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THE ESSENCE OF SCIENCE FESTIVALS: IISF- REASON TO REJOICE MAKING EVERY MOMENT COUNTS

EMPOWERING FUTURE THROUGH SCIENCE AND TECHNOLOGY

GEOLOGICAL DISASTERS AND THEIR PLAUSIBLE MITIGATION WITH REFERENCE TO THE UTTARAKHAND HIMALAYA

THE INDIA INTERNATIONAL SCIENCE FESTIVAL- CELEBRATION OF SCIENCE

SHATTERING BOUNDARIES: IASST'S EMPOWERMENT CAMPAIGN FOR NORTHEAST INDIA'S TRIBAL WOMEN

WILL AI TAKE OVER THE WORLD



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Celebrating Science - 9th Edition of India International Science Festival (IISF)

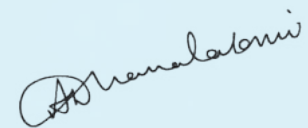
A rich past for a robust present and future - India's excellence inspires pursuits on frontiers of science and technology and societal benefits. Science and technology provide opportunities for citizens to excel in their respective fields and contribute to larger-scale benefits for the country as a whole. The pursuit of knowledge is a unique opportunity for further investigation and enriching knowledge system that could be used for the common wellbeing of all the citizens of the country. There are two important takeaways for policymakers in this context. One is the urgent need to recognize the pervasiveness of science in all spheres of our daily lives. The other is the fact that investments in science should not be seen through the perspective of business models that expect immediate returns. This paradigm is central to ensuring the common good that goes beyond profit motives. Applications of such knowledge systems could emerge in response to locally felt needs and heuristics through a continual integration of locally relevant socio-economic systems.

Our world has multifaceted challenges. Science and Technology fuel evidence-based solutions and have the power to shape our collective future. Science outreach activities and programmes must be curated to highlight the significant role of science in society and the need to engage the wider public in debates on emerging scientific issues. Outreach activities should also underline the importance and relevance of science in our daily lives.

Scientific advances, technological changes, and innovation are important drivers of the overall growth of society. India has provided significant leadership in several frontiers and consistently for the benefit of people around the world. India's Policy has created adequate scope to develop and implement appropriately aligned plans and programmes to fulfil her developmental aspirations through robust outputs and outcomes. The Ministry of Science and Technology, Government of India through its departments and related institutions develops strategically important mechanisms to deliver immediate and long-term benefits to the stakeholders.

Engaging people with science is of utmost importance to build a robust society. An understanding and appreciation of science is an essential life skill. While it aids in solving real-life problems, it also helps develop logical thinking. Inculcating scientific temper is essential if we want to see a society where everyone can think rationally with a pursuit of truth rather than prejudice.

Ministry of Science and Technology and Ministry of Earth Sciences, Government of India, in association with Vijnana Bharati recently conducted India International Science Festival (IISF). One of the objectives of IISF was to engage the general population with science, thereby contributing to health, prosperity, and meaningful life for all. IISF extends opportunities for people and the scientific community, both within the country and internationally, to come together, collaborate, and cooperate towards sustainable development. Programs like IISF help engaging general people, particularly students learning science in a joyful manner.



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THE ESSENCE OF SCIENCE FESTIVALS: IISF-REASON TO REJOICE MAKING EVERY MOMENT COUNTS

Get ready to celebrate the joy of science! India has a rich legacy in science, technology, and innovation and our scientists have been at the forefront of groundbreaking research. The joy of celebrating science and how it shapes our lives in profound ways is unlimited. Science is not merely a matter of opinion; it is grounded in facts, evidence, and rigorous exploration. It holds the key to our survival as a species and enables us to understand the mysteries of the universe. So buckle up and get ready for an exhilarating journey through the realm of scientific knowledge! Through India International Science Festival (IISF).

But before we embark on this journey, let's pause for a moment to reflect on our role as Indian citizens. The Indian constitution emphasizes that it shall be our duty to develop scientific temper, humanism, and spirit of enquiry and reform. This means embracing curiosity, questioning established norms, and seeking answers through scientific methods is expected from all of us. By nurturing these qualities within ourselves, we contribute not only to our personal growth but also to the progress of society as a whole. Mentorship is one of the crucial aspects that aid us in channelising our ideas towards meaningful scientific endeavors. Having mentors who guide us along this path can make all the difference between mere dreams and tangible achievements. They inspire us with their wisdom, share their experiences, nurture our talents, and help us navigate challenges along the way which helps in unleash our potential as future scientists or innovators.

In the journey of student life these festivals provides special encouragement. Sometimes extraordinary work flows through in ordinary ways. Whether we're in devastating challenges, like Covid-19, or a time of unrealized dream's. Sometimes our witness marks may seem like small things but they can make a vital difference in someone's life. An uplifting word, and a listening ear, and an act of kindness is more than enough. We don't need formulas to lead others. What matters most is to inculcate scientific temper.

Research and funding institutions like Department of Science and Technology, Indian Institutes of Technology (IITs), Council for Scientific & Industrial Research (CSIR), and Indian Space Research Organisation (ISRO), Defence Research & Development Organisation (DRDO), etc. have been instrumental in propelling India's technological advancements on to the global stage. Our tech industry stands at the fore front of solving pressing global problems, redefining possibilities, and transforming lives across different sectors. This fills us with immense pride for what we have accomplished so far. But our aspirations do not end with past achievements. We strive for greater heights and relish a brighter future that lies ahead. So come join us as we celebrate the Indian International Science Festival (IISF), a vibrant

As part of the IISF celebrations, the main motto is to Motivate the Young for queries like — Why, What, and How?

- Introduce the Nuances of Science Communication and its Role in Upliftment of the Society
- Inculcate Inquisitiveness and Inspire

the Young to Innovate

- Encourage students to opt for a Science Career.

The India International Science Festival (IISF) this year, is being anchored by Department of Science & Technology (DST) and hosted at DBT THSTI - RCB in collaboration with Ministry of Earth Sciences, Department of Space and Department of Atomic Energy, Department of Biotechnology (DBT), Council of Scientific and Industrial Research (CSIR) in partnership with Vijnana Bharati —is an excellent platform for scientific community and institutions to exercise/execute the “Scientific Social Responsibility (SSR)” as suggested by the Hon'ble Minister of Science & Technology Dr. Jitendra Singh at the beginning itself. The present-day school and college students are the important generation who would face future challenges. They need to be groomed from this early stage to manage these challenges later. Only S & T can provide solutions to these vital challenges. Under the leadership of our beloved Prime Minister, the Government of India with vivid foresight has come out with many national programmes such as 'Swachh Bharat', 'Skill India', 'Smart City', 'Save Water', etc., to make a better World for this upcoming generation. In this context, the IISF is a timely action plan as it targets the young minds, which is ideal for grooming. Habits learned early in life go long way and become stable all through life.

The major highlights of the programme are:

- Inculcating the culture of inquisitiveness on one hand and

scientific temper on the other, amongst the students and their teachers,

- Enabling the students and teachers to practically experience the theoretical concepts taught in science by visiting this festival.
- To teach the importance of S & T communication and scientific temper in the overall development of the community
- To share our lifetime learning with these younger generations so that they understand their need for participation in nation development, not for anybody else but themselves
- To inspire students for their contribution towards these national missions mentioned by Government of India and make this world a better place to live.

The SDG Index ranks countries based on their performance across the 17 Sustainable Development Goals. The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate change, environmental degradation, peace, and justice. The fourth goal of quality education for all reaffirms the belief that education is one of the most powerful and proven vehicles for sustainable development. This goal ensures that all children complete free primary and secondary schooling by 2030. It also aims to provide equal access to affordable vocational training and to eliminate gender and wealth disparities to achieve universal access to a quality higher education. Quality education (Primary, Secondary and Higher) is one of 17 Global Goals that make up the 2030 Agenda for Sustainable Development. These, science festivals, definitely motivates children to certainly contributes to the agenda of quality education.

The joy of celebrating science festivals helps to encourage scientific temperament in students through interacting with scientists directly. Observing scientists closely and interacting with them possibly bring in confidence in themselves, and also get inspired to become one such scientist. Young minds are vibrant and free. Once

trained for query, such minds can think beyond the routine. Who knows, these unprecedented frequent meetings between these two groups may result in some brilliant breakthrough discovery one day. The goals of IISF include providing the opportunity for young students to explore the possibilities of science and allowing them to experience first-hand what a scientist does daily and providing students and scientists the opportunity to explain their research and practice and improve their skills. Further, through various models of engagement as proposed here, we explain to the students how they can contribute individually to the national mission such as Swachh Bharat, Save Water, Save Environment, Green Good Deeds in their day-to-day life in a simple manner. If students are trained en masse in such deeds and develop them into habits, then protection of this habitat is certain.

IISF provides an excellent opportunity for not only students but also their teachers to get exposure to the latest technology and sophisticated high-end laboratory equipment at various laboratories across the country. CSIR-NIScPR is one of the country's premier science publishing institutes dedicated to science communication and Policy studies exclusively. The involvement of the Institute in IISF has been transformative, bringing together scientists, researchers, educators, and enthusiasts from around the world to share knowledge and ignite scientific curiosity. It has been playing a pivotal role in making IISF a platform that showcases India's scientific progress. Through IISF-Vigyanika, students and teachers get to know the importance of science communication and also pick up the basic skills needed for communicating science, be it in written media, oral, or multimedia. If doing science is important, sharing it with your peers is also important. Not only that but taking this academic science to the masses (meaning popularizing it) is also equally important. Teachers practically observe this phenomenon in. Listening is learning. IISF provides an ideal platform for S & T staff to execute their "Scientific Social Responsibility (SSR)". With IISF, CSIR-NIScPR, gets some extra charm,

color, and brightness, and a vibrant environment. It is not our imagination, but feedback from colleagues irrespective of whether they are involved or not involved with IISF. When young students are around we also become young and get some extra energy to manage the unusual numbers compared to other routine days. Learning is a never-ending process. However, when you learn something new, you ought to teach others what you have learned. Teachers, being in this profession already, learning science communication professionally, not only they become warriors of science communication; they also make their students as soldiers of science communication.

Through captivating demonstrations, workshops, and lectures by renowned scientists, the festival sparks curiosity and encourages participants to explore the fascinating world of science. Moreover, IISF provides a unique opportunity for students to showcase their scientific talents through competitions and exhibitions. This not only boosts their confidence but also nurtures their passion for scientific exploration. By celebrating science at such events like IISF, we can cultivate a culture that values scientific knowledge and innovation. It inspires young minds to pursue careers in STEM fields (Science, Technology, Engineering, Mathematics) and contributes towards building a scientifically literate society. The Indian International Science Festival (IISF) plays a crucial role in promoting the joy of celebrating science. By bringing together scientists, researchers, students, and enthusiasts under one roof, it creates an environment where everyone can appreciate the wonders of science while inspiring future generations to explore its limitless possibilities.

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EMPOWERING FUTURE THROUGH SCIENCE AND TECHNOLOGY

Empowering younger generation through S&T towards rational and critical thinking is extremely important for creating knowledge driven society. The Department of Science & Technology (DST), Government of India, has developed several strategies & mechanisms to encourage, empower and energise the school going children across the country through the joy and supremacy of science and technology to address challenges of the society. These initiatives are in line with New Education Policy (NEP) to inspire children towards breaking barriers, think beyond conventional boundaries, and dream big. “Empowering Future through Science and Technology is therefore not just a slogan; it is a transformative journey that holds the promise of a brighter and more innovative future for India.

Some of the major initiatives of DST with children centric approach are as follows:

MANAK (Million Minds Augmenting National Aspirations and Knowledge): Fostering Innovation and Scientific Temper Among School Children

The MANAK is a flagship programme of DST that aims to generate ten lakh ideas/innovations from more than five lakh middle and high schools across the country rooted in science for societal applications to foster a culture of creativity and innovative thinking among school

children from Class 6-10. The program is being executed by National Innovation Foundation–India (NIF), an autonomous body of DST. Ideas are submitted on an online web portal (<https://www.inspireawards-dst.gov.in>) or a mobile application, the digital platform enables students even in remote location i.e Andaman Nicobar Islands and unite the country on the premises of the innovation. In the year 2020-2021, 6.53 lakhs ideas were submitted from more than 2 lakhs middle and high schools across the country.

One lakh ideas are shortlisted for financial assistance of Rs. 10000/- each, directly into the bank accounts of the students through Direct Benefit Transfer for preparation of project/model/showcasing of the idea. These selected students participate in a three-tier competition i.e. District, State, and National level exhibitions. The top 60 innovations are selected from the National Level Exhibition. The ideas are also protected for Intellectual Property Rights (IPR) and provided with incubation support.

National Children’s Science Congress: Nurturing Budding Scientists

The National Children’s Science Congress (NCSC) complements the government’s efforts to popularize science and disseminate scientific knowledge, especially among children. It stands

as a testament to India’s commitment to nurturing a scientifically inclined younger generation. NCSC is targeted to spread the concept and method of science among the children with their project activities adopting the principle of learning through doing. It is not only for the school going children but is also open for the children outside the formal boundary of schools, in the age group of 10 to 17 years (where 10 to 14 years is considered as junior group and 14 + to 17 years as senior group). Every year a theme is announced to conduct activities at district, state and national level. It gives an opportunity to children to imbibe method of science and essential skills of observation, measurements, comparison, contrasts, classification, estimation, prediction & interpretation, critical & creative thinking, drawing conclusion, team building skill, documentation & communication skill. NCSC reaches out to 2.5 lakhs children every year. It stands as a beacon for hands-on, innovative, and community-centric learning, fostering a scientific mindset among the youth of the nation for past 31 years.

Empowering STEM Innovators: IRIS National Fair

The Initiative for Research and Innovation in STEM (IRIS) National Fair stands as a collaborative effort between Broadcom, the Department of Science and Technology (DST) of the Government of India, and EXSTEMPLAR Education

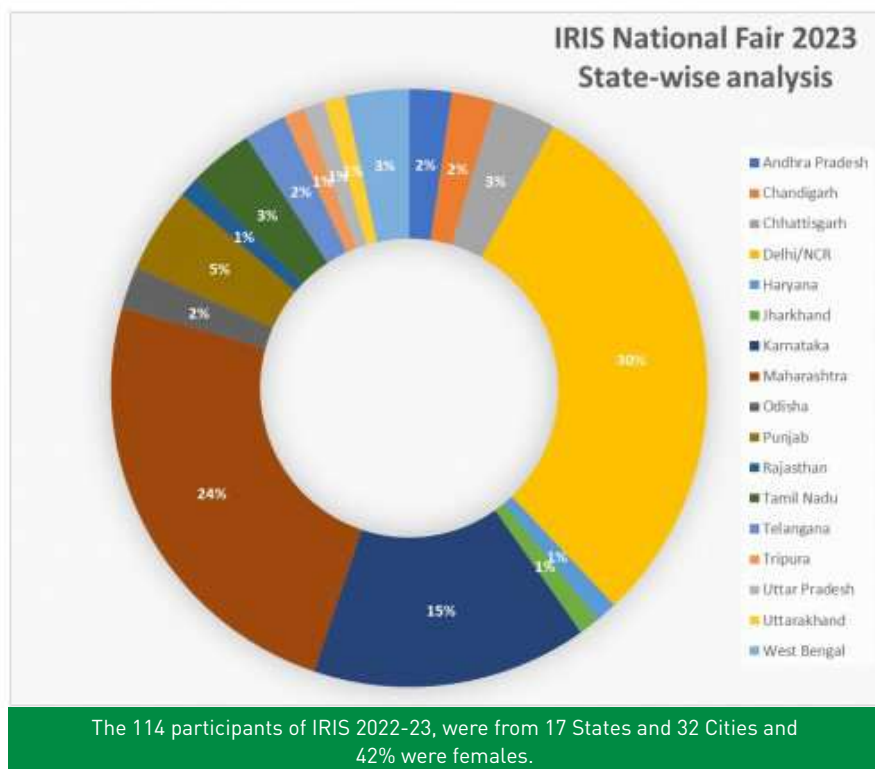
ACTIVITY SCHEDULE OF NCSC

Activities	Time Schedule
1) State level /District level orientation of Guide Teachers-	April-June
2) Selection of subjects and activity for registration of teams	June-July
3) Working on the project	2-3 months
4) District level Congress	September-October
5) State level Congress	November
6) National level Congress	27-31 December

Linkers Foundation to cultivate and celebrate research in Science, Technology, Engineering, and Mathematics (STEM) among young Indian minds. It is a research-based initiative started in 1996 to popularize science and innovation among students of Class 5 -12 and reaching out to over 45 Lakhs school students since 2014. By recognizing and rewarding outstanding projects, IRIS provides a vital platform for these young innovators to gain national and international visibility at STEM events.

The IRIS National Fair takes place annually in India, drawing participation from school students competing in 21 subject categories viz. Animal Sciences; Behavioural and Social Sciences; Biochemistry; Biomedical and Health Sciences; Biomedical Engineering; Cellular and Molecular Biology; Chemistry; Computational Biology and Bioinformatics; Earth and Environmental Sciences; Embedded Systems; Energy: Sustainable Materials & Design; Engineering Mechanics; Environmental Engineering; Materials Science; Mathematical Sciences; Microbiology; Physics and Astronomy; Plant Sciences; Robotics and Intelligent Machines; Systems Software and Translational Medical Science.

The winners of this fair earn the privilege of representing India at the prestigious Regeneron International Science and Engineering Fair (ISEF) held in the USA and are mentored in camps on soft skills and guided on participating in IRIS. This strategic approach ensures the continuous



development and encouragement of the next generation of innovators in India.

Children-Centric Outreach Programme: Inspiring Young Minds in Science

- Science Demonstrations and Shows: Captivating science demonstrations and shows are organized to showcase the wonders of scientific phenomena in a visually engaging manner. These events are crafted to pique children's interest and leave a lasting impression

on their understanding of science.

- Mobile Science Labs: Taking science directly to schools and communities, DST's mobile science labs bring fully-equipped laboratories to the doorstep of children. This initiative ensures that even in far flung areas, children have access to practical scientific learning experiences.
- Innovative Science Exhibitions: The programme incorporates innovative science exhibitions featuring interactive displays, models, and exhibits. These exhibitions are designed to make



complex scientific concepts accessible and intriguing for children of all ages.

- **STEM-based Educational Kits:** DST provides STEM-based educational kits to schools and communities, offering children the tools they need to engage in hands-on learning. These kits cover a range of scientific disciplines and encourage exploration and experimentation.
- **Digital Learning Platforms:** Leveraging technology, DST ensures that children have access to digital learning platforms featuring interactive lessons, virtual experiments, and educational games. This approach caters to the evolving needs of tech-savvy young learners.
- **Hands-on Learning:** Recognizing the importance of experiential learning, the DST has introduced schemes that facilitate hands-on experiences for children. Science clubs, science fairs, and mobile science labs bring learning outside the confines of textbooks, allowing children to witness and



engage in experiments first-hand. This approach not only makes learning enjoyable but also nurtures a sense of wonder and curiosity.

The Mobile Science Exhibitions and Labs has been able to reach out to more than 20 million beneficiaries in 180 districts and has empowered 8.0 million students in 22,000 schools across 9 States viz. Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Punjab, Uttar Pradesh.

DST, GoI through its Children-Centric Outreach Programme is not just imparting scientific knowledge but also

nurturing new generation with inquisitive mind, instilling passion towards discovery, and sowing the seeds of innovation, critical and design thinking to become future leaders in science.

Through these initiatives, DST is shaping the scientific landscape by empowering and inspiring the scientists of tomorrow thus preparing India for 2047.

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GEOLOGICAL DISASTERS AND THEIR PLAUSIBLE MITIGATION WITH REFERENCE TO THE UTTARAKHAND HIMALAYA

Summary

The Himalaya has been experiencing different kinds of geological disasters with variable intensities. Here we synthesize scientific reasons of Himalayan hazards related to landslides, glaciers avalanches, glacier-lakes outbursts, flash-floods, earthquakes, etc. and provide their plausible mitigation with reference to the Uttarakhand (UK) Himalaya. It is the Himalayan landscapes and geomorphology, which are influenced by the natural phenomena, environmental degradation, anthropogenic activities, and climate change. All these, in turn, regulate the damage patterns during a catastrophic event. Hence, we need geoscientific investigation to critically look into these factors in gauging the Himalayan geo-hazards and evolving respective strategies for reducing their impacts. To live with the adversities, we suggest some measures as way forward. First of all, we must identify the most susceptible or vulnerable zones through acquisition and analysis of diverse sets of data. Then we

need to establish state-of-the-art sensors, suited for monitoring specific hazards and development of AI-enabled Early Warning Systems (EWS) to safeguard

Abundant moisture in the atmosphere and increase in land/sea temperatures have been responsible for the torrential rainfall in July-August, 2023 in the Himachal Pradesh (HP) and UK Himalayas

lives and properties. Definitely, the success of mitigation depends on sensitization to local people about their responsible roles on Do's and Don'ts. The next measure is the stringent implementation of mountain-specific town planning

and building codes. The final and the most crucial part is the maintenance of fine balance between the preservation of Himalayan ecosystem and exploitation of resources for the socio-economic-cultural growth and strategic development.

Himalayan Hazards and Way Forward

a. Glaciers and Glacier-Lakes related Hazards and Mitigation:

Tiwari et al. (2022) identified increase in surficial dynamics as seismic precursor, first of its kind, for more than 3 hours before the 2021 ice-rock mass avalanche took place (Fig.1) at Chamoli district of UK Himalaya that led to the development of an EWS against the Glaciers avalanche. The glaciers hazards are generally assessed by hydro-meteorological data. By having recognized the Glacial Risk - Seismic Link, a network of hydrological (AWLR), meteorological (AWS) and seismological (BBS) stations has been established for long term monitoring in Rishiganga-

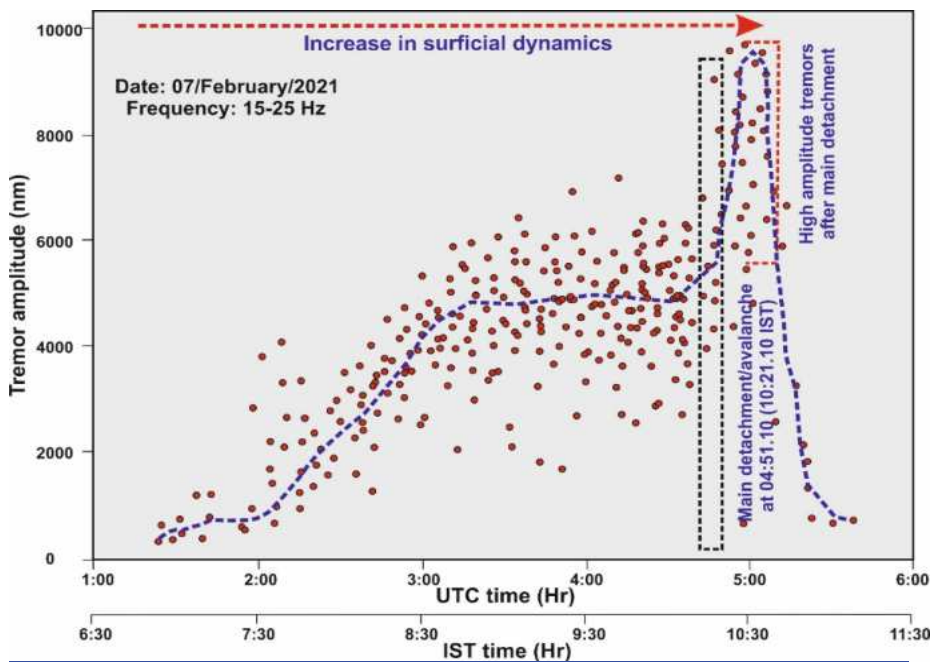


Fig.1: Precursory tremors, observed more than 3.5 hrs. before the ice-rock mass avalanche at 10:30 Hr. IST (after Tiwari et al., 2022)

Dhauliganga glacierised basin, which has evolving activities and considerable habitation in the downstream with a view to developing an alert system. Most of the Glacial-lakes in the UK Himalaya are supraglacial that may not be perilous; around 350 lakes are moraine-dammed, which may pose threat to downstream. The study made by the WIHG shows that the Bhilangana lake at ~4750m height in the Bhagirathi catchment, associated with

the Khatling glaciers, is one such lake that has grown to 0.38 Km² in the last 45 years, and the associated glaciers are thinning. Thus, monitoring of this glacier is need o the hour to avert hazards due to lake outburst, as has been recently experienced in October, 2023 by partial outburst of the fast growing South Lhonak lake in Sikkim Himalaya and complete outburst of Chorabari lake in 2013 in the UK Himalaya.

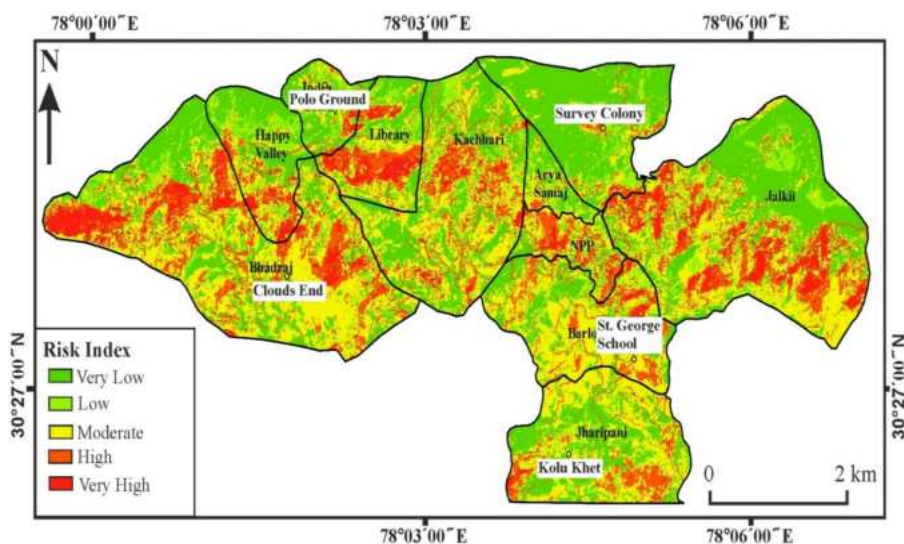


Fig.2: Landslide risk map of the Mussoorie town (modified after Gupta et al., 2023)

b. Landslide Hazards and Mitigation:

Gupta et al. (2023) updated the landslide risk maps in hilly areas for Mussoorie (Fig.2) and Nainital towns, as well as for the Bhagirathi and Goriganga basins based on multiple parameters. These maps provide useful inputs for preparing the land-use map in developing green corridors or smart cities. Since landslides are triggered mainly by rainfall (earthquake, reservoir drawdown, human intrusion also play role), we have been working to couple the Slope instability with Rainfall threshold for landslide-forewarning by monitoring through web-based sensors like rain gauge, piezometer, inclinometer, extensometer, InSAR, Total stations, etc. at Chakrata region of Dehradun. This study bears a significant societal implication with reference to monitoring the land sliding at Joshimath.

c. Earthquake Precursory studies and Early Warnings:

Though we have not been able to predict an earthquake, studies show sudden changes in the physical and chemical properties, emanation of inert gases, and fluctuation of water level before a seismic event occurred. If we monitor the spatio-temporal anomalous behaviours, known as the precursors, and establish a link between an earthquake and precursors, we shall be able to forewarn the seismic event. For this, WIHG has established a Multi-Parametric Geophysical Observatory at Ghuttu in Garhwal Himalaya by installing numerous sophisticated stations. An example of precursory events (Fig.3) from the Ghuttu observatory shows abnormal behaviour of water level, and emanation of radon-gamma and radon-alpha before the 2015 Nepal earthquake. The real time broadcast of these data from the field to lab, processing and integrating of the data using AI/ ML algorithms, and identifying a threshold for alert, is the need of the hour.

It is essential to develop an earthquake warning system based on time difference between the onset (Tp) of faster P-waves and arrivals (Ts) of destructive shear or S-wave, i.e. Ts-p, of a large earthquake

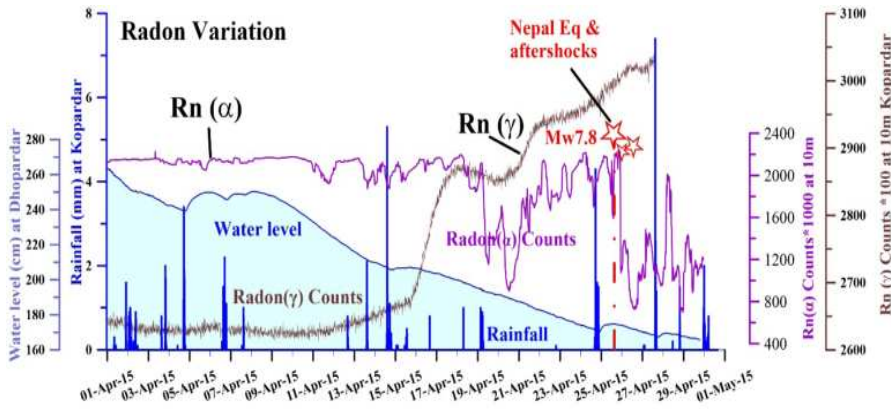


Fig.3: Precursory Events observed at Ghuttu Observatory, Garhwal Himalaya (modified after Kumar et al., 2017)

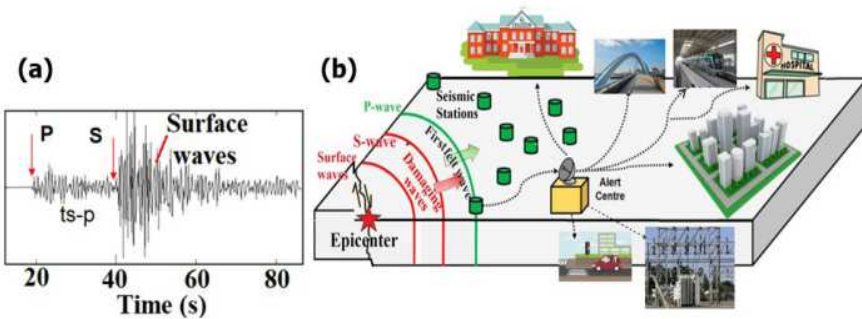


Fig.4: Schematic diagram for an earthquake early warning system demonstrating that seconds before a strong hit can save life! (a) Difference between onset of first P-wave and damaging S wave that increases with epicentral distance; (b). Alert to several critical structures.

(Fig.4a). An earthquake can be located by a local network of seismic stations; magnitude can be estimated within seconds using earthquake-generated P-waves. Before the destructive waves arrive depending on the epicentral distance, a warning can be issued (Fig.4b). There are some success stories of earthquake early warnings in Japan, China, USA, Mexico within 10 or 20 seconds of Ts-p. Of course, this has been accomplished by strict implementation of earthquake-resilient structures and building codes, sensitization to local people, and regular mock drill practices etc. A prototype of EWS has been developed for the UK state by IIT-Roorkee (Kumar et al., 2023).

d. Climate-induced hazards and mitigation:

Some of the latest flash floods and inundations that have occurred in the UK Himalaya under the influence of climate change are elaborated by Sain

Energy is the prime engine for the socio-economic progress of any country. The world's gigantic energy requirement is primarily (80%) met by the fossil fuels (coal, oil, and natural gas) burning of which emanates GHG, mainly the CO₂, the chief constituent of global warming.

(2023a, 2024). Scientific reasons of flash floods have been explained and plausible mitigation in terms of rope ways and proper drainage system has been suggested. It is to be mentioned that abundant moisture in the atmosphere and increase in land/sea temperatures have been responsible for the torrential rainfall in July-August, 2023 in the Himachal Pradesh (HP) and UK Himalayas. The confluence of SW monsoon from the Arabian Sea and weak Westerly Disturbances from the Mediterranean Sea moving eastward over northern India has intensified the rainfall. The warming of atmosphere due to GHG emission, especially the CO₂, increases the capacity of holding more moisture leading to heavy rainfall. Recent landslides in hilly areas of HP and UK states and flash floods in plains have been attributed mainly to the climatic factor – concentrated rainfall over a short span of time as well as continuous normal rainfall. The other factor is the land degradation – the top most part, made up of phyllites, mica-schist, quartzite, limestone etc. for the Simla region is highly weathered, fractured, jointed caused by cooling and warming processes. The third factor is the anthropogenic activities – deforestation, unauthorized construction, slope instability due to toe cutting in unscientific way, improper drainage system that allowed percolation of house-hold waters into the subsurface. The heaviness due to water-saturation of top loose soil along with water percolation underneath has accelerated mass movement by the gravitational forces over the plane of weakness. The land-sliding and development of cracks in Joshimath in the beginning of January, 2023 has also been attributed to the hydrological imbalances (Sain, 2023b).

Energy is the prime engine for the socio-economic progress of any country. The world's gigantic energy requirement is primarily (80%) met by the fossil fuels (coal, oil, and natural gas) burning of which emanates GHG, mainly the CO₂, the chief constituent of global warming. For plausible mitigation of climate change, which is a global phenomenon, definitely we need to make a renaissance in the green or renewable energy sectors to achieve the UN-goals of carbon neutrality by 2050 and net zero carbon by 2070. It is, thus,

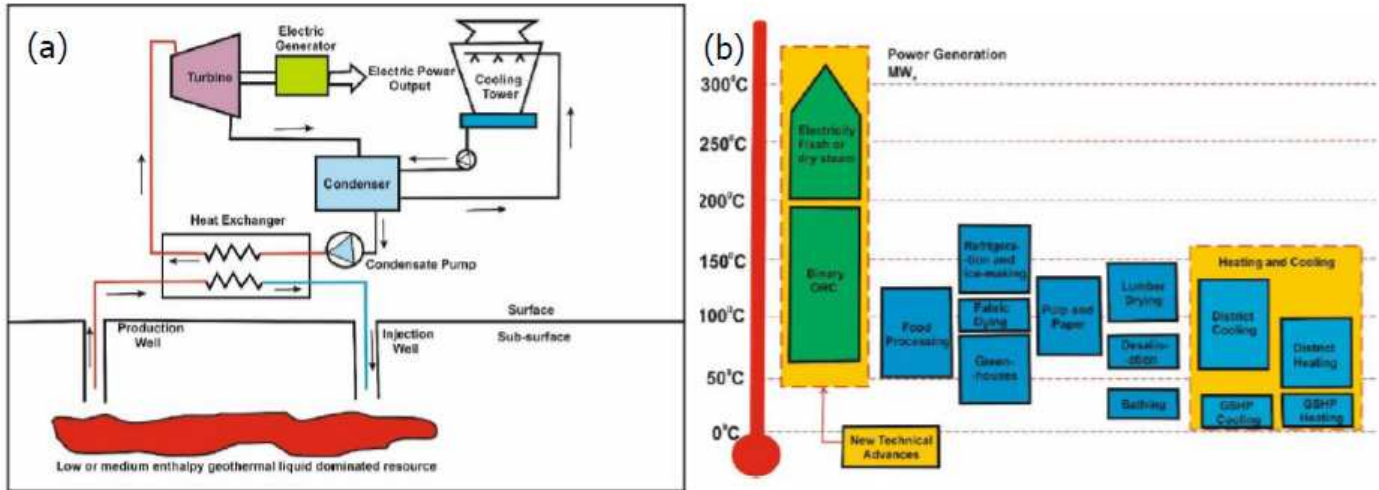


Fig.5: (a) A low and intermediate BOREC system for electricity generation; (b) Application of GTS depending on surface and reservoir temperature [after Kumari et al., 2023]

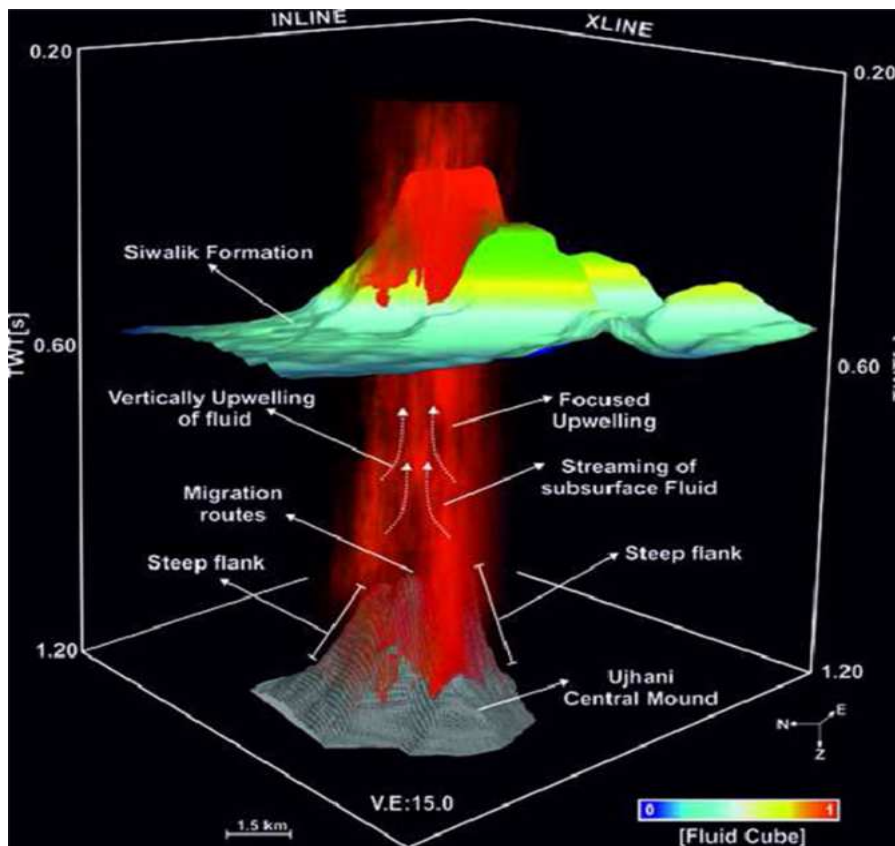


Fig.6: Fluid-cube meta-attribute demonstrating fluid migration from subsurface source to the surface [after Kumar et al., 2023]

geothermal energy potential, which is equivalent to 10,600 MW power. WIHG has taken an initiative for a pilot study in converting the geothermal energy into electricity along with a synergistic program on generating geothermal-solar hybrid energy. Reservoir temperature of 100-150°C is suitable for Binary Organic Rankine Cycle (BORG) power plant (Fig.5a) and that between 70 to 100°C can be used for space heating and balneotherapy (Fig.5b). This will add tremendous value for providing Green Energy to the Char-Dham Pariyojana of the UK state.

Sain and Kumar (2022) developed AI/ML-based semi-automatic approaches, and computed a meta-attribute first time by fusing several other attributes for the delimitation of subsurface geologic features from surface data. This has led to the delineation of 3D configuration of hydrocarbon seepage from the subsurface ‘source to surface’ (Fig.6) in the Indo-Gangetic foreland basin of the Himalaya. This study is very important in linking the subsurface with the surface in comprehending the geodynamics, resource evaluation, and hazards assessment.

Recommendations

It is highly recommended to look into the climatic factors, natural processes, geomorphic features, land degradation, and anthropogenic activities to identify the most potential zones of hazards. It

necessary to focus on two critical areas: (i) securing a reliable/affordable/sustainable renewable/green energy resources or (ii) gradually transitioning into a low-carbon and environment-safe energy supply. If we have to rely on fossil fuels, we require to strengthen the Carbon Capture,

Utilisation, and Sequestration (CCUS) experiment too (Sain, 2023a).

Tiwari et al. (2022) mapped 40 geo-thermal springs (GTS) in the UK Himalaya; characterized surface and reservoir temperature; and evaluated their

is the need of the hours to develop an integrated EWS against any geo-hazard in the Himalaya, caused by natural processes, land degradation, anthropogenic activities, or climate change by establishing a dense network of sensors, long-term observation and real-time monitoring, fast processing equipment, advanced modelling, and integration of data using AI/ML. Investment in EWS is far more cost-effective than rehabilitation, restructuring, loss of lives and livestock, and damage to homes and infrastructure.

The Himalaya possesses plethora of resources that can be harnessed for socio-economic growth, agro-cultural development, and strategic advancement. However, there must be a fine balance between the exploitation of resources for economy and optimal conservation of fragile ecosystem of the Himalaya. It must be emphasised that the entire Himalaya is not friable or vulnerable to disasters. We have to sensitize or educate local people on how to live with the disasters; build climate-adaptable and disaster resilient future; and figure out the

The Himalaya possesses plethora of resources that can be harnessed for socio-economic growth, agro-cultural development, and strategic advancement.

sustainable growth. Followings are some of the measures that can be considered for mitigation of Himalayan hazards: Adaptation to nature-based solution; implementation of mountain-specific policies; execution of severe punishment against unauthorised construction and deforestation; effecting proper drainage system; building retaining walls, wire-mesh, insertion of bolts and shotcrete for arresting slope failure; development of

satellite towns instead of having populace around one business town; assessment of slope stability before any construction in hilly-area and while toe-cutting in a slope; immediate disposal of mucks after rock cutting; non-exposure to highly vulnerable zones; usage of light-weight construction materials; disaster-resilient building or retrofitting old buildings; periodic assessment of load bearing capacity at different scales; environment impact assessment, etc..

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ADVANCING EARTH SCIENCES: VISION 2047 AND BEYOND

Remember the days when we could plan a weekend getaway without worrying about sudden weather surprises? Now, it feels like our vacations are at the mercy of sudden storms or heatwaves, turning our travel plans into climate roulette. It is no secret that our planet is facing unprecedented challenges, from climate change and rising sea levels to extreme weather events and biodiversity loss—all of which jeopardise the delicate balance of the biosphere. The Ministry of Earth Sciences (MoES) not only recognises the urgency of these challenges but is also committed to spearheading efforts to address them.

Under the MoES umbrella, our institutions are diligently working toward specific objectives in atmospheric, ocean, polar, and solid earth sciences. These encompass enhancing our comprehension of climate patterns, delving into ocean currents and marine ecosystems, exploring polar regions, and researching the Earth's geophysical processes. Through state-of-the-art research and technological innovations, the aim is to make substantial

contributions not only to the scientific community but, more importantly, to society as a whole.

Looking ahead to the year 2047, the centennial celebration of India's independence, our aspiration is to position India as a global leader in earth sciences. In the pursuit of scientific excellence and a deeper understanding of the Earth and its intricate systems, we outline some of our future goals—ambitions that, perhaps, one of you can play a pivotal role in realising.

Atmospheric Sciences: Revolutionising Weather Understanding

The atmosphere, a dynamic force shaping climate, weather, and air quality, serves as the cornerstone of our vision for atmospheric sciences. Our comprehensive approach aims to transition beyond conventional weather forecasting to encompass weather modification and management. To achieve this evolution, we need to prioritise strengthening observations through both in-situ methods and cutting-edge remote sensing technologies. The attainment of very high-resolution modelling stands as a crucial objective, requiring a simultaneous enhancement in high-performance computing (HPC) capabilities. By filling existing knowledge gaps, our goal is to elevate our understanding of weather patterns to unprecedented levels.

Upon the establishment of a robust weather management system, we anticipate several critical outcomes, including improved weather forecasts, the capability to modify weather patterns, and the





development of strategic measures for mitigating and adapting to natural disasters. The vision extends to safeguarding against potential weather-related threats and actively engaging in weather warfare. Through the implementation of these strategies, we aspire to revolutionise atmospheric sciences, contributing to a safer, more resilient global environment.

Ocean Sciences: Navigating Blue Economy Growth

With an extensive coastline and diverse marine ecosystems, India is poised to become a global leader in ocean sciences. Here, the vision revolves around the ambitious goal of doubling the current GDP contribution from the blue economy in India. Recognising the vast potential of the blue economy, the aim is to significantly enhance its role in economic growth and sustainability.

This comprehensive endeavour encompasses a multi-dimensional approach aimed at optimising fisheries practices, improving maritime transportation efficiency, fostering responsible tourism, implementing strategic marine spatial planning, establishing comprehensive data repositories, exploring ocean-based renewable energy resources, addressing water scarcity through sea water purification, sustainable mining of marine minerals, and enhancing disaster resilience

against natural hazards.

Through collaborative efforts, innovative research advancements, and the adoption of responsible practices, this initiative strives to make enduring contributions to the nation's economic prosperity and environmental stewardship.

Polar Sciences: Unraveling Climate Barometers

Within the expansive field of Polar Sciences, our visionary approach extends across the Earth's crucial climate barometers – the Arctic, Antarctic, and

Himalayas. Recognising these regions as integral components in regulating global climate patterns, our interdisciplinary goals aim to unravel complexities and tackle pressing challenges.

In the Arctic, our focus is on exploring the intricate telecommunication between the poles and tropics. Foreseeing the significant consequences of the expected disappearance of summer sea ice by the late 2040s, we delve into the geopolitical, Living and Non-living Resources, shipping, and scientific ramifications. Of particular importance is its influence on the South Asian monsoon, driving us to understand and navigate its far-reaching consequences.

In the Antarctic, our mission is rooted in upholding the Antarctic Treaty System, emphasising the harmonious coexistence of scientific exploration and peace. We embark on a journey to deepen our understanding of sea-ice and ice shelf processes, with a specific lens on their connections to the Indian Ocean and the monsoon. Through these dedicated efforts, our objective is to contribute to a more comprehensive grasp of climate dynamics and regional impacts.

Turning our attention to the Himalayas, our focus takes on a holistic perspective, addressing challenges intricately tied to glacier melt and water availability. Acknowledging the millions of people reliant on Himalayan glaciers for their



water supply, our purpose is not only to assess and manage this vital resource but also to mitigate potential disasters such as landslides and glacier lake outburst floods. By doing so, we envision ensuring the sustainable and secure future of this critical region.

In summary, by advancing our comprehension, fostering global cooperation, and implementing sustainable strategies, we aspire to be at the forefront of ensuring the well-being of communities and the preservation of the environment in these polar regions and beyond.

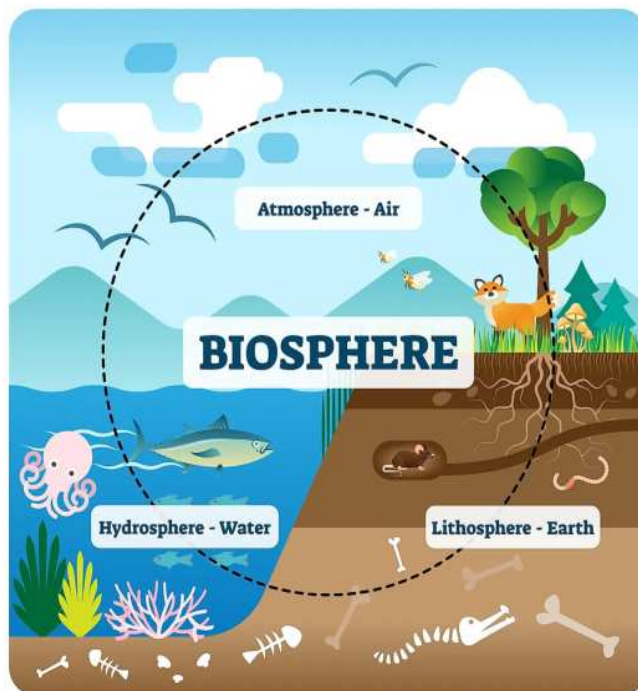
Solid Earth Sciences: Ensuring Structural Resilience

By 2047, our ambition is to establish early earthquake warnings akin to the current early tsunami warning systems. This entails enhancing observation systems, developing technological precursors for early warnings, deepening our understanding of seismic processes, exploring and identifying precursors and warning signs. Also, imperative in constructing earthquake-resistant buildings, conducting micro-zonation studies for cities, and delving into liquefaction phenomena.

By putting our focus into these areas, we're not just aiming for early warning system but also pushing for buildings that can stand up to earthquakes. Through a combination of technological innovation, heightened understanding, and strategic planning, Solid Earth Sciences aspire to play a big role in making our communities and structures safer when earthquakes come knocking.

Role in the Biosphere: Earth Sciences' Interconnected Impact

Earth sciences are not solitary entities; rather, they intricately interconnect with and directly influence the biosphere. Understanding these interconnections is essential for addressing environmental



challenges, conserving biodiversity, and managing natural resources sustainably. It also helps in predicting and mitigating the impacts of natural disasters and climate change on ecosystems and human societies. The interdisciplinary nature of Earth sciences allows scientists to develop a holistic view of the planet and its dynamic processes.

Looking Ahead to 2047: Making a Difference

The vision for 2047 is not only about achieving scientific milestones for the benefit of society, but also about making a difference. Envisioning India's pivotal role in global scientific leadership by 2047 necessitates fortifying the Ministry of Earth Sciences with the fervour and expertise of the next generation. It's a call to action for young minds to embrace the challenges and opportunities presented by the Earth sciences, contributing their ideas, skills, and passion towards creating a sustainable and resilient future.

Choosing careers in atmospheric, ocean, polar, and earth sciences means not only becoming part of a scientific community but also serving as a stepping stone to secure our planet's future. Let us work together towards understanding, protecting, and sustaining the Earth's systems for the benefit of all living beings.

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SHATTERING BOUNDARIES: IASST'S EMPOWERMENT CAMPAIGN FOR NORTHEAST INDIA'S TRIBAL WOMEN

The Institute of Advanced Study in Science and Technology (IASST), Guwahati, an autonomous Institute of DST, has integrated programs that highlight the significance of women's empowerment in the Northeast region because women are the driving force of change and are necessary for a nation to prosper and sustain itself. With its objective to empower tribal women and promote sustainable livelihoods, IASST has become a beacon of success in Northeast India's varied cultural landscape. The institute has integrated its efforts with the Government of India's 'Atmanirbhar

Bharat' and 'Vocal for Local' initiatives while also revolutionizing traditional customs through creative activities under the "ST/SC Community Development Program at IASST," which is supported by DST's SEED division.

Reviving Tradition: *Xindol's* Journey from Traditional Household Delicacy to Supermarket Shelves

At Bakrapara village, near Guwahati, a Self-Help Group (SHG) named *Upasona* ethnic food society was formed, bringing together 21

rural tribal women to promote their traditional delicacy, *Xindol*—a fermented fish product deeply embedded in their cultural heritage. IASST was pivotal in elevating *Xindol* from a household delight to a marketable product by conducting nutritional analyses, facilitating FSSAI certification, and safeguarding traditional knowledge through geographical indication (GI) filing.

IASST has set up a Biofloc system for fish farming to guarantee a steady supply of fish for fermentation. The members have received specialized training in handling *Xindol* safely. Additionally, IASST has fostered the society for market connection



WOMEN EMPOWERMENT

under the Bionest facility. In addition to over 300 direct and indirect beneficiaries, this program has tremendously aided 21 women in creating sustainable subsistence.

Diversification for Prosperity: Eri Silk and Edible Pupae Production

Recognizing the need to enhance income opportunities, IASST expanded its initiatives to include the production of *Eri* silk and its edible pupae. This forward-looking approach not only contributes to the economic prosperity of tribal women but also preserves and promotes indigenous practices, fostering a sense of self-sufficiency within the community. Many women in the three adopted villages of IASST, viz. Satargaon, Kallapara, and Bakarapara have incorporated *Eri* rearing into their livelihoods as a significant income source. Through hands-on



training provided by IASST, these women are now equipped with the knowledge and skills required for successful sericulture.

Soybean Cultivation: Transforming Lives and Landscapes

Scientists at IASST have launched an unprecedented project to grow soybeans to transform the agricultural landscape and lives of tribal people in Northeast India. To reduce dependence on imported soybean seeds, IASST's strategic intervention in Barnagaon village, Udalguri district, led to the formation of the Daogalang Soya Society and Gwjwnsri

Soy Society, focusing on the cultural and economic importance of fermented soybean. Comprising more than 20 tribal women from the Bodo community, this society processes soybean seeds into various products, including soy tofu. This initiative has positively impacted more than 200 individuals directly and indirectly. Through its BioNEST incubation facility, IASST is crucial in facilitating market linkages for women engaged in soybean-related businesses. The institute supports the commercialization



of products developed by women, ensuring that their efforts translate into tangible economic opportunities.

IASST's Commitment and Goal: Towards a Sustainable Future

The B. R. Ambedkar Centre for Social Empowerment (BRACE), a specialized platform created to serve the particular requirements of the weaker portion of society, primarily focusing on women, is central to IASST's commitment to social empowerment. Equipped with cutting-edge facilities, BRACE is the focal point for programs promoting inclusive empowerment. It provides targeted training, skill development, educational opportunities, and awareness campaigns, particularly for women from underrepresented groups. The center aims to enable women to actively advance society by creating a supportive atmosphere through networking and mentorship opportunities.

Beyond empowering tribal women, these programs significantly contribute to Northeast India's larger objective of developing a locally oriented and self-sufficient economy. IASST grows crops and sows the seeds of prosperity and change as success stories keep coming to life, influencing the next generations.



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WILL AI TAKE OVER THE WORLD

The rapid advancements in artificial intelligence (AI) have sparked both curiosity and concern among people worldwide. As AI technology evolves, discussions about its potential to surpass human capabilities and take over the world have become a prevalent topic. However, separating fact from fiction is crucial in understanding the true impact and potential of AI.

The Myth of AI Domination

The idea of AI taking over the world often stems from science fiction narratives, portraying sentient machines that surpass human intelligence and gain control over civilization. While these stories capture imagination, they often exaggerate AI capabilities and oversimplify the complexities of technology.

Understanding AI's Current State

As of now, AI systems excel in specific tasks by analyzing vast amounts of data, recognizing patterns, and making predictions. These capabilities have transformed industries, from healthcare to finance, enhancing efficiency and decision-making. However, AI lacks consciousness or emotions, limiting its decision-making abilities to programmed parameters. AI development was progressing rapidly across various domains, revolutionizing industries and impacting daily life. Several domains were experiencing significant advancements:

Progression in AI Domains:

1. Healthcare: AI was making strides in diagnostics, drug discovery, and personalized medicine. Machine learning algorithms helped analyze

medical images, predict patient outcomes, and optimize treatment plans.

- 2. Finance:** AI was enhancing fraud detection, risk assessment, and portfolio management in banking and finance. Automated trading systems were leveraging AI to make complex decisions in milliseconds.
- 3. Autonomous Vehicles:** The automotive industry was investing heavily in AI for self-driving cars, advancing technologies related to perception, decision-making, and navigation.
- 4. Natural Language Processing (NLP):** AI-powered language models were improving translation, sentiment analysis, chatbots, and content generation, transforming communication and content creation.
- 5. Robotics:** AI was enabling more sophisticated and adaptable robots



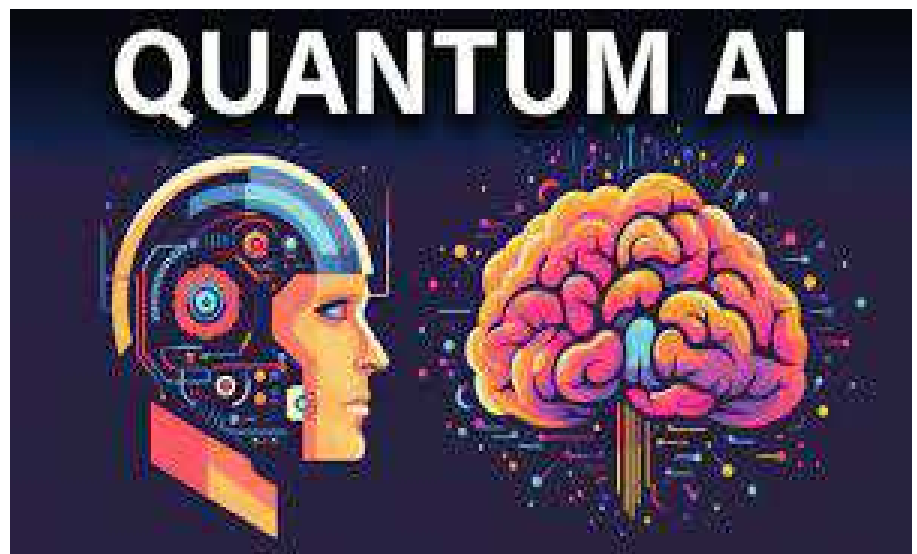
with other technologies like quantum computing and edge computing is likely to drive further innovation.

Need for Progression: While AI has made remarkable strides, several areas require further development:

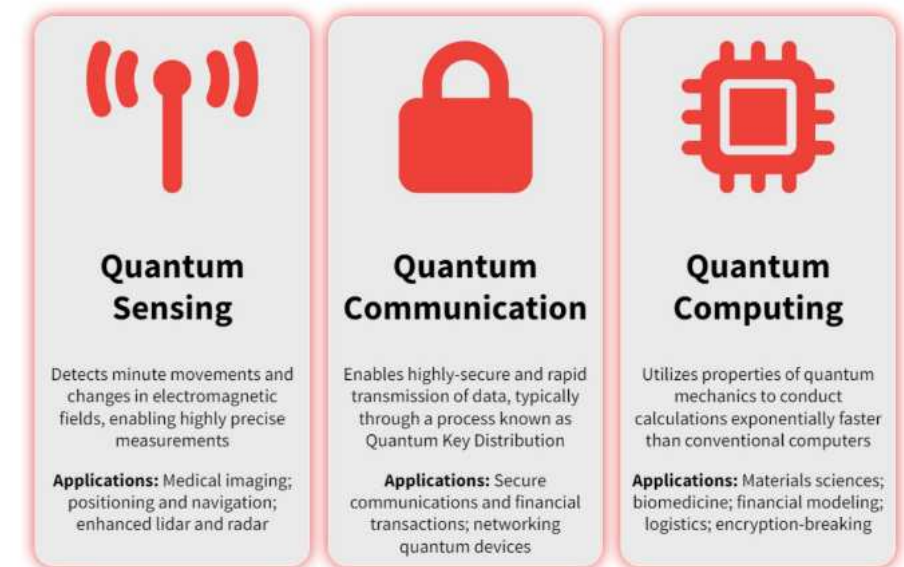
- 1. Ethical AI Implementation:** Addressing bias, fairness, and transparency in AI systems is crucial. Developing ethical frameworks and ensuring algorithms do not perpetuate societal biases is an ongoing challenge.
- 2. Interpretability and Explainability:** Understanding and interpreting AI decisions remain a challenge. Making AI systems more explainable and transparent is essential, especially in

used in manufacturing, healthcare, and even household chores.

- 6. Education:** Technological Integration: Education is undergoing a transformation with the integration of technology. E-learning platforms, MOOCs (Massive Open Online Courses), and virtual classrooms have expanded access to education globally. AI-driven personalized learning, adaptive assessments, and AI tutors are enhancing the learning experience. Immersive technologies are offering new ways of learning, providing hands-on experiences and simulations.
- 7. Agriculture:** Agriculture is experiencing a technological revolution, often termed "AgriTech." Using AI, IoT (Internet of Things), and drones for precise monitoring of crops, optimizing irrigation, and applying fertilizers, minimizing waste and maximizing yield. CRISPR technology and genetic modification are revolutionizing crop breeding, creating disease-resistant, and climate-resilient varieties. Innovations in urban farming, employing controlled environments, and hydroponic systems are maximizing space and reducing water usage.
- 8. Space Exploration:** AI plays a pivotal role in space exploration, powering autonomous rovers, optimizing mission trajectories, and analyzing vast amounts of data to uncover celestial mysteries. Additionally, the convergence of AI



Three Key Types of Quantum Technologies



critical domains like healthcare and law.

- 3. **AI Robustness and Security:** Enhancing AI systems' robustness against adversarial attacks and ensuring their security is imperative to prevent manipulation or exploitation.
- 4. **Generalization and Contextual Understanding:** AI models often struggle with understanding context or generalizing knowledge beyond their training data. Progress in this area could significantly enhance AI's versatility and reliability.
- 5. **Collaborative Human-AI Interaction:** Creating seamless interactions between humans and AI systems that complement each other's strengths is an area needing further development. Balancing AI automation with human oversight and intervention is critical.

Limitations of AI

AI's current limitations are significant barriers to the concept of it 'taking over.' AI operates based on algorithms created by humans, which means it doesn't possess self-awareness or autonomy. Its actions are bound by predefined instructions and data, making it incapable of independent thinking or intentions.

Ethical and Regulatory Frameworks

As AI applications grow, concerns about ethics, bias, and accountability emerge. Addressing these concerns requires robust regulatory frameworks to ensure AI's responsible development and use. Ethical guidelines are essential in preventing AI systems from perpetuating biases or making decisions that could harm individuals or society.

Collaboration, not Domination

Rather than a scenario of AI domination, a more realistic view is one of collaboration between humans and machines. AI's potential lies in augmenting human capabilities, assisting in complex problem-solving, and handling repetitive tasks, allowing humans to focus on creative and critical thinking.

The Importance of Human Oversight

Human oversight remains crucial in AI development and deployment. While AI systems can process data at incredible speeds, they lack moral judgment and ethical understanding. Human

intervention is necessary to ensure AI aligns with societal values and doesn't infringe on human rights.

Conclusion: Coexistence and Responsible Implementation

In conclusion, the fear of AI taking over the world is a product of imagination rather than reality. AI's current state, limitations, and the absence of consciousness or emotions make such a scenario implausible. However, responsible development, ethical guidelines, and human oversight are vital in harnessing AI's potential for the betterment of society.

The key lies in understanding AI's capabilities, implementing stringent regulations, and fostering a collaborative relationship between humans and AI. Embracing AI as a tool for empowerment and progress while ensuring it operates within ethical boundaries will shape a future where humans and intelligent machines coexist harmoniously.

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SURVEY OF INDIA'S TECHNOLOGY TRANSFORMATIONS & FUTURE ASPIRATIONS

The fundamental of any geospatial data is the foundation data based on National Geodetic Reference Frame (NGRF). Foundation data can be broadly categorised as Vertical Coordinate, in layman term the height above sea level, and other being Horizontal Coordinate, meaning the accurate latitude and longitude of a point on the ground.

Survey of India has switched to digital levelling method which are used to measure heights. This task is arduous and requires the Surveyor march on foot along the path connecting two points. Along with High precise levelling, these height points are also being observed for highly precise gravity (9.8 m/s^2 is used general calculations in scientific word, but we measure it till 8th decimal place). Employing this new age levelling technique, SOI has realised the Indian Vertical Datum (IVD) in 2009. The IVD is being constantly strengthened by SOI and till date, about 2,00,000 kilometres of levelling have been completed.

Recently, to Strengthen the Horizontal Datum of India, SoI has recently launched nation-wide real-time positioning 'Continuously Operating Reference System' (CORS). It comprises 1000+ permanent stations which are operational 24x7x365. These stations are equipped with high precise world class GNSS receivers and have been designed to remain active during power outage or even during adverse weather conditions such thunder storm or ambient temperature of +65/-20 degree Celsius.



Fig 1 CORS Permanent Receiver Station

CORS real time services are going to be a game changer in the field of accurate mapping and navigation. Now, geospatial engineers and surveyors are spending very less time and requiring less team size, resulting in saving to the tunes of crores. In future, this technology will become the back bone for autonomous pilot less drone surveys, driver less driving and real time monitoring applications in various domains such as supply chain management, movement of freight, or monitoring of utilities of strategic importance and disaster management applications.

Survey of India has taken great strides in employing Unmanned Aerial Vehicles – 'Drone' in its arsenal to generate high resolution Orthorectified Imageries (ORI) using principles of Photogrammetry in which even the minute ground features such as land boundaries or a lamp post are visible for digitization.

The high accurate development of Digital Elevation Models (DEM) depicting the general slopes of the terrain is also a direct product of this technology. Along with Optical Camera Sensors, now Light Detection and Ranging (LiDAR) technology has been incorporated which has proved to be a highly efficient in generating DEMs in projects such as National Mission for Clean Ganga and National Hydrology Project.



Fig 2 Survey of India's Survey Grade Fixed Wing Drone

LiDAR is playing a pivotal role in realization of 3D models of real world, popularly known as Digital Twins. Digital twins are exact replica of real world in digitized environment. Digital twins have each and every element present above of below the ground. LiDAR have the capability to even capture the very thin elements such as wires of a power lines or rain water drains along the roads. It can be safely be extrapolated that the technology of future will employ combination of various sensors such as Optical, LiDAR, Thermal, etc and will revolutionize the geospatial data generation quickly with high frequency.

Next big thing in geospatial ecosystem and the future of mapping and decision making will be 3D digital Twins. They carry immense potential to enhance the efficiency of government interventions. For instance, today it is a common sight where after building new roads, it is destructed multiple times to lay water or sewer pipe lines or power or communication cables. With a common 3D Digital Twins available to public and decision makers, such repeated wastage of time and money can be averted and the various components of infrastructure can be developed simultaneously and without disturbing existing infrastructure. Also, 3D digital Twins are going to play a vital role in strategic sectors such as security, disaster management and mitigation, urban development and urban expansion planning.

Realising that the availability of comprehensive and highly accurate Geospatial Data will significantly benefit diverse sectors of the economy, will significantly boost innovation in the country and will greatly enhance the preparedness for emergency response, the government came up with progressive Geospatial Guidelines in Feb, 2021. These guidelines liberalised the acquisition and production of geospatial data and geospatial data services using latest and emerging geospatial technologies. By releasing the guidelines, a conducive environment has been provided by the government for the growth of geospatial industry. The impact of guidelines can be noticed in terms of

high-resolution geospatial data which has been generated by SOI alone. Drones have been successfully used as an aerial platform for earth observation to collect high resolution images under SVAMITVA scheme for generation of very large scale land parcel maps. The involvement of private industry has also increased in acquisition and processing of geospatial data. In general, the geospatial thinking and geospatial activities have increased after the much needed impetus provided by the New Geospatial Guidelines-2021.

In furtherance of Geospatial guidelines and to strengthen the geospatial sector, Government of India has notified a comprehensive National Geospatial Policy which was approved by the Union Cabinet in Dec, 2022. This landmark policy has laid down the blueprint and framework for the growth of geospatial sector to support national development,

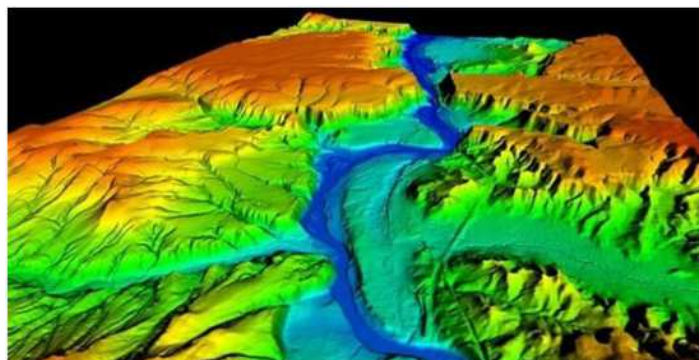


Fig 3 Digital Elevation Model

economic prosperity, and a thriving information economy. The aim of policy is to make India a world leader in the global Geospatial space. The immediate focus of the government is to build upon the policy framework and work towards achieving goals and targets defined in the policy. SOI will have a greater role to play as an overarching organisation in fulfilling the objectives of the policy. The policy has made a paradigm shift from map-centric architecture to the seamless and unified architecture for production and delivery of geospatial information. The government is investing in generation of the foundational geospatial data layer – Ortho-Rectified Image (ORI) and Digital Elevation Model (DEM) based on National Geodetic Reference Frame (NGRF). The geospatial industry will have an equally important role in providing the technology and services

for collection, processing, management and dissemination of geospatial data. SOI will collaborate with all relevant stakeholders – Ministries/Departments and Industry to work synergistically to build the Geospatial infrastructure for the country in harmonised manner. SOI will continue engagements with the State Govts. to facilitate modernisation of their land records by Resurvey/Survey using the latest geospatial technologies to build future smart land information systems.

Building geospatial infrastructure and its effective utilisation would require skilled workforce and this entails inclusion of appropriate geospatial modules in course curriculum from college level onwards. SOI and Industry is already working together in developing the training & qualifications requirements for different job roles as per the National Skills Qualifications Framework which will help in filling the gap of skilled workforce in the geospatial sector.

SOI has always been a remarkable institution when it come to the scientific surveying and measurements in the country and bears a special responsibility to fulfil the objectives of the National Geospatial Policy. NGP has it all to ensure access to updated and high resolution geospatial information for evidence based decision making, improving governance and making the citizens life better. Giant leaps are being taken to embrace latest geospatial technologies, to support and reinforce private industries providing geospatial services and products, and to enhance ease of access to the data & map repository of Survey of India.

With the ongoing synchronised efforts of Government, Industry and academia, the foundations are being laid to achieve the objectives of Amrit Kaal by 2047 – The year marking 100 years of India's Independence - as envisaged by Hon'ble Prime Minister, and to return the past glory to Survey of India as being most advanced and citizen centric National Mapping Agency of the World.

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THE INDIA INTERNATIONAL SCIENCE FESTIVAL - CELEBRATION OF SCIENCE

The India International Science Festival (IISF) is a celebration of science, captivating the hearts and minds of millions across the nation. The creative events and activities in IISF engage common people with science in a joyful manner and provide opportunities for the public and scientific fraternity from India and abroad to come together and work for the well-being of humanity.

IISF is an initiative of Ministry of Science and Technology and Ministry of Earth Sciences, Government of India, in

association with Vijnana Bharati. In 2021, Department of Space and Department of Atomic Energy joined this noble initiative. Since its inception in 2015, IISF has traversed the diverse landscapes of our nation, leaving a trail of inspiration for the people of the country. The eight editions of this festival have graced different regions of the country while traveling through the esteemed institutions of the country. With each edition, IISF has burgeoned and evolved into a global phenomenon that transcends geographical boundaries.

Extending the legacy of previous

editions, the grand celebration of the 9th edition embodied its theme 'Science and Technology Public Outreach in Amrit kaal' and reached millions of individuals with its wide array of events, leaving a lasting impact on countless lives. It was organized at the vibrant campus of DBT THSTI RCB, Faridabad, Haryana, from January 17 to 20, 2024. It comprised of 17 diverse events.

The **Outreach program** was instrumental in disseminating information about IISF 2023 nationwide. Starting from the launch of IISF 2023 website in



Inauguration of IISF 2023 in the presence of Dr. Jitendra Singh, Hon'ble Minister of Science and Technology; Shri Mool Chand Sharma, Hon'ble Minister of Higher Education, Govt. of Haryana; Prof. Ajay K Sood, Principal Scientific Advisor; Dr. Shiv Kumar Sharma, National Joint Organising Secretary, VIBHA; Dr. M. Ravichandran, Secretary, Ministry of Earth Sciences (MoES); Prof. Abhay Karandikar, Secretary, Department of Science of Technology (DST); Dr Rajesh S. Gokhale, Secretary, Department of Biotechnology (DBT); Dr. (Mrs.) N. Kalaiselvi, Director General, CSIR & Secretary DSIR and Smt. A Dhanalakshmi, Joint Secretary, DST

the presence of Hon'ble S & T Minister, Dr. Jitendra Singh, Hon'ble Minister of Higher Education, Govt. of Haryana, Shri Mool Chand Sharma, and various secretaries, extensive outreach was done through 61 institutions (CSIR - 36, DAE - 2, MoES -4, DoS -4, DST -9, and DBT-6), various social media platforms, and wide print and electronic media coverage. Engaging 19 states and 3 union territories, outreach activities of IISF 2023 assured inclusivity for the main science fest.

The **Student Science Village** attracted the participation of over 1500 students including around 450 students from aspirational districts and 'first villages'. Divided into 8 houses, students engaged in hands-on science activities while witnessing demonstrations by experts. INSPIRE-MANAK and IGNITE student innovators represented around 20 technologies. The event stressed on practical learning and interdisciplinary exploration, aligning with the vision of nurturing future scientists and innovators for 'New Bharat.'

Face to Face with New Frontiers of Science and Technology event featured distinguished speakers sharing notable insights on AI, nuclear medicine, space research, and biotechnology. The event hosted 6000 students from 130 schools, engaging them with interactive lectures on cutting-edge topics like generative



Inauguration of Young Scientists Conference in the presence of Hon'ble Cabinet Minister, Shri Kiren Rijju during IISF 2023

AI, nuclear medicines, robotics, space exploration challenges, and advancements in pharma through virology and molecular biology. Sessions included discussions on space exploration, pharmaceutical advancements, and sustainability, nurturing school students' passion for science.

Science through Games and Toys event focused on promoting scientific learning among youth through interactive methods. It underlined the sessions on creating educational toys, STEM

workshops, origami demonstrations, drone workshops, and meteorology presentations. Experts highlighted innovative teaching methods, integrating science and art, and emphasized the importance of scientific methodologies. Prominent figures from academia and research institutions concluded the valedictory while participants also explored activities like drone demonstrations, bottle rocket experiments, and SCIToon presentations. Also, visitors enjoyed a display of 40 aircraft models, exploring aerodynamics and the fun of flying things.

Student Innovation Festival-Space Hackathon engaged over 4,500 teams to tackle space challenges with 57 teams shortlisted for a 30-hour hackathon. Finally, four teams were declared winners, whose ideas will be supported by ISRO. Notable figures from ISRO and academia participated, encouraging innovative solutions. Top teams addressed issues like Voice-Activated Search Assistant and Cyber Security, etc. Parallel lectures highlighted opportunities in ISRO and global perspectives. The event impelled innovation and emphasized societal contributions through science and technology.

Vigyanika - Science Literature Festival facilitated in-depth discussions and dialogues for effective science communication through insightful discussions, workshops, scientific



Visit of Shri Manoharlal Khattar, Hon'ble Chief Minister of Haryana during IISF 2023

sessions and other engaging activities. Approximately 400 delegates, including 200 school students, science communicators, and enthusiasts from across India, attended the event from 26 states.

State S&T Ministers and Officials Conclave: Seven state ministers, 27 officials, and 75 delegates convened to strategize on catalyzing the STI ecosystem through S&T Councils, aligning with government policies. Themes centered on regional S&T strengthening and developing homegrown solutions, emphasizing the importance of a robust technology foundation. Also discussion on strategies to strengthen the technology foundation, ensuring that it aligns with the evolving needs and aspirations of the nation were part of the deliberations. Collaboration and innovation were tinted as key drivers for advancing the science and technology landscape across states.

IISF Challenge is a world record-making attempt titled 'Most people assembling models of picosatellite kits simultaneously' wherein 508 students of class 9 and class 10 from 12 different schools from the state of Haryana accomplished the task. 508 WeMoSats - the weather monitoring picosatellites were assembled simultaneously in 75 minutes

and the testing of satellites was carried out by launching them to the height of 500 feet with the help of paramotors. The data of 4 weather parameters namely, temperature, humidity, pressure, and altitude was received by individual students on their smartphones and the LED display, in the form of graphs and values.

Education For Aspiring India - The National Science Teachers Workshop event brought together passionate educators nationwide to raise experiential learning and enhance problem-solving skills, aligning with the principles of the National Education Policy (NEP). With 300 teachers, the event featured notable sessions by experts, encouraging hands-on learning, and emphasizing innovative teaching methods. Key topics included experiential learning, interdisciplinary approaches, mental health awareness, and the NEP 2020's impact on assessments. International perspectives, practical activities, and engaging panel discussions contributed to development of culture of innovation in science education.

Young Scientists Conference (YSC): From a substantial pool of 2552 applicants, 426 outstanding individuals were chosen for presentation, including 124 for oral delivery and 302 for poster sessions. This event served as a platform for aspiring

young scientists to contemplate the impact of recent technological breakthroughs and ongoing efforts towards inclusive science, paving the way for a sustainable future for all. It featured plenary and invited talks, covering nine contemporary themes aligned with national programs, promoting exchange and contributing to India's scientific vision.

The New Age Technology Show was a four-day event with cutting-edge technological advances. With 1800 applications, 150 were shortlisted to represent students nationwide. The event covered topics like 5G/6G communication, Drone Technologies, AR/VR, IoT, Industry 4.0, 3D Printing, AI/ML, Health, Agriculture, Robotics, Quantum Computing, and Cyber Security. The National Quantum Mission was launched during the valedictory function, highlighting significant achievements and insights in diverse technological domains.

The **National Social Organisations and Institutions Meet (NSOIM)**, held as part of IISF 2023, enabled the exchange of ideas between social and scientific communities. With a focus on "Technological Innovations for Grassroots Development," it gathered 215 participants. Sessions covered topics like water conservation, grassroots



Exchange of Memorandum of Understanding between National Innovation Foundation – India and organizations of various countries during IISF 2023



Women Scientists and Entrepreneurs participated during IISF 2023

innovations, societal health challenges, and livelihood-centric systems. The event displayed 15 grassroots models and emphasized collaborative approaches for rural prosperity. It concluded with the release of *Navonmesh* handbook, encouraging meaningful discussions for societal betterment.

Science, Technology, and Innovation Exhibition: This mega expo introduced 100 exhibitors, presenting a diverse array of innovations from leading organizations like DST, DBT, DRDO, and ISRO. Pavilions from prominent R&D institutions and government bodies such as ICMR, CSIR, BrahMos, MoES, and NTPC were also prominently featured, underlining their contributions to scientific and technological advancements.

The Science & Technology Media and Communicators Conclave aimed to promote effective science dissemination and collaboration. Key sessions addressed social media's role in science communication, media's impact on science diplomacy, and cinema's potential in outreach. Deliberations emphasized collaborative initiatives and recommendations focused on enhancing

science representation via fake news, deep fake AI and its effects on journalism career. The event raised discussions and networking, highlighting the importance of making science accessible to the public via efficient use of social media.

Science, Technology, and Innovation B to B Meet encouraged collaboration between startups, innovators, and the business community. Thirteen technology business incubators highlighted their successes, accompanied by over 75 startups and grassroots innovators displaying their innovations. The DST NIDHI PRAYAS CENTRE demonstrated its prototype development capabilities, including rapid prototyping and testing. The event also aided a startups investor meet, promoting interactions between startups and prominent investors.

The Women Scientists and Entrepreneurs Conclave empowered women in science, entrepreneurship, sustainability, and technology. Over two days, it drew 125 participants from diverse fields. Participants from 20 states and Union territories convened for a two-day conclave featuring six diverse sessions. Topics included challenges and

opportunities for women entrepreneurs and academicians, roles in sustainable development, pioneers in STEM education, and modern lifestyle practices rooted in ancient wisdom. The conclave provided a comprehensive platform for discussions on women's roles and contributions across various sectors.

India International Collaboration IISF 2023 facilitated **India's global scientific outreach** by hosting **delegates from 21 countries**. The National Innovation Foundation organized a roundtable to have international collaborations in Science, Technology, and Innovation (STI). Discussions focused on convergence for sustainable development, learning from overseas achievements, and formulating collaborative goals. Key collaborations included partnership of NIF with entities from Armenia, Australia, Malaysia, Kenya, Namibia, Myanmar, Vietnam, Indonesia, Rwanda, and the USA.

In the 4-day extravaganza, IISF 2023 successfully spread awareness among public, elevated scientific curiosity and meaningful interactions.