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DIVECHA CENTRE FOR CLIMATE CHANGE

Newsletter of the

DIVECHA CENTRE FOR CLIMATE CHANGE

Future Earth Series VIII: Biodiversity Conservation

Training programme on glacier and remote sensing

Environmental risk factors for cardiovascular diseases

Climate adaptation for resilient mountain water towers

Indian Institute of Science
Bengaluru
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CONTENTS

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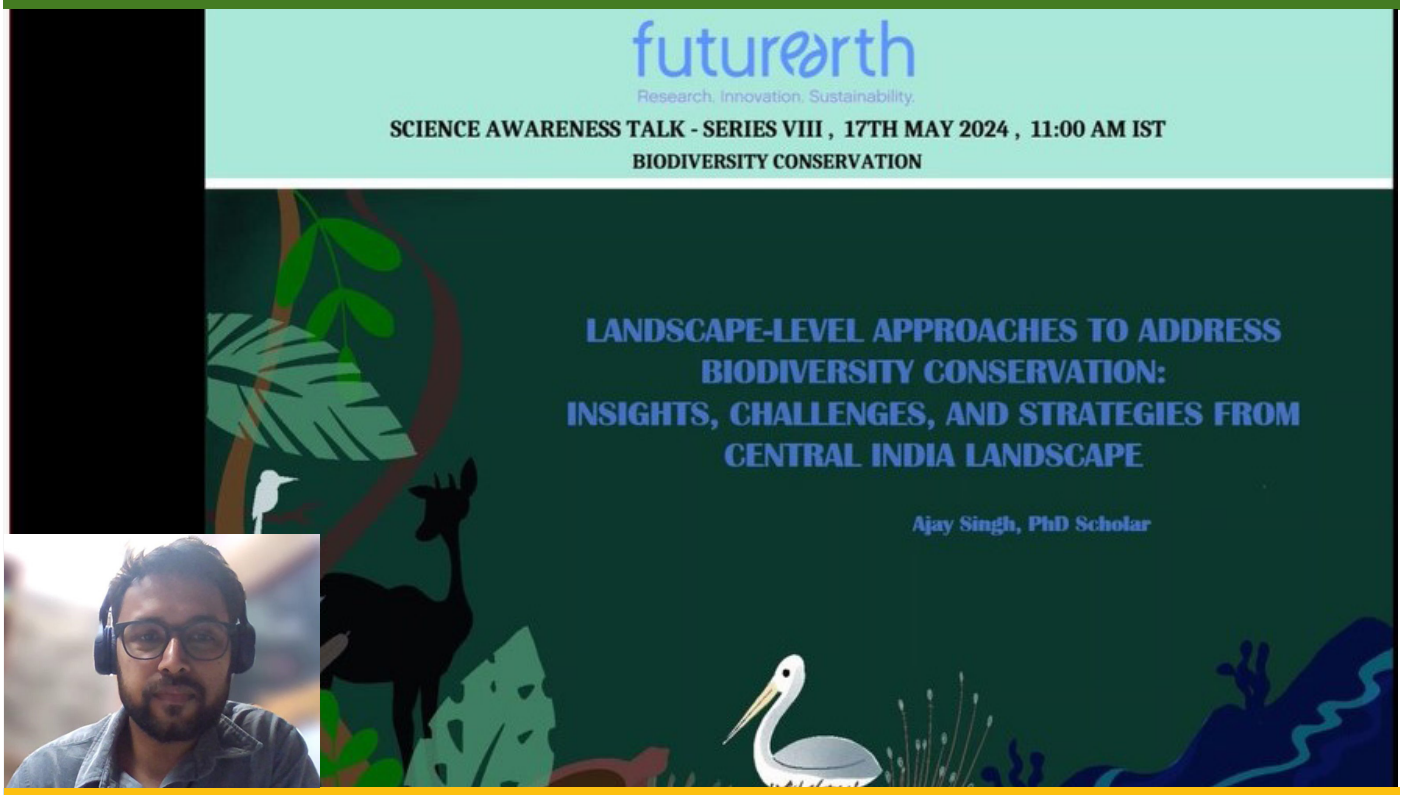
FROM THE CHAIR

Greetings!

In 2023, the global mean temperature was 1.5 degrees Centigrade above normal (compared to 1890-1900), and this was both on account of the relentless increase carbon dioxide as well as the El Nino that appeared after 3 years of La Nina conditions in the equatorial Pacific Ocean. The climate models predicted that there will be a transition from El Nino to La Nina in the middle of 2024. Based on this the India meteorological department predicted that the Indian summer monsoon will be above normal in 2024. In June, there was a delay in the northward progress of the monsoon and hence the rainfall in June was 11% below normal. The monsoon revived in July and August and the hence cumulative rainfall from 1st June to 31st August was 7% above normal. The transition from El Nino to La Nina has not occurred so far. The Indian monsoon has been above normal so far because the amount of water vapor in the eastern Arabian sea has been around 10% above normal so far. This is partly on account of the increase in sea surface temperature in the Indian ocean. Most climate models have predicted that the Indian monsoon rainfall will be higher in the future on account of the increase in sea surface temperature caused by global warming. Some models predict that El Ninos may occur more often in the future on account of global warming. If this happens the India may witness more droughts in the future. A much greater calamity will occur if the Atlantic meridional ocean circulation becomes weaker on account of the rapid melting of ice in the Arctic. This will reduce the transport of heat from the tropics to the Arctic and will result in decline in the Indian monsoon. The speleothem data from the Himalayas indicate that the Indian monsoon rainfall declined dramatically around 13,000 years ago during the Younger Dryas event in Greenland. Hence there is a need to monitor the decline in the Atlantic meridional ocean circulation to determine if the increase in carbon dioxide in the atmosphere will trigger a decline in the ocean circulation.

S. K. Satheesh

FUTURE EARTH SERIES VIII: BIODIVERSITY CONSERVATION



Dr. Ajay Singh, Ph.D. Scholar, Forest Research Institute, India, delivering his talk on 17th May 2024.

The Future Earth Global Secretariat Hub South Asia, DCCC organised a webinar session on Science Awareness Series-VIII on 17th May 2024. The first speaker Dr. Ajay Singh, Ph.D. Scholar, Forest Research Institute, India, delivered a talk on "Landscape-Level Approaches to Address Biodiversity Conservation: Insights, Challenges, and Strategies from Central India Landscape". The Panna Landscape is vital to Central Indian biogeography in terms of biodiversity conservation amidst the challenges posed by the changing climate. The study was conducted in a vast landscape encompassing various ecosystems and land uses.

Dr. Ajay and his team delineated the landscape boundaries utilizing ecological knowledge, laying the foundation for comprehensive biodiversity surveys. They conducted extensive surveys, exploring primary and secondary data through diverse methods. The synthesis of these datasets, alongside top graphical and climatic analyses, facilitated the generation of maps elucidating biodiversity dynamics. Their discussion extends to the array of primary and secondary sources instrumental in landscape-level investigations, underscoring their significance in informing conservation strategies. Furthermore, there are inherent opportunities and challenges to

landscape-level studies crucial for effective biodiversity conservation.

In the second session, Dr K. P. Acharya Professor, Tribhuvan University, Institute of Forestry, Nepal, spoke on "Acting for our Future: Biodiversity Conservation in Changing Climate". As climate change accelerates, protecting biodiversity becomes increasingly crucial. His presentation focused on the complex relationship between climate change and biodiversity, with a special focus on Nepal-a country renowned for its diverse ecosystems and vulnerable wildlife. Here, the pressure from human activities like degradation and land conversion greatly threatens natural habitats. Through detailed exploration of fieldwork and case studies from Nepal,

Dr. Acharya discussed the environmental impacts observed. They could celebrate recovery successes, showcasing examples like the resurgence of the tiger, Rhinos and the gharial to illustrate effective strategies and inspire hope. Nepal has also embraced climate-smart approaches in its conservation strategies within protected areas. These practices are designed to enhance ecosystem resilience to climatic changes and ensure sustainable biodiversity conservation. Outside protected zones, community forestry has proven highly effective in restoring and conserving biodiversity, with local communities playing a pivotal role in managing forests. Equipping young researchers and students with a comprehensive overview of challenges and innovative solutions, this talk aims to empower a new generation of conservationists to actively engage in and advocate for sustained conservation efforts. Dr. Acharya emphasized the need for awareness, participation, and the critical role of community in driving positive change.

TRAINING PROGRAMME ON GLACIER AND REMOTE SENSING

Dr. Kulkarni welcoming Dr. Shailesh Nayak, Director, NIAS during the inaguration of the training programme at the Divecha Centre from 18th to 28th June 2024.

The large concentration of seasonal snow and glaciers in the Himalayas provides a sustainable water source for people living in the mountains and the downstream plains. However, the rise in temperature in the Himalayan region has caused rapid loss in glacier mass and seasonal snow, influencing water availability. In addition, retreating glaciers have also created new hazards like flash floods from glacier lakes, affecting the safety and livelihood of people living in the mountains. Therefore, continuous monitoring of the Himalayan cryosphere is essential to assess future risks. Due to rugged terrain and extreme weather conditions, satellite-based technology is used extensively to monitor the Himalayan cryosphere. However, a lack of proper training can sometimes lead to erroneous assessments and public controversies. Therefore, the Divecha Centre for Climate Change has been conducting 10-day training course on 'Glacier studies and Remote sensing' every year to overcome this limitation. The course began in 2011, and around 1000 students have been benefited since then, creating a large pool of trained scientific personnel. This program focuses on training graduate and postgraduate students about glaciological

research and enlightening them with vast opportunities.

This year, the training course was conducted from 18th to 28th June 2024 at Divecha Centre for Climate Change, Indian Institute of Science, Bangalore. The number of applications was significantly higher this year, with about 890 applications from 310 Indian institutions. Finally, we selected from which 65 candidates were selected, from 36 institutions. Most of the applicants were either PhD or postgraduate students. Dr. Shailesh Nayak, NIAS Director, inaugurated the program and delivered an inaugural talk on "Earth System Science Research for the Benefit of Humanity".

The course covered various aspects of glaciology and remote sensing. The glaciology aspects include the following topics: 1. snow distribution and glaciers; 2. remote sensing of snow and ice; 3. snow cover monitoring; 4. Glacier inventory; 5. glacier mass balance; 6. snow melt runoff modelling; 8. Hazards in the Himalayas; and 9. Opportunities for cryosphere research in India. One of the key aspects of the training program is the exercises. The exercises included glacier depth estimation, snow reflectance, glacier inventory, supra-glacier debris cover estimation, glacier mass balance using the IAAR method, and runoff estimates. It provided unique opportunities for young aspiring scientists to interact with experienced researchers and understand exciting opportunities in this field of research.

Participants of the training programme organised by the Divecha Centre conducted from 18th to 28th June 2024.

ENVIRONMENTAL RISK FACTORS FOR CARDIOVASCULAR DISEASES

Dr. Darshan Krishnappa, Cardiologist, Mallige Medical Centre and Manipal Hospital, delivering his talk on 25th July 2024.

Divecha Centre for Climate Change organised a talk on "Environmental Risk Factors for Cardiovascular Diseases: Early Recognition and Measures to Mitigate" by Dr. Darshan Krishnappa, Cardiologist, Mallige Medical Centre and Manipal Hospital, on 25th July 2024.

In his talk Dr Krishnappa highlighted that recent years environmental pollution has an impact on cardiovascular diseases, 25% of heart attack, 20% of strokes are related to air pollution. We are facing heart attacks in younger age group. While traditionally most of the emphasis of cardiovascular disease prevention has been on the personal domain, increasingly the importance of the natural and social environment is being recognised. Circadian rhythm is the most primordial natural phenomenon that is common to both animals and plants. Heat and cold waves representing the extreme of temperature fluctuations have consistently been shown to be associated with an increased risk of cardiovascular disease. Cold temperatures are associated with a greater risk than hotter temperatures - their effect also lasts for a longer duration.

Air pollution is now recognised as the second most important cardiovascular risk factor and is ubiquitous - stronger measures at individual and policy maker level to curb its ill effects. Climate change and its social, economic and health effects are well recognised - greater efforts to curb green-house gas emissions are the need of the hour while also strengthening disaster response infrastructure. Also, noise pollution is an emerging health hazard. Dr. Darshan highlighted that multipronged effort involving all stake holders - administrators, scientists and cardiologists in drafting and implementing prevention and response strategies is important and necessary.

Participants of the seminar organised by the Divecha Centre on 25th July 2024.

CLIMATE ADAPTATION FOR RESILIENT MOUNTAIN WATER TOWERS

Prof. Christopher Scott, Pennsylvania State University, delivering his talk on 23rd Aug 2024.

Divecha Centre for Climate Change organised a talk on "Climate adaptation for resilient mountain water towers: Insights and opportunities in the Appalachians and Andes" by Prof. Christopher Scott, Pennsylvania State University, on 23rd Aug 2024.

Water is an essential resource for large urban populations, indigenous and local communities, downstream hydropower and irrigation uses, and highly diverse ecosystems. Mountains provide a wide range of ecosystem services globally. Under expanding risks from climate change and other human pressures, mountain water towers are at a crossroads, requiring urgent evidence-based action for adaptation and mitigation to enhance their resilience.

In his presentation, Dr. Scott reviewed climate adaptation experience in Pennsylvania, with emphasis on the Allegheny plateau of the Appalachian Mountains that serve as headwaters for major river systems and the Chesapeake Bay downstream. Additionally, ongoing research and policy

engagement are presented from the Andes of Colombia, Argentina, and Chile, where rapid glacier retreat and modified seasonality of river flows has major impacts on hydropower and irrigation.

Dr. Scott made a comparative reference of the Appalachians and Andes water resources to the Himalaya Hindu Kush region. Adaptive management responses to climate change involves improved hydrometeorological forecasting, infrastructure "re-adaptation," and engagement with public agencies and private sector stakeholders using "serious games" scenario planning.

Participants of the seminar conducted on 23rd Aug 2024.

ROLE OF GREEN SPACES FOR SUSTAINABILITY IN RAPID URBANISATION

Dr. H Paramesh, Visiting Professor, DCCC, addressing the 11th Bengaluru IAP PEDICON on June 15th 2024 at NIMHANS Convention Hall.

The green space provides safe access to everyone including people with disability. It reduces the adverse per capita environmental impact of cities by reducing air, water. Soil pollution and solid waste with sound pollution. In addition, green spaces support positive social, economic and environmental links to strengthening generation.

The world environmental day slogan of 2024 is “Protect, Preserve and Prosper a Greener Future” for all on the planet and emphasizes action-oriented decisions. Rapid urbanisation is swallowing the green land of our Gomalas in the village meant for grazing of animals and a good lung space as well. We lost over 16000 acres of land in Bengaluru urban district about 1200 villages. Based on Supreme Court judgement in 2021 and our High Court order in 2022, all the grazing land needs to be restored as social forestry while maintaining the existent green spaces in the center of our city. This needs the efforts of officials in revenue department, local leaders, real estate developers and other organisation with consciousness for sustenance of lives.

VISIT OF STUDENTS FROM JSS POLYTECHNIC

Students from JSS Polytechnic, Nanjangud Mysore district, attending Dr. H. Paramesh's talk, on 9th Aug 2024.

JSS Polytechnic students from Nanjangud Mysore district visited Divecha Centre for Climate Change on 9th Aug 2024. Dr. H. Paramesh, Visiting Professor, DCCC, gave a talk on "Rapid Urbanisation – Need for Green Spaces including Gomalas for Sustenance of Lives". Green spaces including Gomalas (Areas designated as common grazing lands or pastures) are linked with positive physical and mental health. In Bangaluru, 16 thousand acres of revenue land have been encroached for urban development. It is essential to find out the number of encroached Gomalas to maintain green space for our lungs and cattle alike.

Dr. Raj Kishore, Consultant Scientist, DCCC, discussed the challenge of raising and maintaining plantations for carbon sequestration by forests. As part of the Paris Agreement (COP21), one of India's Intended Nationally Determined Contributions (INDCs) is to increase forest cover to absorb 2.5 billion tonnes of CO_2 by 2030.

Dr. Raj Kishore said "Consider the forested areas around Nanjangud. A single mature tree can sequester approximately 162 kg of CO_2 per year, meaning that six trees are required to absorb a tonne of CO_2 annually. On a

larger scale, about 10 tonnes of CO_2 are absorbed by one hectare of forest each year".

Taking an example of the Bandipur National Park, which is world-renowned and located near the JSS institute, Dr. Raj Kishore said that the park covered approximately 900,000 hectares. To meet the INDC target of sequestering 2.5 billion tonnes of CO_2, one would need to create over 2,500 forests equivalent to Bandipur. On the flip side, each of us contributes to carbon emissions in various ways. A carbon footprint represents the total amount of greenhouse gases (mainly CO_2 and methane) generated by our actions. For example, one tonne of CO_2 emissions is roughly equivalent to driving 4,000 km in a car or charging 120,000 smartphones.

In conclusion, while the avenues for increasing carbon emissions are expanding rapidly as society progresses, creating forests for carbon sequestration is an incredibly challenging task.

Students from JSS Polytechnic with DCCC faculty and staff.

QUIZ PROGRAMME 2024

Students from Raja Rajeshwari English school participating in the quiz programme held on 30th August 2024.

A programme on climate and environment was organised at Raja Rajeshwari English school in Yeshwanthpur on 30TH August by Ms. Kavitha Ramkumar, senior project associate at Divecha Centre for Climate Change. About 500 students studying in class 9 and 10 participated in this programme.

Dr. H. Paramesh, Visiting Professor, at Divecha Centre for Climate Change gave a talk on the impact of air pollution on health. He highlighted the adverse impact of air pollution on children. The second session started with a short talk on weather and climate by Prof J. Srinivasan, former Chairman, Divecha Centre for Climate Change. This was followed by a quiz on climate and environment. Students participated in this quiz with great enthusiasm. They learnt about heat waves, sea level rise, good and bad ozone as well as ice ages through the questions posed during the quiz. The teachers in the school were delighted that, for the first time a program on environment and climate was conducted at this school by eminent scientists.

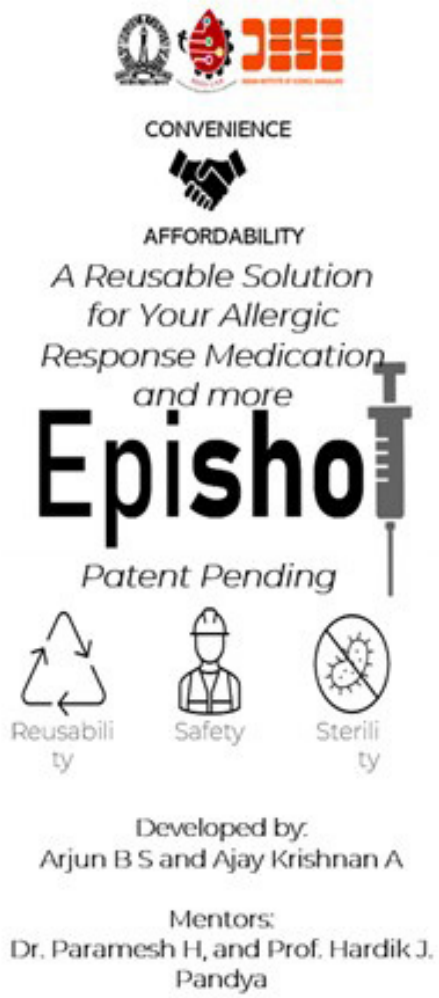
IMPACT OF GLOBAL CLIMATE AND ENVIRONMENT ON CHILD DEVELOPMENT

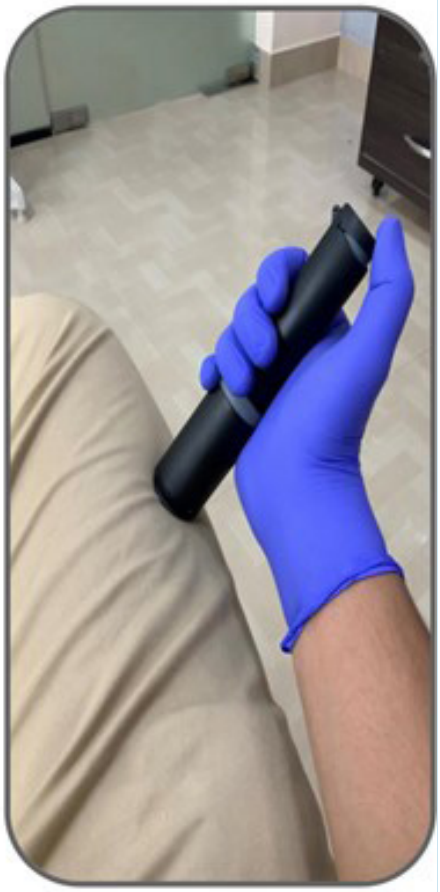
Prof S. K. Satheesh, Chair, DCCC, inaugurating the National Conference of Developmental Pediatrics programme held between 31st Aug and 1st Sept 2024.

Environment and climate change with air pollution have significant impact from womb to tomb on child development in particular congenital disorders. As of report from W.H.O in 2023 the mortality from Congenital anomalies is 2,40,000 in neonates and 1,70,000 in 1 month to 5 years age globally. The long-term disability with psycho-socio-economic burden will be on low- and middle-income countries.

The usual type of disabilities are visual, hearing, mental health, intellectual, physical, cardiac and respiratory disabilities causing barriers for these children in terms of attitudinal and social exclusion, systemic or organisaional, physical communication of information and new technology. Pregnant mothers exposed to air pollution have higher risk of giving birth to cerebral palsy more in boys, fixed airway obstruction from placental coagulopathy syndrome and olfactory behaviors pattern.

A NEW WAY TO DEAL WITH ANAPHYLAXIS





Anaphylaxis is a serious allergic reaction and can be fatal if not properly recognized and treated. The lifetime prevalence is 1.6% to 5.1%. Allergy to food is the most common source of Anaphylaxis.

Epinephrine is the emergency medicine used to save life. The self-injectable EpiPen are available but very expensive, costing $450 to $2500 for an injection.

Dr. H. Paramesh, Visting Professor at Divecha Centre for Climate Change along with the faculty at Department of Electronic Systems Engineering IISc, developed a new injectable device EPISHOT that will cost around $5.

This device has been patented by Indian Institute of Science for the next 20 Years. This emergency medicine should be available in all doctor's kit, all nursing station, all vaccine injectable areas, chemotherapy centers, all

cafeterias, all clubs with sports event, all school and all sports arenas.

(Top Left) Dr. H Paramesh, Visting Professor, DCCC, Mentor / Clinical Collaborator, (Top Right) Dr. Hardik Pandya, Principal Investigator, DESE, IISc., (Bottom Left) Mr. Arjun, Ph.D. Scholar, DESE, IISc., (Bottom Right) Ajay Krishnan, Project Assistant, DESE, IISc.

RESEARCH HIGHLIGHTS

LAND DEFORMATION IN THE JOSHIMATH REGION, UTTRAKAND

The Himalayas are highly susceptible to various natural disasters, such as land deformation, earthquakes, landslides, and extreme climatic events. Recently, the Joshimath town witnessed extensive land subsidence activity. The phenomenon resulted in the development of large cracks in roads and over 868 civil structures, posing a significant risk to the inhabitants and infrastructure of the area. The investigation was carried out using a time-series synthetic aperture radar (SAR) of the Sential-1 satellite. The interferometry-based PSInSAR approach is used to monitor land deformation. The line of sight (LOS) land deformation velocity for the Joshimath region for 2022–2023 varies from − 89.326 to + 94.46 mm/ year. The + ve sign indicates the LOS velocity/displacement away from the SAR sensor, whereas the −ve sign signifies the earth's movement towards the SAR sensor in the direction of the LOS. The displacement was further validated using multi-temporal high-resolution Planet datasets. The results are consistent.

The study also separately estimated the land deformation for 2016–2017, 2018–2019, and 2020–2021. Our results show that the Joshimath region experienced the highest land deformation during 2022–2023. During this period, the maximum land subsidence was observed in the north-western part of the town. The maximum LOS land deformation velocity +60.45 mm/year to + 94.46 mm/ year (2022–2023), occurred around Singhdwar, whereas the north and central region of the Joshimath town experienced moderate to high subsidence of the order of +10.45 mm/year to + 60.45 mm/year (2022–2023), whereas the south-west part experienced an expansion of the order of 84.65 mm/year to − 13.13 mm/ year (2022–2023). Towards the south-east, the town experienced rapid land subsidence, −13.13 mm/ year to − 5 mm/year (2022–2023).

The study analyzes the causative factors of land deformation. Uncontrolled population growth, unplanned built-up development, and inadequate drainage systems are the leading causes. To mitigate the issue, the government needs to implement a comprehensive approach. This includes establishing a well-designed drainage system, implementing regular maintenance and effective waste management, and preventing water seepage and infiltration. Measures such as constructing retaining walls and employing erosion prevention techniques are essential to address toe erosion and slope instability. The immediate actions should involve minimizing construction activities utilizing lightweight and earthquake-resistant building materials and promoting sustainable development practices. Joshimath's future relies on practical strategies considering the region's

delicate geological and environmental conditions. This entails regulating urban growth, carefully planning and executing large-scale infrastructure projects, and diversifying industries. By doing so, the government can ensure the long-term prosperity and well-being of the region while preserving natural resources and safeguarding the population from natural disasters.

Reference: Awasthi, S., Jain, K., Sahoo, S., Kumar, R., Goswami, A., Joshi, G.C., Kulkarni, A.V., Srivastava ,D.C., Analyzing Joshimath's sinking: Causes, consequences, and future prospects with remote sensing techniques . In: Scientific Reports, 14, 10876, 2024

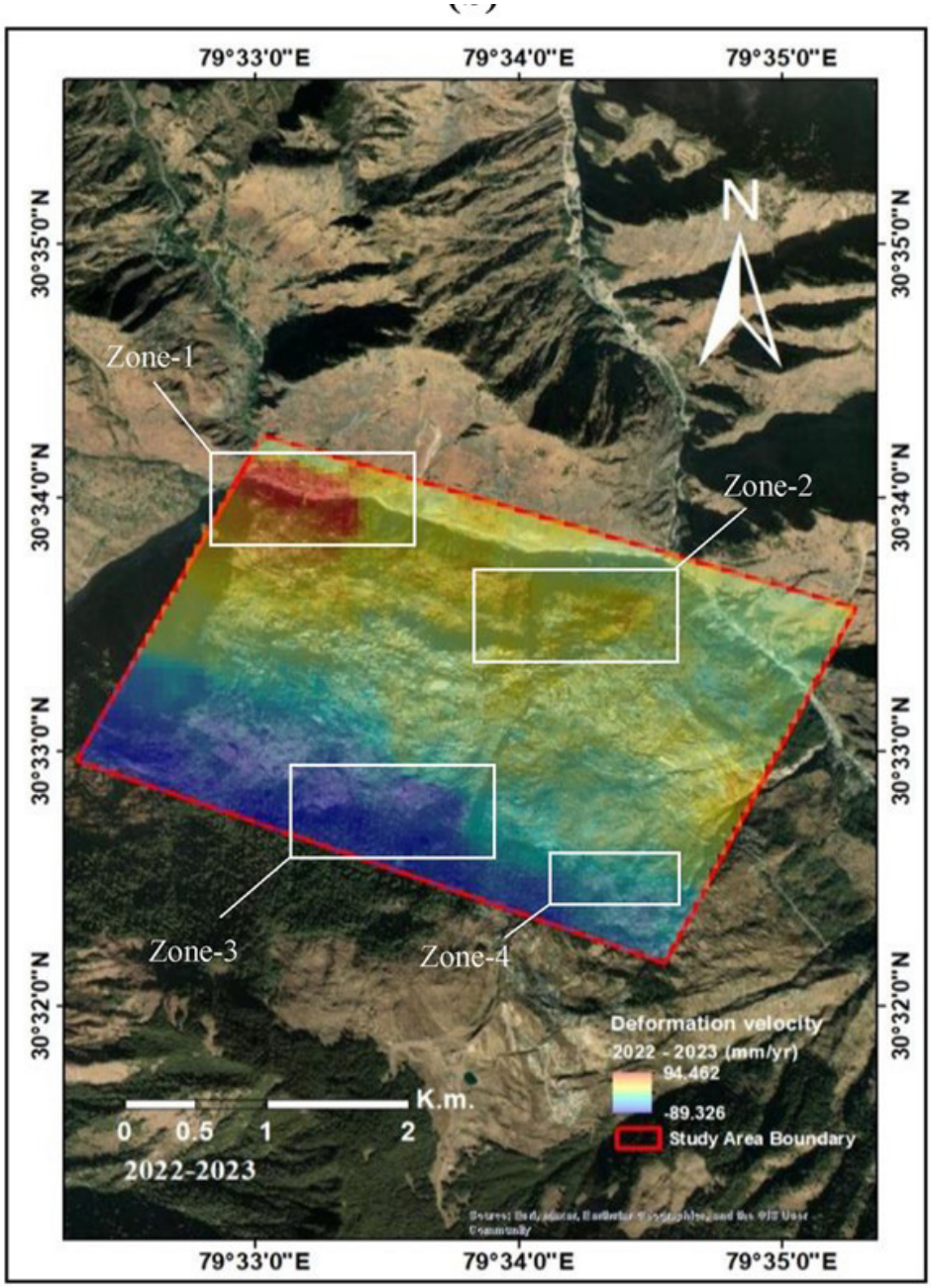


Figure: land deformation in the Joshimath region during 2022–2023. Maximum deformation was observed in Zones 1 and 3.

MAPPING OF URANIUM CONCENTRATIONS IN GROUNDWATER SAMPLES

The geomorphology, geohydrology, lithology and ecological features of the area influence the uranium content in groundwater. The groundwater samples were collected from 75 locations of Davanagere district, Karnataka, India. Uranium analysis in the water samples was done using LED fluorimeter, based on fluorescence of dissolved uranyl salts. The uranium concentration in water samples varied from 18.41 to 173.21 µg per liter. Higher concentration was observed in the metamorphic, plutonic and volcanic/meta volcanic rock types. In all, 15.3% of samples showed concentration above the prescribed level of 60 µg per liter by AERB and 66.8% of the samples above the WHO and USEPA guideline value of 30 µg per liter. Higher uranium concentration in groundwater was observed in Harapanahalli and Jagalur taluk of Davanagere district, which falls in the Eastern Dharwar Craton, which is generally known to contain more radioactive minerals than the Western Dharwar Craton.

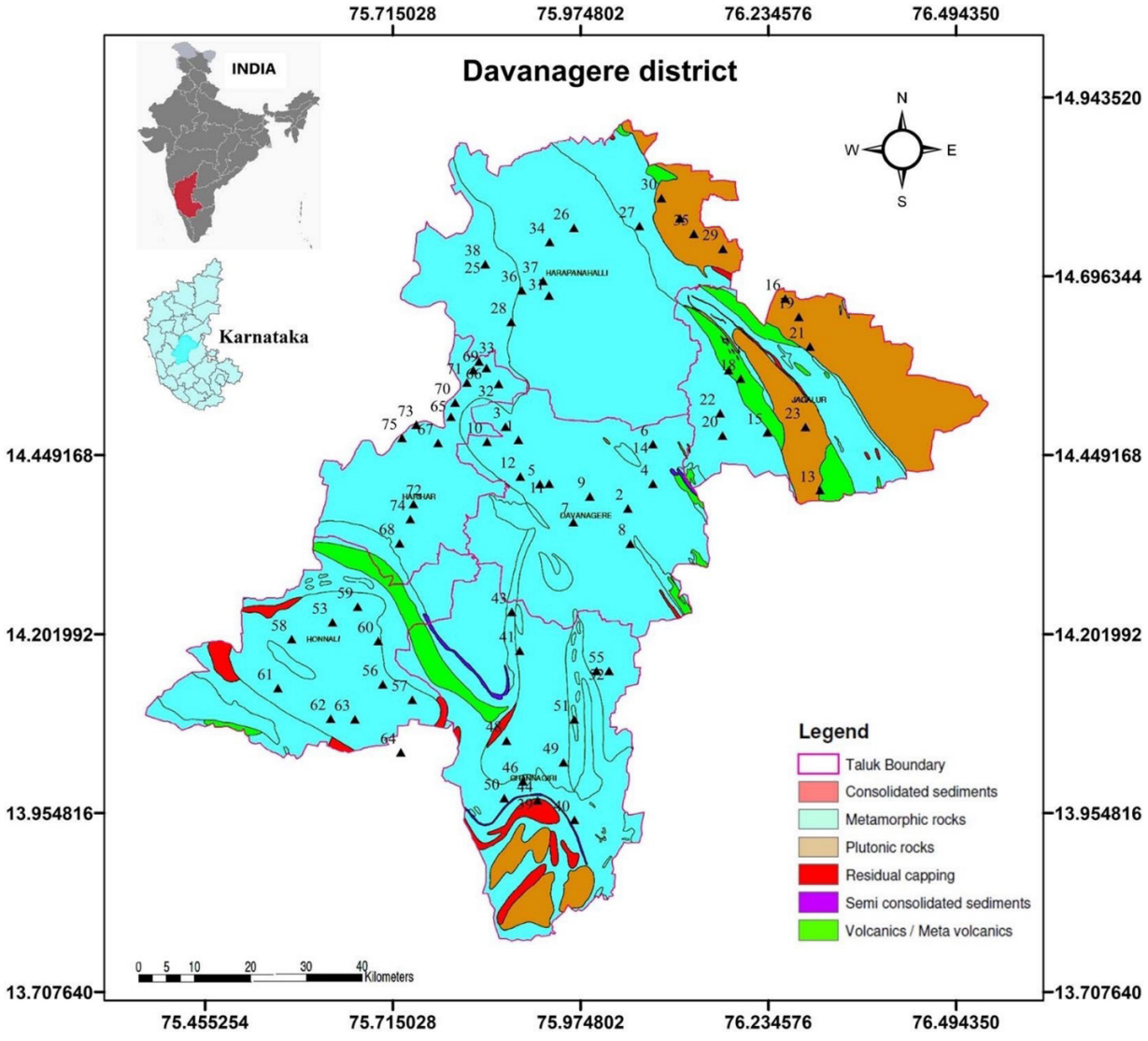


Figure 1: Geological map and sampling stations of Davanagere district.

The effective ingestion dose and lifetime cancer risk to the population were calculated using uranium concentration in the drinking water. The annual ingestion dose to the population of Davanagere district because of varied from 15.00 to 141.11 μSv per year.

People consuming groundwater where uranium concentration is above the maximum contamination limit are prone to radiological and chemical risks. The higher uranium activity is correlated with the geological structure of the study area. Concentration of uranium must be monitored periodically to assess the radiological risks to the public.

Reference: Hidayath M., Lavanya B.S.K., Namitha S.N., Chandrashekara M.S. and Pandit S.A. Mapping of uranium concentrations in groundwater samples of Davanagere district, Karnataka, India, and assessment of effective dose to the population. Radiation Protection Dosimetry, 2024, 200(11–12), 994–1002. https://doi.org/10.1093/rpd/ncae036

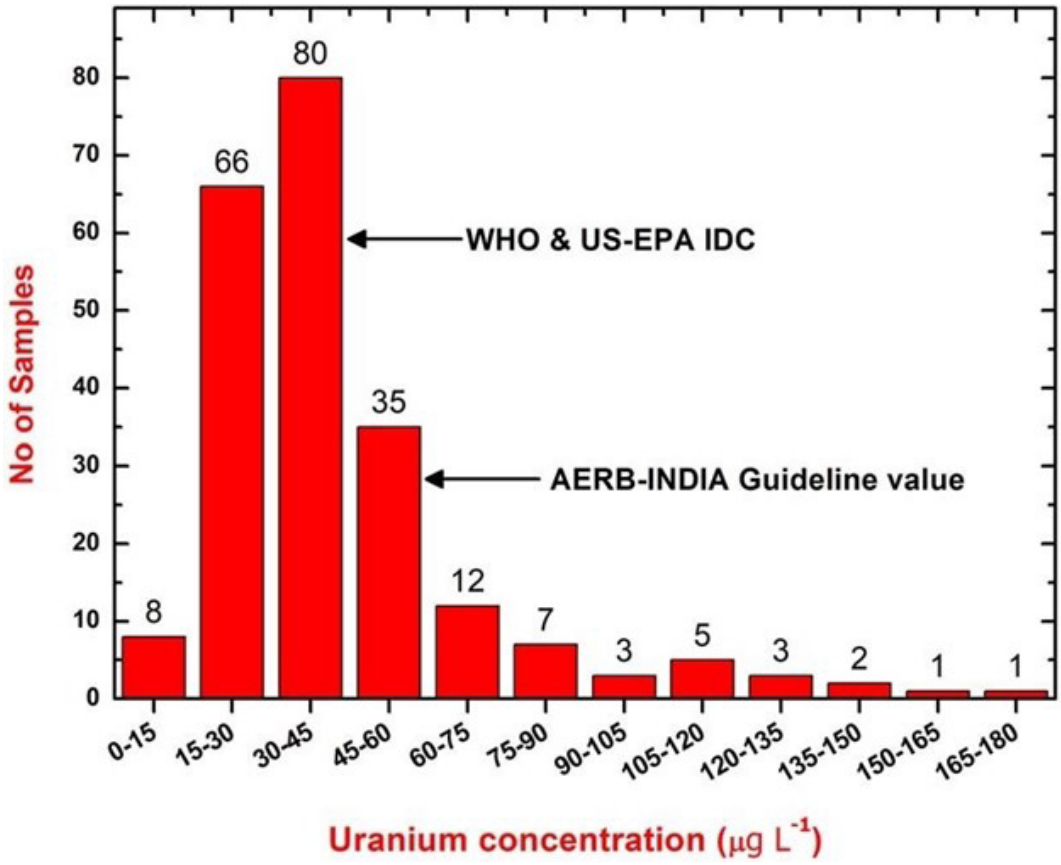


Figure 2: Frequency distribution of uranium concentration in water samples of Davanagere district.

Image courtesy: *https://frontline.thehindu.com/*