BCKIC
Bhubaneswar City
Knowledge Innovation
Cluster Foundation

Office of the Principal Scientific Adviser
to the Government of India

SCIENCE & TECHNOLOGY CLUSTER

Bridging Minds, Building Futures

THE S&T CLUSTER ECOSYSTEM

A Collective Vision and Voices
from Diverse Sectors

BCKIC FOUNDATION

MAGAZINE

VOLUME 1

TABLE OF CONTENTS

ACKNOWLEDGEMENT

We extend our deepest gratitude to the leadership of the Office of the Principal Scientific Adviser (PSA) to the Government of India, whose unwavering commitment and visionary direction have been instrumental in shaping the science and technology clusters in India. We sincerely thank Prof. Ajay Sood, Principal Scientific Adviser, for his insightful guidance, strategic foresight, and steadfast support in fostering a culture of innovation and collaboration within the scientific community. His leadership has been pivotal in driving our mission forward. We are also immensely grateful to Dr. (Mrs.) Parvinder Maini, Scientific Secretary, for her invaluable insights and unwavering encouragement, which have been crucial in guiding the BCKIC Foundation's efforts toward our shared vision of sustainable development and technological advancement.

We are also profoundly grateful to the dedicated team at the Office of the PSA, for their continued support and collaboration. We take pride in being part of a united family of S&T clusters across India, including those in Delhi, Hyderabad, Pune, Bangalore, Jodhpur, the Northern Region, and Visakhapatnam. Together, we are collectively working toward our shared goals of building a sustainable and prosperous future for our nation.

We offer our heartfelt thanks to all the contributors who made this inaugural issue possible. Special appreciation goes to our partners from academia, government, NGOs, NPOs, industry, and international organizations for sharing their invaluable insights. Your diverse perspectives have enriched this publication and sparked meaningful dialogue across our community.

We also acknowledge the tireless efforts of the BCKIC Foundation team in curating this issue, and we are grateful to our readers for their continued support and engagement. Together, we celebrate the spirit of innovation and collaboration that drives positive change in our country.

PREFACE

Dr. Mrutyunjay Suar

Chairman
BCKIC Foundation

As Chairman of the Bhubaneswar City Knowledge Innovation Cluster (BCKIC) Foundation, an initiative of the Office of the Principal Scientific Adviser, to the Government of India, under the guidance of the Prime Minister's Science, Technology, and Innovation Advisory Council (PM-STIAC), it is with great pleasure that I introduce the inaugural issue of our magazine. This publication marks a significant milestone in our mission to foster innovation and knowledge exchange across diverse sectors in Odisha and beyond.

In this edition, we present a broad range of perspectives from leaders in academia, government, industry, international organizations, and NGOs/NPOs. This magazine is intended to be more than just a collection of knowledge; it is a dynamic platform for sparking ideas and fostering collaborations. By featuring these varied voices, we aim to showcase the immense synergistic potential within our cluster, highlighting the innovative strides being made in key sectors. These voices cover a wide array of fields, including health tech, critical minerals, the blue economy, green hydrogen, and the conservation of natural resources. Collectively, they provide a comprehensive view of the challenges and opportunities we face, and the future we aspire to create. Our contributors offer valuable insights into the transformative potential of their work, emphasizing our shared commitment to innovation, sustainability, and the practical application of cutting-edge technologies.

At the BCKIC Foundation, we are dedicated to harnessing science and technology to address critical challenges and drive sustainable development. A major focus of our efforts is the deployment of technologies—ensuring that innovations move from research and development into practical applications that benefit society. Our cluster aims to catalyze collaborations, providing an environment where new ideas can flourish and align with global priorities such as climate action, clean energy, resource conservation, and sustainable economic growth.

As we embark on this journey, we look forward to engaging with you, our readers and stakeholders, to accelerate innovation, champion sustainable practices, and build a prosperous future. We hope this publication inspires and catalyzes further dialogue and action.

Thank you for joining us on this journey of exploration, discovery, and innovation. Together, we can build a resilient and sustainable future by leveraging the strengths of our diverse community.

NOTE FROM CEO

Dr. Namrata Misra

CEO

BCKIC Foundation

Bhubaneswar City Knowledge Innovation Cluster (BCKIC), supported by the Office of the Principal Scientific Adviser (O/o PSA) to the Government of India on recommendations from the Prime Minister's Science, Technology, and Innovation Advisory Council (PM-STIAC), is part of the eight Science & Technology (S&T) Clusters established across the country. The purpose of these clusters is to serve as formal umbrella structures for S&T organizations in various cities, enabling better synergy while maintaining their autonomy.

Over the past three years, BCKIC has undertaken and supported a multitude of activities, ranging from fostering multi-institutional collaborative research to addressing some of the state's most pressing challenges, enhancing the innovation and patent landscape of academic organizations, to supporting technologies from Proof of Concept (PoC) to validation and real-world deployment, and driving socially impactful projects. Additionally, BCKIC has provided mechanisms for incubator support and, most importantly, has strengthened the connection between industry, academia, and government. BCKIC will continue its journey as a "connector and catalyst."

This special publication is an attempt to echo the vision of various enablers within this ecosystem. While it may not be exhaustive, we have made an effort to capture the essence of this vibrant ecosystem and the strategic roadmap envisioned by the country's thought leaders for aspiring to achieve a $300 billion bioeconomy by 2030. I am confident that you will find this publication valuable.

We plan to make this initiative ongoing, with future thematic issues focusing on emerging technologies aligned with the Sustainable Development Goals (SDGs), women in STEM, and the products, services, and enablers (industry, academia, policymakers, startups, NGOs, philanthropic organizations) that have contributed immensely to the growth of India's S&T landscape.

I would like to thank all our stakeholders, partners, and each member of the S&T Cluster family for their contributions in making this journey successful.

EDITOR

Dr. Aanchal Katoch

Scientific Communication Manager
BCKIC Foundation

Welcome to the inaugural issue of our magazine from the BCKIC Foundation, where we bring together perspectives from a diverse group of stakeholders.

In this edition, you will find insights from academic leaders on the importance of research and innovation, as well as perspectives from government councils on creating policies and programs that support sustainable growth. We also feature the voices of NGOs and NPOs, who stress the need for inclusive technologies that benefit everyone, especially marginalized communities. Industry experts share their thoughts on scaling innovations and boosting entrepreneurship, while our international partners offer valuable perspectives on global collaborations. This magazine includes thought-provoking questions and answers from these diverse leaders, providing a well-rounded view of the challenges and opportunities in various sectors.

By presenting these varied viewpoints, this magazine showcases the dynamic ecosystem of our cluster. Our goal is to foster a deeper understanding of how different sectors can work together to drive positive change and innovation in Odisha and all over India. We hope this collection of insights will inspire new ideas and partnerships, contributing to the growth and development of our community.

As the editor of this magazine, the process of bringing together these diverse voices has been an enriching learning experience, deepening my understanding of the intricate interplay between innovation, collaboration, and sustainable development across various sectors.

Office of the Principal Scientific Adviser to the Government of India

SCIENCE & TECHNOLOGY CLUSTER

Dr. Maini is a key figure in India's scientific landscape, serving as the Scientific Secretary at the Office of the Principal Scientific Advisor to the Government of India. With her expertise, she spearheads the expansion of the R&D ecosystem and formulates policies that drive progress in science, technology, and innovation.

Dr. Maini is committed to fostering collaboration among industry, academia, and government to develop solutions that benefit citizens across the nation. Her dedication to advancing science and technology makes her a pivotal leader in India's quest for scientific excellence.

Dr. (Mrs) Parvinder Maini

Scientific Secretary at the O/o PSA to the Govt. of India

Q What are the key recent advancements or initiatives in science and technology that you find most impactful?

A India has made major strides in the science and technology sector. Some examples include advancements in Quantum, DPIs, and the Space sector.

DPI: One of the recent technological transformations that India has brought in the domestic as well as international landscape is through **Digital Public Infrastructures (DPIs).** Since the launch of Digital India Mission in 2015, we have come a very long way in this transformative journey. The role of DPIs in India's international engagement is also remarkable as we witness the extended engagements and deployment of UPIs in partner countries such as the United Arab Emirates (UAE) and Singapore etc. as well. With the historic launch of UPI in Paris last month, we have also reached a major milestone in terms of international penetration of India's DPI expertise in the developed world.

Quantum Frontiers: India is taking major steps in terms of advancing the frontiers of Quantum Technology research and innovation. The launch of the National Quantum Mission (NQM) aims to accelerate research and development in quantum computing, communication and cryptography, Quantum materials, and Quantum sensing and leverage the scientific advancements in the field for the country's economic growth and national security. With the ongoing efforts in Quantum Frontiers, **India joins as the 6th country among the global leaders** in this space including the US, Austria, Finland, France, and China.

We need to ensure we have sustained efforts in terms of addressing critical human resources needed in this technological frontier to be globally competitive.

Space Sector: Another significant advancement that is having a far-reaching impact is in the space sector. The Indian space sector is seeing exponential growth with all the recent mission successes **(Chandrayaan-3, Aditya-L1, Gaganyaan, Mangalyaan-2, etc).** Leveraging the sector's growth and channeling it towards larger socio-economic progress is one of the country's key policy priorities. Opening the space sector holds several strategic, economic, and technological advantages. The Government of India has taken measures to incentivize and encourage the participation of private stakeholders at various stages of its

overall value chain. This is essentially to improve the space industrial sector and job growth, technological advancements through space R&D and to increase India's global competitiveness in this critical sector. Diversification and cost optimization of various space services including satellite communication, earth observations, etc are some of the direct benefits.

With the Liberalized Geospatial Data Policy and new space policy in place, we will be witnessing a holistic growth of this sector.

Deep Tech Innovations: There are also now focused initiatives to promote deep tech innovations and entrepreneurship in the country. Deep Tech innovations and startups play a critical role in transforming various sectors including health, energy, agriculture, etc. Deep Tech innovations establish a competitive advantage in frontier sectors and gain a strong position in the market value chain. Recognizing the potential, a **national deep tech startup policy (NDTSP)** is in the making with a focus on accelerating India's progress as a strong product-based, knowledge-driven economy. These efforts are an extensive culmination of India's ambitions through the **Startup India program launched in 2016. This has resulted in a strong entrepreneurial culture and robust startup ecosystem in the country with India positioned at the 3rd place globally with 1 lakh+ startups.**

Q What do you see as the main challenges and opportunities for the S&T community in India?

A Science and Technology is becoming essential for all aspects of socio-economic development. S&T taking center stage in all aspects of life, also comes with evolving challenges. As for India, what we see as challenges for the S&T ecosystem also present enormous opportunities.

Funding: In terms of funding for research and innovation, although our national gross expenditure on research and development (GERD) is constantly increasing in absolute volume, the ratio of **GERD to GDP as a comparable indicator is still significantly low, at 0.7%.** Recognizing this challenge, the Government of India has taken major steps to boost investments in S&T activities. The recent **announcement of ₹1 lakh crore corpus to help finance technology research** will catalyze growth, employment, and development in the country. Also, with the **Anushanthan National Research Foundation (ANRF)** coming into force this month, we will see exponential growth of opportunities in terms of STI funding.

Capacity Development: Another foundational building block for a robust S&T ecosystem is critical human capital. Attracting, training, and retaining quality human resources for various frontier areas of science and technology is essential. **One of the challenges we face in India is about ensuring state-of-the-art quality and skill sets** in various critical, essential as well as strategic sectors.

Reskilling is equally important as upskilling, as we witness fast-paced technological changes impacting the workforce

The success of almost all our national missions including that of the national semiconductor mission, green hydrogen mission, national quantum mission, etc **depends heavily on highly critical special human talent.**

Access: Given the large demography and diversity we host as a country, one of the challenges we face in the scientific enterprise is in terms of providing equitable access to scientific knowledge and infrastructure to all sectors of the scientific community. **The uneven concentration of research infrastructure**, as well as the **imbalance in terms of demand and supply of the knowledge and infrastructure resources** for pursuing science, technology development, and innovation-related activities, is certainly a challenge. However, with the help of carefully crafted initiatives such as **One Nation and One Subscription (ONOS) and the Indian Science, Technology and Engineering Facilities Map (I-STEM)**, we aim to address these challenges and ease the process significantly. With ONOS, we aim to not only provide access to scientific literature to a large share of the scientific community but also optimize the pricing model. Similarly, I-STEM is an initiative that provides information about various scientific and technological facilities across the country. I-STEM also enables any individual, with or without any institutional affiliation, to gain access to cutting-edge research infrastructure. However, having most of the institutes list their equipment is still a challenge. We must therefore ensure that the Sharing of resources to enable every researcher to have the benefit of using the facilities for their research needs to be encouraged.

Scaling up and ensuring the success of such initiatives is our common priority towards the scientific community.

Q What pivotal role do S&T Clusters in India play in fostering innovation, collaboration, & advancements in diverse fields?

A Under Prime Minister Narendra Modi's leadership, major milestones have been achieved in fostering innovation, collaboration, and entrepreneurship across various sectors through initiatives like Atal Innovation Mission, Startup India, Digital India, Make in India, and the Smart Cities Mission, along with the Office of the Principal Scientific Adviser's Manthan and the Science and Technology (S&T) Clusters.

The S&T Clusters stand out for their unique positioning in addressing local and global challenges by bringing together academia, industry, startups & government in a consortium mode to tackle challenges & capitalize on collective expertise for R&D. Spanning across **Bengaluru, Pune, Bhubaneswar, Delhi, Jodhpur, Hyderabad, the Northern Region,** and **Visakhapatnam**, these clusters are at the forefront of India's innovation landscape.

If I must delineate some major ways through which the clusters are fostering innovation and collaboration, these would be:

Fostering Industry-Academia Collaborations: Each cluster works towards creating a synergistic ecosystem by bringing together all stakeholders to leverage their respective strengths and foster an innovation-conducive environment. With this, clusters can ensure that research and innovation are aligned with market needs, helping in the rapid commercialization of innovations and enhancing the relevance of academic research.

Addressing Regional and Global Challenges: Each cluster, while harnessing local strengths, focuses on solving regional problems with the potential for national and global applications. This includes partnering with local incubators and connecting with state S&T councils and innovation societies.

Supporting Startups and Entrepreneurship: S&T clusters provide comprehensive support to startups and entrepreneurs, including prototyping, incubation support, and funding, helping to commercialize innovations. Focus is also on nurturing startups & entrepreneurs by providing access to research facilities, and mentorship. This support is crucial in translating research into market-ready products and driving economic growth.

Driving Social Innovation: Beyond technological advancements, the clusters engage in projects aimed at social innovation, addressing issues in public service delivery by introducing technology in conventional systems. These projects involve cross-sector collaboration, bringing together government, NGOs, and the private sector to work on solutions that have a direct impact on society.

Q How does the O/o PSA collaborate with stakeholders like research institutions, academia, industry, and clusters to drive innovation in India?

A The Office PSA's Manthan platform is a unique platform conceptualized to promote collaboration at scale between industry and scientific research and development ecosystems.

The platform has enabled public-private-academia collaboration to achieve sustainability goals, giving a thrust to innovation and work towards making India a global innovation hub.

THIS ENDEAVOR IS A TRUE ENABLER OF GOVT. OF INDIA'S DIGITAL INDIA

Manthan's model works on driving R&D collaboration involving foundations, philanthropic organizations, central line ministries, state governments, and foreign governments/embassies on the demand side and academic and research Institutes, startups, student innovators, and individual users, grassroots innovators, SMEs, S&T clusters on the supply side. It supports the facilitation of research and innovation, sharing challenges, and opportunities in emerging technologies and scientific interventions with a focus on social impact, **hence contributing to United Nations' Sustainable Development Goals (SDGs).**

Manthan stands out as a digital platform that not only connects but also **catalyzes collaboration between academia & research institutions.** Through **its digital interface, it offers an accessible, user-friendly space** where researchers and academics can showcase their projects, share insights, and discover each other's work. This digital meeting ground is vital for fostering initial connections in today's fast-paced world, enabling stakeholders to explore potential collaborations, discuss new ideas, and form partnerships without geographical constraints.

Manthan also facilitates workshops, seminars, and networking events that bring together researchers and academics in physical spaces to encourage deep, meaningful exchanges that can lead to long-term partnerships & groundbreaking research projects.

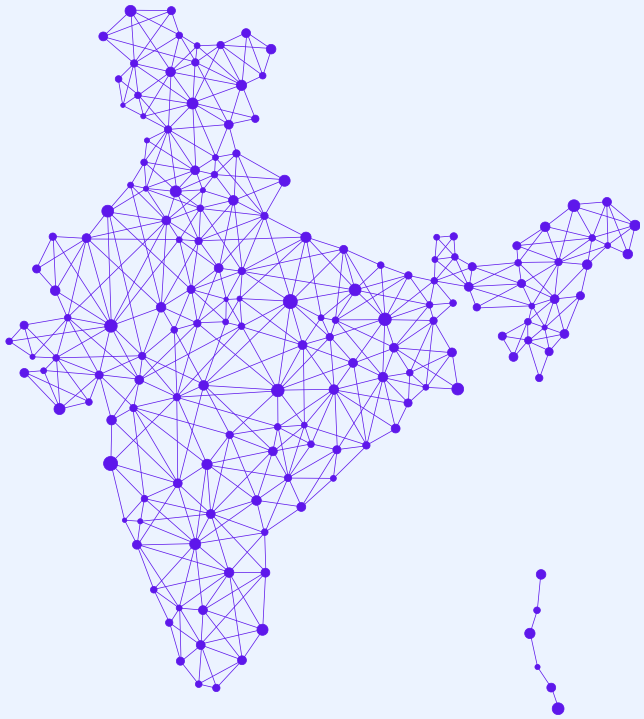
Manthan
Ideas and Implementation through Science Technologies and Innovations

Since the **LAUNCH OF THE I-STEM PORTAL IN INDIA,** researchers from academia and startups have significantly benefited. With access to government-funded community research equipment, the burden of procuring expensive instruments has been lifted from institutions and startups. Instead, they can now utilize the instruments available in i-STEM facilities at minimal costs.

I-STEM®
Linking Researchers and Resources

This initiative has not only reduced financial strain but has also democratized access to essential research tools.

It fosters an environment conducive to research, particularly among young minds in India, by making equipment more accessible.



To amplify research visibility and impact, it is our vision to strategically integrate Manthan and I-STEM portal to enable I-STEM technologies on this central platform, thereby further bridging the gap between R&D resources and potential collaborators.

Q What strategies should be implemented to increase research funding from both the government and private sector for scientific progress?

A The Government of India has launched a slew of initiatives to increase the involvement of the private sector in research funding for our country's holistic growth.

From introducing innovative funding mechanisms such as **Atal New India Challenges (ANIC) under the Atal Innovation Mission** which encourages startups and innovators to solve sectoral challenges of national importance and societal relevance to policy and budgetary announcements such as the recently enforced **ANUSANDHAN NATIONAL RESEARCH FOUNDATION ACT, reflecting government's commitment to foster scientific progress.**

Various Science ministries and departments and think tanks including DST, DBT, CSIR, ICMR, and NITI Aayog aimed at increasing government funding in research across various scientific and technological domains. These include **Atal Incubation Centers (AICs), Prime Minister's Research Fellowship, Impacting Research Innovation and Technology (IMPRINT), National Initiative for Developing and Harnessing Innovations (NIDHI), and DBT's BIRAC.**

The government is taking proactive steps to include industries and academia in active discussion by forming **private-government and academia-government hybrid committees** and listening to their challenges, opinions, and ideas to make them an integral part of India's growth and development trajectory. Private companies and philanthropic organizations are contributing to research funding in India. **Collaborations between industry and academia** are being encouraged to bridge the gap between research and its commercialization. There is also a push to **Corporate Social Responsibility (CSR) funds to be directed towards R&D in sectors like healthcare, energy, and technology, a step towards inclusive development.**

Q How do you envision the future initiatives and growth trajectory of the BCKIC Foundation in the broader landscape of S&T advancements in India?

A BCKIC Foundation has been meaningfully contributing to the S & T ecosystem of the country.

I have seen BCKIC Foundation consciously take up activities under selected S & T topics that are concurrent with the times and are aligned with the national priorities. In addition, true to its character as a cluster, BCKIC Foundation regularly engages with other S & T bodies in the state which include Government labs, local bodies, industries, and start-ups.

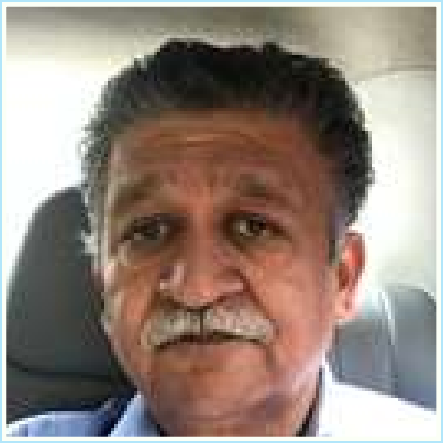
This is a good strategy as this not only helps BCKIC Foundation to be abreast with contemporary scientific issues but also enables the development of an ecosystem centered around national priorities. These efforts will eventually help BCKIC Foundation in its growth trajectory as a cluster and in times to come,

> "I envision BCKIC Foundation championing the cause of the common person by providing S&T based citizen-centric solutions through multi-stakeholder engagement."

-Dr. (Mrs) Parvinder Maini

Mr. Harkesh Mittal served as the Chairman of the Startup India Seed Fund Committee. His extensive experience includes his former role as an Adviser to the Ministry of Science & Technology, NSTEDB, DST, Government of India.

Mr. Mittal is renowned for his pivotal role in promoting technology entrepreneurship and innovation across India. He has been instrumental in conceptualizing and implementing numerous groundbreaking programs, significantly advancing the country's entrepreneurial ecosystem. His visionary leadership continues to inspire & foster a culture of innovation & technological advancement.



Mr. Harkesh Mittal

Ex-Chairman of the Startup India Seed Fund Committee

Q How do you perceive the current state of Science and Technology in India, and what are the pivotal areas that have witnessed significant growth and innovation?

A The current state of Science and Technology in India is marked by rapid advancements and notable achievements across various domains.

India has emerged as a **global leader in sectors like information technology, pharmaceuticals, and space research.** The country's emphasis on research and development, coupled with a growing pool of skilled professionals, has fueled innovation and contributed to its technological growth. **India's space program, particularly ISRO's achievements**, has also garnered global recognition. Additionally, **initiatives such as Digital India and Make in India** have further propelled the adoption and development of cutting-edge technologies like **artificial intelligence, biotechnology, and renewable energy.**

Q What drives the growth of Science and Technology startups in India, and how does it impact the country's technological landscape?

A The growth of Science and Technology startups in India is driven by several factors. The country's large and diverse market provides ample opportunities for startups to innovate and cater to specific needs.

Additionally, the availability of **venture capital funding, government support** through initiatives like **Startup India,** and a **conducive regulatory environment** have created a favorable ecosystem for startup growth. These startups are not only driving innovation but also creating employment opportunities and contributing to economic growth.

Their impact on the technological landscape is significant, as they bring new ideas & solutions that have the potential to transform industries & improve the quality of life for millions.

Q What are the key opportunities & challenges for the Science and Technology sector in India, and how does DPIIT envision its role in fostering growth?

A The Science and Technology sector in India is poised for exponential growth, with key opportunities lying in areas such as healthcare, agriculture, and renewable energy. However, challenges such as infrastructure bottlenecks, regulatory hurdles, and skill shortages need to be addressed.

DPIIT plays a crucial role in fostering growth by facilitating ease of doing business, promoting innovation and entrepreneurship, and providing support to startups through initiatives like the Startup India Seed Fund. By addressing these challenges and leveraging opportunities, DPIIT aims to create a vibrant ecosystem that encourages innovation and drives sustainable growth in the Science and Technology sector.

DPIIT envisions its role in fostering growth by facilitating a supportive ecosystem for startups

THROUGH

POLICY INTERVENTIONS

CAPACITY BUILDING

ACCESS TO MARKETS & FUNDING

Q How does the Startup India Seed Fund actively engage in mentorship and guidance to nurture the growth and development of startups beyond financial support?

A The Startup India Seed Fund actively engages in mentorship by providing startups with access to experienced mentors who can offer guidance and support. These mentors help startups navigate challenges, refine their business strategies, and make valuable connections in the industry. Additionally, the fund **PROVIDES WORKSHOPS, NETWORKING EVENTS, AND OTHER RESOURCES TO NURTURE THE GROWTH AND DEVELOPMENT OF STARTUPS.**

Q What advice would you give to aspiring entrepreneurs and founders and what qualities or elements do you believe make a startup stand out?

A ***My advice to aspiring entrepreneurs and founders is to focus on identifying a genuine problem or need in the market and developing a unique solution that addresses it.***

They should also prioritize **building a strong team** with complementary skills and a shared vision. Other qualities that make a startup stand out include

> “agility, adaptability, and a relentless focus on customer satisfaction.”

By staying true to their vision, being open to feedback, and continuously learning and evolving, startups can differentiate themselves and succeed in a competitive market.

Q Please share your perspective and strategies for BCKIC Foundation to achieve its vision and ensure its sustainable future.

A ***BCKIC Foundation can achieve its vision and ensure a sustainable future by adopting a multi-faceted approach.***

Firstly, it should continue to focus on building strong partnerships with key stakeholders, including government agencies, academic institutions, and industry partners, to leverage their expertise and resources. Secondly, investing in skill development and capacity-building programs can help create a talent pool that is equipped to drive innovation and research in key areas.

Promoting entrepreneurship and supporting startups through mentorship and funding can catalyze innovation and build a thriving ecosystem.

> “Finally, **embracing digital technologies and leveraging data analytics** can enhance the foundation's efficiency and impact, ensuring that it remains relevant and sustainable in the long term.”

-Mr. Harkesh Mittal

पृथ्वी विज्ञान मंत्रालय
Ministry of Earth Sciences
सत्यमेव जयते

Dr. (Mrs) Swati Basu is a prominent figure in the field of Earth Sciences, currently serving as an Advisor at the Ministry of Earth Sciences. With her expertise and guidance, she plays a pivotal role in shaping policies and initiatives that contribute to sustainable development in this crucial field.

Dr. Basu's work revolves around understanding and mitigating environmental challenges, ensuring that our planet's resources are managed efficiently. Her contributions to Earth Sciences make her a key leader in the journey towards a more sustainable future.

Dr. (Mrs) Swati Basu

Advisor at the Ministry of Earth Sciences

Q How does the integration of climate and environmental science with technology contribute to sustainable development in India?

A In the last decade, climate and environmental science has generated new knowledge about the scale and speed at which human societies are affecting the Earth.

Enhanced efforts to harness science and technology are crucial for taking bold and transformative steps to put India on a sustainable and resilient path.

Evidence-based approaches must be undertaken as research advances may identify new risks and opportunities. Partnerships across policymakers, scientific communities, and various sectors of society will be key in this regard.

For sustainable development, actionable, accessible, and authoritative science-based information would help India to undertake certain transformative steps.

To meet these challenges, it is essential to prioritize the following:

- **Enhancing preparedness** and reducing losses of life & property from hydrometeorological extremes.
- **Climate-smart decision** to build resilience & adaptation to climate risk.
- **Harnessing Technological advancements** in renewable energy sources, such as solar, wind, and hydroelectric power. This will reduce greenhouse gas emissions, and support the transition to a more sustainable, low-carbon energy system.
- **Optimal Utilisation of the insights regarding resource extraction and waste generation impacts.** Precision agriculture technologies to minimize water and fertilizer use, and circular economy technologies that enable recycling and reuse of materials, contribute to sustainable production and consumption patterns.

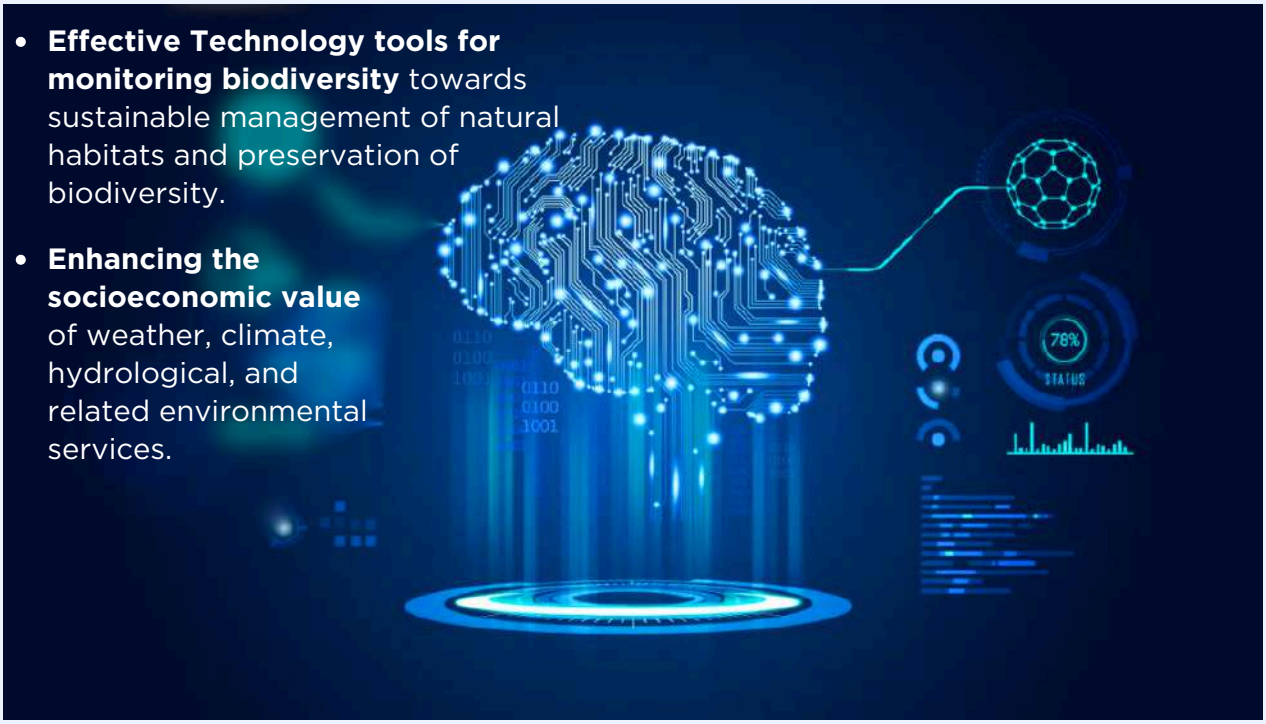
ARTIFICIAL INTELLIGENCE

along with

MACHINE LEARNING & DEEP LEARNING

tools has the potential to address these challenges and bring a paradigm change in making **"SMART AND INFORMED" DECISIONS.**

- **Effective Technology tools for monitoring biodiversity** towards sustainable management of natural habitats and preservation of biodiversity.
- **Enhancing the socioeconomic value** of weather, climate, hydrological, and related environmental services.



Q What are the key recent advancements or initiatives in science and technology that you find most impactful?

A ***Renewable Energy Technologies in the field of solar and wind energy and storage solutions, such as lithium-ion batteries and alternative storage technologies are crucial for reducing global dependence on fossil fuels and mitigating climate change.***

- **Genome Editing and Synthetic Biology** would allow specific modifications in the genome or create organisms with new traits/abilities. This technology has vast application potential, including treating genetic disorders, improving crop resilience, and combating infectious diseases. Proportional to the advancement in new technology, steps need to be undertaken to meet the emergence of biological risks.
- **Artificial Intelligence (AI) and Machine Learning** are transforming industries by enabling the analysis of massive datasets, improving decision-making processes, optimizing operations, and driving innovation. Applications range from healthcare diagnostics and personalized medicine to autonomous vehicles and smart cities, including smart power grid systems, improved weather and climate predictions, groundwater assessment, and smart agricultural practices.
- **Quantum Computing** is a significant leap forward to solving complex problems beyond the reach of traditional computers, such as drug discovery, climate modelling, and optimizing problems across various sectors.
- **5G networks** promise unprecedented data speeds and connectivity for billions of devices, enabling the Internet of Things (IoT) to flourish and paving the way for innovations in smart cities, telemedicine, augmented reality (AR), and virtual reality (VR).
- **Advancements in satellite technology** are expanding our understanding of the universe, improving global communication, navigation, and Earth observation capabilities for ensuring food security, biodiversity conservation, and improved land use practices.
- **Manned deep-sea exploration** with homemade world-class submersible **"Matsya 6000"** will be a path breaker for deep ocean exploitation.
- **Blockchain technology** is impacting various sectors by enabling secure, transparent communication and transactions.
- **Advances in biodegradable materials** for reducing waste and environmental pollution.
- **The National Green Hydrogen Mission** is expected to lead to significant decarbonization of the economy, reduce dependence on fossil fuel imports, and enable India to achieve technology and market leadership in the green hydrogen sector.

Q As a Scientific Consultant, what role do you see of Science and Technology clusters playing in addressing environmental challenges and promoting eco-friendly solutions?

A ***Science and Technology (S&T) clusters are pivotal in addressing environmental challenges and promoting eco-friendly solutions.***

These clusters have been established in various cities representing different geographical locations of the country. It provides a platform to bring on board, the National and state research laboratories, relevant ministries, academic institutions, industries, start-ups, entrepreneurs, and the local authorities to work together and

provide possible solutions to local problems with their collective effort and S&T interventions. **The clusters provide an excellent platform in fostering innovation and coll oration among existing institutions and deployment of sustainable technologies.** The solutions provided could be translated to regional and National levels.

Thus, the **S&T clusters by creating a vibrant ecosystem encourage collaboration and knowledge sharing among various stakeholders both at the National and International level.** This collaborative environment accelerates the development of innovative technologies and solutions to environmental challenges, such as renewable energy, waste management, sustainable agriculture, green mobility, effective education, governance, sustainable livelihoods, conservation of Biodiversity and so on.

By concentrating resources, expertise, and investment, S&T clusters facilitate the scaling up of sustainable technologies. They provide the infrastructure and support needed for start-ups and entrepreneurs to develop, test, and commercialize their innovations, making eco-friendly solutions more accessible and affordable.

The clusters are going to play a vital role in shaping India's scientific and technological landscape for future.

Q Given the rapid pace of technological change how do you envision the future of Scientific research & innovation in India?

A ***India's vision for the future of scientific research and innovation is shaped by its recognition of the rapid pace of technological advancement and its ambition to be a leading nation in science and technology globally.***

To fulfil this vision one needs to prioritize the following:

- **Strengthening Core Research and supporting high-impact research projects** that can contribute to major scientific advancements.
- **Focus on bridging the gap between research and industry**, ensuring that scientific discoveries and innovations are efficiently translated into technologies and products that can benefit society. This includes fostering a culture of innovation, entrepreneurship, and startups within the science and technology sector.
- **Emphasize the importance of interdisciplinary research and collaboration between various sectors and stakeholders including government, academia, and industry.** This would facilitate in tackling complex issues such as climate change, healthcare, and sustainable development more effectively.
- **Investing in education and skill development is central to India's vision.** This includes continuous review of science education, promoting STEM (Science, Technology, Engineering, and Mathematics), and creating opportunities for young scientists and researchers through fellowships, internships, and exchange programs.
- **Fostering collaboration at the National and International level.** This is imperative in facilitating knowledge exchange, access to cutting-edge technologies, and joint efforts to address global challenges.
- **Recognize the importance of engaging the public in science and technology,** promoting scientific literacy, and encouraging public participation in scientific discussions and policymaking.
- **Leveraging Space and Nuclear Technologies for civilian and defense purposes.** The technology needs for a large country like India range from space and nuclear to rural. India needs both industrial and rural development.

Q Considering your involvement in policy formulation, what initiatives are crucial for fostering a conducive environment for science and technology clusters to thrive and contribute to national goals?

A ***A conducive environment is necessary to encourage and foster innovation, interdisciplinary, and cross-sectoral/ institutional collaboration.***

Over the last decade, India has emphasized innovation as a growth strategy. Innovation (deep technology & grassroots technology) creates growth in society by addressing its diverse challenges. It is pertinent that emphasis should be laid not only on the number of innovators that are encouraged and nurtured but also on ensuring its impact is felt at the various levels of society.

Encouraging and facilitating collaboration among universities, research institutions, industry, and government agencies helping in knowledge transfer and innovation. Initiatives like conferences, workshops, Adjunct professorship of Industry personnel in universities/academic institutions, and joint research/PhD projects can foster networking and partnerships.

- **Target Funding and Investment including long-term funding.** This includes government grants, venture capital, corporate investment, and public-private partnerships.
- **Supportive policies and regulatory frameworks** that encourage the growth of Science and Technology clusters, protect intellectual property rights, and provide incentives for startups and SMEs (Small and Medium Enterprises) engaged in innovation.

- **Adequate physical infrastructure,** state-of-the-art laboratories, incubators, and tech parks are crucial. High-speed internet and reliable power supply are equally important.
- **Investing in education and training to develop a skilled workforce is fundamental.** This involves enhancing STEM (Science, Technology, Engineering, and Mathematics) education, supporting higher education and research institutions, and facilitating lifelong learning and re-skilling opportunities.

Offering incentives for R&D activities, such as grants for innovative projects, awards for breakthroughs, and support for patenting and commercialization, can stimulate creativity and innovation among the researchers.

Dr. Kinkini Dasgupta Misra previously served as a Senior Scientist at Vigyan Prasar, a prestigious science communication organization under the Government of India.

She is currently a Senior Scientist at the Indian National Science Academy (INSA), under the Department of Science and Technology (DST).

Dr. Kinkini Dasgupta Misra

Senior Scientist Indian National Science Academy (INSA)

Q How do you believe effective science communication can contribute to bridging the gap between scientific advancements & public understanding?

A ***Today, the landscape of science communication has expanded to encompass activities like sharing research findings, institutional outreach, and promoting public engagement with scientific developments.***

In recent years, communication around diseases like COVID-19, and a growing mistrust in science have made that gap even more apparent.

Public engagement with science creates connections between

SCIENTIFIC & NON-SCIENTIFIC COMMUNITIES & BRIDGES SCIENCE TO THE PEOPLE.

Science communication encompasses various facets, including scientific knowledge dissemination, facilitating discussions on ethical, societal, and cultural implications, and enhancing engagement between scientists and diverse audiences.

Science communication is important for bridging the gap between scientists, researchers, and the public, encouraging understanding, engagement, and appreciation for scientific explorations and advancements.

In an era where science and technology shape every aspect of our lives, effective communication of scientific research findings is more critical than ever. **Effective science communication is even more important not only to ensure that scientific knowledge is accessible to all, but also to empower individuals to make informed decisions, influence policymaking, and improve trust in the scientific community.**

Effective science communication requires

CLARITY, CREATIVITY, AND ENGAGEMENT STRATEGIES

tailored to diverse audiences. With clear language and compelling storytelling, science communicators can effectively bring science to the people, thereby **enhancing public awareness and understanding of the profound impact of science on society.**

Bringing science to the people is making scientific knowledge accessible and relevant to individuals in society. It involves breaking down the perceived barriers between scientific experts and the public, ensuring that the benefits of scientific research and development are not confined to academic circles but are shared widely for the betterment of society.

Further taking science to the people requires a deep understanding of the cultural, social, and linguistic contexts in which information is received.

Tailoring messages to cater to different communities and addressing their specific concerns and interests enhances greater acceptance and engagement.

To reach targeted audiences, scientists and science communicators must employ various channels and mediums, including print, digital, electronic, and social media. Beyond dissemination, bridging the gap in increasing public understanding requires two-way dialogue and collaboration between scientists and the public.

By inviting questions, feedback, and participation, individuals are empowered to actively engage with scientific concepts, contributing to a more informed and scientifically literate society and helping in building a more inclusive and empowered society where everyone can benefit from and contribute to scientific progress.

Q What are some of the major challenges you've encountered in science communication?

A *We have seen how the public interest in science communication increased during the pandemic.* ***The COVID-19 pandemic made it clear how crucial it is to communicate science to the public*** *to increase knowledge about health issues and ways to avoid contracting the disease. People learned about public health measures, vaccinations, virology, and the mechanisms of action of new vaccines through scientific communication. People have become more interested in understanding the science behind the virus, how it spreads, and the development of vaccines and treatments.*

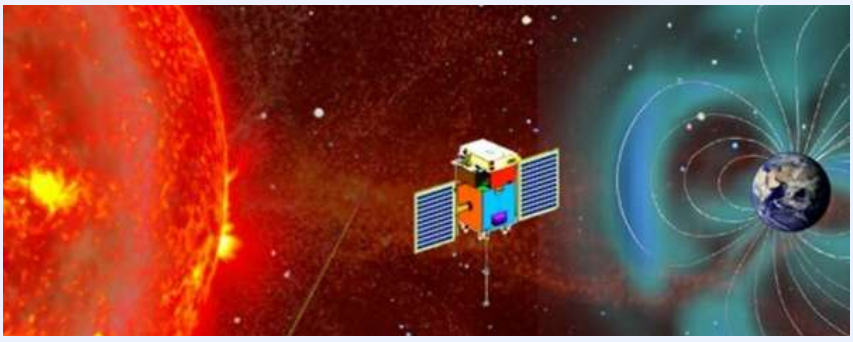
Similarly, the successful launches of **Chandrayan and Aditya L1 Missions** and scientific discoveries related to these missions have sparked curiosity among the public about space exploration, and technology, leading to increased efforts in science communication to cater to this interest.

Overall, both the Chandrayaan missions and the COVID-19 pandemic have contributed to a greater appreciation for science and technology in India. It also **created opportunities for**

SCIENTISTS, HEALTHCARE PROFESSIONALS, AND SCIENCE COMMUNICATORS

to engage with the public through **various platforms,** including

SOCIAL MEDIA, PRINT MEDIA, AND PUBLIC HEALTH CAMPAIGNS.



Scientists and science communicators face various challenges in communicating and translating scientific knowledge to larger audiences.

Communicating complex scientific concepts to a layperson audience can be challenging, but it's essential for ensuring widespread understanding and engagement with important issues.

Science Communicators help in breaking down of complex information into lucid and accessible language without oversimplifying or distorting the facts.

Most of the scientific knowledge is available and communicated in English making communicating science can be difficult while trying to reach audiences from diverse cultural and linguistic backgrounds.

Differences in language, cultural context, and educational background can impact the effectiveness of communication strategies. Science communication must be inclusive of diverse cultural and linguistic backgrounds to effectively reach a larger audience. This inclusivity can be achieved by repurposing scientific content and translating it into regional and local languages, while also considering the unique socio-cultural contexts in India. By contextualizing content in ways that resonate with different communities' values, beliefs, and everyday experiences, science communicators can enhance understanding, acceptance, and engagement with scientific knowledge. By tailoring messages to fit the cultural, social, and linguistic context of the audience, science communicators can ensure that scientific concepts are not only understood but also valued by diverse communities.

This approach helps to cultivate a scientific temper within society, making science not only more accessible but also more meaningful to people from all walks of life.

Effective science communication is crucial in combatting misinformation, particularly in the age of digital and social media where misinformation and disinformation are extensive. **The rise of social media and online platforms has facilitated the rapid spread of misinformation and pseudoscience.** **Misinformation and mistrust** in science can stem from various sources, including ideological biases, cultural beliefs, and deliberate misinformation campaigns. We have seen how the misleading content created confusion and anxiety during the pandemic emphasizing the urgent need for accurate scientific information to control the virus's spread. Combating digital misinformation requires proactive efforts to promote credible sources, fact-checking, and scientific literacy.

The issues of Climate change, vaccine safety, food insecurity, and other health issues, have long been troubled by misinformation. With the plethora of information available on social media, it becomes at times a challenge with communicators to ensure that scientific information is presented responsibly with credibility and accuracy, & addressing these misconceptions requires patience, empathy, and targeted strategies to rebuild trust. Establishing trust with the public is more important than the mere dissemination of facts & data.

Science communication can be affected by media coverage, which may prioritize sensationalism or controversy over accuracy and nuance.

Communicators must navigate these to ensure that evidence-based scientific information is presented & communicated.

Communicating scientific research responsibly requires ethical considerations, such as ensuring informed consent, protecting sensitive information, and avoiding fear-mongering tactics.

Another challenge often faced by science communicators is the **balancing of timeliness in delivering accurate scientific information.**

In the fast-paced world, communicators may feel pressure to deliver information on time and quickly, sometimes at the expense of thorough research and verification. One significant challenge for science communicators is the **lack of trust in scientists and science.**

Therefore, the primary goal of science communication is to build awareness and understanding among the public. This requires establishing **trust and ensuring accuracy, clarity, & accessibility** in scientific messaging. Addressing these challenges requires collaboration among scientists, communicators, policymakers, & the public to promote a culture of scientific literacy, critical thinking, and evidence-based decision-making.

Engaging meaningful dialogue between scientists, communicators, and the audience with consistent & transparent communication, coupled with active listening to public concerns and feedback, can contribute to building a more informed and inclusive society. **This can be achieved by utilizing engaging formats such as visuals, multimedia, podcasts, and interactive platforms that can enhance audience engagement and comprehension.**

Q **What innovative approaches or strategies do you think science and technology clusters can adopt to enhance public engagement and awareness about their initiatives?**

A *One of the key objectives of science & technology clusters is to realize the vision of*

ATMANIRBHAR
BHARAT

By nurturing innovation, entrepreneurship, & technological advancement, these clusters contribute to building India's capacity to meet its own needs and become a global leader in science and technology.

Science and technology clusters can adopt several innovative approaches to enhance public engagement and awareness about their initiatives. Citizens are increasingly involved in shaping decisions regarding science and technology through various means such as **community-based research and participatory initiatives**. This evolving trend is notably influencing government policies and funding in the realm of science and technology.

A multitude of programs and endeavors have emerged to facilitate collaborative research ventures and initiatives involving citizen groups, academic institutions, and governmental bodies. **The profound societal implications of scientific and technological advancements stress the importance of engaging citizens in decision-making processes.**

Moreover, the landscape of scientific research and policymaking has experienced significant transformations over the past 75 years, presenting challenges for policymakers striving to keep pace with the rapid evolution of new technologies and their societal impacts.

Some of the innovative approaches that can be considered by S&T Clusters to enhance public engagement & awareness about their initiatives could be engaging the public more in citizen science initiatives where individuals can contribute to scientific research and data collection. These programs encourage a sense of ownership and engagement in the scientific process of the S&T clusters by enabling individuals to actively engage in the scientific process.

Involving the Community in Partnerships and Outreach to deliver science and technology cluster programs and outreach activities.

These partnerships ensure that initiatives are accessible and relevant to diverse communities, fostering inclusivity and equity in STEM research and engagement.

Engaging with local communities to increase awareness and support for the science and technology clusters could include **organizing community events, volunteering in schools, and participating in public outreach activities** to foster a culture of innovation and entrepreneurship and drive societal impact.

Creating interactive exhibits and creative corners within the clusters where the public can engage with cutting-edge technologies, conduct hands-on experiments, and participate in workshops. These spaces serve as hubs for creativity, innovation, and learning. Organizing regular scientific dialogues and public lectures and consultations featuring scientists, engineers, and innovators discussing their work in clear and engaging ways would also create awareness of the S&T Cluster initiatives.

These events provide opportunities for the public to interact with experts, ask questions, and learn about recent developments in science and technology.

Developing interactive Apps and digital platforms that allow the public to explore science and technology facilities, laboratories, and research projects remotely.

The virtual tours also can be exposed to the public, provide access to S&T Clusters programs and activities and foster curiosity and interest in STEM subjects. These digital tools make learning fun, engaging, and accessible to people of all ages, encouraging a culture of sustained learning.

Similarly, **hackathons and innovation challenges** can be organized that bring together scientists, technologists, entrepreneurs, and the public to collaborate on solving real-world problems. These events promote creativity, collaboration, and interdisciplinary learning.

Providing Science Communication Training to scientists and researchers

would also enhance their communication skills like storytelling workshops, and media engagement to effectively convey complex scientific concepts to diverse audiences.

Creating compelling storytelling and multimedia content, such as videos, podcasts, and documentaries, that highlight the impact and significance of science and technology initiatives. These stories humanize scientific research, enabling the general people to relate to and be inspired by it.

Q What role do you think public understanding plays in the growth and development of science and technology clusters?

A ***Public understanding plays a crucial role in the growth and development of science and technology clusters.***

These clusters, comprised of **research institutions, universities, industry, and other organizations,** thrive on **collaboration, innovation**, and **support** from the broader community.

Public understanding can influence government funding decisions for research and development.

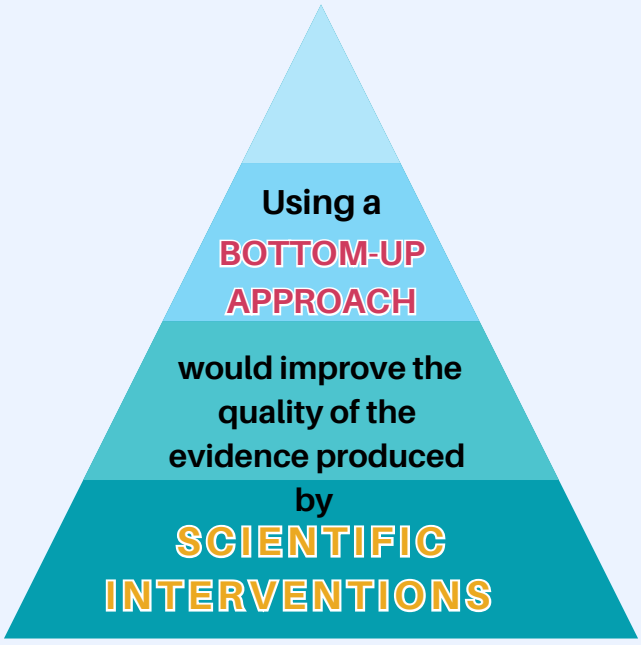
When the public is aware of the importance of scientific & technological advancements, they are more likely to support funding initiatives that foster innovation within clusters. This financial support enables the clusters to undertake ambitious projects, attract more talent, and invest in infrastructure. **Further, public engagement with science and technology fosters a culture of innovation within communities.** When people understand the potential benefits of scientific research and technological advancements, they are more likely to embrace new ideas, take risks, and pursue entrepreneurial endeavors. This cultural support is vital for the growth of science and technology clusters, as it encourages collaboration and the exchange of ideas among researchers, entrepreneurs, and investors.

A well-informed public recognizes the exciting opportunities within clusters.

This awareness attracts talent – researchers, entrepreneurs, and investors – boosting the intellectual capital that drives innovation and economic growth.

Strong Public understanding promotes collaboration among various stakeholders within science and technology clusters. When people understand strongly the critical role of scientific research and technological innovation, they are more likely to support initiatives that promote collaboration between academia, industry, and government. This collaboration enhances the exchange of knowledge, resources, and expertise, leading to breakthrough discoveries and the development of cutting-edge technologies.

Societal Challenges can be effectively addressed with increased public understanding of science and technology. The local community can be engaged in informed discussions and decision-making processes regarding issues such as climate change, healthcare, and better agricultural practices, for effective deployment of technological solutions.



Right from the community level to knowledge organizations, and implementing agencies, and going upwards toward the broader objectives of the programs would help in gathering data and insights from the ground level to inform the decision-making process and provide evidence to support program goals and outcomes.

A recent program carried out by DST helped us understand the effectiveness of bottom-up approaches in the absorption capacity of technologies and their solutions by the community. The analysis of the program revealed that testimony of the empowerment of science and technology in the community depends on various factors like context, local knowledge, local innovation, the availability and access to resources and support, and the level of community participation and ownership. Engaging the people from the grassroots level and their participation in the design of the projects and programs would help not only in better alignment of the S&T interventions with the community's needs and priorities. but also, in strengthening the science and technology-based livelihood generation achieving the goal of **Atmanirbhar Bharat.**

CULTURE OF INNOVATION

Therefore, by nurturing an innovation culture, attracting talent, facilitating collaboration, and addressing societal challenges, an increase in public engagement contributes significantly to the success and impact of these clusters on both **LOCAL & GLOBAL SCALES.**

Q How can science communication play a role in fostering collaboration and knowledge exchange among different stakeholders within a S&T cluster?

A Science communication is pivotal in fostering collaboration and knowledge exchange among different stakeholders within a science and technology (S&T) cluster.

Effective communication bridges the gap between experts and non-experts, facilitates understanding and encourages collaboration.

Science Communication can facilitate **Collaboration** & **Knowledge Exchange** within an **S&T Cluster**

by breaking down complex concepts and disseminating the scientific advancements in the local languages, building relationships, facilitating networking, promoting interdisciplinary collaboration, sharing best practices and lessons learned from the ground and cross-collaboration within S&T Clusters.

By making scientific knowledge understandable to diverse stakeholders, including

Policymakers, Investors, & the Public,

science communication enables everyone to participate in discussions and contribute ideas within the cluster. Effective science communication helps in building relationships among stakeholders within the S&T cluster, by sharing information, insights, and experiences clearly and engagingly. It can promote trust and rapport among researchers, entrepreneurs, policymakers, and other key players. These relationships form the foundation for collaboration and knowledge exchange.

Opportunities for networking and collaboration within the S&T cluster can be strengthened through conferences, seminars, workshops, and other events, stakeholders can exchange ideas, form partnerships, and identify areas for collaboration. **Communication platforms also enable stakeholders to connect virtually, expanding the reach of the cluster beyond geographical boundaries.**

Science communication encourages cross-collaboration within the S&T cluster. By highlighting the intersections between different fields of study & the potential for cross-disciplinary innovation, communication encourages researchers from diverse backgrounds to collaborate on projects and share expertise.

This interdisciplinary approach fosters Creativity & Accelerates Scientific Breakthrough.

Science communication facilitates knowledge sharing and the sharing of best practices and lessons learned within the S&T cluster as well as from the ground. Through case studies, success stories, and failure analyses, stakeholders can learn from each other's experiences and apply insights to their work, and it can enhance the overall effectiveness and efficiency of the cluster.

Engaging Stakeholders in decision-making processes within the S&T cluster by providing relevant information and fostering open dialogue, science communication enables stakeholders to participate in setting priorities, allocating resources, and shaping the direction of research and innovation initiatives.

THIS INCLUSIVE APPROACH

ensures that decisions reflect the needs and perspectives of all stakeholders and contribute to the cluster in advancing scientific research, innovation, and economic development.

-Dr. Kinkini Dasgupta Misra

HUWEL
LIFE SCIENCES
thriving with science

Dr. Shesheer Kumar is the Director of HUWEL Lifesciences Pvt. Ltd. and SirfBio Pvt. Ltd. where he drives innovation and advancement in the field of life sciences. With a keen focus on research and development, Dr. Kumar spearheads initiatives that aim to improve healthcare and quality of life.

Under his leadership, both organizations have made significant strides in developing cutting-edge solutions and products. Dr. Kumar's expertise and vision continue to shape the future of life sciences, making him a respected figure in the industry.

Dr. Shesheer Kumar
Director of HUWEL Lifesciences Pvt. Ltd. and SirfBio Pvt. Ltd.

1

How do you perceive the role of Science and Technology in driving advancements in the life sciences sector in India?

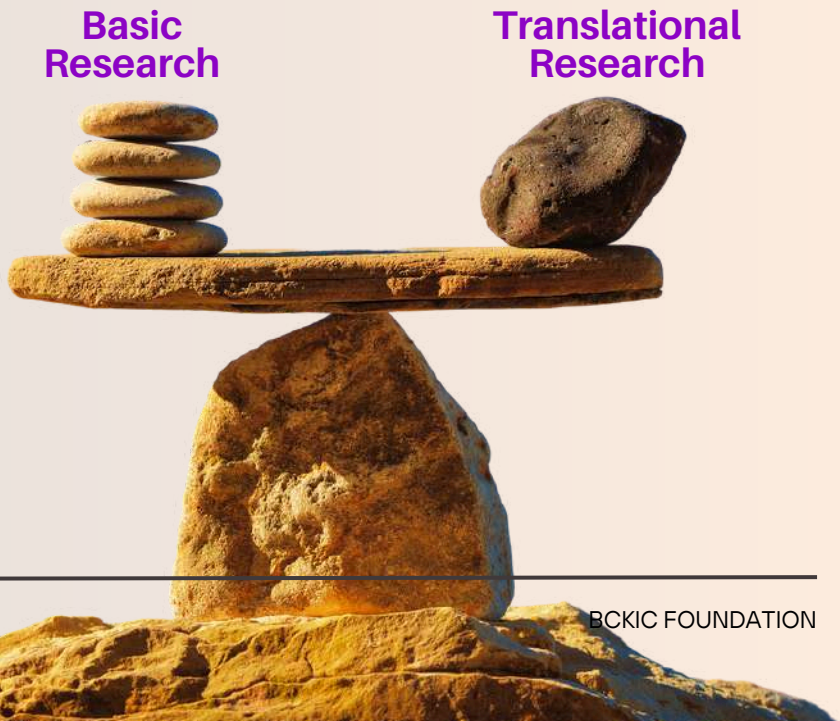
This seems to be a **golden period for life sciences startups,** lots of **import substitution and innovation** have been agenda of the many companies owing to Atmanirbhar Bharath. Science and Technology solutions where India was lagging have

COME TO THE FOREFRONT NOW.

2

How do you plan to bridge the gap between industry & academic research for innovation in the life sciences sector, both nationally and internationally?

There is a traditional research mindset still in Indian academic institutions. There should be a separate scientific pool recruited for translational research or tech transfer. **There should be a balance between basic research and translational research.** Internationally many of the institutions are working with industries, and we in India need this work culture more.



3

How does your company balance growth with sustainable and responsible practices, especially considering ethical and healthcare challenges?

We develop and manufacture end-to-end components for the IVD Industry, We sell components to various manufacturers and use them in manufacturing of various kits and devices.

4

How have industries, particularly in life sciences, responded and evolved during the COVID-19 pandemic?

Indian industries responded very well to the COVID pandemic with vaccines, diagnostic kits, drugs, and other accessories like gloves, masks, etc. Unlike the Vaccine industry, other industries were not prepared for big volumes but within no time many industries have ramped up their production capacities to cater not only to Indian markets but also to other countries for the lowest pricing.

5

What areas of the life sciences sector show the most promise for growth and innovation in India, and how do your companies contribute to these advancements?

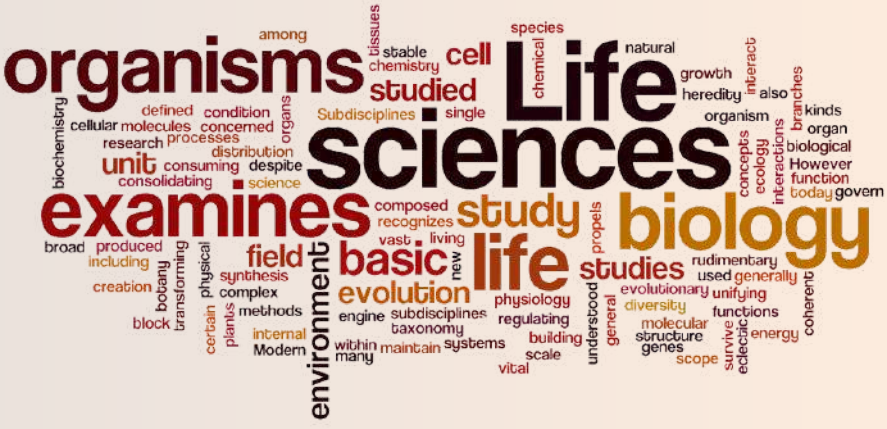
Medical Devices and IVD are very promising apart from cell and gene therapy and mRNA vaccines. We at Huwel develop novel POCT devices and IVD kits for infections, genetic diseases, and cancers.

6

What keeps your passion alive for pushing the boundaries of science, technology, and healthcare, and what legacy do you aim to leave within the S&T Cluster?

We at Huwel will continue to develop & manufacture various IVD reagents and devices. The complete indigenization helped us to get down the COVID pricing from Rs 1200 per test to Rs 16 per test. We would like to

BUILD AN INNOVATIVE LIFE SCIENCES COMPANY.



Mr. Prasanta Biswal is at the forefront of JSW Group's endeavors in Odisha, serving as the Head of Corporate Social Responsibility (CSR) and Corporate Relations. His role involves managing the company's social and environmental initiatives, ensuring they align with the group's values and contribute positively to society.

With a focus on sustainable development, Mr. Biswal's leadership has been instrumental in driving impactful projects that benefit communities and the environment. His work underscores JSW Group's commitment to responsible corporate citizenship and sustainable practices in Odisha.

Mr. Prasanta Biswal
Head CSR & Corporate Relations at JSW Group Odisha

1

Could you share JSW Group's initiatives promoting sustainable development in Odisha, particularly in science & technology?

JSW group implements community development and sustainable development programs through its CSR arm JSW Foundation. A number of these programs are either based on technological interventions or are actively using technology to deliver social goods.

For example, JSW Foundation has introduced

DIGITAL HEALTH DIAGNOSTICS

across its rural dispensaries, the foundation has installed

WATERBODY REJUVENATION SYSTEMS

in community ponds using both pro-biotics as well as **IOT-BASED DEVICES**

As part of its drinking water access program, JSW Foundation has installed almost

40 SOLAR-POWERED BOREWELLS

that have eliminated the need for transporting water through diesel-run tankers daily. JSW has so far installed over

800 SOLAR STREETLIGHTS

across its direct impact zone in Odisha.
To promote livelihood and agriculture production in Odisha, JSW Foundation has partnered with multiple organizations and is ensuring adoption of technology wherever required to enhance productivity.

2

How does JSW collaborate with local S&T clusters to address community challenges in Odisha?

With the help of the BCKIC Foundation, JSW has been conducting a

HYDROGEOLOGICAL STUDY IN COASTAL ODISHA

This collaboration has also helped JSW Foundation to identify technology solutions developed by **various startups and has been able to deploy** the same in parts of Odisha.

3

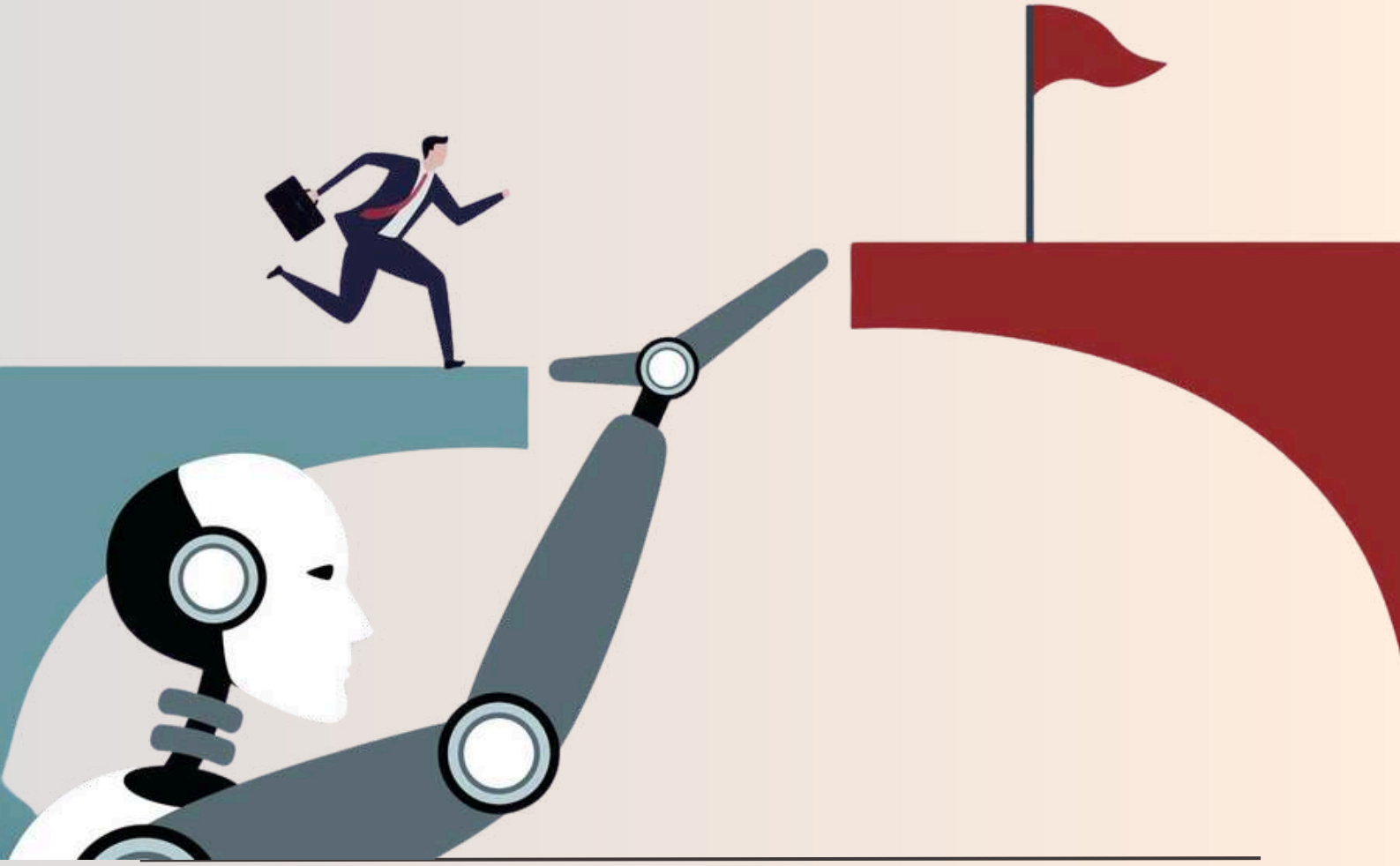
What challenges do you see in fostering S&T advancements in India, and how can collaborations address these challenges?

A platform to identify and match deployable technologies for social good is something that's not yet mature in India.

While on one side, there are a bunch of good technologies being developed by Indian Startups and SMEs, there are tons of socio-technological challenges across the country. However, they fail to meet each other. Besides, missing maintenance ecosystem also leads to lowering the confidence of corporates or CSR organizations in new technology solutions.

Collaborative efforts

can plug this gap to a large extent and make deployable technologies available with a maintenance ecosystem.



Dr. Girija Bharat is the Managing Director at Mu Gamma Consultants Pvt. Ltd., a renowned organization dedicated to fostering green development in India. With a multifaceted approach, Dr. Bharat's work spans various critical areas including Water Resource Management, Water Supply and Sanitation, Chemical and Plastic Pollution, Climate Action, and Environmental Management.

Mu Gamma Consultants' initiatives are instrumental in driving sustainable practices and environmental conservation across the nation. Dr. Bharat's leadership and expertise are pivotal in advancing India's green development agenda, making significant strides towards a cleaner, greener future.

Dr. Girija Bharat

Managing Director at
Mu Gamma Consultants Pvt. Ltd.

Q Could you share examples of successful projects or initiatives undertaken by Mu Gamma Consultants Pvt Ltd. that have positively impacted sustainable development?

A Mu Gamma Consultants (MGC) has spearheaded numerous impactful projects in the realm of sustainable development, showcasing a commitment to fostering positive change.

One notable endeavor is the

India-Norway Cooperation Project **on reducing plastic and chemical pollution in India** and generating coherent data for science-informed policy recommendations. MGC has also spearheaded a project titled:

Endocrine Disrupting Chemicals (EDCs) in several food items and drinking water (in India) and developed policy recommendations for the Ministry of Health and Family Welfare, Government of India.

Another significant contribution by MGC has been shaping India's **National Policy Framework on Safe Reuse of Treated Wastewater** a pivotal initiative geared towards promoting used water reuse practices, thereby conserving freshwater resources. **The actionable hand hygiene roadmap for Odisha and the sanitation roadmap for Leh City** exemplify MGC's expertise in the sanitation and hygiene sector, tailored to the unique needs of local communities.

MGC has demonstrated **adaptability** and **innovation** in response to emerging challenges, such as the COVID-19 pandemic. The project on **monitoring community wastewater for early detection of SARS-CoV-2** in Chennai underscores MGC's expertise in wastewater-based epidemiology (WBE) and the proactive approach to public health and crisis management.

Through initiatives like case studies under the **Climate Resilient City Action Plan** several cities in India and Bangladesh, MGC has consistently championed climate action and environmental stewardship. **MGC with the Norwegian Institute for Water Research (NIVA)** has hosted the **International Knowledge Hub against Plastic Pollution (IKHAPP).** All these projects implemented by MGC foster sustainable development practices that resonate globally.

Q What strategies do you suggest for monitoring and reducing the impact of POPs on the environment and human health?

A MGC advocates a comprehensive approach to monitor and mitigate the impact of Persistent Organic Pollutants (POPs) on both the environment and human health.

MGC conducts **systematic monitoring programs** to meticulously track the exposure of different categories of POPs such as polybrominated diphenyl ethers (PBDEs), Polychlorinated biphenyls (PCBs), and several organochlorine pesticides (OCPs) in different matrices such as water, soil, sediments, air, and biota. **This data-driven approach enables informed decision-making and targeted interventions to reduce exposure of POPs on human health.** MGC disseminates the findings of these research studies **through peer-reviewed journal articles, and policy briefs**.

MGC also conducts **biomonitoring programs**, particularly targeting occupationally exposed

groups such as **workers handling municipal waste, e-waste, and industries where hazardous chemicals are involved**. These programs help in the identification of vulnerable communities and their training needs.

MGC works towards **supporting global plastic treaties and Conventions such as the Basel, Rotterdam, Stockholm, and Minamata Conventions**. By fulfilling obligations under relevant conventions and regulations, MGC co-creates action plans and guidance documents for reducing POP emissions and promoting management practices.

MGC conducts **capacity building** and **awareness generation** events **on dietary and other routes of exposure of POPs and minimizing their release into the environment**. This empowers communities to adopt more environmentally responsible behaviors. This also equips practitioners to take prospective action towards environmental sustainability.

Q What are the key challenges Mu Gamma Consultants face in promoting sustainable development in India, and how are these challenges tackled?

A India's vision for the future of scientific research and innovation is shaped by its recognition of the rapid pace of technological advancement and its ambition to be a leading nation in science and technology globally.

Policy implementation hurdles:
Despite the robust policies in India, inadequate enforcement mechanisms and inefficiencies often hinder their successful execution. To address this, MGC engages in advocacy efforts, collaborating with government agencies and stakeholders to streamline policy implementation processes. MGC also prepares action plans and guidance notes to assist government agencies in implementing these policies.

Resource constraints:
Limited financial resources and infrastructure pose significant challenges to sustainable development initiatives. MGC addresses this by leveraging innovative financing mechanisms such as public-private partnerships and seeking funding from international donors and development agencies. We also prioritize resource optimization and efficiency in project implementation, maximizing impact of available resources.

Stakeholder engagement & awareness:
Engaging diverse stakeholders and fostering widespread awareness of sustainable development principles are essential but challenging task. MGC employs participatory approaches, conducting stakeholder consultations, and fostering partnerships with local communities, civil society organizations, and businesses. Through targeted outreach campaigns, workshops, and educational programs, we raise awareness about the importance of sustainable practices and mobilize support for development initiatives.

Institutional and cultural barriers:
Institutional inertia and cultural norms that prioritize **short-term gains over long-term sustainability present formidable obstacles to sustainable development efforts**. MGC addresses these challenges by **advocating for institutional reforms that incentivize sustainability and align development interventions with local cultural contexts**.

By adopting a multifaceted approach that combines **advocacy, capacity building, innovative financing, stakeholder engagement, and cultural sensitivity** MGC navigates the complex landscape of sustainable development challenges in India, paving the way for transformative change and lasting impact.

Q What role do public-private partnerships play in promoting sustainable social and economic development in India?

A Public-private partnerships (PPPs) serve as vital mechanisms for promoting sustainable social and economic development in India by harnessing the synergies of both sectors.

These partnerships facilitate the mobilization of finance, resources, technological expertise, and professional skills necessary for the effective implementation of policies and programs aimed at sustainable development.

PPPs have played a pivotal role in various facets of India's development journey:

Infrastructure Development: PPPs have been instrumental in delivering critical infrastructure projects such as the Mumbai-Pune Expressway, Delhi Airport, and Delhi Metro. These projects have not only enhanced connectivity but also reduced travel time and stimulated economic growth in the regions they serve.

Urban Development: PPPs are integral to initiatives like the Smart Cities Mission, attracting private investment to address urban challenges such as mobility, waste management, and e-governance. This fosters sustainable urban growth and enhances the quality of life for urban residents.

Renewable Energy: PPPs have facilitated the development of renewable energy projects such as wind farms and solar power plants. These initiatives contribute to mitigating climate change, creating employment opportunities, and providing clean energy to communities.

Water and Sanitation: PPPs have proven successful in improving water supply and sanitation infrastructure, ensuring communities have access to safe drinking water and proper sanitation facilities. This contributes to public health improvement and environmental sustainability.

Moreover, PPPs empower individuals economically by generating employment opportunities, fostering skill development, and enabling sustainable livelihoods, thereby, contributing to poverty reduction and inclusive growth.

By fostering collaborations between the public and private sectors through PPPs, India can effectively address complex societal challenges, mobilize resources efficiently, and work towards a more equitable and sustainable future for all stakeholders involved.

-Dr. Girija Bharat

Q How do you envision the role of Indian S&T clusters in advancing sustainable development, including water resource and sanitation policies?

A ***The Indian Science and Technology (S&T) clusters are pivotal in advancing sustainable development, particularly in shaping water resource, sanitation, and waste management policies.***

These clusters, encompass research institutions, universities, industries, and government bodies, and serve as hubs of innovation and knowledge creation, driving progress in various sectors.

Through interdisciplinary collaboration and cutting-edge technologies, **these clusters contribute to the development of innovative solutions for water conservation, purification, and wastewater treatment, and safe reuse**.

These **S&T clusters also serve as platforms for fostering collaboration and knowledge exchange among stakeholders** involved in water resource, sanitation, and waste management sectors. These clusters promote the co-creation of solutions that are scientifically sound, economically viable, and socially inclusive and scalable. This collaborative approach enhances the effectiveness and efficiency of policy implementation, ensuring that interventions are tailored to local contexts.

Moreover, **S&T clusters play a critical role in capacity building and skill development** in these sectors. Through education, training programs, and technology transfer initiatives, these clusters empower professionals and practitioners with the knowledge and tools needed to implement sustainable practices and policies. By nurturing a skilled workforce, S&T clusters contribute to the long-term sustainability and resilience of water resource and sanitation systems.

In essence, Indian S&T clusters serve as catalysts for innovation, collaboration, and capacity building in advancing sustainable development, including the formulation and implementation of water resource and sanitation policies.

Through their multifaceted contributions, these clusters play a transformative role in addressing pressing societal challenges and promoting the well-being of present and future generations.

PROUD TO SUPPORT GREAT BRITAIN & NORTHERN IRELAND

Ms. Sarah Fallon is the Regional Director for India & the Middle East at the British High Commission, overseeing Science, Innovation, and Technology initiatives. With a focus on fostering collaborations and advancing technological advancements, Ms. Fallon plays a pivotal role in strengthening ties between the UK and these regions.

Her leadership and strategic vision have been instrumental in promoting scientific cooperation and driving innovation across borders. Ms. Fallon's work exemplifies a commitment to leveraging science and technology for a positive global impact.

Ms. Sarah Fallon
Regional Director for India and the Middle East at the British High Commission

Q How does the British High Commission support initiatives relate to sustainable development in India?

A ***The UK and India are uniquely placed to harness together the power of science and tech in achieving sustainable development goals.***

By matching the UK's research and science experts base with India's remarkable manufacturing expertise, we've helped our people – and the world. With over one billion doses produced, the

Covishield success story (Oxford-AstraZeneca-Serum)
is one for the ages.

We're taking this partnership further – mitigating future pandemics – through work on **ANTIMICROBIAL RESISTANCE ("SUPERBUGS")** and zoonotic, the groundbreaking **MALARIA VACCINE** authorized by WHO in October 2023 and an **EBOLA VACCINE** developed and contributed to a WHO clinical trial at pace in August 2023. In 2021, the first UK-India clinical trial was set up, as an arm of the UK's RECOVERY trial to test the efficacy of Covid drugs in South Asian patients.

OUR NEWTON FUND WORK

another source of great pride. **The UK Met Office partnered with the**

INDIAN MINISTRY OF EARTH SCIENCES (MOES) to develop **weather prediction tools** through the

WEATHER AND CLIMATE SCIENCE FOR SERVICE PARTNERSHIP (WCSSP)

program supported by the Newton Fund. The tool provides timely forecast guidance to produce earlier and more accurate warnings of extreme weather events.

The stats hold up: **the UK has committed £346m in 11 partnerships implemented and anchored with India's Department of Economic Affairs.** This has resulted in the reduction of 1.2M MT greenhouse gas emissions, the recycling of over 40M litres of wastewater annually, and credit being made accessible to over 300,000 women in Tier 2 and Tier 3 cities. Out of all joint UK-India publications, 43% were related to the SDGs. This is a powerful demonstration of the work we can and have done in achieving the SDGs together. We are serious about launching tangible initiatives that have mutually beneficial impacts.

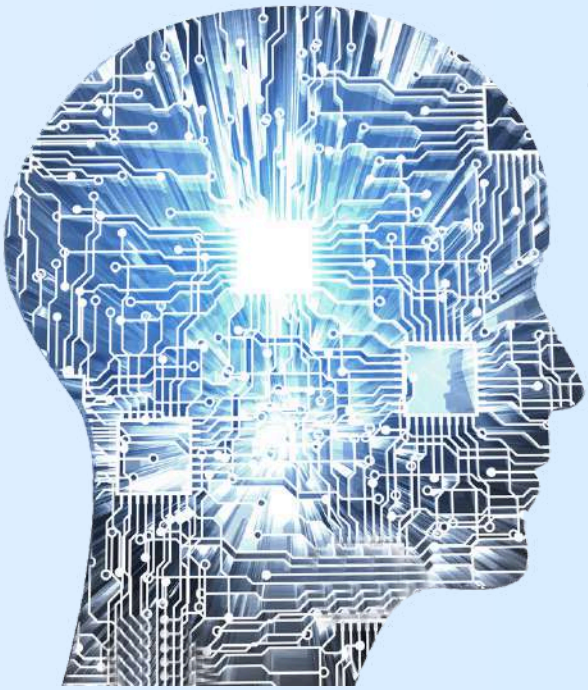
Q What specific sectors within science and technology do you believe hold the most potential for collaboration between the UK and India?

A "The second question people always ask me (after "Do you get to meet astronauts?") is what I enjoy most about my job. My answer is always the same: "I travel into the future daily".

-Ms. Sarah Fallon

The UK's International Technology Strategy outlined AI, quantum technologies, engineering biology, semiconductors, and telecoms as priority technologies, with data as a crucial enabler. **Both the UK and India have ambitious tech agendas,** with collaboration steadily deepening in these fields but also others, such as critical minerals, advanced materials, and telecoms. Last year, the UK hosted the first **AI Safety Summit, where India and the UK, along with other countries, signed The Bletchley Declaration on AI safety.** This was an exciting moment as it delved into the next layer of what we will do about AI as Governments & crafted building blocks for scientific consensus about the risks & opportunities posed by AI models.

The first deep-sea mission with UK and Indian scientists discovered a new sea creature and a feeding phenomenon known as the "trapping effect" in 2022. Our marine science partnership has generated 6 research cruises and environmental surveys, 5 peer-reviewed scientific papers, and over 500 environment education packs in 9 regional languages. This work informs decisions around future Marine Protected Areas' development, boosting biodiversity, and curbing marine pollution.



Last year we held the **first-ever UK-India Working Group on Responsible and Trustworthy AI and a UK-India Workshop on Quantum Technologies,** unlocking new avenues for collaboration. The UK-India Future Networks Initiative, a £1.4 million project funded by UKRI, will build shared capabilities in telecoms diversification technologies and research for 5G and beyond. This is tech collaboration at its best – helping our citizens connect faster and most effectively with no one left behind - from the Hebrides of Scotland to the peaks of Ladakh.

The topic of Critical Minerals has also been rising in the global agenda. What minerals are "critical" and why? Where can they be found? How can they be sourced responsibly? These are some of the questions our experts brainstormed at the recent

UK-INDIA CRITICAL MINERALS WORKSHOP, WHICH WE DELIVERED IN COLLABORATION WITH BCKIC FOUNDATION.

Q What strategies would you recommend for fostering stronger bilateral ties in research and development?

A *It is an exciting time as we are truly deepening our partnership every step* of the way. Last year, the **UK and India signed a research and innovation MoU that cut substantial red tape related to setting up future collaborations.** Now, we spend less time on bureaucracy and more time joining researchers together and getting projects off the ground quickly.

Every big challenge people in our labs are working on every day – cracking hydrogen production, blending sustainable aviation fuel more effectively, preserving artifacts of high cultural value – is a systems problem that requires an interdisciplinary approach. But it's sometimes difficult to know where to start or how to join everything together.

That's why the

UK's International Science Partnerships Fund

has been set up to provide a platform for UK and Indian innovators to collaborate on multidisciplinary projects tackling the key challenges of our time.

We need to build on our bilateral partnership and continue unlocking our science and technology potential to solve global challenges. Our **GLOBAL RESEARCH PARTNERSHIP**

brings together innovators who've made a device to reduce maternal deaths by preventing pre-eclampsia – a condition causing high blood pressure and high levels of protein in urine during pregnancy. **Over 10,000 devices were delivered in India, Africa, & Haiti, with over 1,500 healthcare professionals trained in their use.**

Finally, we need to support next-generation innovators and leaders to continue the work we are doing today so that they may solve the challenges of tomorrow.

This means building on programs such as the

UK-INDIA EDUCATION AND RESEARCH INITIATIVE (UKIERI), delivered by the British Council, to continue strengthening education and research collaboration between our countries.

Q How can collaborations between Indian and British science and technology clusters contribute to innovation and knowledge exchange?

A *Science and technology clusters such as the* **UK'S CATAPULTS NETWORK & THE OFFICE OF THE PRINCIPAL SCIENTIFIC ADVISER'S S&T CLUSTERS**

create strong linkages among industry, academia, and governments to turn cutting-edge ideas and blue-sky thinking into valuable innovations.

Our work with the BCKIC Foundation is already helping us exchange knowledge and innovate solutions for developing resilient critical minerals supply chains & delivering health-tech solutions for both our countries.

The UK-India Net Zero Innovation Centre is another stellar example. Serving as a unique coalition of UK and Indian innovation policymakers, R&D companies, start-ups, investors, and Catapults, the Centre harnesses the UK-India science and tech superpower partnership to accelerate our path to Net Zero.

Two of its pillars involve the work of our **Catapults. Innovating for Transport and Energy Systems (ITES),** led by the Energy Systems Catapult in the UK and the Indian Institute of Science in Bangalore, India, focuses on accelerating the decarbonization of transport and energy systems. CPI, a deep tech innovation organization and part of the **UK's High-Value Manufacturing Catapult, and NCL Pune have signed an MoU** to decarbonize the Indian pharmaceutical and fine chemical industries. They will set up a 'living lab' where UK and Indian R&D organizations and SMEs can trial innovations demonstrating sustainable manufacturing practices.

Collaborations between our clusters and their partners can force multiply the exchange of expertise and facilities, already at play to supercharge our innovation ecosystems.

Q In your view, what are the key challenges and opportunities for cross-border collaborations in the S&T domain?

A The goal is to build and strengthen prosperity-driven connections between science and innovation policymakers, thinkers, and doers in the UK and India.

India's science and innovation community is young, dynamic, mobile, and keen to partner with us. Opportunities pop up daily across a wide range of states - more than what my team can realistically broker. Furthermore, we have support from the apex of a complex and skilled administration governing the biggest democracy in the world -

Prime Minister Narendra Modi has called the UK-India science partnership an "unbeatable combination".

Great moments are always the work of many. They take time to bloom, skidding messily across annual delivery plans, disregarding our reporting frameworks. This gig is not for the faint-hearted or people thirsty for a quick fix. ***As science diplomats, we must feel comfortable on the frontier.*** Whilst we all want to grow our carefully curated consortia into larger scale markets, infrastructure, or research propositions, sometimes they won't be viable. **If evidence suggests initiatives will fail, we record and share those insights too.** It is crucial as it allows **UK Government departments, agencies, and private sector stakeholders to make informed decisions.**

Working with multiple levels of bureaucracy and aligning program implementation and funding requirements is challenging. And, without a shared understanding of risks, opportunities, and appetite, it is nearly impossible to deliver. But there is both funding and ambition to deepen partnerships, which is repeatedly reinforced by our Prime Ministers and science leaders. **We have the plans: the UK-India 2030 Roadmap sets out the vision for our partnership.** Our policy makers and decision takers are developing a shared understanding of risks, especially those concerning critical technology fields, such as AI and critical minerals. **I have the privilege of meeting many "21st century magicians"** redefining the course of history from their labs or incubators.

My value as a science diplomat is drawing their brilliance together to solve the most pressing problems, save lives, or generate prosperity for both countries. This is where the real magic of science diplomacy lies – brokering science, technology, and innovation partnerships that deliver benefits our citizens can touch, see, and feel in every corner of our countries.

PCET's Pimpri Chinchwad University
Learn | Grow | Achieve

Indo Japan Business Council

Mr. Ikuo Kawauchi is a seasoned advisor with a wealth of experience in business strategy, planning, and development. He plays a pivotal role at Indo-Japan Business, BCKIC Foundation, Pimpri Chinchwad University, and several other esteemed organizations.

His strategic insights and innovative approach have contributed significantly to the growth and success of various ventures. Mr. Kawauchiis' expertise & dedication to excellence make him a key figure in the business and innovation landscape.

Mr. Ikuo Kawauchi
Advisor at Pimpri Chinchwad University, BCKIC Foundation

Q What is the importance of international partnerships & cross-cultural understanding in driving innovation, knowledge exchange, and progress in Science & Technology and its impact on broader socio-economic development?

Innovation by science and technology must be implemented in society to help solve various social issues. Since the beginning of mankind's history, mankind has solved numerous challenges through science and technology.

Social issues are, at the same time, **generally global issues, and innovation should be shared globally, beyond national borders**. On the other hand, **social challenges are regionally dependent due to their geopolitical & geoeconomic characteristics.**

Therefore, cases often arise in which science and technology, or its products and services, that are effective in one region or country are ineffective in another. In this sense, scientific and technological research and its implementation in society should not be conducted under the hegemonic one-country-dominated system.

Understanding the importance of international partnership and cross-cultural understanding is an ethical, moral, ideological, & philosophical issue

In this sense, those who are engaged in science and technology and those who seek to make use of it for the benefit of society need to be educated people with a background in the humanities and social sciences and to have a global thinking mind. There are approximately 8 billion people living in the modern world, and each one of them is different. ***There is no superiority or inferiority to each of them. People need to accept and respect talents and personalities that are different from their own.*** *I think that's what's important about international partnerships and cross-cultural understanding.*

Q What opportunities do you see for Indian and Japanese Businesses in S&T?

A ***The business possibilities are endless.*** *I am Japanese and live in Japan.*

As such, one point I would like to make is the issue of marketability and market size. Japan has a lot of excellent science and technology. However, the reality is that it is very difficult for these technologies to become businesses. EVs and biomass are good examples. Because of the lack of marketability, there are aspects of these technologies that are not viable for businesses in Japan.

We need to create **MORE SCHEMES in which businesses are launched in India and implemented in society by utilizing Japanese technology in such business areas.**

> "Indians and Japanese have the same background in ancient oriental thought and philosophy, and I feel that they have a high degree of spiritual affinity. We share the same ultimate goal."

However, very often, the methodologies differ. **Japanese people tend to emphasize processes** and tend to think carefully and thoroughly before acting. **Indians are results-oriented and methodologically flexible.** If these characteristics complement each other well, great results can be expected. The benefits of science and technology arising from Japan and India should extend beyond the borders of both nations, benefiting a global audience.

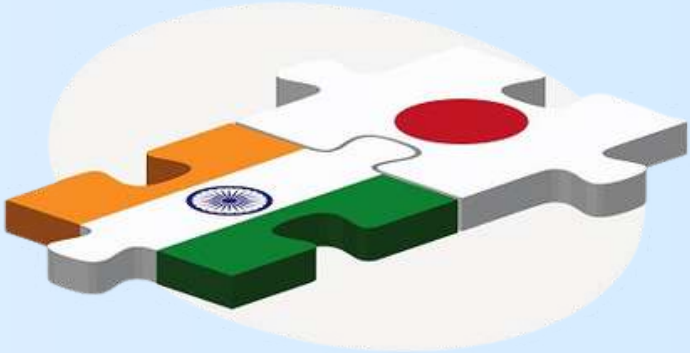
These advancements are not limited to the citizens of India or Japan alone but hold significance for humanity and our planet. In this regard, the potential for impact is boundless.

Q How does the Indo-Japan Business Council promote S&T collaborations between India and Japan?

A ***The Indo-Japanese Business Council (IJBC) is an organization that promotes business exchanges, and the organization that promotes joint research in the field of science and technology is a separate entity.***

However, **IJBC supports student exchanges, such as internships between Japanese and Indian students.** In the process whereby student exchange deepens the relationship between universities and other research institutions, the research level will develop and lead to innovation.

IJBC MAY PLAY A ROLE IN OPENING THE FIRST DOOR FOR SCIENCE AND TECHNOLOGY COOPERATION.



Most scientists are expected to immerse themselves daily in research and development in their field of expertise. It is the role of businesspeople to think about what products and services will result from the application of those results and in what ways they will be used in society.

IJBC IS AN ORGANIZATION OF BUSINESSPEOPLE

Therefore, we believe that the role is to play a key role in promoting science and technological relations between India and Japan and to play a role in shaping the environment. There is one thing I would like to point out: the research carried out by current science and technology researchers will be put to good use in the future of human society and in the society in which future children will live. **The extremely important role of businesspeople is to forecast and predict what will happen to human society & the global environment in the future.**

We must share knowledge and information with scientists about what to do and what kind of science and technology are needed to achieve this. The two should not be considered and acted upon separately. I believe that they need to have a close relationship with each other and walk as one.

Q What are the key challenges and prospects for enhancing bilateral S&T relations between India and Japan, and how would the Council address them?

A Scientific and technological interactions are like chemical reactions between substances or the relationship between a patient suffering from a certain disease and the drug he or she prescribes.

Unless both parties know each other's characteristics and ingredients well and are compatible with each other, the desired effect will not be achieved. However, the interaction should not be carried out blindly; it should be done strategically, with a good understanding of each other's characteristics.

> "People with such strategic thinking should oversee promoting India-Japan scientific and technological exchange. Even though Indians and Japanese generally agree on the goals of scientific research, there are differences in the way of proceeding and the methods used."
>
> -Mr. Ikuo Kawauchi

However, by complementing each other's fields and areas of expertise, researchers from both countries can achieve synergistic results that may not be attainable by researchers from either country alone.

I sense one challenge: Japanese researchers do not know well how many excellent research institutes and universities there are in India. Indian researchers may not be familiar with Japanese institutions and universities.

For example, Japanese may only know the name of IIT, and Indians may only know the names of the University of Tokyo and Kyoto University. Many Japanese people know about Delhi, Maharashtra, Bangalore, Karnataka, Chennai, and Tamil Nadu, but they don't know much about Odisha. I feel very sorry for that.

> "To solve such problems, we need people who are active in both Japanese and Indian organizations, and it is such people who can open windows to new perspectives."

Q Could you highlight successful Indo-Japan S&T collaborations that have driven innovation?

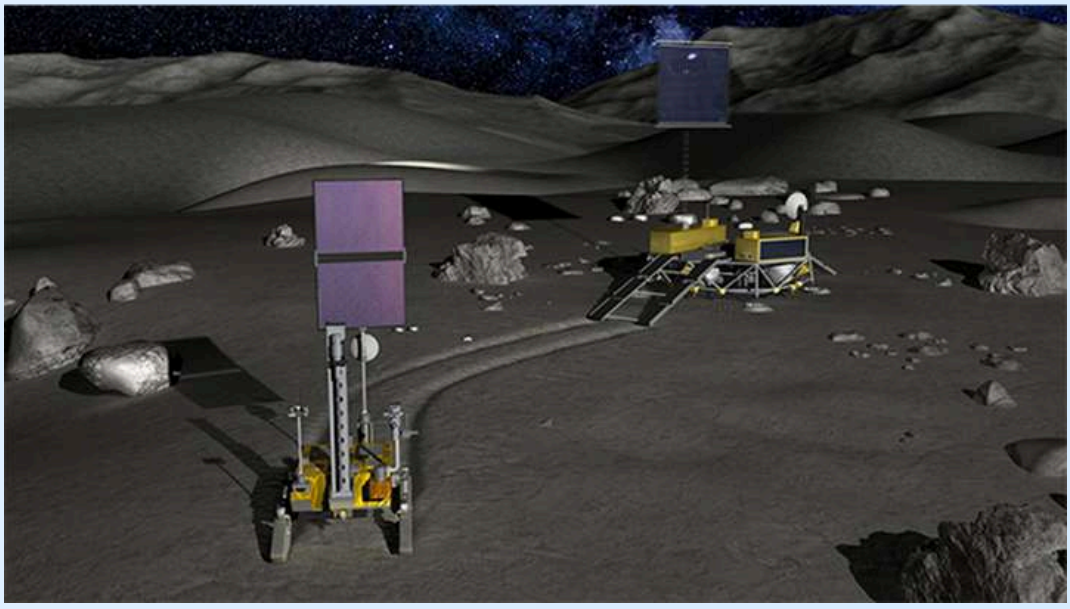
A An international team of researchers from universities and other institutions in Japan and abroad, led by Associate Professor Tomoki Nakayama, who studies environmental science at Nagasaki University, has quantified air pollution conditions in northwest India (rural, semi-rural, and urban areas of Punjab, Haryana, Delhi NCR, and western Uttar Pradesh)

FOR THE FIRST TIME USING A **HIGH-DENSITY OBSERVATION NETWORK** constructed with inexpensive and accurate small sensors (very high particulate pollution over northwest India captured by a high-density in situ sensor network) (https://www.nature.com/articles/s41598-023-39471-1). The results show that network observations, including source observations, can be beneficial in understanding the impact of agricultural residue burning on air pollution at regional and multi-state scales. Many of these leading researchers in environmental science are in Japan. Their basic research and Japan's sensor development technologies are among the best in the world.

If these technologies are supported by **advanced IT and AI-applied technologies** and implemented in society as products and services that can be used over networks and remotely, they can be useful in addressing many of the social issues that India, with its vast land area, faces. Although it has just begun and the results are yet to be seen, there are completely new topics related to science and technology between India and Japan.

ACCORDING TO ISRO, **INDIA-JAPAN SPACE SCIENCE COOPERATION** AT THE **NATIONAL LEVEL,** SPACE AGENCY LEVEL **(ISRO AND JAXA),** AND **INSTITUTE LEVEL** WAS DISCUSSED WITH SPECIFIC REFERENCE TO THE JOINT **LUPEX (LUNAR POLAR EXPLORATION)** MISSION.

This LUPEX mission was envisaged to explore the 'dark side of the moon', or, in scientific terms, the side that is perpetually facing away from Earth. The main objective of the mission is to confirm the presence of water in the polar regions of the moon.



Dr. Robert Mitchell as the Principal Scientist at CPI (Centre for Process Innovation), spearheads numerous innovative research initiatives that are shaping the future of energy technologies. He is a leading figure in the field of energy materials, catalysis, and inorganic chemistry.

Dr. Mitchell's expertise and dedication to advancing scientific knowledge have earned him recognition as a pioneer in his field. His work has the potential to revolutionize the way we store energy, making him a key player in the quest for sustainable energy solutions.

Dr. Robert Mitchell
Principal Scientist at CPI (Centre for Process Innovation)

Q How do critical minerals drive energy materials research for sustainable energy solutions?

A To achieve global CO2 reduction targets and limit planetary warming, shifting away from reliance on fossil fuels is a necessity.

Electrification is a key solution that can drive lower carbon emissions, for example, the production of an electric vehicle may produce more carbon emissions in mining and battery processing, but typically by a few 10's of thousands of miles emissions reach parity with an internal combustion engine car, and from then on EV emissions are lower. However, extensive volumes of critical minerals are required to achieve this electrified future.

Electric vehicles need large quantities of metals in wiring and for batteries such as copper, nickel, cobalt, manganese, lithium, and rare earth elements in the electric motors. **Due to demand many of these elements are now considered critical by many nations and are added to lists of critical minerals.** The power grids to support charging infrastructure require a transition from high carbon-emitting processes such as burning coal to renewable sources such as solar and wind, with magnets for wind turbines again reliant on critical rare earth materials.

As more of the worlds transport and infrastructure is electrified, research into sustainable alternatives is also of paramount importance.

New and improved sustainable processing and production methods are critical.

RESEARCH INTO ALTERNATIVE MATERIALS THAT ARE LESS CONSTRAINED IS A KEY ANGLE for research groups worldwide, **as an example sodium-ion batteries** are likely to deploy to the mass market in coming years, with companies like Altris/Northvolt and CATL key players in this field.

Q How does the Centre for Process Innovation contribute to critical minerals innovation in the UK?

A ***The Centre for Process Innovation***

(CPI) acts as a Catalyst

for translational research, supporting the scale-up of processes from academic research towards commercial reality.

In the critical minerals space, CPI is supporting several companies who are using innovative solutions to tackle the challenges of net zero and enhancing materials to be longer in use and reuse.

CPI provides services ranging from supply chain mapping, market assessment, and landscaping and has **a wide network that brings together academic and industrial entities, and signposting companies to the support required.** From the technical side, CPI has an asset base exceeding £170 million (1800 crore INR) including screening capability for extraction, refining, synthesis, formulation processes, and application testing. CPI hosts the **UK's National Formulation Centre with vast industrial knowledge** in formulation processes covering a wide variety of sectors from food, feed, and pharma to agritech and battery materials.

CPI also offers process technology support which ranges from desk-based studies looking at scale-up parameters, mass balance, and design of plant up to pre-FEED assessment, as well as costing studies such as technoeconomic analysis and carbon accounting through LCA.

Q What role could UK-India collaborations play in critical minerals and energy materials research especially in Odisha?

A **ODISHA HAS RICH MINERAL DEPOSITS & MINING HERITAGE COUPLED WITH STRENGTH IN INDUSTRY AND RESEARCH,** for example, BCKIC Foundation, CSIR-IMMT, Jindal Steel, and Tata Group. **Growing tech transfer between UK-India** will help the region continue to develop as a hub for Indian critical minerals development.

The UK has a strong research and innovation base, with many companies and research institutes working on innovative solutions to tackle challenges in critical minerals and energy research. Many companies are already supporting Indian infrastructure, for example, **LiNa Energy** is developing a 10 kWh sodium battery energy storage system in India, which has huge potential to support the Indian grid due to seamless operation in the Indian climate; a challenge for lithium-ion-based systems.

The reduced carbon footprint of mining operations is paramount to limiting the climate impact of electrification, and many UK companies are operating in this space, one such example being **Altilium, whose DNi process** is improving the sustainability of nickel processing. **New battery chemistries such as those developed by Echion Technologies based on niobium** could be suitable for vehicles such as mining trucks with a duty cycle, allowing fast charging to keep operations running smoothly and cleanly.

Other examples of UK-India collaboration involve the

Tata group & JLR/Agratas

with the intention to produce UK and Indian battery gigafactories. Reliance New Energy Solar bought the UK tech company Faradion working in sodium ion battery technology. These impressive companies will drive strong UK-India relations and support the growing electrification in both countries.

https://www.lina.energy/2023/11/07/lina-energy-readies-novel-sodium-battery-energy-storage-system-for-pilot-with-strategic-partner-in-india/

> "The UK is keen to work with other global economies to provide technology solutions and beneficial relationships in exchange for access to critical minerals required to support localized production in the UK."

Q What challenges does the UK face in securing a sustainable critical minerals supply?

A ***A critical factor in reducing global carbon emissions is the localization of supply chains,*** such that where possible transport of materials, battery production, and OEM assembly is co-located. On the other end of the scale, recycling processes want to minimize the transport of batteries, which can be costly and hazardous, by again co-locating or by the provision of hub-spoke models where centralized collection and disassembly/shredding is supported by spokes in which leaching and synthesis of pre-CAM or CAM is undertaken (CAM - cathode active material).

In addition to the sustainability angle in the above points, the UK following Brexit must comply with regulations known as the 'rules of origin', whereby to allow tariff-free trade, increasing the requirement for content of materials with the final processing step undertaken in the UK is required. **This again points to localized supply chains as a necessity.**

The UK is not rich in mineral deposits and needs to source many of the requirements for an electric future from overseas. This requires **trade deals and strategic partnerships with overseas governments to enable supply of the minerals required.**

Q What is the future of critical minerals research, and how can science and technology clusters like BCKIC Foundation contribute?

A Some key challenges in critical minerals research are around mining, refining and critical mineral supply, alongside alternative material options and improved recycling technologies. Many of these points have been touched on already, however in **particular on recycling, there is an opportunity for 'urban mining'** where recycling and circular processing of materials to maintain in circulation rather than return to landfill enables critical minerals to be longer in use and reuse.

Companies such as

Altilium Clean Technologies

are developing recycling methods to take battery waste and convert it back to precursors for remanufacture. Even more promising are methods that require less intensive processing. Extensive research is being undertaken by projects like the UK ReLib project, and companies such as OnTo technology in Canada are exploring ways to recover materials without dissolution, known as direct recycling.

> “BCKIC Foundation and CPI work in similar paths enabling effective translational research from Academic research to commercial scale.”

-Dr. Robert Mitchell

These centers are important for derisking new ideas, demonstrating whether a product or process is scalable and cost-effective, and providing a picture of the commercial landscape and challenges within. Small companies can struggle to scale up their technologies quickly and efficiently without the support of these organizations.

NETWORKING AND INFORMATION SHARING can be highly effective in enabling effective collaboration and allowing for example academic groups to see how their research can be influential in real challenges faced by companies, and for companies to know how the research academic groups are undertaking can support their growth.

Natural Resource
CONSULTING LIMITED

Mr. Tim Archer, the CEO of Natural Resource Consulting in the UK, is a prominent figure in the field of natural resource management. His expertise and leadership have been instrumental in driving innovative solutions and sustainable practices in the industry.

Mr. Archer's connection to the BCKIC Foundation through the UK-India Critical Minerals project highlights his commitment to international collaboration and the advancement of critical mineral research and development.

Mr. Tim Archer
Director & Chief Executive Officer, Natural Resource Consulting, Eastbourne, UK

1

How does Natural Resource Consulting contribute to the exploration and development of critical minerals in the UK?

Natural Resource Consulting Limited (NRC) is a UK-India joint venture promoted with a mandate to advise key stakeholders, both Indian and international, to jointly develop the highly potential early-stage exploration market for critical and deep-seated minerals. As part of this remit, **we lobby governments, educate explorers, & establish communications between like-minded parties in the exploration sector.**

2

How do you see the demand for critical minerals evolving in the context of emerging technologies?

CRITICAL MINERALS ARE NOW SORELY NEEDED BY MOST NATIONS ON EARTH.

As demand increases, more efficient means for finding and extracting these scarce resources will ned to be deployed and enhanced. Rapid exploration technologies such as airborne geophysics and satellite imagery will be key in prioritizing exploration areas for more costly ground-based follow-up.

3

How can UK-India collaborations in critical minerals contribute to global efforts towards sustainable development and environmental stewardship?

Fossil fuels must end. And the world does not currently have enough low-carbon raw materials to replace them. Critical minerals feature prominently on this shortage list. **WITH INDIA'S VAST MINERAL POTENTIAL & THE UK'S MATURE EXPLORATION EXPERTISE, BOTH NATIONS CAN PLAY A SIGNIFICANT ROLE IN ACHIEVING NET ZERO.**

4

Can you provide examples of successful India-UK collaborations in critical minerals and natural resources consulting?

NRC'S MANAGEMENT TEAM HAS CONSULTED TO MINERAL EXPLORERS IN MORE THAN 48 COUNTRIES OVER FIVE DECADES.

Several critical mineral consultancy projects are currently underway, and India's recent decision to market 45 critical and strategic mineral auction blocks will swell this number over the coming months.

5

What role do you see for Indian science and technology clusters, especially BCKIC Foundation, in fostering innovation and sustainable practices in critical mineral extraction & processing?

THE INDIA-UK WORKSHOP IN BHUBANESHWAR WAS AN EXCELLENT EXAMPLE OF INTERNATIONAL COLLABORATION AROUND CRITICAL MINERALS CHALLENGES.

Research initiatives should be broadly inclusive wherever possible, and well-publicized to ensure maximum impact.

LV Prasad Eye Institute

Prof. Taraprasad Das holds the position of Vice Chairman Emeritus at the L V Prasad Eye Institute, where his visionary leadership has significantly advanced the field of ophthalmology. His academic contributions extend globally, serving as a Professor of Ophthalmology at Sun Yat-sen University in Guangzhou, China, and as an Adjunct Professor of Ophthalmology at the University of Rochester Medical School in Rochester, NY, USA.

Prof. Das is also recognized as a Fellow of the National Academy of Medical Sciences in India, highlighting his distinguished career & exceptional contributions to medical science. His work spans across continents, enriching the global medical community with his expertise and dedication to ophthalmic education and research.

Prof. Taraprasad Das
Vice Chairman Emeritus at the L V Prasad Eye Institute

Q How do the institutes nurture the next generation of eye care professionals, researchers, and innovators in the S&T Cluster through education and training?

A *The right way is to develop a culture & ecosystem of science and translational research.*
This should be considered an investment, not an expense.

The starting point is identifying the project(s). It must be based on a few important components: **(1) the core strength of the leader, (2) the institute's long-term vision, (3) collaboration, (4) funding opportunities, and (5) societal benefit.**

In the LV Prasad Eye Institute, the process begins with important questions like **'What,' 'Why,' 'Who,' and 'How.'**

What do we want to do?
the ***VISION***

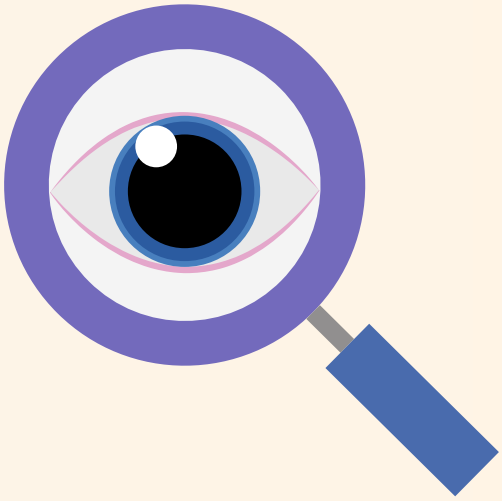
Why do we want to do it?
SOCIETAL BENEFIT

Who will lead?
LEADER

How will it be done?
FUNDING & COLLABORATION

Because we are an eye institute with both urban and rural presence,

WE LOOK AT THE PROJECTS THAT WOULD BENEFIT THE PATIENTS IN DIAGNOSIS AND TREATMENT.

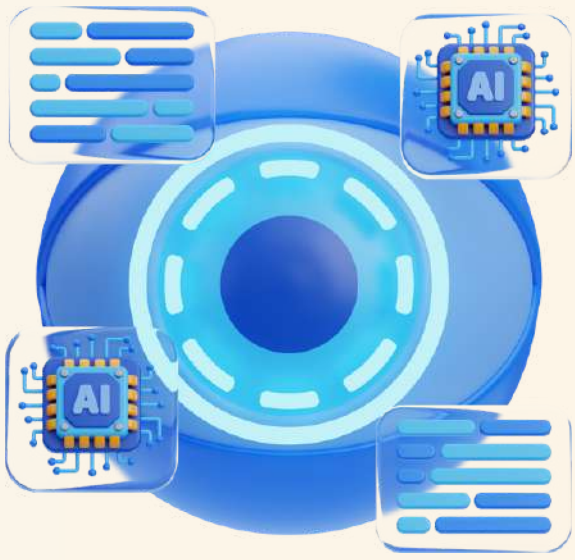


Q What are the key areas of potential growth and innovation in Ophthalmology, and how does India contribute to global advancements in this field?

A ***India has a large patient, disease pool, and less penetrative insurance system (as of now).***
This gives us a few advantages:

- Large patient data could be effectively utilized to create & test the next-generation artificial intelligence (AI) tool.
- Certain eye disorders are either unique (for example, eye infection) or present in abundance (example, cataract, and diabetes).
- Design and deploy less expensive quality tools for diagnosis and treatment referrals.

The LV Prasad Eye Institute has developed an AI tool to predict refractive error in children (myopia particularly) and several smartphone-based tools for home care and teleophthalmology. Several Indian ophthalmic companies have also developed quality tools; these are effectively used in India and similar economies worldwide.



Q Could you share instances where technological innovations enhanced the diagnosis and treatment of eye conditions, particularly at the L V Prasad Eye Institute?

A ***Here are some specific ones:***

- FoFo- Folding Phoropter for assessing refractive error
- Holden- Hand-held slit lamp photography
- Grabi- Anterior segment photography
- Pupil Lite- Assess the pupil
- OM- Visual Field testing in adults
- Pediatric perimeter- Visual Field testing in non-verbal children (Patented)

Q What advice would you give to young scientists and researchers aiming to make impactful contributions to Ophthalmology, especially in the context of advancing S&T in India and beyond?

A

- Learn to ask relevant research questions.
- Equip oneself with the right learning before undertaking any project.
- Willingly collaborate for a larger benefit.
- Confine to the country's need- more translational than esoteric research.
- International collaboration.
- Excel than merely existing.
- Plan for a long-term investment rather than a short-term benefit.

Prof. Aparajita Chowdhury
Vice-Chancellor of Rama Devi Women's University

Prof. Aparajita Chowdhury, Vice-Chancellor of Rama Devi Women's University, is a pioneer in Home Science education in Odisha and brings over three decades of expertise in Human Development and Family Studies. As the Vice-Chancellor of Rama Devi Women's University, she continues to lead with a rich background in academia and a profound commitment to women's education and empowerment.

Rama Devi Women's University (RDWU), one of the premier institutes for women in the state of Odisha was established in 2015. It is the only Women's University in the state, having both unitary and affiliating status with 48 affiliated women's colleges across nine coastal districts of the state.

The University is marching forward with a vision to develop into a centre of excellence in higher education through the promotion of quality teaching and research for women. Research and Innovation have been integral parts of the University's activities & committed to building an inclusive, as well as diverse and collaborative research environment, prioritizing quality research and innovation having societal relevance.

Q Role of Science and Technology in the field of Home Science in shaping education and research for women in India?

A ***Home Science,*** is a multidisciplinary subject that aims at **enriching the quality of life by strengthening the individual, family, and community in general.**

It focuses on integrating technology with social relevance to improve the standard of life and prepare for future readiness.

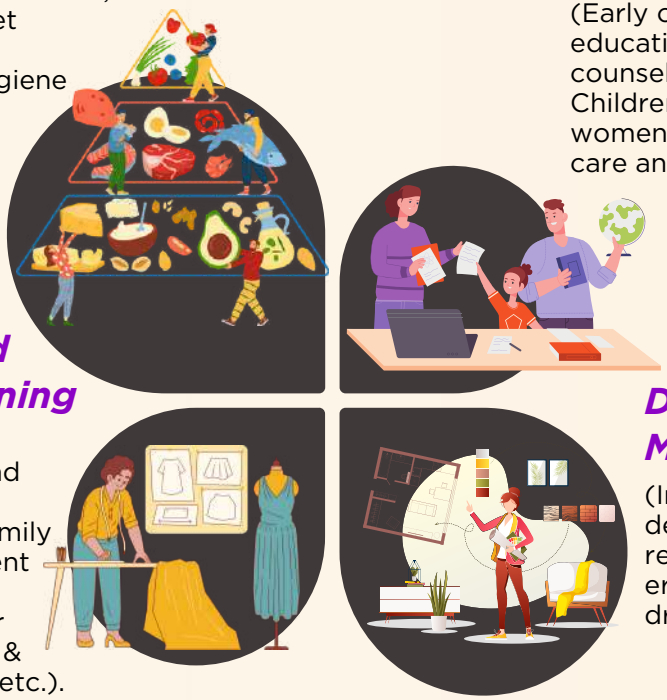
Home Science education, being an applied science, offers specialized courses such as

A) Foods and Nutrition

(Human Nutrition, Public health, Community Nutrition, Clinical Nutrition, Diet therapy, & Nutrition counseling, Food hygiene and sanitation, Food analysis, Food preservation, etc.).

B) Human Development and Family Studies

(Early childhood care and education, Family and marriage counseling, Exceptional Children, Youth development, women's issues and geriatric care and issues etc.).



C) Textiles and Apparel Designing

(Computer aided designing, Dyeing and printing, Fashion designing, etc.) & Family Resource Management (Interior and space designing, Consumer science, ergonomics & drudgery reduction, etc.).

D) Family Resource Management

(Interior and space designing, Human resource management, ergonomics, and drudgery reduction, etc.).

Through various specializations, Home Science Education prepares young women to meet global challenges.

The need of the hour is to conceptualize the objective of the discipline to apply modern technologies in family and community life as well to enhance the quality of life and standard of living. In this context,

RDWU has restructured the UG and PG program in Home Science and offering B.Sc. and M.Sc. Certifications.

The Indian social fabric has been changing rapidly during the last few decades or so, however, the role of women in the family still is of paramount importance to maintain a harmonious family life.

At this juncture, the role of science & technology is crucial to making the discipline more impactful by taking up applied research and extension activities along with academia.

This will boost the research aptitude of the women students in our state as well as the country.

Q How can academic programs in universities extend beyond the curriculum to enhance student's overall development & equip them with skills essential in today's competitive world?

A ***A more flexible program*** **coupled with strong academic & research advising structures, allows young people to find their strengths and interests – & to change direction, wherever needed.**

It can also allow them to develop the interdisciplinary perspectives needed to address the key issues facing society in the 21st century.

National Education Policy 2020

has envisaged **holistic development of the students through flexibility and an interdisciplinary approach.** Teaching being the core principles and theories of a given specialization is not enough to prepare graduates for a changing global workplace that is digital and disruptive. This requires a university curriculum that focuses on outcomes-based education, such as transferable future skills and facilitating student's choices.

For this, RDWU is using pedagogies such as:

- Experiential learning (learning by doing principle)
- Work-related learning goals (Industry exposure/ internship/ fieldwork)
- Good curriculum alignment (Curricula need to focus on 21st-century skills that will help graduates thrive in the future workplace, such as creative thinking, resilience, and adaptability)

RDWU has strong base opportunities for the all-round development of women students through NCC, NSS, YRC, sports, and students' clubs, beyond the academic curriculum. University has introduced several value-added courses and certificate courses for skill enhancement in the opportunity areas of contemporary society for employability and skill up-gradation to promote start-ups and entrepreneurship.

Emphasis is also being given on effective governance and leadership, developing human capital, collaborations, extension and extracurricular activities, and ICT platforms to make the students future ready.

THIS IS **BOOSTING THE INNOVATION ECOSYSTEM** ON THE CAMPUS.

Q Perspective on the global & national status of women in various fields, including the challenges they face in striving for excellence compared to their male counterparts.

A ***ASIAN GAMES OF 2023,*** **is a befitting example of sportswomen in India thriving on the global stage despite the multiple challenges.**

It was a notable victory to have a greater share in winners' medals as compared to sportsmen, despite their greater amount of struggle. The past 20 years have witnessed progress for women in the world of work and in terms of gender equality in society.

Today, more women than ever before are both educated and participating in the workforce, and **there is greater awareness that gender equality is of paramount importance in efforts to reduce poverty and boost economic development.**

In the global scenario, despite an increasing number of women pursuing higher education globally,

A GENDER GAP IN EMPLOYMENT RATES remains among highly educated women in some countries.

IN THE INDIAN CONTEXT, ACCORDING TO THE LATEST WORLD BANK FIGURES, FROM 2021, FEWER THAN 1 IN 5 INDIAN WOMEN WORK, AT LEAST FORMALLY.

Though most work in India is informal like agricultural or domestic work which often doesn't get counted.

Over nearly two decades,

India's female labor participation rate looks like a steady downward curve: From 32% in 2005 to 19% in 2021.

Women are still facing various challenges in the workplace including Gender Bias in the workplace, Mental/Physical harassment, Unequal Pay, issues in work-life balance in dual-earner families, issues created for going on business tours/training, safety concerns, etc.

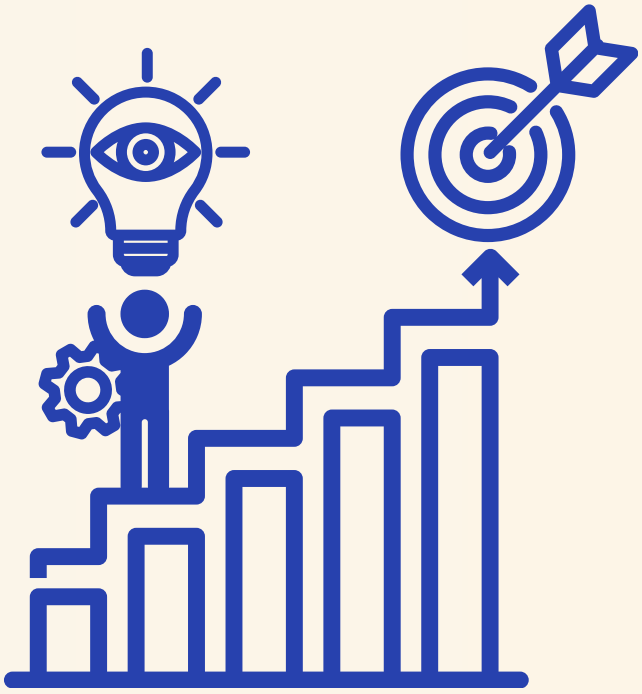
Without social security, women in our society struggle hard in both the front – Family and Work. The freedom to work – by choice, in conditions of dignity, safety, and fairness – is integral to human welfare.

Guaranteeing that women have access to this right is an important end in itself. From an economic perspective, **reducing gender gaps** in labor force participation could substantially boost global GDP.

Q Vision and Mission of RDWU in empowering women through Higher Education.

A *Vision:*

- To ensure the holistic development of women through the promotion of quality teaching and research.
- To enhance global visibility in terms of quality, employability, inclusivity, and women empowerment with future readiness through social innovations.



Mission:

The mission statement of the University is –

“सा विद्या या विमुक्तये”

(Sa Vidya Ya Bimuktaya) - It is the knowledge that liberates.

- To provide quality higher education for the holistic development of women.
- Strive for excellence by continuously enriching the curriculum and work culture of the University through teaching, research, and extension.
- To ensure a stress-free and inclusive environment by providing easy access and facilities to diverse categories of students.
- To develop entrepreneurial skills and self-reliance among students through well-structured skill-based, future-ready, and value-added courses.
- To strengthen the capacity of the students through exposure and hands-on experience with institutions of national and international repute.
- To foster maximum participation of women in community growth and nation-building.

Q University's initiatives or partnerships that connect students and faculty with the local community and promote social responsibility.

A *In the University,*
SOCIAL RESPONSIBILITY
is being taken up by the students and staff in collaboration with the **Child & Women Development Society, Centre for Youth and Social Development, and State Commission for Women** to create awareness among the mass and skill development programs are carried out jointly by **Nandi Foundation, Hyderabad, FICCI Ladies Organization, BBSR, NASSCOM, New Delhi and Diverse Us Society, BBSR.**

Many MoUs have been initiated recently with organizations of national and international repute to have collaborative research and community development.

Programs like NCC, NSS, and YRC connect students to the community by organizing blood donation camps, health awareness programs, plantation programs, cleaning programs, etc. This is inculcating the sense of responsibility towards the community among the women students. The alumni connect of the university is thriving and creating a huge impact among the young alumnae and students to shape their personalities.

We conceptualize stakeholders' views as a collection of the interaction of individuals and institutions.

> "The key stakeholders or facilitators of the research ecosystem of an institution are their faculty, doctoral students, research associates, and postgraduate students. Here, it should also be noted that research in isolation is not possible in the new age and knowledge economy."

Cutthroat competition, changing technology, & other resource constraints define the context that calls for collaboration with external institutions, industry, & central or state government.

> "For the research ecosystem to survive, every stakeholder of the University must play a critical as well as responsible role."

-Prof. Aparajita Chowdhury

जैव प्रौद्योगिकी विभाग
Department of Biotechnology
Ministry of Science & Technology
Government of India

Dr. Meenakshi Munshi, is the former Advisor and Head of Human Resource Development at the Department of Biotechnology, Government of India. A distinguished leader in the fields of education, research, and development, Dr. Munshi has made significant contributions throughout her illustrious career. She has also served as the Director of Research Development and continues to contribute as a Consultant at the Manipal Academy of Higher Education. Her work reflects a deep commitment to advancing academic excellence and fostering innovation in education.

With a distinguished track record, Dr. Munshi continues to inspire and lead in her various capacities, driving forward the frontiers of education and scientific research.

Dr. Meenakshi Munshi
Former Adviser
DBT, Govt of India

Q In your varied roles as a Researcher and Advisor, can you highlight how academia's involvement drives R&D in India.

A The seeds of research are sown in us sometimes at very initial stages in life, or at times it takes a long time to understand that one wants to pursue research as a career.

In my case, the seed of research (so-called PhD) was sown in me at a very tender age when I was told that in a PhD, one writes a book, which was a trigger point in my life to take up research as a career. It is our teachers who help us make our fundamentals of education strong, which goes a long way with us. It is the academic growth of a person that helps a person go forward in research. But at times things don't go the way one envisages, like in my case, where I wanted to be in hard-core research, but it wasn't destined to be, and I had the opportunity to join the Department of Biotechnology, Govt. of India, where I was an enabler for others where I could help researchers in the country.

In India, or for that matter, all over the world, fundamental research is carried out by young students in research labs, and with the guidance of their mentors and research guides, they produce excellent research outcomes.

ACADEMICS HAVE A DEEP PENETRATION INTO THE RESEARCH ECOSYSTEM OF THE COUNTRY.

Q How do collaborative efforts between academic institutions and industries accelerate technological innovation?

A *There was a time when* every individual worked in their silos.

Modern day research demands that we work together as a team if we want to progress. There is a need to tackle a problem, so it needs the expertise of different field experts.

The industry-academic partnership is the need of the hour, & this partnership has promoted new synergies and models. These collaborations provide access to expertise and research that leads to innovation.

COLLABORATIVE RESEARCH HAS A MUTUAL BENEFIT:

the industry gets skilled workers, while academic institutions get the opportunity to work on important research problems using pertinent technologies available to the industry.

> “These collaborations reduce the investment costs for both partners and expedite their research goals.”
>
> -Dr. Meenakshi Munshi

Q How have you observed Science and Technology advancements influencing India's technological landscape, considering your background in academia and government?

A Research and development were primarily conducted at universities and research institutes, with primary funding support from the government.

The Indian research ecosystem has become robust over the years, and India as a nation has developed various world-class technologies. With improvements in infrastructure development and the creation of advanced laboratories, the

INDIAN RESEARCH CANVAS HAS GROWN LARGE.

Government funding has also increased fairly. **The standard of research has gone up, culminating in the development of new drugs and vaccines.** The government is making a sincere effort to identify **cutting-edge technologies that are supported to translate them into products and processes.**

Q Could you highlight strategic initiatives or policies pivotal for accelerating Science and Technology progress in India?

A The science and technology ecosystem has been nurtured since independence.

Science, technology, and innovation (STI) have emerged as key drivers of national development around the world.

Since independence,

five major policies have been implemented:

01 **Scientific Policy Resolution (SPR 1958)**

02 **Technology Policy Statement 1983**

03 **Science and Technology Policy 2003 (STP 2003)**

04 **Science and Technology Innovation Policy 2013 (STIP 2013)**

05 **STIP 2020**

As India strives for faster, more sustainable, and inclusive growth, the Indian STI system, which benefits from a large demographic dividend and a large talent pool, has played a pivotal role in achieving these national objectives. India has created universities, public and private enterprises, and human resources to expand the STI ecosystem.

According to data collected in **2010–11, there are over 16,000 Colleges, 600 Universities, 2000 Research and Development Institutes, and over 400,000 Science Professionals.** The science and policy ecosystem has benefited every Indian scientist in one way or another. Taking forward the defined policies, the government has created excellent research institutes where world-class research is carried out. **The government has also provided financial support for**

Mega-Research Initiatives

that have brought India to the international level, be it in space, atomic energy, or basic, or applied research.

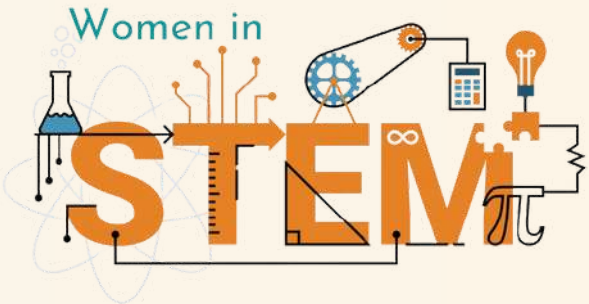
Q What role has mentorship and guidance played in the success of Science & Technology initiatives, particularly in your work with the Department of Biotechnology?

A ***The value of effective mentorship in the sciences is increasingly being recognized.***

How India has positioned itself in science and technology has indeed been possible **due to the able guidance of Indian and international scientists/ and industrialists who have guided policymakers from time to time in framing relevant policies and scientific schemes.** Based on their inputs, Indian science has shown rapid growth and has made its presence felt internationally.

The Department of Biotechnology constituted various task force committees with relevant national and international subject experts who guided DBT from time to time and came up with excellent scientific programs.

MENTORING PLAYED A PIVOTAL ROLE IN SHAPING THE FUTURE OF DBT, and it is an ongoing process. Some of the initiatives of DBT deserve special mention, like the setting up of BIRAC, supporting PG programs in biotechnology, creating centers of excellence, creating high-end infrastructure, creating new research theme-based institutes, reverse brain drain, and supporting cutting-edge research, to name a few.



Q How do you perceive the transition in the role of women in STEM from 'then' to 'now'?

A **GONE ARE THE DAYS WHEN IT WAS SAID THAT WOMEN WERE FOR HEARTH & MEN WERE FOR FARMS.**

Women were not encouraged to go for higher studies, while boys were always encouraged & pushed into studies, whether they were interested or not. Over the years, things have improved. When I was a student, not many people would opt for math as a subject; at the max, girls would opt for biological sciences so that they could become doctors. Girls were seen only as teachers, caregivers, or nurses. Girls in engineering were very far and few. The government of India has taken a proactive role by implementing various women-centric schemes; this has also helped to a great extent. Now women are found in every possible field that were reared during our growing-up days.

But still, the glass ceiling has not been broken.

Women had been stereotyped as more delicate, tender, and unfit for hard jobs. Women have to take care of their families, so they were never encouraged. One of the reasons could also be that there were not enough female role models to admire and follow. If you look at the statistics, out of the 866 Nobel Prize winners so far, only 53 have gone to women, which is far less than is the case with the Bhatnagar Awards. As we have moved along in this journey, women in STEM have made their presence felt in every sphere of life; they have become entrepreneurs, scientists, engineers, policymakers, doctors, fighter pilots, taken on leadership roles, educators, and whatnot.

But this is not enough; if we provide them with a conducive environment, women will reach the top of the success ladder.

Prof. P.P. Mathur

Vice Chancellor of Birla Global University (BGU)

Prof. P.P. Mathur currently serves as the Vice Chancellor of Birla Global University (BGU). With a prolific career in higher education, Prof. Mathur has previously held esteemed positions, including Professor & Head at Pondicherry University, Dean at KIIT University, and Distinguished Visiting Professor at M.D. University.

A respected figure in the scientific community, Prof. Mathur is a Fellow of several prestigious academies and has served in numerous leadership roles for various scientific societies. Prof. Mathur's leadership at BGU is marked by a dedication to fostering innovation, promoting interdisciplinary research, and enhancing the quality of higher education. His visionary approach continues to inspire students and faculty alike, driving forward the mission of Birla Global University.

Q What role does Science and Technology play in shaping HR practices in India, and where have we seen notable growth and innovation?

A Science and technology have been playing a significant role in shaping human resources (HR) practices in India and abroad. Technology has leapfrogged efficiency, data-driven decision-making, and overall organizational effectiveness.

Gone are the days of printed advertisements and notices. For quite some time **technological advancements have revolutionized the recruitment process** through online job portals, social media platforms, and professional networking sites. **Companies in India increasingly use these platforms to reach a wider pool of candidates and streamline the hiring process.** This seemingly manual-intensive job has become much more automated now.

The adoption of technology was accelerated during Covid-19 pandemic. Online courses, webinars, and virtual training programs contributed to upskilling and reskilling the workforce. **Learning Management Systems (LMS) platforms** are used to deliver, track, and manage training and development initiatives efficiently.

Technology aids in improving internal communication through tools like messaging apps, intranet platforms, and collaborative software. This fosters better employee engagement and teamwork.

Q Could you share your vision for fostering interdisciplinary collaboration and research excellence among students and faculties?

A ***It is critical to promote interdisciplinary collaboration for research & innovation.***

Promoting excellence among students and faculty is crucial for advancing knowledge and addressing the complex challenges of today and the future. Having lot of work done through national and international collaborations I consider the following efforts very important in this direction.

The promotion of a culture of collaboration among faculty members, students, and various stakeholders from different disciplines is of prime importance.

Organization of regular interdisciplinary seminars, and workshops to facilitate networking and idea exchange are very important.

Designing joint degree programs and courses integrating interdisciplinary content into existing programs must be thought of and implemented.

Cross-departmental appointments for faculty members could be formulated which will allow them to hold positions in multiple departments helping them to collaborate on research projects in different areas. Students and faculty from diverse backgrounds must be encouraged to work together on projects through incubation centres and innovation hubs. Interdisciplinary collaboration nurtures a culture of innovation and research excellence.

ADVANCED TECHNOLOGIES THAT FACILITATE INTERDISCIPLINARY RESEARCH SHOULD BE MADE AVAILABLE

through dedicated interdisciplinary research centres along with bringing together experts from various disciplines. I am happy to indicate that the multidisciplinary collaborative work that I started and strengthened for more than twenty years at Pondicherry University led to interdisciplinary teaching and research in life sciences through the development of a Bioinformatics Centre and an Interdisciplinary Centre of Life Sciences which immensely helped the students in their academic pursuits.

Q What is your perspective on the key challenges and opportunities in HR management in India, & how to address these issues through education and research?

A ***HR practices have changed significantly in the digital world. From a physical workplace, HR is now connected to a virtual workplace.***

The recruitment, training, employee support, and grievance handling systems have been automated using AI and data analytics. **Working from home has become a regular practice with many companies leading to savings of financial resources and ensuring work-life balance.** The innovation in digital technology has **enabled employees to access all the facilities of the physical office and their colleagues in a distributed system.** The recruitment, training, employee support, and grievance handling systems have been automated using AI and data analytics. The employee performance appraisal system, internal communication, rewards, incentives, etc are based on results which are now based on data analytics.

Automated performance management systems facilitate continuous feedback, goal tracking, and performance appraisals. This seeks to ensure a more transparent and fair evaluation process. The rise of remote work has led to increased reliance on collaboration tools, project management software, and virtual communication platforms.

This transformation has necessitated adjustments in HR policies and practices to accommodate remote work dynamics.

Q What are the focus areas of the Centre for Research (CFR) at BGU and how is the research contributing towards the welfare of society?

A The Centre for Research (CFR) at BGU is working on different domain areas directed towards the welfare of society. The training programs on:

start-up ecosystems, talks by successful entrepreneurs, hackathons among the students generating new ideas, faculty research projects in the areas of financial inclusion, new HR practices, financial market, the role of AI in market decision-making, etc. are all aimed at improving societal welfare.

Most of the research works are based on interdisciplinary areas. The data science department conducted one hackathon where new ideas like crop disease detection systems, Traffic route management systems, automation in pesticide spray through drones, etc. were developed using AI, big data analysis, and cloud computing.

Through the CFR, there have been frequent **interactions with software experts of STPI about the application of new-age technology in solving various socio-economic problems. A Research Conclave is organized every year** where expert researchers and scientists deliver motivational talks on various dimensions of impactful research and review the research projects of the research scholars working both at BGU and in other universities.

Q How to promote a holistic educational experience, learning, extracurricular activities, and community engagement, to foster innovation and entrepreneurship among its students?

A Promoting a holistic educational experience that fosters innovation and entrepreneurship involves creating a well-rounded environment that goes beyond traditional classroom learning.

Here are several strategies to achieve this we need to **integrate real-world projects and case studies into the curriculum along with emphasizing interdisciplinary approaches for problem-solving.**

Collaboration with industry professionals helps to create relevant up-to-date course content and also provides students with hands-on experience. **The institutions should organize networking events, workshops, and seminars** with experienced entrepreneurs and research institutions.

Experiential learning opportunities can be provided by **supporting and funding student-led clubs or organizations related to entrepreneurship, innovation, and technology.** In Birla Global University we have been able to reap rich benefits by providing immense opportunities through various clubs and community engagement to the students of all the disciplines.

We need to **provide flexibility to the students in choosing their courses and projects** to pursue their passions and encourage independent research and self-directed learning At the top of all, we need to **foster a global mindset by encouraging international collaborations, study abroad programs, and exposure to diverse cultural perspectives.** By implementing these strategies, educational institutions can create an environment that not only imparts academic knowledge but also nurtures the skills, mindset, and experiences needed for innovation and entrepreneurship.

Q Could you highlight the importance of collaborations between the institutes and industries that have provided students with valuable real-world experiences?

A Certainly, collaborations between educational institutions and industries are crucial for several reasons, particularly when it comes to providing students with valuable real-world experiences.

Collaborations between institutes and industries play a vital role in preparing students for the workforce, fostering innovation, and contributing to the overall development of both educational institutions and industries. Here are some key points highlighting the importance of such collaborations.

Collaborations with industries allow students to apply theoretical knowledge gained in the classroom to real-world scenarios. This hands-on experience is invaluable in helping them understand how concepts are implemented in practice.

Working with industry professionals exposes students to the skills and competencies that are in demand in the workforce. This can include technical skills, problem-solving abilities, communication skills, and teamwork, all of which are essential for success in the professional world.

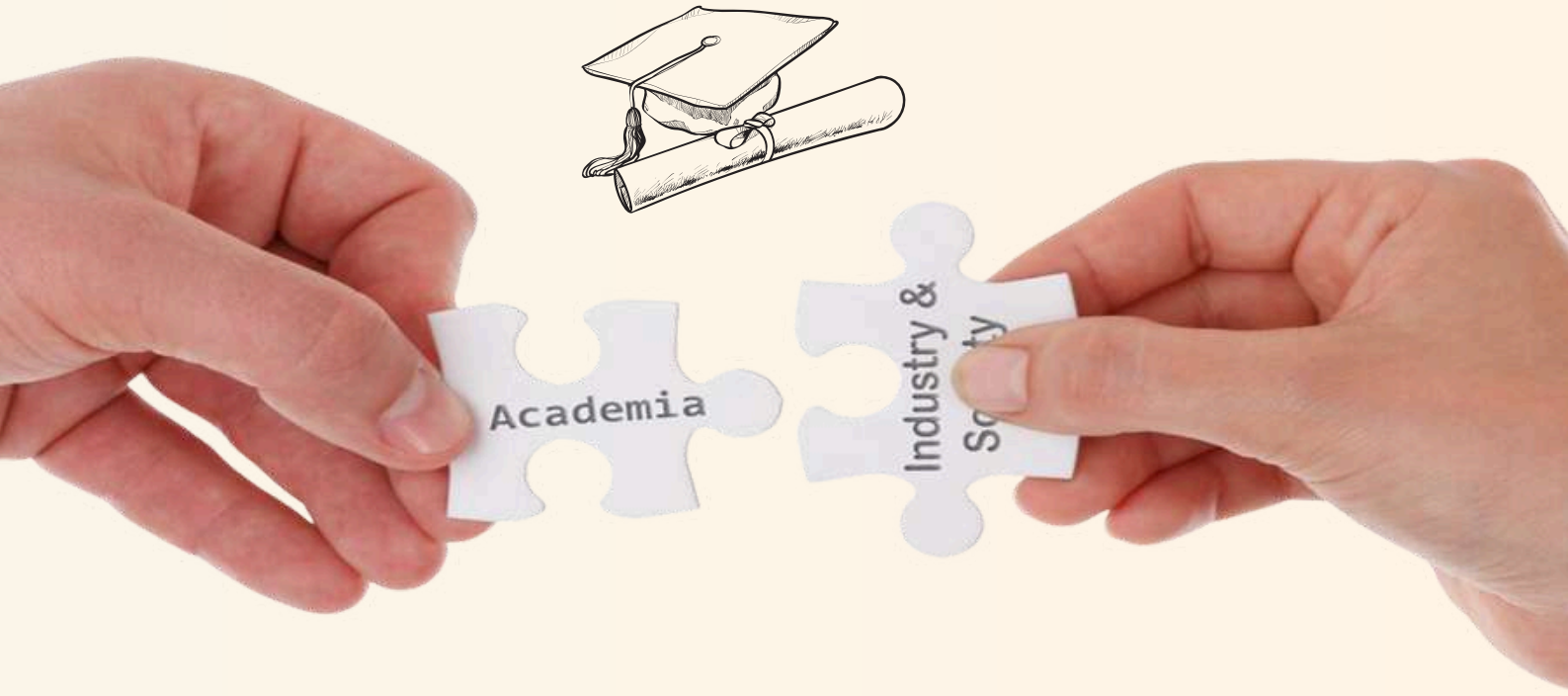
Collaboration ensures that educational programs are aligned with industry needs. This helps in designing curricula that are up-to-date and relevant, preparing students for the current demands of the job market.

STUDENTS GET THE CHANCE TO BUILD A NETWORK OF CONTACTS WITHIN THE INDUSTRY, which can be beneficial for future job opportunities. Industry collaborations often involve mentorship programs, workshops, and networking events, providing students with exposure to potential employers.

Students who have exposure to real-world industry experiences are better equipped to compete globally.

They bring a practical understanding of industry practices and challenges, making them more adaptable and attractive to employers on an international scale.

> "The symbiotic relationship between academia and industry creates a win-win situation that benefits students, institutions, and society at large."
>
> -Prof. P.P. Mathur



Institute of Life Sciences Bhubaneswar

Dr. Debasis Dash is the Director of the Institute of Life Sciences (ILS). With a distinguished career, Dr. Dash has made significant contributions to various scientific domains, showcasing his extensive expertise in Sequence Analysis, Genome Informatics, Bioinformatics, Systems Biology, and Proteomics.

Under his leadership, ILS has made strides in advancing our understanding of complex biological systems. Dr. Dash's work not only bridges gaps in fundamental research but also paves the way for innovative applications in health and disease management. His commitment to excellence and his pioneering research continues to inspire and drive progress in the life sciences community.

Dr. Debasis Dash
Director of ILS

Q AI in computational biology & its broader societal impact.

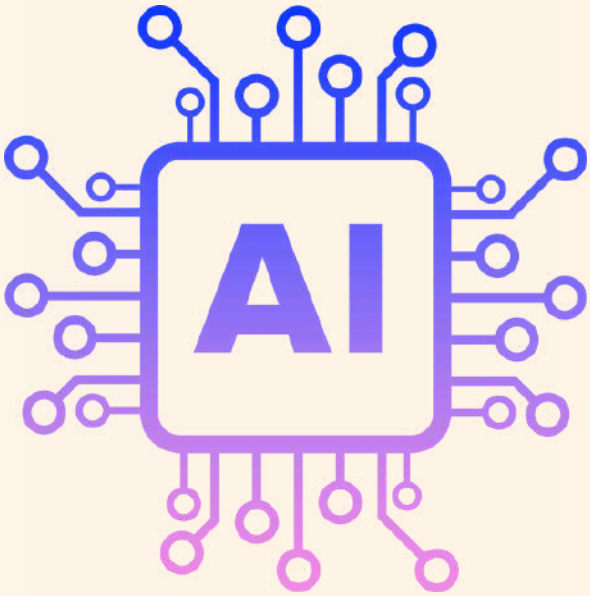
A Emerging AI technologies in computational biology transform healthcare, drug discovery, education, and environmental conservation.

AI Revolutionizes Data Analysis

in computational biology and bioinformatics, enabling discoveries in disease diagnostics, prognostics, and therapeutics. AI algorithms analyze medical imaging data for early disease diagnosis, as seen in

Qure.AI's algorithm for detecting Covid-19 from chest X-rays.

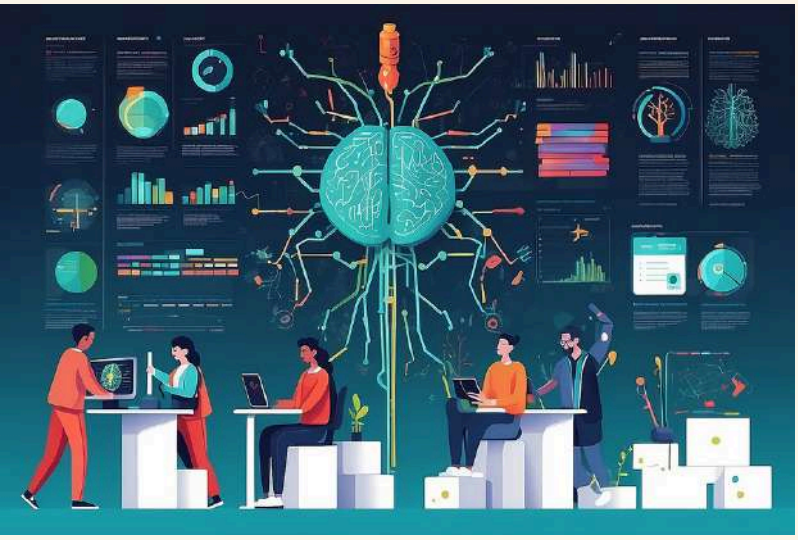
Another shining example of how such technologies can enable disease surveillance at mass level, is **The Arogya setu app. Recently, IIT Kharagpur has developed a portable, user-friendly, and non-invasive device for detecting oral cancer using such techniques.** AI accelerates drug discovery by predicting drug efficacy and safety, identifying drug targets, and enabling precision medicine by analyzing individual patient data. **AI-related startups** are extending **healthcare to remote areas, potentially positioning India as a global healthcare leader.**



AI also aids environmental conservation by analyzing environmental and biodiversity data to monitor ecosystems and combat illegal wildlife trade.

However, widespread **AI use raises ethical and societal concerns, including privacy issues and algorithmic bias.** Despite these challenges, **AI enhances education with accessible educational tools** and improves workforce development, particularly in healthcare. AI integration into the computational biology curriculum **necessitates capacity-building efforts** to train researchers and professionals in AI technologies.

> "Overall, AI in computational biology offers transformative benefits, but its ethical use and societal impacts require careful consideration."
>
> -Dr. Debasis Dash



Q Computational biology to address local or regional issues like healthcare, biodiversity conservation, or agricultural sustainability.

A Odisha faces several challenges in healthcare, biodiversity conservation, and agricultural sustainability.

Computational biology offers approaches for addressing some of these issues through data-driven approaches and predictive modeling. However, it will require collaborative efforts involving educators, researchers, policymakers, health and other professionals along with local communities (e.g. panchayats) to exploit the potential of computational biology and AI.

Some of the applications are described below:

HEALTHCARE

Odisha faces challenges in healthcare, biodiversity conservation, and agricultural sustainability.

Computational biology can help address some of these issues through data-driven approaches and predictive modeling. However, collaborative efforts are needed among educators, researchers, policymakers, health professionals, and local communities. In healthcare, computational biology can aid in personalized medicine, disease risk assessment, and treatment prediction. It can also analyze the relationship between food habits and disease prevalence. Diagnostic and prognostic tools have been developed to improve disease diagnosis and treatment in rural and remote areas.

BIODIVERSITYC ONSERVATION

Odisha's has great biodiversity.

However, it is threatened by habitat loss due to deforestation, urbanization, pollution and climate change etc. Computational models can predict the impact of climate change on species distribution and help in designing conservation strategies.

The AI models can help assess the economic value of biodiversity e.g. cataloging and alternate uses of medicinal plants and ecosystem services, aiding in policy-making and conservation planning.

AGRICULTURAL SUSTAINABILITY

Odisha's agriculture is vulnerable to climate variability, including erratic rainfall and extreme weather events e.g. cyclone etc.

Degradation of soil health due to erosion, salinization, and nutrient depletion is a challenge. AI-based models can simulate crop growth under different climatic conditions and help in optimizing agricultural practices. Genomic tools can be used for breeding high-yielding and stress-tolerant crop varieties.

Though Odisha faces several challenges in healthcare, biodiversity conservation, and agricultural sustainability, AI and computational biology offer opportunities to address such issues through data-driven approaches.

Ama KrushAI is an agro chatbot launched in Odisha to inform farmers about best agronomic practices, government schemes, and loan schemes from many commercial and cooperative banks.

It is heartening to note that recently **"Odisha for AI" was launched,** a self-learning online program to raise public awareness about Artificial Intelligence. Initiatives such as these can transform people's livelihoods, leading to the development of innovative solutions in healthcare, biodiversity conservation, and agriculture.

Q What are the main drivers behind the growth of Science and Technology startups in India and their impact on the technological landscape?

A The main driver behind S&T start-ups is the

created over the last few years.

contributes to science-based entrepreneurship. The last decade has witnessed a steep growth in the emergence of incubators, providing the much-required impetus to the mass of enthusiastic individuals brimming with ideas to take up this avenue. The S&T start-ups are contributing to the technological landscape substantially by providing cost-effective solutions to customers. These solutions reach potential users at affordable cost and reasonable time.

Q What opportunities and challenges do you see for the Science & Technology sector in India, and how can government policies further boost its growth?

A The opportunities in the S&T sector in India are immense.

The funding opportunities for R&D across various sectors, including both basic and applied research, to promote innovation and technological advancements have given a boost to the sector. The government's initiatives have been especially helpful in establishing public-private partnerships. The public-private partnerships, coupled with encouraging corporate investment in R&D, are likely to contribute significantly to the S&T scenario in the upcoming years in India.

In addition, the last few years have seen an expansion in research infrastructure facilities to a world-class level. **The challenge that is in front of us is to train our existing manpower to utilize the world-class infrastructure available.** Brain gains from trained Indian scholars will strengthen the vibrant scholar pool. We need to focus on the n

and solve the various issues society is facing.

Q How does DBT-ILS collaborate nationally and internationally to boost research capabilities and elevate India's position in global science?

A The objective of the Institute of Life Sciences (ILS) is human health and welfare, with core strengths in Infectious Diseases, Cancer Biology, Genetic & Autoimmune Disorders, and Plant and Microbial Biotechnology.

It uses cutting-edge technology to gain insights at cellular and molecular levels, including bioinformatics, pathogen biology, cancer biology, biomaterials, nanotechnology, and plant biotechnology. ILS aims to create trained scientific personnel in modern biosciences and biotechnology research, supported by infrastructure such as research facilities, genomics and proteomics platforms, flow cytometry, imaging facilities, and a small animal facility adhering to international standards. Additionally, it has a state-of-the-art zebrafish facility and an animal BSL-3 and immunogenicity platform. **ILS is focused on commercializing in-house technologies and promoting entrepreneurship among its faculty and students.** It aims to expand its **research programs internationally through collaborations** with similar research groups. Scientists at ILS are disseminating their research activities on **several national & international platforms.** Researchers at ILS publish their **findings in peer-reviewed international journals and engage in international collaborative research programs, with efforts to strengthen these collaborations further.**

Dr. Sakthi Saravanan Chinnasamy

Associate Professor at the Department of Earth Sciences, Indian Institute of Technology Bombay (IIT Bombay)

Dr. Sakthi Saravanan Chinnasamy is an Associate Professor at the Department of Earth Sciences, Indian Institute of Technology Bombay (IIT Bombay), Powai, Mumbai, India. With over fifteen years of experience in teaching and research, Dr. Chinnasamy specializes in the field of Economic Geology. Before his current role at IIT Bombay, Dr. Chinnasamy served as an Assistant Professor at NIT Rourkela for four years. His expertise encompasses ore petrology, hydrothermal and magmatic-hydrothermal ore systems geochemistry, fluid inclusion studies, and stable isotopes.

Dr. Chinnasamy is highly skilled in geological fieldwork, the preparation of geological maps, and the independent collection, assessment, and interpretation of various geological data and samples both in the field and laboratory settings. At IIT Bombay, Dr. Chinnasamy continues to contribute significantly to the academic and research community, inspiring students and colleagues with his dedication and expertise.

Q How does economic geology contribute to identifying and extracting critical minerals for sustainable development?

A Economic geology is the fundamental science for Resource Identification. healthcare, drug discovery, education, and environmental conservation.

Economic geologists study the Earth's crust to identify mineral deposits that contain critical elements essential for various industries such as modern technology, renewable energy, and healthcare. By understanding geological processes, they can pinpoint target locations where these minerals are to be found. **Economic geologists develop and apply advanced exploration techniques** such as remote sensing, geophysical surveys, and geochemical analysis to **locate mineral deposits.**

These methods assess **the potential of an area for mineral extraction without extensive drilling or excavation, reducing environmental impact and exploration costs. Economic geologists create models** of mineral deposits based on geological data, which helps **to understand the formation and distribution of critical minerals.** This knowledge is crucial for predicting where similar deposits may occur and guiding exploration efforts. **Economic geologists evaluate the environmental impact of mineral extraction processes and develop strategies to minimize negative effects.**

They assess factors such as water usage, waste management, and habitat disruption to ensure sustainable extraction practices. **Economic geologists collaborate with engineers and scientists to develop innovative technologies** for mineral extraction. This includes in-situ leaching, bioleaching, and recycling methods, which can improve resource efficiency and reduce environmental footprint.

Economic geologists contribute to sustainable supply chains for critical minerals by identifying potential sources, assessing their viability, and evaluating geopolitical risks associated with their extraction.

This assists in diversifying supply sources and reducing dependence on a few regions or countries. **Economic geologists provide expertise to policymakers and regulatory agencies to formulate laws and regulations that promote responsible mineral extraction practices.**

This includes measures to mitigate environmental damage, ensure fair labor practices, and support local communities affected by mining activities.

In summary, economic geology serves as a foundation for sustainable development by identifying, characterizing, and extracting critical minerals in an environmentally and socially responsible manner.

By integrating geological knowledge with technological innovation and policy initiatives, economic geologists play a vital role in meeting the growing demand for essential resources while minimizing negative impacts on the planet.

Q What advanced technologies aid in the efficient extraction and processing of critical minerals?

A ***Remote sensing techniques, such as satellite imagery and aerial surveys, provide valuable geological information for identifying potential mineral deposits.***

These technologies help geologists map large areas quickly and identify anomalies indicative of mineralization, reducing the need for extensive ground exploration.

Geophysical Methods,

including magnetometry, gravimetry, and seismic surveys, help in characterizing subsurface geological structures associated with mineral deposits. By measuring variations in physical properties, these surveys can delineate mineralized zones and guide exploration efforts more accurately.

Advanced Geochemical Analysis

techniques, such as mass spectrometry and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS), enable precise identification and quantification of trace elements in mineral samples. This information is crucial for assessing the economic potential and quality of mineral deposits.

3D Modeling & Visualization

software allows geologists to create detailed representations of mineral deposits and their surrounding geological features. These models facilitate a better understanding of deposit geometry, structure, and spatial distribution, optimizing extraction plans, and minimizing waste.

Advanced Drilling Technologies,

including diamond drilling, directional drilling, and automated drilling systems, improve the efficiency and accuracy of exploration drilling. These technologies enable deeper penetration into the Earth's crust and provide high-quality core samples for geological analysis.

In-Situ Leaching (ISL) and Bioleaching

are environmentally friendly techniques used for extracting minerals from ore bodies without the need for traditional mining methods. These methods involve injecting leaching solutions or microbial agents into the ground to dissolve target minerals, which are then recovered through wells or collection systems.

Hydrometallurgical Processes,

such as leaching, solvent extraction, and electrowinning, are used to extract and purify metals from mineral concentrates or ores. These processes are more environmentally sustainable compared to traditional pyrometallurgical methods and can recover metals from low-grade or complex ores.

Advanced Separation Technologies,

including flotation, magnetic separation, and gravity separation, help in concentrating valuable minerals from ore streams with high efficiency and precision. These technologies improve mineral recovery rates and reduce the environmental impact of processing operations.

Recycling Technologies

play a crucial role in recovering critical minerals from end-of-life products and industrial waste streams.

Advanced recycling processes, such as hydrometallurgical recycling and urban mining techniques, enable the recovery of valuable metals from electronic waste, batteries, and other recyclable materials.

Overall, these advanced technologies contribute to the efficient and sustainable extraction and processing of critical minerals, ensuring a reliable supply of essential resources for various industries while minimizing environmental impact and resource depletion.

Artificial intelligence (AI)

has been increasingly applied in mineral exploration due to its ability to analyze vast amounts of data, recognize patterns, and make predictions.

AI is specifically used in the above-mentioned fields and beyond such as Data Analysis and Integration, Target Identification, Drilling Optimization, Remote Sensing and Imaging, Machine Learning for Predictive Modeling, Geological Data Interpretation, Risk Assessment and Decision Support, Environmental Monitoring and Mitigation.

AI is revolutionizing mineral exploration by enabling faster, more accurate, and cost-effective identification of mineral deposits, ultimately contributing to the sustainable development of mineral resources.

Q What are the main challenges and opportunities in India for economic geology, particularly in exploring and using critical minerals?

A ***Main Challenges in India for economic geology, particularly in exploring and using critical minerals are listed here:***

Infrastructure Constraints

Limited infrastructure, particularly in remote and geologically challenging areas, makes exploration and mining operations more difficult and costly. Improving infrastructure, such as transportation networks and power supply, is essential for unlocking the full potential of India's mineral resources.

Limited Exploration

India's geological potential is still relatively underexplored compared to other countries such as Australia, Canada, and South Africa which have similar geological settings and crustal environments. A lack of comprehensive geological mapping and exploration data hinders the identification of potential mineral deposits, including critical minerals.

Environmental Concerns

The mining industry in India often faces criticism for its environmental impact, including deforestation, water pollution, and habitat destruction. Implementing stringent environmental regulations and promoting sustainable mining practices are necessary to minimize these impacts.

Regulatory and Permitting Issues

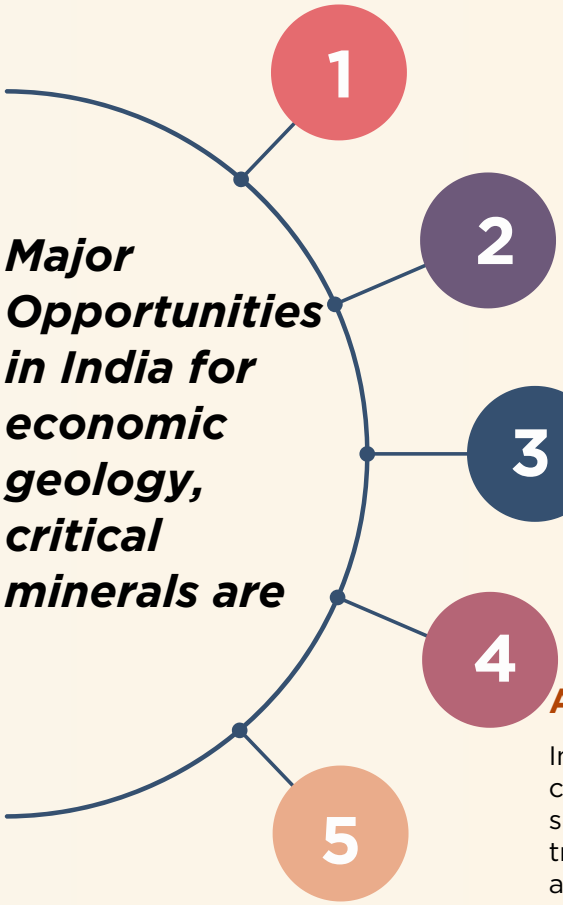
Complex regulatory frameworks, existing mineral auction policy and bureaucratic hurdles can delay exploration and mining projects, discouraging investment in the sector. Streamlining permitting processes and providing clearer guidelines for mineral exploration and extraction would attract more private investment.

Skill Shortages

There is a shortage of skilled professionals, including geologists, engineers, and technicians, with expertise in economic geology and mineral exploration. Investing in education and training programs to develop a skilled workforce would support the growth of the mining sector.

Rich Geological Endowment

India is geologically diverse and hosts significant mineral resources, including several critical minerals such as rare earth elements, lithium, and cobalt. Exploring and developing these resources could reduce India's dependence on imports and stimulate economic growth.



Renewed Focus on Exploration

Renewed Focus on Exploration: The Indian government has shown a renewed interest in mineral exploration and development through initiatives like the National Mineral Exploration Policy (NMEP) and the auction of mineral blocks with series of amendments. Encouraging public-private partnerships and incentivizing exploration activities could accelerate mineral discovery & development.

Technological Advancements

Advances in exploration technologies, such as remote sensing, geophysical surveys, and data analytics, offer new opportunities for identifying mineral deposits more efficiently and cost-effectively. Embracing these technologies could enhance exploration success rates and reduce exploration risks.

Attractive Investment Environment

India's growing economy & expanding industrial base create opportunities for investment in the mining sector. Streamlining regulations, improving transparency, and offering fiscal incentives would attract both domestic & foreign investment in mineral exploration & development projects.

Demand for Critical Minerals

The increasing global demand for critical minerals, driven by trends such as the transition to renewable energy and electric vehicles, presents an opportunity for India to capitalize on its mineral resources. Developing domestic sources of critical minerals would enhance energy security and support the country's industrial growth.

Hence, addressing the challenges and seizing the opportunities in economic geology is essential for India to harness its mineral potential effectively, achieve self-sufficiency in critical minerals, and promote sustainable development.

> "Collaboration between government, industry, and academia is crucial for realizing these goals and maximizing the socio-economic benefits of mineral resource development."
>
> -Dr. Sakthi Saravanan Chinnasamy

Q How can collaborations between BCKIC Foundation, IIT Bombay, and national & international partners, enhance the sourcing and utilization of critical minerals?

A ***Collaborations between the BCKIC Foundation, Indian Institute of Technology Bombay (IITB), and national and international partners though a Memorandum of Understanding (MoU) can significantly enhance the sourcing and utilization of critical minerals in several ways such as:***

Research & Development

These institutions can collaborate on research and development projects focused on critical minerals exploration, extraction, processing, and utilization. By pooling their expertise in geology, metallurgy/materials science, engineering, and other relevant fields, they can develop innovative technologies and methodologies to improve the efficiency & sustainability of critical minerals sourcing and utilization.

Data Sharing & Analysis

Collaborative efforts can involve sharing geological, geochemical, and geophysical data to enhance understanding of mineral deposits and their geological settings. By combining datasets from different sources and applying advanced data analysis techniques, researchers can identify new mineralization targets and optimize exploration strategies.

International Partnerships

Engaging with international partners, including research institutions, universities, and industry players, from for example UK and Australia, can provide access to expertise, funding, and markets. Collaborative projects with international partners can leverage diverse perspectives, resources, and capabilities to address common challenges and capitalize on emerging opportunities in the global critical minerals market.

Hence in general, collaborations between BCKIC Foundation, IIT Bombay, and national and international partners can catalyze innovation, build capacity, foster knowledge exchange, and promote sustainable development in the critical minerals sector, ultimately contributing to India's economic growth and competitiveness in the global market.

Technology Transfer and Commercialization

Collaborations can facilitate the transfer of technologies & know-how from research institutions to industry partners for commercialization. This can accelerate the adoption of innovative technologies for critical minerals extraction, processing, and value addition, driving economic development and competitiveness in the sector.

Training & Capacity Building

Collaboration between academic institutions like IIT Bombay and research organizations like BCKIC Foundation can facilitate training and capacity building programs for students, researchers, and industry professionals. These programs can focus on critical minerals exploration, mining, processing, & environmental management, ensuring the availability of a skilled workforce to support the sector's growth.

Policy Support and Advocacy

Collaborations can also involve engaging with policymakers and govt. agencies to advocate for policies and regulations that support sustainable development and responsible utilization of critical minerals. By providing evidence-based research and recommendations, these institutions can influence policy decisions & create an enabling environment.

Supply Chain Integration

Collaboration along the entire critical minerals supply chain, from exploration and extraction to processing and manufacturing, can enhance supply chain integration and resilience. By working together, we can identify potential bottlenecks, mitigate risks, and optimize supply chain efficiency to ensure a stable and reliable supply of critical minerals for various industries.

Q How do you envision the role of S&T clusters, specifically BCKIC Foundation in Odisha in advancing sustainable development in critical minerals and beyond?

A S&T clusters like BCKIC Foundation in Odisha can play a pivotal role in advancing sustainable development in critical minerals and beyond by focusing on the following key areas:

Research & Innovation

Spearhead research and innovation initiatives aimed at exploring, extracting, and sustainably utilizing critical minerals. By leveraging the expertise of scientists, engineers, & researchers, BCKIC Foundation can develop cutting-edge technologies and methodologies for mineral exploration, processing, and value addition, with a focus on minimizing environmental impact and maximizing resource efficiency with establishing a suitable multi-Inter disciplinary centre of excellence in mineral exploration and extraction.

Capacity Building

Contribute to capacity-building efforts by providing training programs, workshops, and skill development initiatives for students, researchers, and industry professionals. These programs can focus on critical minerals exploration, mining techniques, mineral processing, environmental management, and sustainable development practices, ensuring the availability of a skilled workforce to support the sector's growth.

Collaboration and Partnerships

Foster collaboration and partnerships with academic institutions, research organizations, government agencies, and industry players to create a vibrant ecosystem for innovation and knowledge exchange. Collaborative projects and initiatives can leverage diverse perspectives, resources, and capabilities to address common challenges and capitalize on emerging opportunities in the critical minerals sector.

Technology Transfer and Commercialization

Facilitate the transfer of technologies and know-how from research institutions to industry partners for commercialization. By supporting technology transfer initiatives and providing incubation support, they can accelerate the adoption of innovative technologies for critical minerals extraction, processing, and utilization, driving economic development and competitiveness in the region.

Policy Advocacy & Advisory Services

Engage with policymakers, government agencies, and regulatory bodies to advocate for policies and regulations that support sustainable development and responsible utilization. By providing evidence-based research, policy analysis, and advisory services, the cluster can influence policy decisions and create an enabling environment while ensuring environmental protection & social welfare.

Community Engagement & Social Responsibility

Promote community engagement and social responsibility initiatives to ensure that the benefits of mineral development are shared equitably among local communities. By fostering dialogue, participation, and partnership with stakeholders, the cluster can address socio-economic concerns, mitigate negative impacts, and promote inclusive and sustainable development in the region.

> **By leveraging its resources & capabilities, BCKIC Foundation can contribute to the economic prosperity, environmental stewardship, and social well-being of the region and beyond.**

Dr. Ajit Pattnaik, the Vice President of Wetlands International South Asia, is a distinguished leader in the field of wetland conservation. With over 35 years of experience in the Indian Forest Service, He has specialized in wetland, lake basin, and coastal zone management, showcasing a deep commitment to environmental conservation and sustainable development.

As the former Chief Executive of the Chilika Development Authority, he led the acclaimed ecological restoration of Chilika Lagoon. His expertise extends to international forums, where he has represented India. Dr. Pattnaik continues to advise government, academic, and private sectors on natural resource management.

Dr. Ajit Pattnaik

Vice President of Wetlands International South Asia

Q With your extensive background in conservation and development, how do you view the role of Science and Technology in shaping environmental policies and practices in India?

A ***From the outcomes of several studies, there is strong evidence that ecosystem resilience is tied to biodiversity.***

Nevertheless, the impact of climate change on biodiversity and food security has been recognized, but little is explored compared to the magnitude of this problem globally. Conserving and restoring natural spaces, and the biodiversity they contain by adopting the technology is essential for limiting emissions, enhancing resilience, and adapting to climate change impacts on the ecosystems.

Climate change is happening due to **natural factors** and **human activities**.

It expressively adversely impacts biodiversity and food security.

Therefore, **Biodiversity Conservation, Wise use of Natural Resources, Promotion of Traditional Ecological Knowledge, and Adoption of Nature-based Solutions** are essential to reduce further biodiversity loss, enhance food security, and mitigate climate change impacts.

Mainstreaming biodiversity considerations into science-informed policies, and strategies of key public and private sectors that impact or rely on plant and animal resources would be the first step in shaping environmental policies and practices in India.

Massive awareness about biodiversity and the **multiple values and ecosystem services** they provide for human well-being, culture, and sustainable development needs to be generated at all levels so that they are widely understood and to identify and overcome barriers to behavior changes required for a step change in the human relationship with the ecosystem and nature.

Q What technological advancements do you find most impactful in the conservation and management of wetlands?

A The most impactful technological advancement in the conservation and management of wetlands is the

Integrated Framework for Wetland Inventory, Assessment, & Monitoring (IF-WIAM).

Considerable attention has been laid to the importance of **wetland inventory**, **assessment**, and **monitoring** as a tool globally for the conservation and management of wetlands to maintain the ecological character of wetlands.

Containing over 90% of the world's liquid surface freshwater; the most readily accessible; high resource values and providing a host of ecosystem services that are vital for human well-being, wetlands assume high conservation priorities. Despite this unfortunately, the loss of wetlands has been much faster in the 20th and 21st centuries, with a loss as high as 64-71% since 1900 AD. Concerned with this alarming trend, the Ramsar Convention has developed several guidelines and tools to be adopted by the contracting parties to prioritize the conservation of wetlands and to halt the loss of wetlands in their respective territories.

As per the National Wetland Atlas, 2011, **15.26 million ha of wetlands** are the **major natural water infrastructure in India**. Conservation of these wetlands is of paramount importance. **Ministry of Forest, Environment & CC** have enacted **Wetland (Conservation and Management), Rules, 2017** as a regulatory regime for conserving wetlands in India. As per the provision of the rule the **"State Wetlands Authorities"** are designated as the policy-making and regulatory agency at the state level. Guidelines for implementing the **Wetland Rule** are issued, and funding support is provided under the **National Plan for Conservation of Aquatic Ecosystems (NPCA)** to conserve and manage **the wetlands in respective States and UTs**.

Q Could you provide insights into Wetlands International South Asia's role in sustainable livelihoods, community engagement, and scientific research within the S&T Cluster?

A Wetlands are often viewed as wasteland and are soft targets of being drained and converted for development and other land uses.

Wetlands have been alarmingly lost through drainage and conversion, and much of the rest have been degraded. As wetlands are lost, people are deprived of their ecosystem services too. As water, land, and food demand increases and climate change intensifies, wetlands are under more pressure. **Wetlands International South Asia with its headquarters in New Delhi**, works exclusively for wetland conservation in ways that relate to the **nature of wetlands as ecosystems**, and the wider ecological and social contexts in which they are placed and function across South Asia, through the operation of a Regional South Asia Platform for wetlands conservation and wise use.

WISA works with **NATIONAL AND STATE GOVERNMENTS, KNOWLEDGE CENTERS, CIVIL SOCIETY, and the PRIVATE SECTOR** often acting as catalysts to enable joined-up actions. The **dependence of local communities on wetlands** for **food, water**, **construction materials**, and **protection against flood**, **drought**, and **saltwater** intrusion is **crucial**. Hence the **maintenance of healthy wetlands is important for poverty alleviation and food security**.

Since securing a positive change in the status of degraded wetlands and linked livelihoods takes considerable time, **WISA works for long-term engagement, forging strategic and innovative partnerships to foster participatory management of the wetlands and their basins.** One of the core competencies of WISA is the **capacity development of wetland managers** in applying integrated approaches.

A multidisciplinary team within the organization and **expert network** enables providing evidence-based scientific and technical advice to national and state governments, wetland authorities, civil society, and the private sector on various aspects of wetland management. One of the **priority areas of the plan for the wetlands** **FORMULATION OF THE INTEGRATED MANAGEMENT** has been with a thrust on participatory management of wetlands with a focus on the wise use of resources and the livelihood of local communities.

Q What do you see as the main challenges and opportunities in using S&T to address environmental issues in India, and how do you envision your role in this effort?

A India is a mega-diverse country both culturally and biologically. It hosts seven to eight percent of all recorded species, four global biodiversity hotspots, ten biogeographic, and fifteen agro-climatic zones. India's emerging transformative economy is at an early stage.

Technological advances can, of course, **contribute analytically to effective smart governance**. But technological advances based on the outcomes of **the R&D and technology, alone may not be able to address the fundamental sustainability issue** that environmental governance must address. While environmental governance is becoming more comprehensive, the **path and pace of development are constantly redefining the problems it faces**. Healthy ecosystems are at the heart of development, underpinning societal well-being and economic growth. **Sustainable management**, and **protection of land**, **rivers**, and **oceans adopting appropriate technology** and **nature-based solutions**, will ensure that the country has adequate food and water and is resilient to climate change and disasters. **Shift to green and blue economic pathways**, can sustain work for billions of people

backed by a science-based policy and decision-making system. Environmental policies require public participation and engagement to define the desired state and goal for technology, offering the opportunity to integrate multiple perspectives in policy-making and environmental governance.

In summary, India faces complex environmental challenges, but its commitment to sustainable development and the fusion of tradition and modernity provides a foundation for positive change where S&T plays a pivotal role.

Q What advice would you give to professionals aiming to effectively integrate S&T in environmental conservation and sustainable development?

A Humanity faces a plethora of environmental challenges; among them, are resource depletion, ecosystem service deterioration, pollution, biodiversity loss, and climate change.

Environmental problems are products of complex, often nonlinear, interactions between people, policy and outlook, and the environment, and our understanding of them is still incomplete and clouded by profound uncertainties. Sustainable development and the impact of climate change are widely recognized as an existential challenge. However, understanding at the policy level often denies environmental imperatives, creating substantial barriers.

Environmental science plays an important role in enabling understanding and communicating complexities. While there is a clear role for environmental science in the production of knowledge, environmental technology has a distinct role in facilitating social change. **There is a need for a new approach to make practical use of R&D outcomes, bring public understanding to the support of science, and teach, negotiate, facilitate, and deal with complex ethical and policy issues.**

Environmental technologists will promote participatory thinking and a holistic understanding of our dependence on nature and its vulnerability to human actions.

They will collaborate with policymakers, stakeholders, and the public **to define environmental problems and support society in implementing integrated, interdisciplinary, and holistic solutions**. This process may require

TRANSFORMATIVE INNOVATIONS, CHANGES IN INDUSTRIAL PRACTICES, & NEW ENVIRONMENTAL POLICIES.

> “Environmental challenges require a new contract between science, technology, and society, one that recognizes the importance of all three and delivers synergies enabling all of them to reach their full potential to foster sustainable development.”

-Dr. Ajit Pattnaik

Foundation india

Mrs. Sarita Bahl is the Former Director of Erstwhile Bayer Foundation India and the Country Group CSR Head for South Asia. With a strong background in coaching and mentoring, she holds an Associate Certified Coach (ACC) credential from the International Coaching Federation (ICF) and is an accredited Senior Practitioner with the European Mentoring & Coaching Council (EMCC).

Mrs. Bahl's leadership at Bayer Foundation India drives impactful corporate social responsibility initiatives and fosters innovation in the region. Her dedication to sustainable development and social impact underscores Bayer's commitment to making a positive difference in communities across South Asia.

Mrs. Sarita Bahl
Former Director-Bayer Foundation India and Country Group CSR Head-South Asia

Q As the Director of Bayer Foundation India, how do you view the role of corporate foundations in promoting innovation and sustainable development?

A ***At Bayer, science and innovation are at the heart of everything we do.*** With a history of more than 120 years in India and core competencies in the areas of healthcare and agriculture, we provide solutions to some of the world's most pressing challenges. The foundation works to drive positive societal change supporting our purpose **"Science for a Better Life"** and fueling our mission **"Health for all, Hunger for none"**.

The programs under our Corporate Societal Engagement (CSE) function are aligned with the global objectives of Bayer while pursuing a long-term, well-planned, multi-stakeholder participatory approach that results in creating a measurable impact on targeted communities. They are implemented and executed through Bayer Foundation India (BFI).

In 2020, Bayer CSR reframed its strategy to look at building long-term impact-driven programs across rural communities.

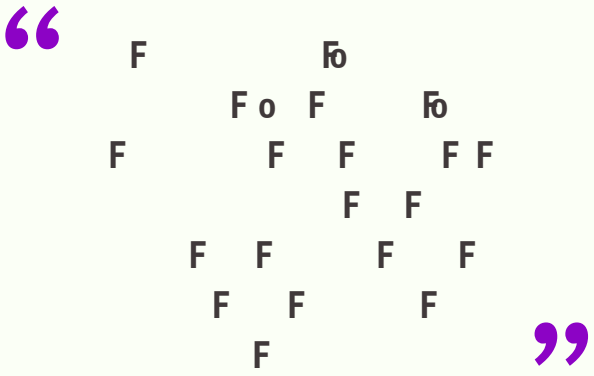
As we held discussions with our stakeholders, the lack of development across aspirational districts came up again and again. Here were districts that were low on indices of prosperity. They lacked accessibility to major transport networks. The communities had limited or no means to harness the benefit of technology, resources, and new skills. Women had very little say in being agents of change. It was clear to us that the path to a new transformational India lay through change in the aspirational districts. This means, our programs and interventions had to be innovative and at the same time, sustainable.

The convergence of corporate initiatives and their impact at the grassroots level is a crucial aspect for achieving both scale and sustainability.

The real challenge lies in translating these high-level commitments into tangible transformations at the grassroots level within the intricacies of value chains. That is what we aim to do through our foundation.

Q With your background in coaching and mentoring, how can mentorship programs contribute to fostering leadership in the science and technology sectors?

A From a very young age women are taught to be risk averse – don't do this or don't go there, it is unsafe...the result is that most of them grow up hesitant to take risks. And that includes taking career risks – which job to join, what is the future like, decisions that relate to negotiations when it comes to salaries, investments, studying STEM, and joining the financial sector, amongst others.



The process of coaching often unlocks previously untapped sources of imagination, productivity, and leadership.

Coaching is about reflective inquiry wherein the individual is encouraged to find their own answers. It is seeded in the belief that we all have the potential to find solutions on our own.

Mentorship is more about subject matter expertise and guidance. I would say, we need both at times. When you empower the team to make decisions and take action irrespective of whether it is through coaching or mentoring, you are actually building future leaders. **These are enabling tools and can act as a nudge and/or a mirror that makes us act, progress in our thoughts, expand our thinking and get going**.

Q Reflecting on your journey, what advice do you have for women aspiring to leadership roles in the fields of science, technology, and corporate governance?

A The biggest hindrance for women professionals from taking the next leap in their careers stems from, **low confidence in their own capabilities and competencies. Imposter syndrome threatens to overtake women**. Sometimes, the quest for perfectionism can also act as a barrier.

LEADERSHIP
is about creating a
Positive Change

Now you don't have to be designated as a leader to do this!

> **Being passionate about what you truly believe in, compassion and empathy, humility and courage to chart your own journey – this is what leadership is all about.**

As a student, you can be a leader. As an individual contributor, you can be a leader. Leadership in this sense is gender agnostic and does not confine itself to any specific role. **It is universal and omnipresent**. We just need to tap it within ourselves.

Imagine if each one of us with our actions and deeds could create an enabling environment...imagine how the world would change. For me,

Leadership Begins with Self.

You are a leader if you are someone who wants to change herself/himself. Leadership is also about communication. **Being clear. Being consistent. Being honest. Open to listening.** As a communicator, I have learned along the way that it is also about **Trust** and **Integrity**.

Remember, that our professional growth will stem from our personal growth and not the other way around.

Q How can organizations effectively align their corporate social responsibility initiatives with national development goals?

A There are three aspects to consider when designing an effective and impactful CSR strategy. The first is to have a **look at your organization's business priorities.** Then **look at the country's priorities.** And last, to **select the best geography** you may want to consider the human development index to zero on communities that can best benefit from the interventions designed. For instance, there is a lot of emphasis by the government on empowering woman. If DEI is critical to your organization, explore how the CSR programs can then be designed in a way that the main beneficiaries are women and it is about their **growth and/or livelihood, education, financial literacy, etc.**

Q What strategies can corporations employ to ensure effective governance in the rapidly evolving landscape of science and technology?

A Effective governance is critical not just for science and technology but for every field. It follows a bouquet of practices – for example,

Clear Policies and Guidelines, Framework for Working with Integrity, and a **Structure for Ensuring Compliance.**

Corporations will need to **continuously review these practices** because of the evolving nature of science and technology.

However, this will work only if corporations have the ***right governance models*** *in place that aim to identify risks along with* ***best practices to mitigate those risks****.*

> "Recognizing the importance of effective communication is central to disseminating authentic information to all stakeholders, internal as well as external."
>
> -Mrs. Sarita Bahl

Ms. Gurvinder B Parmar

Director of Strategy & Partnerships at India Health Fund

Ms. Gurvinder B Parmar serves as the Director of Strategy and Partnerships at India Health Fund, where she plays a key role in driving innovation & partnerships in the healthcare sector. With a background spanning diverse business functions, including Regulatory, International, and Domestic Tax for Corporate and Not-for-profit clients, High Networth individuals, and Business Advisory functions, Parmar brings a wealth of experience to her current role.

Her expertise and strategic vision are instrumental in advancing healthcare solutions and fostering collaborations that address critical health challenges in India. Under Parmar's leadership, India Health Fund continues to be a driving force in catalyzing impactful healthcare innovations for a healthier future.

Q From your perspective, what are the key areas in science and technology that require focused attention in India?

A ***India and other LMICs bear an outsized burden of infectious diseases that continue to significantly impact the healthcare and economic budgets leading to sickness, deaths, and loss of productivity.***

The reported global number of people diagnosed with TB in 2022 was 7.5 million, highest since the WHO global TB monitoring began in 1995. On the other hand, mosquitoes transmit diseases like Dengue, Malaria, Chikungunya, etc which account for more than one million deaths annually. Climate change has significant consequences for public health. It is well established that amongst other measures, science and technology-driven innovations can play a disruptive role towards improved health outcomes by offering greater access to the last mile, affordability, efficiency, etc. However, there are critical gaps that impede research, development, validation, and subsequent adoption of promising innovations for healthcare, especially for infectious diseases that have been largely neglected.

Lack of funding for innovation R&D is one of the major hurdles, eg shortage of approx. $13 billion against the UN target of total funds for TB prevention, diagnostics, and treatment services between 2015 to 2020.

There is a dire need for greater spending on research and innovations by the Government, improved incentives for developers, innovative models and tools to attract private enterprise, a stronger collaborative ecosystem to translate innovations from the lab into economic and social goods for healthcare.

Q How does India Health Fund drive health innovations and tech advancements?

A ***India Health Fund is an initiative of the Tata Trusts, set up in 2017*** *as a* pooled mechanism to bring various actors and mobilize resources for public health goals. We rely on a **collaborative approach** for various aspects of our work

Identification of Gaps, Scouting for Promising Innovations, and **Mobilizing Funds** and other **Non-financial Support for the Innovations,**

creating the much-needed evidence and awareness to advocate the cause of infectious diseases.

India Health Fund (IHF) de-risks the development of promising technology through **GRANT FUNDS AND ECOSYSTEM SUPPORT** for science-led solutions with the potential to make a significant difference in the diagnosis, treatment, and prevention of communicable diseases like TB, malaria, dengue, etc. IHF collaborates with public and private sectors to facilitate the development, adoption, and scaling of these solutions, improve health outcomes focusing on primary care and low-resource settings. IHF follows an approach centered around identifying the healthcare gaps in consultation with the public and other health experts and stakeholders.

Most promising innovative solutions are supported for development, pilot scale demonstration, and evidence generation through financial support and enabling ecosystems.

To date, we have supported fifteen innovations through various stages of development, six of these game-changing tools are now in use in public health settings, at a minimal or no cost to patients in the remotest corners of the country.

Q How can strategic partnerships with S&T clusters accelerate health-focused innovations?

A ***India has a very diverse healthcare landscape and faces numerous*** **challenges in fostering health-focused innovations. These challenges span across technology, regulatory, social, and economic domains, impacting the access, affordability, and effectiveness of healthcare systems.** Minimal to noninvasive, easy to use screening and point of care diagnostic solutions which can be used by primary care health workers have the potential to improve and strengthen the delivery of primary healthcare. The fragmented nature of healthcare delivery

systems and the lack of standardized protocols often result in siloed data that hampers information exchange and coordination of care. There is also a need to facilitate and de-risk the deployment of end-to-end solutions by forging partnerships between various stakeholders like incubators, accelerators, research institutions, government agencies, and industry.

S&T clusters have been established to solve issues related to the lack of R&D in India. It aims to create a **shared ecosystem of incubators, research institutions, industry experts, and decentralized R&D.** S&T clusters could accelerate the development of health-focused innovations through coordinated efforts for a robust pipeline of innovations and. ecosystem support for early and translational research. S&T clusters can **also leverage the partnership with funding organizations like CSRs, foundations, and government agencies to provide catalytic support for health innovations.**

India Health Fund's support to innovations at the mid-stage of their development journey complements seamlessly the early-stage support provided by various S&T clusters, ensuring they **do not succumb to the "valley of death"**, instead they have an expedited development pipeline.

As part of IHF's work, we actively collaborate with S&T clusters to support our mission and multiply our impact. For instance, last August, IHF was one of the key knowledge partners for a convening organized by DRIIV on the role of open access in equitable climate and health action for disease prevention, health systems resilience, and financing.(website link to know more - Role of Open Access in equitable climate and health action: disease prevention, health systems resilience, and financing | DRIIV). More recently, IHF in collaboration with partners including BCKIC Foundation had launched a Request for Proposals (website link to know more - Innovations For Screening Or Detection Of Tuberculosis And Vector-Borne Diseases. - India Health Fund) seeking minimally-invasive innovations for screening and

Innovations For Screening Or Detection Of Tuberculosis And Vector-Borne Diseases. - India Health Fund) seeking minimally-invasive innovations for screening and diagnosis of tuberculosis and vector-borne diseases. This January, IHF and BIRAC created India's first public-private partnership pooled fund to finance the development of diagnostics and digital tools to tackle infectious diseases relevant for India and other developing countries, towards bettering equity and access to healthcare.(website link to know more - India Health Fund and BIRAC pool in funds and forces to tackle infectious diseases head on - India Health Fund).

Q What role can digital health solutions play in transforming healthcare accessibility across diverse regions in India?

A Digital technologies have led to increased productivity, economic growth, and innovation across various sectors including healthcare but in a limited way. With a projected global shortage of 10 million healthcare workers by 2030, **digital innovations offer a promising solution to strengthen primary care delivery and data-driven decision support. WHO estimates a billion people could gain better healthcare access and protection through digital technologies**. IHF's work in digital health is focused on **design thinking and evidence generation** including provider-defined use cases, solutions design, validation & evidence generation, community involvement & inclusion, investment cases, models for adoption, and financing.

Digital health technologies, including AI, Machine Learning, and the Internet of Things (IoT), hold significant potential in strengthening the disease care continuum – from diagnostics and screening programs to surveillance and treatment adherence -- especially at the last mile, by enhancing accuracy, speed, efficiency, and effectiveness.

Some examples of digital innovations developed and deployed through IHF's support are:

- **Medprime's AI-based detection**, parasitic load calculation, and species differentiation for faster and more accurate diagnosis of malaria to reduce the workload of clinicians by automating result interpretation for microscopes.
- **Swaasa**, a non-invasive patient-friendly AI-led mobile application that can detect active TB cases in minutes by analyzing cough sounds. It has the potential to screen patients for TB in remote places of India where the traditional healthcare ecosystem couldn't reach.
- **Moskeet**, an intelligent surveillance solution to classify and predict mosquito-borne disease outbreaks enabling quicker and more informed decision making.
- **TMEAD**, a digital pill box that helps TB patients adhere to their treatment reducing dependence on manual efforts by ASHAs.
- **qXR**, an automated chest X-ray screening solution to identify TB within minutes through AI for quicker screening and increasing point-of-care detection.

S&T clusters can help champion seamless development and enable scaled deployment of digital solutions for healthcare.

Q What measures should be taken to foster a more collaborative and innovative ecosystem within the S&T domain in India?

A **S&T clusters offer an intuitive and promising solution for creating vibrant local ecosystems that promote collaboration, innovation, and growth in the science and technology sectors, ultimately contributing to economic and social development**. Below are some of the areas which can be considered to enhance collaboration and innovation:

- **Bridging the gap between academia and industry** is essential for fostering collaboration. Clusters can act as catalysts for enabling industry and sector-led research, transferring technology from research institutions, and enabling the lab-to-market journey more effectively and efficiently. For instance, accelerated development of COVID-19 would not have been possible without effective collaboration between academia and industry.
- S&T clusters should aim to **leverage private sector resources, expertise, and infrastructure under the PPP** (Public-Private Partnership) model to enhance efficiency, accelerate innovation, and create a conducive ecosystem for sustainable development.

- S&T clusters can play a crucial **role in mobilizing, aggregating, and coordinating resources and expertise for areas of national priority** e.g. neglected diseases, AMR, and the impact of climate change on health.
- There is a **need to raise awareness and outreach of S&T clusters** by organizing conferences, workshops, and networking events to facilitate knowledge exchange and collaboration among researchers, entrepreneurs, policymakers, and other stakeholders.
- Clusters can play an important **role in strengthening the ecosystem for entrepreneurship and innovation** by continued funding, mentorship, and incubation support to startups through collaborations.
- Clusters can strengthen overall political commitment, financial resources, and public policies for health. **Encourage the policies required to create a more conducive environment for investment, and product development and delivery**.

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