# OPSA INITIATIVES FOSTERING FRUGAL INNOVATIONS SCIENCE AND TECHNOLOGY CLUSTERS

*"Frugal Innovation means optimizing resources and ecosystem effectively and finding innovative solutions to problems by utilizing local resources for creativity. At S&T Clusters, we promote Frugal innovations by working in a consortium mode bringing together academia, R&D institutions, industries, and local government bodies to solve regional problems through S&T interventions. By working together and leveraging their collective strengths, the S&T clusters aim to bring positive impact on the economy and society at large."*



**Dr. Vishal Choudhary**  
Scientist 'F', OPISA

## Empowering Communities: JCKIF's Frugal Tech Journey



— By OPISA Communications Team

In the array of India's diverse landscapes, the trails of innovation weaving the story of technological progress become a necessity. In this interplay of accessibility and frugal innovations, the Jodhpur City Knowledge & Innovation Foundation (JCKIF), one of the seven Science and Technology Clusters, is an initiative of the Office of the Principal Scientific Adviser to the Government of India, which pioneers transformative solutions to distinct challenges emerging from the different realms of society. Promoted by IIT Jodhpur, its endeavours span across diverse sectors, like Medical Technologies, Water & Environment among others.

Harnessing the potential of technology to address complex challenges efficiently and affordably in underserved areas, JCKIF'S inventive approach to frugal innovations fosters sustainable livelihood

through science and technology with the essence of accessibility and inclusive development.

The article delves into the various technological approaches of JCKIF that encompass affordability and accessibility to small households and local artisans of Rajasthan.

### Gravity-Filters: Clay Ceramic Water Filters

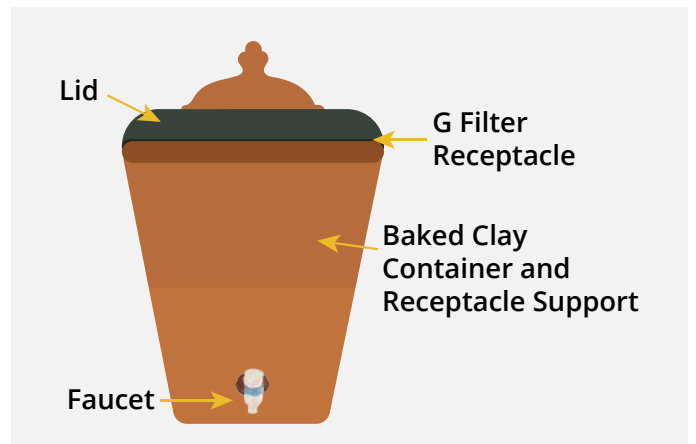
Over the years, in rural areas, the severity of water purification has spurred the development of various water purification methods, which have been costly and energy-intensive, rendering them impractical for the rural population in the developing world. Recognizing this challenge, PhD students at IIT Jodhpur, Sandeep Gupta, Amrita Kaurwar, and Rajkumar Satankar, developed the concept and an effective working model display of

clay ceramic water filters, called Gravity filters (G-filters) in 2018, perceiving the traditional skills of potters' household manufacturing and easy adaptability in rural areas of the region.

With no piped water infrastructure, this simple yet accessible option for safe drinking water penetrates the lowest strata of the economic pyramid, ensuring affordability for these small households in rural areas. Empowering local artisans, these frustum-shaped clay ceramic water filters are produced by baking the press-formed clay with varied organic material composites together in specific proportions.

This design effectively traps non-soluble contaminants and bacteria in the ultrafine pore passages with high tortuosity in the clay material. Achieving an impressive efficiency of approximately 2.8 LRV (Log Reduction Value) in E. coli bacteria removal, this technology having a lifespan of 2-3 years, exemplifies frugality in innovation. With a filtration rate of 1-3 liters per hour, these pots can effectively produce a voluminous amount of safe drinking water—over 600 ml/hr. Through the grassroots approach of IIT Jodhpur students and engineers in partnership with various organizations like Rupayan Sansthan in Rajasthan, Sehgal Foundation in Bihar, Kerala

technology within their community. With the dissemination of manufacturing technology carried out among traditional potter families using ingenious techniques, sustaining the businesses of these residents in rural parts of India like Jodhpur (Rajasthan), Sirohi (Rajasthan), Jhunjhunu (Haryana), Samastipur (Bihar), Tindivanam, and Thiruvallur (Tamil Nadu), etc., this frugal technology serves the aim of providing potable water to small households in these areas.



Components of G-Filters



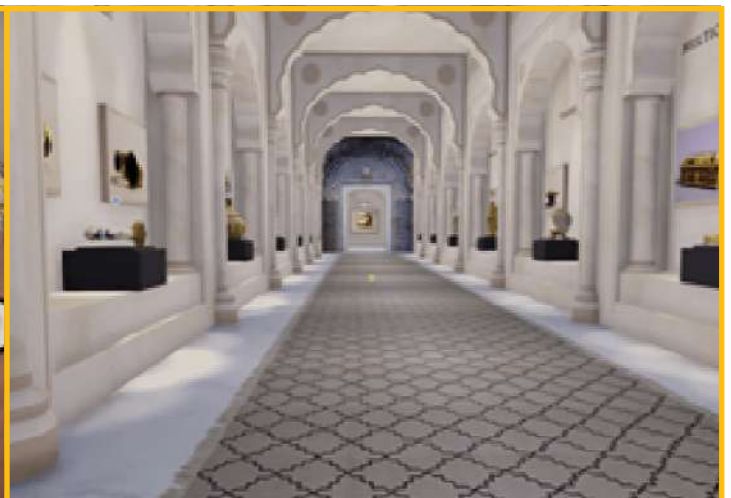
G-filter set up in a house in Banad Village, Jodhpur Rajasthan, India (Image Credit: JCKIF)

Velar Association, facilitated by JCKIF, educating local potters about the technology and familiarizing them with the properties of locally available material in rural areas across India, master potters are cultivated to propagate this

### Kalaanubhav.in: An e-commerce platform with 3D Experience

The handlooms and handicrafts in India, embodying the cultural and traditional skilled craftsmanship, have been overshadowed by alternatives available in the dynamism of globalized markets. Preserving these handicrafts is vital for safeguarding the economic sustainability and livelihood of artisans and weaver communities in rural and marginalized

providing a glimpse into their workspaces showcases interviews with artisans, and through a virtual showroom demonstrating products coming to life in real-world settings, users can envision how these handcrafted products would look and feel. This cutting-edge technology of Augmented Reality and Virtual Reality creates an immersive and accessible experience by harnessing the power of frugal innovation, revolutionizing the way we interact with artisanal products.



3-D Experience Centre Gallery (Image Credits: JCKIF)

regions of the country. With over 7 million artisans employing inherited techniques and indigenous knowledge forming the backbone of the Indian handicraft industry, leveraging technological innovations frugally to benefit these communities can streamline the production process and enhance their craft to new frontiers, standing as a testament to their traditional and cultural heritage.

Acknowledging this gap between the physical and digital worlds, JCKIF has established a dynamic virtual space, Kalaanubhav.in, which enables users to navigate freely through the tapestry of the tangible realm of artisanal products and the virtual world. At the heart of this innovative space lies a gallery exhibiting the marvels and intricacies of artisanal creations. Another section celebrates the accomplishments of artisans and their contributions on interactive displays. Furthermore, a theatre

Kalaanubhav.in, an e-commerce platform, is an initiative by IIT Jodhpur and OPSA to empower artisans with a platform to directly showcase and sell their handloom and handicraft products to customers. Transcending geographical barriers, the 3D viewing capacity with a virtual rotate feature of the platform allows customers to immerse themselves in the products' intricate details and unique characteristics from the comfort of their homes. Users can use a mobile camera to engage with the product and see how it would appear in physical space. With 536 products (Bone & Horn, Block Printing, Leather Mojari, Salawas Durry, and Tie & Dye) from five craft clusters by 23 artisan families and over 400 associates displayed, the e-commerce platform serves as a digital marketplace for artisans to connect with customers, instilling a sense of recognition and empowerment in the artisanal community. These initiatives reflect a paradigm



shift and the innovations and sophistication in the simplicity of the technology adopted by JCKIF, unlocking new possibilities for more equitable and inclusive development of all communities in society. The transformative application of these

technologies by rural households in India uplifts them and empowers them, regardless of their circumstances.



*“Frugal innovation has significant potential for enhancing livelihoods. By combining resourcefulness, adaptability, and a deep understanding of local needs, JCKIF is supporting the livelihood of peoples in and around Jodhpur through science and technology interventions in the crafts sector through e-commerce platform Kalaanubhav.in & supporting daily needs by developing affordable water solution: gravity filter.”*

- Dr. G.S. Toteja, CEO, JCKIF

(This article has been curated by OPSA Communications Team)



## Empowering Odisha- Frugal Innovations Shaping Healthcare, Technology and Sustainability



— By Dr. Aanchal Katoch

*"Frugal Innovation means achieving more with less for more. Startups and SMEs are embracing Frugal principles for efficiency and ingenuity. At Bhubaneswar City Knowledge Innovation Cluster (BCKIC), we foster a thriving Frugal Innovation environment, combining local expertise and global best practices to tackle challenges sustainably."*

- Dr. Namrata Misra, CEO, BCKIC Foundation

BCKIC Foundation, one of the seven Science and Technology Clusters being led by Office of the Principal Scientific Adviser to the Government of India, plays a vital role in promoting the development of frugal technologies in Odisha, which are cost-effective and impactful, through its strategic initiatives and partnerships.

BCKIC Foundation stands with these frugal innovations by fostering a collaborative ecosystem that nurtures and supports these transformative ideas, driving positive change across various sectors. BCKIC Foundation supports startups in various ways depending on their need, including technology deployment, establishing pilot-scale plants, product validation, connecting with industry and government entities, securing CSR funds, building investor relations, market linkage, and access.

This article sheds light on stories of such frugal technologies that BCKIC Foundation has supported, paving the way for sustainable and inclusive growth in Odisha.

**MedTel Healthcare: A telehealth platform for remote health monitoring patients in hospitals and remote locations.**



Dr. Lalit Ranjan Manik and Dr. Timviresh Das, both seasoned healthcare professionals from Odisha, joined forces with Ajit Choudhury, a software development expert, to embark on a transformative journey. The journey began with a poignant real-life experience, witnessing a mother sitting by her second son's hospital bed, awaiting the grim outcome of malaria. This experience catalyzed change, leading to the vision of a healthcare system empowered by technology, particularly IoT devices and artificial intelligence, and thus the creation of the flagship program, MedTel-iLab, in 2017.

An early user's experience at the heart screening camp also ignited the beginning of their journey. During the camp, the connected ECG device, integrated with the AI engine of MedTel-iLab, detected signs, indicative of an inferior wall infarction—a potentially life-threatening condition. Hence, the swift intervention, including angioplasty, based on the alert and consultation with the cardiologist, saved the user from complications.

This experience led them to develop a connected platform, integrating 25+ IoT medical devices, providing 75+ parameters alongside teleconsultations, and delivering instant reports, predictive analytics, and actionable insights for governments and healthcare providers on the individual and population levels. MedTel Healthcare follows a cost-effective approach



MedTel Healthcare kits (Image Credit: BCKIC)

by building teams from tier-2 colleges and small towns, whom they train and sustain for longer periods. This strategy helps MedTel develop a cost-effective product that serves underserved communities.

The founders pivoted their business model from Business-to-Consumer (B2C) to Business-to-Business (B2B) in 2020. Since then, it took MedTel 4 years to reach 10 states and secure 50 B2B partners. MedTel has impacted 300,000 individuals and digitized 550

rural health centers. Their IoT-based medical devices have benefited pregnant women and senior citizens. MedTel's projects have significantly impacted lives and transformed healthcare delivery, revolutionizing healthcare accessibility.

Asserting Med-Tel's impact in making healthcare accessible to all, the founders say, "Bridging Healthcare Gaps for 1 Billion Underserved Population Through Technology & Innovation has been the motive behind our interventions."



MedTel Healthcare kits and their work in the field (Image Credits: BCKIC)

**EzeRx: A non-invasive Hemoglobin Screening Device**



In 2018, Partha Pratim Das Mahapatra, Founder and CEO of EzeRx, left his lucrative job in Singapore to pursue his higher calling in healthcare entrepreneurship in Odisha. His mother's battle with anemia since childhood made him recognize the necessity of addressing the silent epidemic. Hence, motivated by his desire to make healthcare more accessible, Partha created EzeCheck, India's first ICMR-RMCBB-validated non-invasive hemoglobinometer. This innovation uses absorbance spectroscopy and AI to evaluate hemoglobin levels.



*EzeCheck device  
(Image Credit: BCKIC)*

EzeRx has already deployed more than 5600 EzeCheck devices, testing over 23 lakh individuals and detecting anemia in more than 7.5 lakh. The flagship device has saved over 15.2 tons of medical waste, preserved 6,075+ gallons of blood, and achieved cost savings exceeding 1.35 million USD ((112723427.25 INR (11.27cr)). Additionally, it has streamlined operations and saved over 1064 years across healthcare processes.

Partha's dedication to the societal impacts extends to his spouse, Chaitali Roy, as they lead EzeRx's journey forward. Their dedication to enhancing preventive healthcare extends beyond profits, as encapsulated in Partha's ethos: "For me, the goal of business is not restrained to just generating profit. It's about changing lives."



*EzeCheck device and the work on the field  
(Image Credit: BCKIC)*

Through assistance from the BCKIC Foundation, these startups are not only thriving but also contributing significantly to the advancement of healthcare, technology, and sustainable practices., BCKIC Foundation's dedication and determination to nurture these startups underscores its mission in shaping the future of entrepreneurship in Odisha.

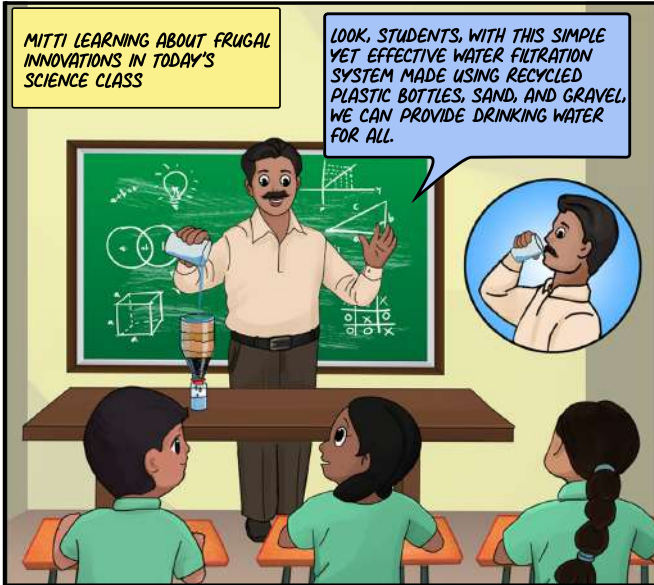
*"Frugal Innovation isn't about being cheap but optimizing resources effectively. In places like India, limited resources spur resilient jugaad innovation. At BCKIC, we celebrate this spirit, driving solutions that address significant challenges while optimizing costs."*

*- Prof. Mrutyunjay Suar, Chairman, BCKIC Foundation*

*(Dr. Aanchal Katoch is the Scientific Communication Manager at BCKIC Foundation, OPISA)*

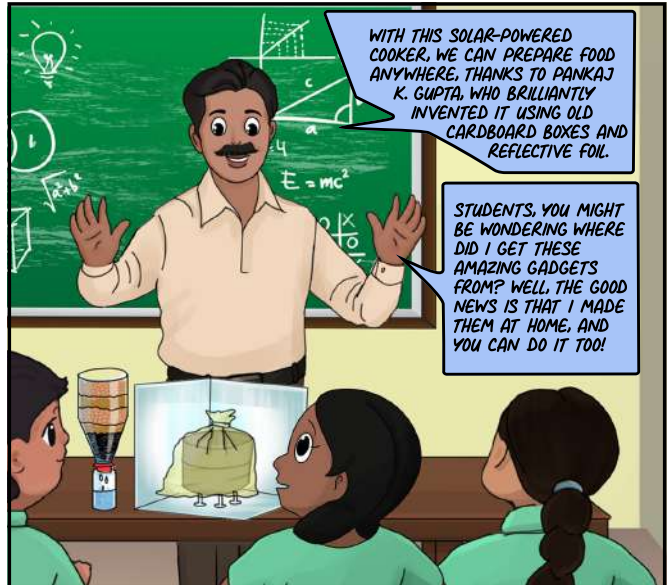
**Chapter 8 - Innovation Begins at Home**

Concept by - Sanchita Jain  
Illustration by - Infoneo Technologies



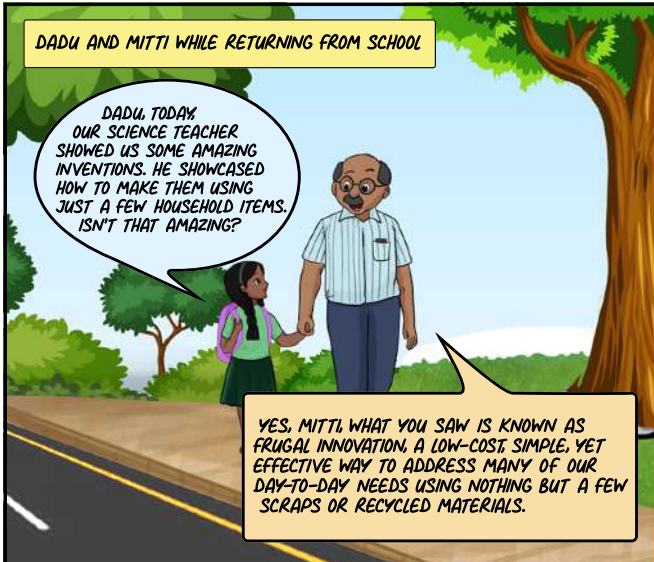
MITTI LEARNING ABOUT FRUGAL INNOVATIONS IN TODAY'S SCIENCE CLASS

LOOK, STUDENTS, WITH THIS SIMPLE YET EFFECTIVE WATER FILTRATION SYSTEM MADE USING RECYCLED PLASTIC BOTTLES, SAND, AND GRAVEL, WE CAN PROVIDE DRINKING WATER FOR ALL.



WITH THIS SOLAR-POWERED COOKER, WE CAN PREPARE FOOD ANYWHERE. THANKS TO PANKAJ K. GUPTA, WHO BRILLIANTLY INVENTED IT USING OLD CARDBOARD BOXES AND REFLECTIVE FOIL.

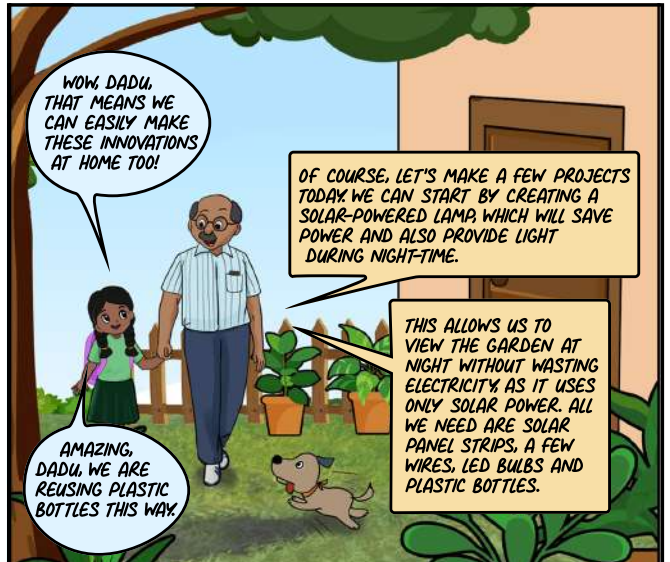
STUDENTS, YOU MIGHT BE WONDERING WHERE DID I GET THESE AMAZING GADGETS FROM? WELL, THE GOOD NEWS IS THAT I MADE THEM AT HOME, AND YOU CAN DO IT TOO!



DADU AND MITTI WHILE RETURNING FROM SCHOOL

DADU, TODAY OUR SCIENCE TEACHER SHOWED US SOME AMAZING INVENTIONS. HE SHOWCASED HOW TO MAKE THEM USING JUST A FEW HOUSEHOLD ITEMS. ISN'T THAT AMAZING?

YES, MITTI, WHAT YOU SAW IS KNOWN AS FRUGAL INNOVATION, A LOW-COST, SIMPLE, YET EFFECTIVE WAY TO ADDRESS MANY OF OUR DAY-TO-DAY NEEDS USING NOTHING BUT A FEW SCRAPS OR RECYCLED MATERIALS.



WOW, DADU, THAT MEANS WE CAN EASILY MAKE THESE INNOVATIONS AT HOME TOO!

OF COURSE, LET'S MAKE A FEW PROJECTS TODAY WE CAN START BY CREATING A SOLAR-POWERED LAMP WHICH WILL SAVE POWER AND ALSO PROVIDE LIGHT DURING NIGHT-TIME.

THIS ALLOWS US TO VIEW THE GARDEN AT NIGHT WITHOUT WASTING ELECTRICITY AS IT USES ONLY SOLAR POWER. ALL WE NEED ARE SOLAR PANEL STRIPS, A FEW WIRES, LED BULBS AND PLASTIC BOTTLES.

AMAZING, DADU, WE ARE REUSING PLASTIC BOTTLES THIS WAY.



DADU, LOOK, THE GARDEN LOOKS SO PRETTY AT NIGHT WITH THE SOLAR LIGHTS ON. IT'S AMAZING HOW WE CAN MAKE ALL THESE INNOVATIONS AT HOME SO EASILY



LOOK, DADU, NOW SAMOSA CAN CHASE BUTTERFLIES AT NIGHT!

SO IT SEEMS, HA HA HA!





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