



SDG 13: Climate Action

TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS

IITGN campus has been designed with key sustainability features, such as solar energy generation, comprehensive waste management, water conservation, purification and recycling, and compost production. Moreover, the campus infrastructure supports passive cooling and energy conservation in all the aspects of construction, operations and management. IITGN is the first campus in India to be awarded a five-star rating by Green Rating for Integrated Habitat Assessment for Large Developments (GRIHA LD) in 2016. The institute takes different initiatives and activities to support climate action, raise awareness of the community on the campus and in the neighbourhood, thus contributing to achieving Sustainable Development Goal 13.

Research

The institute is undertaking substantial research activities on a wide range of areas related to climate change. Nearly 30 researchers at the institute work in areas related to climate change including drought monitoring and assessment, water resilience strategies, changes in terrestrial water storage, urban water crisis management, extreme weather events and forecasts, vegetation growth, hydrological models, and climate change projections among others. The institute informs and supports local, regional and national governments in climate change related projects. A list of projects undergoing at the institute during the year 2020-21 is provided below.

- An experimental operational hydrologic modelling and forecasting system for river basin hydrology and extremes for India; Indian Institute of Tropical Meteorology
- Developing physics guided super-resolution approach and evaluations strategies for downscaling earth system model outputs; Science and Engineering Research Board
- Establishing Gujarat state climate change centre; Department of Science & Technology (DST)
- Flood risk assessment in tropical rivers in the anthropocene under climate change scenario using hydro geomorphic modelling; Ministry of Education
- Harnessing solar energy to achieve near zero carbon emission for brine treatment; DST
- Impact of sea level fluctuations, climate change or tectonic activity on the decline of the Harappan settlement of Dholavira, Kutch, India; DST
- Impacts of climate variability and climate change on water resources in the Sabarmati river basin; Ministry of Jal Shakti
- Implications of COVID-19 on Gujarat state from climate change perspective; Gujarat Energy Development Agency

- Institutionalising Capacities on Climate Change, Regional Training on Climate Science and Modelling; Ministry of Environment, Forest and Climate Change
- Physics guided data science approach for predictive understanding of hydrological processes; Ministry of Education
- Tectonic and climatic control on variability of sediment routing in the NW Himalaya since late quaternary; DST
- UAV-based laser spectroscopic monitoring of greenhouse gas emissions in urban and rural India; Royal Academy of Engineering

Education

The institute offers the following courses relating to climate change:

CE 201: Earth Materials and Processes
 CE 202: Sustainability and Environment
 CE 308 A: Water Resource Engineering
 CE 611: Advanced Engineering Hydrology
 CE 633: Water Resource Systems: Planning and Management
 EH 602: River Morphology and Ecology
 EH 605: Modelling of Earth System and Sustainability
 EH 608: Biodiversity Conservation and Sustainable Development

An online short course on ‘Digital Terrain Model (DTM): Data Sources and Processing’ was conducted by Prof Pradeep Srivastava, Adjunct Professor, Earth Sciences, IITGN from August 16 to 30, 2021.

A lecture on ‘Climate, environment and the Indus Civilization: Insights from the land, water and settlement and TwoRains Projects’ was organised by Archaeological Sciences Centre on March 27, 2021. The instructor was Prof Cameron Petrie, Reader in South Asian and Iranian Archaeology, Department of Archaeology, University of Cambridge. This lecture considered the nature of climatic and environmental context and how it impacted the lifeways of Indus Civilisation populations. It also examined the degree to which those populations were able to adapt to a changing environment and developed resilient and sustainable strategies in the face of dwindling water availability.

Community Outreach

Indo-UK Virtual Conference on the 5 C’s of Water Vulnerability

The Indo-UK Virtual Conference on the 5C’s of Water Vulnerability: Climate Change, Contaminants, Co-occurrence, Conflicts, and Covid-19 was held from December 14 to 16, 2020. The conference was co-organised by Earth Sciences discipline, Dr Kiran C Patel Centre for Sustainable Development, the UK-India Education Research Initiative (UKIERI), Newcastle University, British Council, and the Department of Science and Technology, Government of India. Prof Manish Kumar from IITGN and Prof David Werner from Newcastle University were the conveners of the workshop. Dr Rakesh Kumar, Director, Council of Scientific and Industrial Research - National Environmental Engineering Research Institute (CSIR-NEERI), delivered the inaugural talk on “Climate Linked Resilient Cities Developmental Planning” that discussed environmental management strategies for healthy and sustainable cities. There were 10 sessions in the conference with nearly 30 panellists discussing themes such as Covid-19 and the

participation of scientists, environmental engineering solutions, geogenic concerns of water, public health and conflicts, microbiological water quality, and river health and geomorphology. The three-day event attracted more than 200 attendees from Australia, Germany, Ghana, Hong Kong SAR, Israel, Japan, Saudi Arabia, Singapore, South Africa, Sri Lanka, Sweden, UAE, UK, and USA. The web conference brought together leading academicians, scientists, researchers, and practitioners from India and abroad to share their experiences and research outcomes on various aspects of water quality in the aquatic environment.

21st National Power Systems Conference

The 21st National Power Systems Conference (NPSC 2020), co-sponsored by the Institute of Electrical and Electronics Engineers (IEEE) Gujarat Section and Power & Energy Society (PES) Gujarat Chapter, was held from December 17 to 19, 2020 at IITGN. The theme of NPSC 2020 was "Sustainable Energy and Resilient Future Grid". It focused on modern power systems, electricity markets, smart grid, renewable energy, distributed generation, power electronics, electrical machines, system integration, and operational challenges. The conference featured 14 keynote talks, two dedicated industry-academia panel sessions, four tutorial sessions, and 132 technical paper presentations.

Sustainability Fair

The Dr Kiran C Patel Centre for Sustainable Development hosted its third annual Sustainability Fair online on March 26, 2021, on the theme of "Renewable Energy and Water Resources" which has a significant linkage with climate change. The Fair was inaugurated by Shri Vijay Rupani, Chief Minister of Gujarat. The event featured keynote addresses by Dr Kalanithy Vairavamoorthy, Executive Director, International Water Association; Dr Ashok Das, Founder CEO, SunMoksha; and Dr Rajendra Singh, Chairman, Tarun Bharat Sangh, on topics related to challenges and opportunities in the international water sector, sustainable energy for rural development and community decentralised water management respectively. Online interactive networking sessions and nearly 50 virtual exhibition stalls by industries and organisations working on renewable energy, water and other sustainability issues were hosted at the event. More than 600 participants attended the Fair from India and across the globe, including Singapore, Thailand, United Arab Emirates, Bangladesh, Germany, United States, Pakistan, Malaysia, Nigeria, Indonesia, Egypt and Sri Lanka.

Sustainability Seminar Series

The Centre organised 14 webinars between September 2020 through March 2021 under the series. Speakers from world-renowned organisations covered topics related to climate change including water, pollution, energy and natural resources, wildlife and ecosystems at the webinars. More than 1,000 people from India, as well as Australia, Austria, Brazil, Ecuador, France, Gambia, Germany, Hong Kong SAR, Indonesia, Italy, Japan, Kyrgyzstan, Saudi Arabia, Spain, Sri Lanka, Switzerland, UAE, UK, and USA, attended the series.

A. Unsustainable use of groundwater resource: Threat to food and drinking water security

Facilitator: Dr Dipankar Saha, Secretary, Indian Chapter of International Association of Hydrogeologists, Former Member (Head Quarters) Central Ground Water Board and Former Member Secretary, Central Ground Water Authority | Webinar held on 28.9.2020

There is an urgent need for sustainable use of aquifers to obviate the threats to food and drinking water security and also to curb collateral environmental damages that emanates from overexploitation of this resource; like, drying wetlands, diminishing flows in rivers, saline water ingress in coastal areas, soil moisture depletion etc. The talk dwelled upon the aquifers and the invisible groundwater resources and their utilisation in India. The involvement needed from different stakeholders and interventions needed for sustainable use of this precious natural resource was also discussed.

B. CARE with MIRACLE: Climate Adaptation and Resilience Engineering (CARE) with Machine Intelligence for Regional Assessment of CLimate Extremes (MIRACLE)

Facilitator: Prof Auroop Ganguly, Professor of Civil and Environmental Engineering (CEE) at Northeastern University (NU) in Boston, MA, USA, and Director of the Sustainability and Data Sciences Laboratory (SDS Lab) | Webinar held on 5.10.2020

Weather and hydrological extremes under climate variability and change act as drastic shocks and threat multipliers, over and above population change and rapid urbanisation, biodiversity loss and ecological perturbations, decay and fragility of infrastructures, as well as growing inequality and unprecedented globalisation, leading to depletion of food-water-energy resources and ecosystems, breakdown of urban and rural sustainability, lack of business continuity and health services, vulnerability to natural and man-made hazards, as well as loss of assets and human lives. The presentation discussed how a range of novel tools and methods ranging from complex systems dynamics and network science or operations research all the way to satellite remote sensing, physics-guided machine learning and data-driven physics enhancements within high-performance computational simulations, can help extract novel science insights and generate new engineering principles, which in turn can inform stakeholders and resource managers to produce societally relevant solutions that are cognizant of policy imperatives.

C. Feedback from land processes to Indian monsoon

Facilitator: Prof Subimal Ghosh, Professor in Department of Civil Engineering, Centre for Urban Science & Engineering and Convener, Interdisciplinary Program in Climate Studies, Indian Institute of Technology Bombay | Webinar held on 19.10.2020

The multi-scale variations of Indian monsoon have impacts on land processes over the Indian subcontinent. The feedback from the land processes to the monsoon is generally neglected in monsoon studies. The feedback from land to monsoon in terms of estimation of recycled precipitation is quantified. It is found that a better presentation of land in a coupled land-atmosphere regional model improves the monsoon simulation with a reduction in dry bias and incorporation of interannual variations of vegetation properties increases the simulations of interannual variations of Monsoon. This can also be explained with information theory-based process networks.

D. Floods in a changing climate

Facilitator: Prof Pradeep Mujumdar, Professor in the Department of Civil Engineering and Chairman, Interdisciplinary Centre for Water Research, Indian Institute of Science Bangalore | Webinar held on 26.10.2020

With an increased climate variability under climate change, the risk of hydrologic extremes of floods is known to be increasing globally. While with the current scientific knowledge it is not possible to attribute a given extreme event to climate change, recurring patterns and increased frequencies of floods are clearly visible both at larger global scales and at smaller regional scales. The Kerala floods of 2018, Chennai floods of 2015 and Uttarakhand floods of 2013 are recent Indian examples of devastating floods that claimed hundreds of lives and resulted in huge economic losses. Such recurring floods point to the need for a better scientific understanding of the events. The talk provided a brief overview of the recent work related to hydro-meteorological aspects of floods in a changing climate. Specifically, the following key issues were addressed : increase in extreme precipitation at a range of spatio-temporal scales and the associated non-stationarity in the process, hydrologic modelling of floods in the face of limited ground observations, detecting human signatures in the extremes and quantifying uncertainties in projections of the extremes.

E. Programa Agua Doce (Fresh Water Program): Drinking water to semi-arid rural communities through desalination in Brazil

Facilitator: Mr Henrique Veiga, Brazilian Federal Govt officer and Mr Emilio Gabbrielli, Ex-President of International Desalination Association, and ex-head of sales for Latin America of Toray Membranes Ltd. | Webinar held on 28.10.2020

The Água Doce Program (PAD) is an initiative of the Federal Government of Brazil, which is coordinated by the Ministry of Regional Development in partnership with federal, state, municipal and civil society institutions. The PAD uses desalination technology to provide quality water to rural communities in the semi-arid region of north-eastern Brazil with access only to underground brackish water. Within a context of environmental sustainability and circular economy, the brine produced in the desalination process is normally put to beneficial use, for instance in fish farming and growth of salt-tolerant plants used as fodder to feed goats and sheep. It has already achieved nearly 1000 plants in operation serving with good quality drinking water for over 320,000 people. The webinar discussed the journey of PAD, illustrating its success and resilience against all odds and many hurdles.

F. Air pollution and health burden in a changing climate: Perspectives for India

Facilitator: Prof Sagnik Dey, Coordinator of Centre of Excellence for Research on Clean Air (CERCA) and Associate Faculty of School of Public Policy, Indian Institute of Technology Delhi | Webinar held on 2.11.2020

Air pollution, the biggest environmental health risk in India, also impacts climate. Understanding air pollution-climate-health nexus is critical in achieving a sustainable environment for our society. The challenges in estimating the health burden attributable to air pollution in India, and how such a burden is expected to change in future in a warming climate were discussed.

G. Air pollution-land use-cloud interactions: Impacts on climate change, agriculture, hydrological cycle, human health and monumental heritages

Facilitator: Prof Sachchida Nand Tripathi, Higher Administrative Grade (Senior) Professor and Head of Department of Civil Engineering, Indian Institute of Technology Kanpur | Webinar held on 9.11.2020

Aerosols are known to modify cloud microphysical properties, their extent and depth. The modifications in clouds can perturb spatio-temporal variations and intensity of rainfall over cities and Earth radiation budget which feeds into monsoon development. On the other hand aerosols can cause adverse impacts on crop yield, human health and monumental heritages. Some recent results covering these issues and the importance of mitigation of aerosols for achieving co-benefits in climate, health and agriculture were discussed.

H. Does biomass burning matter?

Facilitator: Prof R R Hoque, HoD of Environmental Science, Tezpur University | Webinar held on 16.11.2020

Biomass burning is an age-old practice that emits large volumes of particulate and gaseous pollutants. It is a concern for both the indoor and ambient air quality. The burning in kitchens has been identified as a major polluter and a cause of several diseases in the exposed population in the developing world. This has a gender bias too as it is the woman of the house who is engaged in the household chores including cooking. There is little doubt that biomass burning is a strong source of air pollution, however, we need to understand the socio-economic association between humans and the biomass burning to address the issue. The government of India has been aggressively distributing cleaner LPG to replace the biomass fuel from the kitchens of the poor. However, biomass is a decentralised and renewable option compared to non-renewable fossil fuel. The talk discussed if we should take biomass burning more seriously than just blaming it as a polluter.

I. Effectiveness of water adaptation responses in reducing climate and associated risks: Early findings from a meta review

Facilitator: Dr Aditi Mukherji, Principal Researcher at the International Water Management Institute | Webinar held on 23.11.2020

Anthropogenic climate change impacts every aspect of water security through changes in water availability and quality, increases in water induced disasters due to extreme events, and changes in ecosystems and their services. All of these directly impact human societies, with often the most vulnerable most affected. Water insecurity is the first component of ongoing climatic changes and is directly impacting people's lives and livelihoods globally. In response to climate and non-climate induced water insecurity, people and governments around the world are undertaking various adaptation responses involving combinations of technologies, incentives and policies. In this presentation, some early results from an ongoing meta-review on effectiveness of water related responses in reducing water insecurity risks were discussed.

J. Sustainable water availability

Facilitator: Dr Virendra Tiwari, Director, CSIR-National Geophysical Research Institute (CSIR-NGRI), Hyderabad | Webinar held on 30.11.2020

India is a traditionally agrarian society and irrigation is the major, more than 75%, consumer of water, primarily groundwater. Unmethodical water exploitation, compounded with climate change, has made the scarcity of quality water a serious societal and environmental issue in India. In recent times, management

of water resources has become one of the biggest challenges due to regional differences in water availability and demand, depletion and pollution/ contamination of aquifers and climate-change induced water stresses. The discussion focussed on quantifying the various components of the hydrological cycle on watershed scale to basin scale with an emphasis on terrestrial water budget and management plans.

K. Ensuring India's water security: The five R's

Facilitator: Amb Venkatesan Ashok, India's Ambassador to the Czech Republic and Zimbabwe and Former Secretary, Govt. of India | Webinar held on 7.12.2020

India is severely water stressed. Revival and strengthening of traditional technologies, many of which have been used for centuries, to retain our surface and groundwater, as well as harvest rainwater, is essential to ensure water security. The presentation illustrated various technologies to reduce water use for agriculture and losses on account of wastage, leaks and theft, methods to monitor surface and groundwater quality and enforcement of "polluter pays" principle to restore water contaminated by natural or anthropogenic activities. It also discussed wastewater treatment and use of wetlands and natural biological techniques for restoring water quality, desalination technologies, including sustainable solar thermal systems, atmospheric water generators coupled to solar PV systems, among others.

L. Conservation at scale: What have we learnt?

Facilitator: Dr Sejal Worah, Programme Director, World Wide Fund for Nature-India (WWF-India), New Delhi | Webinar held on 18.1.2021

India is on a development trajectory that will have profound impacts on biodiversity and natural resources in the coming decades. Is it possible to reconcile economic development and conservation in such a scenario? What are the lessons learnt over the last two decades of working on conservation at a landscape scale that can help adapt to a rapidly changing external context? What are the emerging challenges, opportunities and partnerships that will define the future of conservation in India? Using examples and case studies, Dr Sejal Worah shared her experience and lessons learnt over nearly 30 years of her conservation journey to try and address these questions.

M. India's power sector transition to 2030: Modelling and insights

Facilitator: Mr Raghav Pachouri, Associate Fellow, Electricity and Fuel Division, The Energy and Resources Institute (TERI) | Webinar held on 22.2.2021

Today, Renewable Energy (RE) capacity (90 GW) in India is 24% of the total installed capacity of 374 GW. India already has strong RE addition targets of 175 GW by year 2022, and 450 GW by 2030. These high RE integration targets and lower RE tariffs (solar tariff of Rs 1.99/kWh recently) are pushing towards a greener power system. In one of our DR studies, 35-40% of RE penetration (from current level of 10%) in the generation mix is possible without any extra system cost by 2030. The introduction of variable renewables like wind and solar into the Indian power mix creates new challenges of balancing these variable sources of supply. By 2030, the share of variable renewables in total power generation could vary on a daily basis from 15% of total generation in non-solar hours to more than 50% of generation during solar hours. This scale of variability poses significant challenges for the Indian power

system. The session focused on the strategies that are required to accommodate the growth of variable renewables and allow for the achievement of India's mid-term renewables targets.

N. Achieving Sustainable Development Goal for clean water in India: Microbial pollution of groundwater and socio-economy

Facilitator: Prof Abhijit Mukherjee, Associate Professor, Department of Geology and Geophysics, and School of Environmental Science and Engineering, Indian Institute of Technology Kharagpur | Webinar held on 19.3.2021

Worldwide, more than 2 billion people (~1/3 world population), mostly living in economically stressed areas of Africa and South Asia, still do not have access to basic sanitation, and ~1 billion still practise open defecation. Water pollution due to open defecation may primarily be linked to the economy, and other factors such as social and hygiene practices, land use and hydrogeological parameters could also have sufficient influence. The presentation described the effect of human development and economic development on groundwater microbial (Faecal Coliform) pollution (FC) across India. It also highlighted and quantified the potential pitfalls that are a possible hindrance for achieving the United Nations Sustainable Development Goal, despite social and economic development, across the spatial scales.

O. Publishing in Nature: A climate science perspective

Facilitator: Dr Michael White, Senior Editor for *Nature* | Webinar held on 18.6.2021

The inner workings of high profile journals can be mysterious. How do they decide what to publish, or even to send out to review? How is the process managed? What are the odds of getting published? Do they publish papers only in the interests of being controversial and getting press coverage? And who makes the decisions? Michael White, Nature's editor for climate, discussed the overall journal processes and specific themes behind the climate science research published in Nature over the past 13 years.

Video recordings of the Sustainability Seminar Series is available at <https://www.youtube.com/playlist?list=PLRfu94TCePTszBBTak5FdWCwG4mx1CY20>

Symposium on "Climate Change: Connecting Science, Industry, and Policy"

The IITGN students successfully organised a half-day virtual symposium on "Climate Change: Connecting Science, Industry, and Policy" in December 2020, as a part of Amalthea, the one-of-its-kind student-driven annual technical summit of IITGN. The event witnessed tremendous participation from students, researchers, and industrialists from across the country. The speakers included renowned Climate Change experts Dr Arunabha Ghosh, CEO of CEEW (Council of Energy, Environment, and Water) and Dr Anil Kulkarni, a distinguished Visiting Scientist at IISc Bangalore.

Operations

The institute operates and maintains buildings in accordance with sustainable management programmes and a green building rating system. The Master Plan laid an emphasis on climate change adaptation and mitigation and incorporated several features that make the campus climate resilient. We are developing a system for real-time monitoring (day-to-day basis) of carbon and water footprints of the campus, which

will have a significant impact on reducing energy usage and enhancing energy efficiency, thus addressing the challenges of climate change.

The institute has a system in place to measure the amount of low carbon (solar) energy used across the whole university. The solar PV generation data can be accessed on the institute's portal <http://solarpv.iitgn.ac.in/>, which is based on energy monitoring, data analysis, optimization and machine learning approaches for energy management.