

**Dr Kiran C Patel
Centre for Sustainable
Development**

**ANNUAL
REPORT
2020-21**





Executive Summary

Dr Kiran C Patel Centre for Sustainable Development (KPCSD) at Indian Institute of Technology Gandhinagar (IITGN), established in January 2019, promotes interdisciplinary research and educational programmes and conducts outreach activities and field projects in various domains of sustainability, including water, pollution, waste management, climate change, energy, natural resources, wildlife and ecosystems. Nearly 20 faculty members are affiliated with the Centre, the single largest faculty cluster at the Institute.

In 2020-21, the Centre experienced significant growth in the volume of research projects and publications related to sustainability at the Institute. The number of sponsored research projects increased by 65% compared to 2019-20. The IITGN faculty published nearly 100 research publications and conference presentations on sustainability during the past year, almost four times the number in 2019-20.

Nearly 50 research projects were sanctioned and or under progress during the past year, with an approximate value of INR 31 crores. 14 projects valued at INR 8.2 crores were in the area of water, ten projects with a sanctioned amount of INR 10 crores covered the domains of pollution and waste management, seven projects valued at INR 5.7 crores related to climate change, 14 projects with a funding of INR 6 crores were in the area of energy and two projects with a sanctioned value of INR 1 crore were related to natural resources, wildlife and ecosystems.

The research projects ongoing at the Institute address the United Nations Sustainable Development Goals, covering a wide range of themes, including water and wastewater management, desalination, air quality monitoring, municipal solid waste management, climate change impact assessment on various sectors such as water agriculture, infrastructure, energy, public health, flood risk assessment, predictive understanding of hydrological processes, high-efficiency photovoltaics, electric vehicle applications, storage of solar energy, energy-efficient buildings, ecological changes, migration and indigenous communities, among others.

Four research works were selected for KPCSD Covid-19 Research Awards, established for encouraging urgent research by IITGN faculty and students on all aspects

of the Covid-19 pandemic. The Centre funded a project on surveillance of wastewater to detect and quantify variation in the genetic material of SARS-CoV-2 in the wastewaters of Gandhinagar. KPCSD also provided a seed grant for a project to turn plastic waste into local businesses through 3D printing.

Faculty members at IITGN are engaged in several consultancy and internal projects relating to sustainability with a combined project value of approximately INR 2.2 crores. The number of consultancy and internally funded projects at the Institute relating to sustainability increased by nearly 65% compared to 2019-20. These projects relate to sustainability, including scalable energy disaggregation, methanol and natural gas-powered fuel cell systems, groundwater quality, sewage treatment, implications of Covid-19 from climate change perspectives, climate change risks and airborne pollutants.

Nearly 15 graduate and undergraduate courses were offered at the Institute in the past year related to sustainability, in which 300 students enrolled. The Institute also conducted several workshops and short courses focused on sustainability to provide a knowledge-sharing platform to initiate and strengthen research networking and explore the possibility of joint research projects and training.

The Centre strives to promote sustainable solutions in the public and private sphere, disseminate conceptual and practical knowledge, and training materials and create awareness of sustainability through several events organised throughout the year. Five major events were conducted in 2020-21, including the Sustainability Fair, WIN-WATSAN Webinar Series, Indo-UK virtual conference on Water Vulnerability, National Power Systems Conference and World Water Day. Fourteen webinars under KPCSD Sustainability Seminar Series and 10 lectures in various disciplines at the Institute, which were almost double in number compared to 2019-20, promoted awareness and facilitated networking among researchers and professionals engaged in sustainability. The events were conducted online due to the pandemic, and a broad range of stakeholders, including industry professionals, NGO representatives, government officials, academicians and researchers, attended the events.

Table of contents

1. About the Centre	5
2. Research	6
2.1 Projects	6
2.2 Publications	12
2.3 Research Facilities	17
3. Grants and Awards	20
4. Practice	21
4.1 Projects and consultancies	21
4.2 Campus sustainability	22
5. Education	25
5.1 List of courses	25
5.2 Workshops and short courses	27
6. Events and Outreach	29
6.1 Sustainability Fair 2021	29
6.2 Indo-UK virtual conference on the 5 C's of water vulnerability	29
6.3 WIN WATSAN Webinar Series 2020: Innovations and Empowerment for Sustainable Watsan Solutions	30
6.4 21st National Power Systems Conference (NPSC 2020)	30
6.5 World Water Day 2021	30
6.6 Sustainability Seminar Series	30
6.7 Lectures on Sustainability	34
7. Affiliated Faculty	36

1. About the Centre

Dr Kiran C Patel Centre for Sustainable Development (KPCSD) at Indian Institute of Technology, Gandhinagar (IITGN) was inaugurated on 30 January, 2019. The Centre aims to advance local and global sustainability solutions through cutting-edge interdisciplinary research and field projects on water, pollution, waste management, energy, natural resources, and climate change. The Centre also promotes sustainable solutions through its strong educational, outreach and technology-transfer programs.

The programs of the Centre include:



The mission of KPCSD is to:

- Identify and conduct interdisciplinary research on sustainability-related problems of high societal importance.
- Develop solutions to sustainability challenges by integrating research, traditional knowledge and field understanding, and translate them into prototypes, patents, and publications.
- Establish an effective technology transfer programme for sustainability solutions in the field.
- Implement sustainability solutions on campus and its neighbourhood.
- Develop a strong outreach programme of training, education, awareness and community engagement on sustainable livelihood and development.
- Promote networking and collaboration among scholars, policymakers, industry, non-profit organisations and other stakeholders on sustainability.
- Promote educational programmes on sustainability at IITGN.

KPCSD current focus areas are:

Water: Water and wastewater treatment, desalination, safe drinking water production, hydraulics and water resources engineering, water resource research, water-energy systems, river science

Pollution and waste management: Air, water and soil pollution, air quality, laser spectroscopy, particle engineering, built environment, low-cost air quality sensors, environmental policy, surface engineering, waste to resource techniques

Energy: Fuel cell systems, energy systems, energy conversion and storage, optimization, energy management, organic electronics and LEDs, solar cells, renewable energy, electricity market, smart distribution

grid, thermodynamic optimization, smart manufacturing

Climate Change: Climate risks, extreme climatic events, climate variability, food-energy-water security, climate change impacts, critical infrastructures resilience, internal variability, hydrometeorological extremes, physics guided machine learning for hydrological processes, hydrologic modelling

Natural Resources, Wildlife and Ecosystems:

Wildlife conservation, indigenous peoples, social and environmental justice, Himalayan borderlands, Northeast India, natural resources management, environmental archaeology, sustainability modelling, earth surface processes, sustainable stream management

2. Research

Extensive research activity is underway at the Institute on a wide range of areas of sustainable development. In its second year, the Centre observed significant growth in the volume of research projects and publications related to sustainability at the Institute. The number of sponsored research projects increased by 65% compared to the year 2019-20.

Major supporting agencies for research work on sustainability include the Department of Science and Technology (DST), Science and Engineering Research Board (SERB), Ministry of Education (MoE), and Gujarat Council of Science and Technology (GUJCOST). The IITGN faculty published nearly 100 research publications and conference presentations on sustainability during the past year, almost four times the publications in 2019-20.

During the past year, nearly 50 research projects were sanctioned and under progress with a combined value of approximately INR 31 crores.

50
Research Projects

valued
31 crores

2.1 Projects

14 projects were in the area of **water**, with a sanctioned amount of **INR 8.2 crores**. **Ten projects** with a sanctioned amount of **INR 10 crores** covered the domains of **pollution and waste management**. **Seven projects (INR 5.7 crores)** related to **climate change**, **14 projects (INR 6 crores)** were in the area of **energy** and **two projects (INR 1 crore)** were related to **natural resources, wildlife and ecosystems**.

WATER

A total of **14 projects** were in the area of water, with a sanctioned amount of **INR 8.2 crores**. The research projects relating to water address the following SDGs:



Students and faculty from IITGN are conducting research on a wide range of themes related to water including water quality, water and wastewater management, desalination and sustainable river management. Prof Gopinadhan Kalon's team conducts research on novel and low-cost 2D materials for water treatment applications. Prof Manish Kumar and his research team have worked on water quality management and wastewater surveillance for SARS-CoV-2 gene detection. Prof Kumar and his team have conducted a detailed study of microcontaminants and water use patterns in households and developed methods for in-situ arsenic and fluoride removal from the groundwater. They have also worked on sustainable water quality management in the urban environment.

Prof Jaichander Swaminathan's group focuses on efficient desalination, brine concentration and energy-efficient reuse of industrial effluents. Prof Pratyush Dayal's team is exploring various options of sustainable systems for sewage disposal and management that can be adopted in high altitude areas. Prof Chinmay Ghoroi's team has developed passive filters for water disinfection. Students and researchers in Prof Vikrant Jain's group focus on sustainably managing water as a natural resource by developing relevant geomorphic models and tools.

Prof Pranab Mohapatra has focused on minimising losses and effectively distributing water to end-users by integrating sensors in Gujarat's water distribution networks. Prof Mohapatra has also worked on developing a fit-for-purpose water sensitive design framework for fast-growing cities.

New projects:

PI	PROJECT TITLE	AGENCY NAME
Gopinadhan Kalon	Electrochemical fabrication of sub-nm pores on mica and Si-nitride sheets for desalination applications	MoE
Manish Kumar	Weekly surveillance of wastewater for SARS-CoV-2 gene detection in Ahmedabad for pandemic curve monitoring	UNICEF
Jaichander Swaminathan	Multi-effect membrane distillation for modular desalination and brine concentration	SERB

Ongoing projects:

PI	PROJECT TITLE	AGENCY NAME
Pratyush Dayal	Sewage disposal and management at high altitude areas	Army Technology Board
Chinmay Ghoroi	Low-cost and non-electric water filter for Point-of-Use (POU) water disinfection	WIN Foundation
Vikrant Jain	Development and application of geomorphic tool for sustainable management of a Himalayan river system, India	MoE
Vikrant Jain	Development of a predictive geomorphic model as a tool for sustainable river management	Ministry of Earth Sciences (MoES)
Manish Kumar	Micro-components quantification of end uses of water consumption in low income settings	WIN Foundation
Manish Kumar	Pilot scale in-situ application for arsenic and fluoride removal from the groundwater: A safe drinking water production perspective	WIN Foundation
Manish Kumar	Vulnerability assessment and sustainable solutions for water quality management in the urban environment	DST
Pranab Mohapatra	Towards development of sustainable water cyber-physical systems: Implementation in Gujarat Water Network Systems	WIN Foundation
Pranab Mohapatra	Water for Change: Integrative and fit-for-purpose water sensitive design framework for fast growing livable cities	DST
Santanu Mukherjee	Development of low-cost novel biomaterials for in-situ groundwater/ soil remediation: A safe drinking water production perspective	SERB
Jaichander Swaminathan	Brine splitting for energy efficient textile dyeing effluent reuse	DST

POLLUTION AND WASTE MANAGEMENT

Ten projects with a sanctioned amount of **INR 10 crores** covered the domains of pollution and waste management. The research projects relating to pollution and waste management address the following SDGs:



Prof Nipun Batra and his research team are working on air quality monitoring and studying the relation between air pollution and Covid-19. With a focus on greenhouse gas and atmospheric pollutant gases, Prof Arup Lal Chakraborty's research group has developed technologies to detect and monitor its effects in urban and rural areas. Prof Sameer Dalvi's team focuses on developing microbubbles to remove trace pollutants.

Students and researchers working with Prof Chinmay Ghoroi are conducting a study, in collaboration with Duke University, to assess and compare indoor air pollutants sources and concentrations, including Volatile Organic Compounds (VOCs) and Particulate Matter (PM) in India, China and the USA. The group also focuses on applying naturally available materials to develop low cost, efficient and scalable materials for CO₂ capture and developing materials for improved performance of solar plants considering the impact of air pollution on solar photovoltaics.

Prof Manish Kumar's research in the area of pollution and waste management includes the development of environmentally and economically sustainable transition metal complex and composite solutions for municipal solid waste management.

New projects:

PI	PROJECT TITLE	AGENCY NAME
Nipun Batra	AI and sensor networks for air-quality monitoring	SERB
Nipun Batra	Impact of air pollution on Covid-related secondary exacerbations	Google
Arup Lal Chakraborty	High sensitive detection of atmospheric pollutant gases to monitor the effects of industrial emissions on urban air quality	GUJCOST
Arup Lal Chakraborty	UAV-based laser spectroscopic monitoring of greenhouse gas emissions in urban and rural India	Royal Academy of Engineering (RAE)
Sameer Dalvi	Synthesis of magnetic catalyst coated microbubbles for removal of trace pollutants	DST

Ongoing projects:

PI	PROJECT TITLE	AGENCY NAME
Chinmay Ghoroi	Assessing the concentrations and sources of indoor VOCs and PM in urban India and comparing to levels in China and the US	DUKE University
Chinmay Ghoroi	Common Research and Technology Development Hub - Chemical Processes	Department of Scientific and Industrial Research (DSIR) and IITGN
Chinmay Ghoroi	Development of low cost, efficient and scalable materials for CO2 capture using naturally available nontoxic stable materials and industrial solid wastes	DST
Chinmay Ghoroi	Understanding the impact of air pollution on solar photovoltaics and developing surface engineered panel materials for improved performance of solar plants	IITGN
Manish Kumar	Development of environmentally and economically sustainable composite solution for municipal solid waste management	Gujarat State Bio- Technology Mission (GSBTM)

CLIMATE CHANGE

Seven projects with a total sanctioned amount of **INR 5.7 crores** related to climate change. The research projects relating to climate change address the following SDGs:



Ongoing research by faculty, researchers and students at IITGN in the domain of climate change includes the development of climate change projections, climate change impacts assessment on various sectors (water resources, agriculture, infrastructure, energy, and public health), flood risk assessment, predictive understanding of hydrological processes, and hydrologic modelling and forecasting.

Prof Vikrant Jain's research group uses hydro geographic modelling to assess flood risk in tropical rivers and studies the impact of natural phenomena such as sea-level fluctuations, climate change or tectonic activity on the decline of the Harappan settlement of Dholavira, Kutch, India. Prof Jain is also leading the project on the Establishment of

Gujarat State Climate Change Centre, implemented by Gujarat Ecological Education and Research (GEER) Foundation under the National Mission of Strategic Knowledge of Climate Change. The project focuses on Risk and Vulnerability Assessment of the seven priority sectors of Gujarat, namely (i) Water Resources, (ii) Agriculture, (iii) Forests and Biodiversity, (iv) Urban Development, (v) Health, (vi) Renewable Energy and Energy Efficiency and (vii) Sea-level Rise and Coastal Infrastructure also covering Vulnerable Communities as a cross-cutting issue in all the above.

Prof Udit Bhatia's team is working on different aspects of climate change, such as understanding of hydrological processes and downscaling earth system model output, with a physics guided data science approach. Prof Bhatia's research attempts to design effective recovery strategies for built and natural systems ranging from transportation and power distribution to water and ecosystem services subject to disparate and evolving threats such as climate change and cyber-attacks.

Prof Vimal Mishra's group focuses on hydrologic modelling and forecasting systems for river basin hydrology and extremes for India and assessing impacts of climate variability and climate change on water resources in the Sabarmati river basin. His group has also examined the effects of climate change on water resources, critical infrastructure for railways and highways in India. In addition, Prof Mishra's group has researched climate change impacts on hydroclimatic extremes including, floods, droughts, and heatwaves in India.

New projects:

PI	PROJECT TITLE	AGENCY NAME
Vikrant Jain	Flood risk assessment in tropical rivers in the Anthropocene under climate change scenario using hydro geomorphic modelling	MoE

Ongoing projects:

PI	PROJECT TITLE	AGENCY NAME
Udit Bhatia	Developing physics guided super-resolution approach and evaluation strategies for down scaling earth system model outputs	SERB
Udit Bhatia	Physics guided data science approach for predictive understanding of hydrological processes	Scheme for Transformational and Advanced Research in Sciences (STARS)
Vikrant Jain	Establishing Gujarat state climate change centre	DST
Vikrant Jain	Impact of sea level fluctuations, climate change or tectonic activity on the decline of the Harappan settlement of Dholavira, Kutch, India	DST
Vimal Mishra	An experimental operational hydrologic modelling and forecasting system for river basin hydrology and extremes for India	Indian Institute of Tropical Meteorology (IITM)
Vimal Mishra	Impacts of climate variability and climate change on water resources in the Sabarmati river basin	Ministry of Jal Shakti

ENERGY

A total of **14 projects** with a funding of **INR 6 crores** were in the area of energy. The research projects relating to energy address the following SDGs:



Research on several aspects related to energy, including high-efficiency photovoltaics, electric vehicle applications, storage of solar energy, thin films for solar cell applications, energy-efficient buildings, etc., is underway at the Institute. Prof Rupak Banerjee and team research on photovoltaics based on layered hybrid perovskites. The research team led by Prof Nipun Batra monitors the mechanism of moving non-intrusive load monitoring (NILM) to the edge of the network. In this approach, appliance level load profiles can be extracted from an agglomerated single-point measurement using statistical or machine-learning methodology resulting in lesser operation cost and reduced power consumption.

Prof Ragavan Kanagaraj's team is working on electric vehicle applications, and Prof Saumyakanti Khatua's group works on efficient solar energy storage as clean fuels. Prof Emila Panda and her research team focus on developing indigenous technologies for solar cells and thin films for solar cell applications. Students and researchers working with Prof Jaichander Swaminathan are investigating the use of solar energy for brine treatment to achieve near-zero carbon emissions.

The research teams led by Prof Atul Bhargav and Prof Krishna Kanti Dey are exploring materials for sustainable and energy-efficient buildings and applications of specific nanocrystals for energy materials, respectively. Prof Kabeer Jasuja's team is developing a new class of energy storage nanocomposites. Prof Naran Pindoriya's research group works on various aspects of intelligent distribution grids/ microgrids and integrated distributed generations and energy management. Some of the projects led by Prof Pindoriya are related to smart energy management, promoting efficient energy utilisation on the IITGN campus, integrating renewable energy sources and energy storage, increasing the robustness of critical infrastructure, and utilising Infrastructure and Communication Technology (ICT) for infrastructure digitisation.

New projects:

PI	PROJECT TITLE	AGENCY NAME
Rupak Banerjee	Harnessing low cost, high efficiency stable photovoltaics based on layered hybrid perovskites	MoE
Nipun Batra	Edge non-intrusive load monitoring	CISCO
Ragavan Kanagaraj	Drives for electric vehicle applications	SERB
Saumyakanti Khatua	Developing new plasmonic antenna- reactor platform for efficient storage of solar energy as clean fuels	GUJCOST
Emila Panda	Studies on optical, electrical and microstructural properties of MoS ₂ , SnS ₂ and MoS ₂ -SnS ₂ hybrid nanostructured thin films for solar cell applications	SERB
Jaichander Swaminathan	Harnessing solar energy to achieve near zero carbon emission for brine treatment	DST

Ongoing projects:

PI	PROJECT TITLE	AGENCY NAME
Atul Bhargav	Materials for sustainable and energy efficient buildings	MoE

Krishna Kanti Dey	Complexation on the surface of metal halide perovskite nanocrystals for application as energy materials	DST
Kabeer Jasuja	High yield exfoliation of layered metal diborides to synthesise boron analogs of graphene for developing a new class of energy storage nanocomposites	SERB
Emila Panda	Development of indigenous technology for CZTS (Cu ₂ ZnSnS ₄) absorber based solar cell using industry friendly magnetron sputtering and RTP (Rapid Thermal Processing) sulfurization process	SERB
Naran Pindoriya	Data-driven intelligent energy management for environmentally sustainable energy access	DST
Naran Pindoriya	Development of a prosumer driven integrated SMART grid	DST
Naran Pindoriya	ECO-WET - Efficient coupling of water and energy technologies for smart sustainable cities	Indo-German Science and Technology Centre (IGSTC)
Naran Pindoriya	Smart integrated campus energy monitoring and management system	SERB

NATURAL RESOURCES, WILDLIFE AND ECOSYSTEMS

Two projects with a sanctioned amount of about **INR 1 crore** were related to natural resources, wildlife and ecosystems. The research projects relating to natural resources, wildlife and ecosystems address the following SDGs:



A project led by Prof Nishaant Choksi seeks to assess the effects of lockdown-induced reverse migration on indigenous communities in real-time. The return of migrant labourers en masse has severe economic and epidemiological consequences for rural and highly under-resourced indigenous communities. Another project undertaken by Prof Choksi will provide the first large-scale comparative ethnographic study of the reorganisation of multilingualism in the context of mobility due to ecological change. The study will examine four sites across South and Southeast Asia where ecological change has led to multilingual communities' displacement, migration, and resettlement.

Dr Sapatashi Dey is working on a research project that evaluates the time windows of prevailing sediment aggradation and related paleo-erosion rates from the southern flanks of the Dhauladhar Range in the western Himalaya to explore landscape responses under variable climatic forcing. Data collected and analysed in the process highlights the highly non-linear response of climatic forcing on landscape evolution and suggest complex depositional processes and sedimentary signals in downstream areas.

New projects:

PI	PROJECT TITLE	AGENCY NAME
Nishaant Choksi	The effects of reverse migration on indigenous communities following India's Covid-19 induced lockdown	Social Science Research Council (SSRC)
Saptarshi Dey	Tectonic and climatic control on variability of sediment routing in the NW Himalaya since late Quaternary	DST

2.2 Publications

IITGN faculty and researchers published nearly 100 articles during the past year, of which 28 are in the area of water, 12 in pollution and waste management, 28 in climate change, 17 in energy and 9 in natural resources, wildlife and ecosystems.

WATER

*Mukherjee, S.; Thakur, A. K.; Goswami, R.; Mazumder, P.; Taki, K.; Vithanage, M. and Kumar, M., "Efficacy of agricultural waste derived biochar for arsenic removal: tackling water quality in the Indo-Gangetic plain", *Journal of Environmental Management*, DOI: 10.1016/j.jenvman.2020.111814, vol. 281, Mar 2021

Karunanidhi, D.; Aravinthasamy, P.; Subramani, T. and Kumar, M., "Human health risks associated with multipath exposure of groundwater nitrate and environmental friendly actions for quality improvement and sustainable management: a case study from Texvalley (Tiruppur region) of India", *Chemosphere*, DOI: 10.1016/j.chemosphere.2020.129083, Feb 2021

Zang, J.; Kumar, M. and Werner, D., "Real-world sustainability analysis of an innovative decentralised water system with rainwater harvesting and wastewater reclamation", *Journal of Environmental Management*, DOI: 10.1016/j.jenvman.2020.111639, vol. 280, Feb 2021

Maity, J. P.; Vithanage, M.; Kumar, M.; Ghosh, A.; Mohan, D.; Ahmad, A. and Bhattacharya, P., "Seven 21st century challenges of arsenic-fluoride contamination and remediation", *Groundwater for Sustainable Development*, DOI: 10.1016/j.gsd.2020.100538, vol. 12, Feb 2021

*Babu, D. S. Suresh; Khandekar, A.; Bhagat, C.; Singh, A.; Jain, V.; Verma, M.; Bansal, B. K. and Kumar, M., "Evaluation, effect and utilisation of submarine groundwater discharge for coastal population and ecosystem: a special emphasis on Indian coastline", *Journal of Environmental Management*, DOI: 10.1016/j.jenvman.2020.111362, vol. 277, Jan 2021

*Asoka, A. and Mishra, V., "A strong linkage between seasonal crop growth and groundwater storage variability in India", *Journal of Hydrometeorology*, DOI: 10.1175/JHM-D-20-0085.1, Dec 2020

Kumar, Manish et al., "First proof of the capability of wastewater surveillance for COVID-19 in India through detection of genetic material of SARS-CoV-2", *Science of The Total Environment*, DOI: 10.1016/j.scitotenv.2020.141326, vol. 746, Dec 2020

Kumar, M.; Snow, D.D.; Honda, R. and Mukherjee, S. (Eds.), "Contaminants in drinking and wastewater sources: challenges and reigning technologies", DOI: 10.1007/978-981-15-4599-3, Singapore: Springer Nature, 2020, ISBN: 9789811545986

Mankad, J., Borse, D., Das, L., Padhiyar, N. and Srinivasan, B., "Development of operational resilience metrics for water distribution systems", in *Resilience, Response, and Risk in Water Systems: Shifting Management and Natural Forcings paradigms*, Switzerland: Springer Nature, 2020

Kumar, M.; Munoz-Arriola, F.; Furumai, H. and Chaminda, T. (Eds.), "Resilience, response, and risk in water systems: shifting management and natural forcings paradigms", DOI: 10.1007/978-981-15-4668-6, Singapore: Springer Nature, 2020, ISBN: 9789811546679

Mishra, Vimal et al., "Extremes in water availability and suicide: evidence from a nationally representative sample of rural Indian adults", *Environmental Research*, DOI: 10.1016/j.envres.2020.109969, vol. 190, Nov 2020

*Kumar, Manish, "Runoff from firework manufacturing as major perchlorate source in the surface waters around Diwali in Ahmedabad, India", *Journal of Environmental Management*, DOI: 10.1016/j.jenvman.2020.111091, vol. 273, Nov 2020

*Selvam, S.; Jesuraja, K.; Venkatramanan, S.; Chung, S. Y.; Roy, P. D.; Muthukumar, P. and Kumar, M., "Imprints of pandemic lockdown on subsurface water quality in the coastal industrial city of Tuticorin, South India: A revival perspective", *Science of the Total Environment*, <https://doi.org/10.1016/j.scitotenv.2020.139848>, vol. 738, Oct 2020

*Bhagat, C.; Kumar, M.; Tyagi, V. K. and Mohapatra, P. K., "Proclivities for prevalence and treatment of antibiotics in the ambient water: a review", *npj Clean Water*, DOI: 10.1038/s41545-020-00087-x, vol. 3, no. 1, Oct 2020

*Dhangar, K. and Kumar, M., "Tricks and tracks in removal of emerging contaminants from the wastewater through hybrid treatment systems: a review", *Science of The Total Environment*, DOI: 10.1016/j.scitotenv.2020.140320, vol. 738, Oct 2020.

Kumar, M.; Mohapatra, S.; Mazumder, P.; Singh, A.; Honda, R.; Lin, C.; Kumari, R.; Goswami, R.; Jha, P.K.; Vithanage, M. and Kuroda, K., "Making waves perspectives of modelling and monitoring of SARS-CoV-2 in aquatic environment for COVID-19 pandemic", *Current Pollution Reports*, DOI: 10.1007/s40726-020-00161-5, Sep 2020

Thakur, A.K.; Vithanage, M.; Das, D.B. and Kumar, M., "A review on design, material selection, mechanism, and modelling of permeable reactive barrier for community-scale groundwater treatment", *Environmental Technology & Innovation*, DOI: 10.1016/j.eti.2020.100917, vol. 19, Aug 2020

Roshan, A. and Kumar, M., "Water end-use estimation can support the urban water crisis management: a critical review", *Journal of Environmental Management*, DOI: 10.1016/j.jenvman.2020.110663, vol. 268, Aug 2020

Raval, N. and Kumar, M., "An overview of big data analytics: a state-of-the-art platform for water resources management", in *Resilience, response, and risk in water systems: shifting management and natural forcings paradigms*, DOI: 10.1007/978-981-15-4668-6_3, Singapore: Springer Nature, pp. 43-56, Jul 2020, ISBN: 9789811546679

*Patel, A.K.; Bhagat, C.; Taki, K. and Kumar, M., "Microplastic vulnerability in the sediments of the Sabarmati river of India", in *Resilience, response, and risk in water systems: shifting management and natural forcings paradigms*, DOI: 10.1007/978-981-15-4668-6_7, Singapore: Springer, pp. 127-138, Jul 2020, ISBN: 9789811546679

*Singh, A.; Patel, A.K. and Kumar, M., "Role of physical parameters in developing a geogenic contaminant risk approach", in *Resilience, response, and risk in water systems: shifting management and natural forcings paradigms*, DOI: 10.14324/111.9781787357488, Singapore: Springer Nature, pp. 57-72, Jul 2020, ISBN: 9789811546679

*Misra, A.; Singh, A.; Suresh Babu, D. S.; Jain, V.; Verma, M.; Bansal, B. K. and Kumar, M., "Sediment and submarine groundwater discharge mediated arsenic flux into the Bay of Bengal, India: an appraisal", *Current Pollution Reports*, DOI: 10.1007/s40726-020-00154-4, Jul 2020

Pandey, A. K.; Mohapatra, P. K.; Jain, V. and Bhatia, U., "Studying subcritical opposing channel flows", *Journal of Applied Water Engineering and Research*, DOI: 10.1080/23249676.2020.1787247, Jul 2020

*Bokalamulla, T. R. S. B.; Chaminda, G. G. T.; Otaki, Y.; Otaki, M. and Kumar, M., "Sustainable water management in the Kelani river basin", in *Resilience, response, and risk in water systems: shifting management and natural forcings paradigms*, DOI: 10.1007/978-981-15-4668-6_17, Singapore: Springer Nature, pp. 323-337, Jul 2020, ISBN: 9789811546679

*Sandeep, V.; Khandekar, A. and Kumar, M., "Water supply, urbanisation and climate change", in *Resilience, response, and risk in water systems: shifting management and natural forcings paradigms*, DOI: 10.1007/978-981-15-4668-6_11, Singapore: Springer Nature, pp. 195-215, Jul 2020, ISBN: 9789811546679

*Bhatia, Udit et al., "Developing a sustainability science approach for water systems", *Ecology and Society*, DOI: 10.5751/ES-11515-250223, vol. 25, no. 2, Jun 2020

*Singh, A.; Patel, A. K.; Deka, J. P. and Kumar, M., "Natural recharge transcends anthropogenic forcing that influences arsenic vulnerability of the quaternary alluviums of the mid-Gangetic plain", *npj Clean Water*, DOI: 10.1038/s41545-020-0075-5, vol. 3, no. 1, Jun 2020

Kumar, Manish et al., "Wastewater-based epidemiology:

global collaborative to maximise contributions in the fight against COVID-19", *Environmental Science & Technology*, DOI: 10.1021/acs.est.0c02388, Jun 2020

POLLUTION AND WASTE MANAGEMENT

*Gahlot, R.; Taki, K. and Kumar, M., "Efficacy of nanoclays as the potential adsorbent for dyes and metal removal from the wastewater: a review", *Environmental Nanotechnology, Monitoring & Management*, DOI: 10.1016/j.enmm.2020.100339, Dec 2020

Taki, K.; Gahlot, R. and Kumar, M., "Utilisation of fly ash amended sewage sludge as brick for sustainable building material with special emphasis on dimensional effect", *Journal of Cleaner Production*, DOI: 10.1016/j.jclepro.2020.123942, vol. 275, Dec 2020

*Tripathi, N. and Sahu, L.K., "Emissions and atmospheric concentrations of α -pinene at an urban site of India: role of changes in meteorology", *Chemosphere*, DOI: 10.1016/j.chemosphere.2020.127071, vol. 256, Oct 2020

Kumar, M.; Furumai, H.; Kasuga, I. and Kurisu, F., "Metal partitioning and leaching vulnerability in soil, soakaway sediments, and road dust in the urban area of Japan", *Chemosphere*, vol. 252, DOI: 10.1016/j.chemosphere.2020.126605, Aug 2020

*Sharma, N., Bajpai, A., Yadav, P. K., Nellaiappan, S., Sharma, S., Tiwary, C. S. and Biswas, K., "Green route for beneficiation of metallic materials from electronic waste for selective reduction of CO₂", *ACS Sustainable Chemistry & Engineering*, 8(32), 12142-12150, <https://doi.org/10.1021/acssuschemeng.0c03605>, Jul 2020

*Srivastava, M. and Kumar, M., "Impact of solid municipal waste landfills on groundwater resources: need for integrated solid waste management aligned with the conservation of groundwater", in *Resilience, response, and risk in water systems: shifting management and natural forcings paradigms*, DOI: 10.1007/978-981-15-4668-6_16, Singapore: Springer Nature, pp. 303-319, Jul 2020, ISBN: 9789811546679

Roy, A. and Chakraborty, A. L., "Intensity modulation-normalised calibration-free 1f and 2f wavelength modulation spectroscopy", *IEEE Sensors Journal*, 20(21), pp 12691-12701, <https://doi.org/10.1109/JSEN.2020.3000470>, Jun 2020

*Kumar, M.; Goswami, R.; Patel, A.K.; Srivastava, M. and Das, N., "Scenario, perspectives and mechanism of arsenic and fluoride co-occurrence in the groundwater: a review", *Chemosphere*, vol. 249, DOI: 10.1016/j.chemosphere.2020.126126, Jun 2020

Zarin, A. S.; Chakraborty, A. L. and Khatua, S., "Time-resolved studies of bioluminescence from *Photobacterium leiognathi* and antimicrobial susceptibility testing on *E. coli* using tunable diode laser

spectroscopy”, *IEEE Sensors Journal*, 40(19), pp 11073–11081, <https://doi.org/10.1109/JSEN.2020.2996228>, May 2020

Taki, K.; Choudhary, S.; Gupta, S. and Kumar, M., “Enhancement of geotechnical properties of municipal sewage sludge for sustainable utilisation as engineering construction material”, *Journal of Cleaner Production*, vol. 251, DOI: 10.1016/j.jclepro.2019.119723 Apr 2020

*Gogoi, A.; Taki, K. and Kumar, M., “Seasonal dynamics of metal phase distributions in the perennial tropical (Brahmaputra) river: environmental fate and transport perspective”, *Environmental Research*, vol. 183, DOI: 10.1016/j.envres.2020.109265, Apr 2020

*Kumar, M.; Ram, B.; Sewwandi, H.; Sulfikar; Ryo, H. and Chaminda, T., “Treatment enhances the prevalence of antibiotic-resistant bacteria and antibiotic resistance genes in the wastewater of Sri Lanka, and India”, *Environmental Research*, vol. 183, DOI: 10.1016/j.envres.2020.109179, Apr 2020

CLIMATE CHANGE

Kumar, V.; Kaushal, R. K.; Taloor, A. K. and Jain, V., “Incorporation of slope and rainfall variability in channel network extraction from DEM data at basin scale”, *Geocarto International*, DOI: 10.1080/10106049.2021.1886340, Mar 2021

Khan, S.; Kamboj, N. and Bhatia, U., “Lifeline infrastructures and hydroclimate extremes climate: a future outlook”, in *Climate change and extreme events*, DOI: 10.1016/B978-0-12-822700-8.00004-4, Amsterdam: Elsevier, pp. 105– 123, Mar 2021, ISBN: 9780128227008

Ambika, A. K. and Mishra, V., “Modulation of compound extremes of low soil moisture and high vapour pressure deficit by irrigation in India”, *Journal of Geophysical Research: Atmospheres*, DOI: 10.1029/2021JD034529, Mar 2021

Moron, V.; Barbero, R.; Fowler, H. J. and Mishra, V., “Storm types in India: linking rainfall duration, spatial extent and intensity”, *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, DOI: 10.1098/rsta.2020.0137, vol. 379, no. 2195, Mar 2021

*Asoka, A.; Wardlow, B.; Tsegaye, T.; Huber, M. and Mishra, V., “A satellite-based assessment of the relative contribution of hydroclimatic variables on vegetation growth in global agricultural and non-agricultural regions”, *Journal of Geophysical Research: Atmospheres*, DOI: 10.1029/2020JD033228, Feb 2021

Harilal, N.; Singh, M. and Bhatia, U., “Augmented convolutional LSTMs for generation of high-resolution climate change projections”, *IEEE Access*, DOI: 10.1109/ACCESS.2021.3057500, Feb 2021

Tripathy, S.; Bhatia, U.; Mohanty, M.; Karmakar, S. and Ghosh, S., “Flood evacuation during a pandemic: a multi-objective framework to handle compound hazard”, *Environmental Research Letters* 16, 034034, <https://doi.org/10.1088/1748-9326/abda70>, Feb 2021

*Aadhar, S. and Mishra, V., “On the occurrence of the worst drought in South Asia in the observed and future climate”, *Environmental Research Letters*, DOI: 10.1088/1748-9326/abd6a6, Feb 2021

*Mishra, V.; Aadhar, S. and Mahto, S. S., “Anthropogenic warming and intraseasonal summer monsoon variability amplify the risk of future flash droughts in India”, *npj climate and atmospheric science*, DOI: 10.1038/s41612-020-00158-3, vol. 4, no. 1, Jan 2021

*Tiwari, A. D.; Mukhopadhyay, P. and Mishra, V., “Influence of bias correction of meteorological and streamflow forecast on hydrological prediction in India”, *Journal of Hydrometeorology*, DOI: 10.1175/JHM-D-20-0235.1, Jan 2021

*Shah, D. and Mishra, V., “Strong influence of changes in terrestrial water storage on flood potential in India”, *Journal of Geophysical Research: Atmospheres*, DOI: 10.1029/2020JD033566, Dec 2020

Ambika, A. K. and Mishra, V., “Substantial decline in atmospheric aridity due to irrigation in India”, *Environmental Research Letters*, DOI: 10.1088/1748-9326/abc8bc, Dec 2020

Kumar, R. and Mishra, V., “Increase in population exposure due to dry and wet extremes in India under a warming climate”, *Earth's Future*, DOI: 10.1029/2020EF001731, Nov 2020

*Mishra, V.; Bhatia, U. and Tiwari, A.D., “Bias-corrected climate projections for South Asia from coupled model intercomparison project-6”, *Scientific Data*, DOI: 10.1038/s41597-020-00681-1, vol. 7, no. 1, Oct 2020

Mahto, S. S. and Mishra, V., “Dominance of summer monsoon flash droughts in India”, *Environmental Research Letters*, DOI: 10.1088/1748-9326/abafld, Oct 2020

*Borgohain, B.; Mathew, G.; Chauhan, N.; Jain, V. and Singhvi, A. K., “Evidence of episodically accelerated denudation on the Namche Barwa massif by megafloods”, *Quaternary Science Reviews*, DOI: 10.1016/j.quascirev.2020.106410, vol. 245, Oct 2020

Mishra, V.; Ambika, A. K.; Asoka, A.; Aadhar, S.; Buzan, J.; Kumar, R. and Huber, M., “Moist heat stress extremes in India enhanced by irrigation”, *Nature Geoscience*, DOI: 10.1038/s41561-020-00650-8, vol. 13, no. 11, pp. 722–728, Oct 2020

Aadhar, S. and Mishra, V., “On the projected decline in droughts over South Asia in CMIP6 multimodel

ensemble”, *Journal of Geophysical Research: Atmospheres*, DOI: 10.1029/2020JD033587, Oct 2020

*Bhardwaj, K.; Shah, D.; Aadhar, S. and Mishra, V., “Propagation of meteorological to hydrological droughts in India”, *Journal of Geophysical Research: Atmospheres*, DOI: 10.1029/2020JD033455, Oct 2020

Kumar, M.; Kuroda, K. and Dhangar, K., “The most eagerly awaited summer of the Anthropocene: a perspective of SARS-CoV-2 decay and seasonal change”, *Groundwater for Sustainable Development*, DOI: 10.1016/j.gsd.2020.100400, vol. 11, Oct 2020

*Mishra, V.; Shah, H.; López, M. R. R.; Lobanova, A. and Krysanova, V., “Does comprehensive evaluation of hydrological models influence projected changes of mean and high flows in the Godavari River basin?”, *Climatic Change*, DOI: 10.1007/s10584-020-02847-7, Sep 2020

Shah, D. and Mishra, V., “Drought onset and termination in India”, *Journal of Geophysical Research: Atmospheres*, DOI: 10.1029/2020JD032871, Jul 2020

Mishra, Vimal, “Relative contribution of precipitation and air temperature on dry season drying in India, 1951–2018”, *Journal of Geophysical Research: Atmospheres*, DOI: 10.1029/2020JD032998, Jul 2020

Mishra, Vimal et al., “Droughts and floods”, in *Assessment of climate change over the Indian region*, Singapore: Springer Nature, pp. 117–141, ISBN: 9789811543265, DOI: 10.1007/978-981-15-4327-2_6, Jun 2020

Bhatia, Udit et al., “Physics-guided probabilistic modelling of extreme precipitation under climate change”, *Scientific Reports*, DOI: 10.1038/s41598-020-67088-1, vol. 10, no. 1, Jun 2020

J. S., Nanditha; Bhatia, U.; Stone, D.; Selten, F. M. and Mishra, V., “A seven-fold rise in the probability of exceeding the observed hottest summer in India in a 2°C warmer world”, *Environmental Research Letters*, DOI: 10.1088/1748-9326/ab7555, Apr 2020

*Asoka, A. and Mishra, V., “Anthropogenic and climate contributions on the changes in terrestrial water storage in India”, *Journal of Geophysical Research: Atmospheres*, DOI: 10.1029/2020JD032470, Apr 2020

*Kumar, M.; Deka, Jyoti, P. and Kumari, O., “Development of water resilience strategies in the context of climate change, and rapid urbanisation: a discussion on vulnerability mitigation”, *Groundwater for Sustainable Development*, DOI: 10.1016/j.gsd.2019.100308, vol. 10, Apr 2020

ENERGY

Bhattar, P. L.; Pindoriya, N. M. and Sharma, A., “A

combined survey on distribution system state estimation and false data injection in cyber-physical power distribution networks”, *IET Cyber-Physical Systems: Theory & Applications*, DOI: 10.1049/cps2.12000, Mar 2021

Abhinav, R. and Pindoriya, N. M., “Risk-Constrained Optimal Bidding Strategy for a Wind Power Producer with Battery Energy Storage System using Extended Mathematical Programming”, *IET Renewable Power Generation*, <https://doi.org/10.1049/rpg2.12058>, vol. 15, pp. 689–700, Jan 2021

Suthar, S. and Pindoriya, N. M., “Energy management platform for integrated battery-based energy storage solar PV system: a case study”, *IET Energy Systems Integration*, DOI: 10.1049/iet-esi.2020.0035, vol. 2, no. 4, pp. 373–381, Dec 2020

*Bouma, A.; Swaminathan, J. and Lienhard, J.H., “Metrics matter: accurately defining energy efficiency in desalination”, *Journal of Heat Transfer*, DOI: 10.1115/1.4048250, Dec 2020

Cherukuri, S. H. C.; Kuhada, R. B.; Kachhad, V. M. and Pindoriya, N. M., “A real time control strategy for improvement of autonomous operation in AC/DC micro grids using electric springs”, *International Transactions on Electrical Energy Systems*, DOI: 10.1002/2050-7038.12626, Oct 2020

Das, L.; Munikoti, S.; Natarajan, B. and Srinivasan, B., “Measuring smart grid resilience: methods, challenges and opportunities”, *Renewable and Sustainable Energy Reviews*, DOI: 10.1016/j.rser.2020.109918, vol. 130, Sep 2020

Bhatia, U.; Sela, L. and Ganguly, A. R., “Hybrid method of recovery: combining topology and optimization for transportation systems”, *Journal of Infrastructure Systems*, DOI: 10.1061/(ASCE)IS.1943-555X.0000566, vol. 26, no. 3, Sep 2020

Sarode, A.; Raj, R. and Bhargav, A., “Effect of confinement and heater surface inclination on pool boiling performance of patterned wettability surfaces”, *Journal of Enhanced Heat Transfer*, DOI: 10.1615/JEnhHeatTransf.2020033852, 2020

Sinha, A. and Bhargav, A., “Effect of state transition, drying kinetics and moisture content on Young’s modulus variation during thermal drying of hygroscopic food materials”, *Journal of Food Engineering*, DOI: 10.1016/j.jfoodeng.2020.109957, vol. 279, Aug 2020

Valerino, M.; Bergin, M.; Ghoroi, C.; Ratnaparkhi, A. and Smestad, G. P., “Low-cost solar PV soiling sensor validation and size resolved soiling impacts: a comprehensive field study in Western India”, *Solar Energy*, DOI: 10.1016/j.solener.2020.03.118, vol. 204, pp. 307–315, Jul 2020

Patnam, B. S. K. and Pindoriya, N. M., "DLMP calculation and congestion minimization with EV aggregator loading in a distribution network using bilevel program", *IEEE Systems Journal*, DOI: 10.1109/JSYST.2020.2997189, Jun 2020

Choksi, K. A.; Jain, S. and Pindoriya, N. M., "Feature based clustering technique for investigation of domestic load profiles and probabilistic variation assessment: smart meter dataset", *Sustainable Energy, Grids and Networks*, DOI: 10.1016/j.segan.2020.100346, vol. 22, Jun 2020

Katiyar, N. K.; Nellaiappan, S.; Kumar, R.; Malviya, K. D.; Pradeep, K. G.; Singh, A. K.; Sharma, S.; Tiwary, C. S. and Biswas, K., "Formic acid and methanol electro-oxidation and counter hydrogen production using nano high entropy catalyst", *Materials Today Energy*, 16, 100393, <https://doi.org/10.1016/j.mtener.2020.100393>, Jun 2020

Fulpagare, Y.; Bhargav, A. and Joshi, Y., "Predictive model development and validation for raised floor plenum data centre", *Journal of Electronic Packaging*, DOI: 10.1115/1.4046554, vol. 142, no. 2, Jun 2020

Rajasekhar, B.; Tushar, W.; Lork, C.; Zhou, Y.; Yuen, C.; Pindoriya, N. M. and Wood, K. L., "A survey of computational intelligence techniques for air-conditioners energy management", *IEEE Transactions on Emerging Topics in Computational Intelligence*, DOI: 10.1109/TETCI.2020.2991728, vol. 4, No. 4, May 2020

Rajasekhar, B. and Pindoriya, N. M., "Heuristic approach for transactive energy management in active distribution systems", *IET Smart Grid*, <https://doi.org/10.1049/iet-stg.2019.0221>, May 2020

Sinha, A. and Bhargav, A., "Young's modulus estimation in food samples: effect of experimental parameters", *Mechanics & Industry*, DOI: 10.1051/meca/2020025, vol. 21, no. 4, May 2020

NATURAL RESOURCES, WILDLIFE AND ECOSYSTEMS

Aiyadurai, A., "Enjoy Enjaami: a call for ecological and social justice", *Countercurrents.org*, Mar 27, 2021

Bhattacharya, D.; Reza, A.; Guha, S. and Singh, R.N., "Stability of vegetation growth in a noise-induced system", *Journal of Earth System Science*, <https://doi.org/10.1007/s12040-020-01502-0>, Feb 2021

Aiyadurai, A., "The implications of legal personhood to nonhumans: insights from India's tiger conservation", *ISLE: Interdisciplinary Studies in Literature and Environment*, DOI: 10.1093/isle/isaa061, Sep 2020

Aiyadurai, A., "Voices from Dibang valley: Idu Mishmi, wildlife biologists and a wildlife sanctuary", *Current Conservation*, vol. 14, no. 1, Sep 2020

Sahoo, R.; Singh, R. N. and Jain, V., "Process inference from topographic fractal characteristics in the tectonically active Northwest Himalaya, India," *Earth Surface Processes and Landforms*, DOI:10.1002/esp.4984, Aug 2020

Nicolaisen, J.; Aiyadurai, A. and Duara, P., "Trans-species listening and the rights of nature: legal persons beyond the human: introduction to special cluster in ISLE 27.3", *ISLE: Interdisciplinary Studies in Literature and Environment*, DOI: 10.1093/isle/isaa058, Aug 2020

Jain, Vikrant et al., "Critical zone: an emerging research area for sustainability", *Current Science*, <https://doi.org/10.18520/cs%2Fv118%2Fi10%2F1487-1488>, vol. 118, no. 10, pp. 1487-1488, May 2020

*Mukherjee, S.; Kumari, D.; Joshi, M.; An, A. K. and Kumar, M., "Low-cost bio-based sustainable removal of lead and cadmium using a polyphenolic bioactive Indian curry leaf (*Murraya koengii*) powder", *International Journal of Hygiene and Environmental Health*, DOI: 10.1016/j.ijheh.2020.113471, vol. 226, May 2020

*Kumar, M.; Chaminda, G. G. T. and Honda, R., "Seasonality impels the antibiotic resistance in Kelani river of the emerging economy of Sri Lanka", *npj Clean Water*, DOI: 10.1038/s41545-020-0058-6, vol. 3, no. 12, Apr 2020

*Research addresses multiple areas (i.e. relates to more than one focus area of the Centre)

2.3 Research Facilities

Research laboratories related to sustainability at IIT Gandhinagar focus on Safe Drinking Water Production, Water Resources, Water Networks and Distribution, Desalination, Energy, Environment, Power Systems, Machine Intelligence and Climate Change among others.



CENTRAL INSTRUMENTATION FACILITY (CIF)

<https://iitgn.ac.in/cif/>

CIF has been established to provide sophisticated characterisation services to researchers within and outside IITGN. It houses several high-end analytical instruments such as SEM, XRD, AFM, NMR, LC-MS, MALDI-TOF, ICP- MS & ICP-OES, Confocal Microscope and Single Crystal XRD. CIF recently added new instruments such as Transmission Electron Microscope (TEM) and Multipurpose XRD with various modules like Powder analysis, Thin Film, SAXS and in-plane scattering for Material Science and Research. The CIF aims to provide a central facility consisting of the latest and advanced analytical Instruments to facilitate multidisciplinary research and to cater to the needs of academic research institutes, universities, and industries for high-end material characterisation. CIF has also been constantly providing services to the universities, institutes and R&D departments.

DRY PROCESS TECHNOLOGY (DRYPROTECH) LAB

<https://sites.google.com/a/iitgn.ac.in/dryprotechlab/home/our-research/copper-homeostasis-in-drosopila>

The state-of-the-art DryProTech laboratory has several sophisticated instruments such as surface energy analyzer (inverted gas chromatography), simultaneous TG-DSC from Netzsch, FT4 powder rheometer (Freeman Technology), laser diffraction particle size analyzer (CILAS) for characterisation in dry and wet mode. In addition, the lab is equipped with a V-blender and cone-mill (Prism Pharma), a humidity-controlled glove box

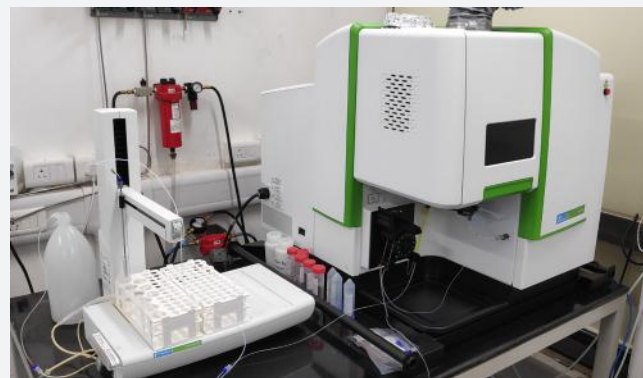
and Faraday cup with electrostatic charge measurement facility, planetary ball mills, furnace chamber, tube furnaces, catalytic reactor to study the performance of catalyst powders, etc.



DSIR-IITGN-CRTDH (COMMON RESEARCH AND TECHNOLOGY DEVELOPMENT HUB)

<https://crt dh.iitgn.ac.in/about-us/>

The DSIR-IITGN-CRTDH is equipped with ICP Analysis Suite (Perkin Elmer), fluorescence spectrometer, multimode microplate, mass spectrometer (Spectrum Automation and Control) UV-Vis spectrometer (Analytic Jena AG), Model - MAX300- CAT (M/s Extrel CMS, LLC, USA), multi-purpose online gas chromatography, TOC analyzer (Analytik Jena AG), HPTLC (CAMAG, Switzerland), basket centrifuge, and refrigerator circulator.



EARTH SCIENCE LAB

The Earth Science laboratory is equipped with basic and sophisticated research facilities /equipment to conduct elementary and advanced water and soil chemistry levels. It aims to address environmental maladies and provide a sustainable scientific solution to society at the grassroots level. This laboratory has several experimental setups to assist research from macromolecular level to ultra-trace level with the help of different instruments such as ion chromatography (IC), Hanna (HI7698194) multiparameter pH/EC/DO probe, etc.

ELECTRICAL MACHINES AND POWER ELECTRONICS LAB

The laboratory is equipped to carry out research work on designing, controlling, and diagnosing various electric machines. These include transformers, rotating electric machines and power converters. Design and analysis of novel and existing topologies are carried out using 2D and 3D electromagnetic finite element analysis in Ansys Maxwell. Test-setups for experimentation on various rotating electric machine topologies are available in the lab.

ENERGY, ENVIRONMENT, AND EXPOSURE LAB

<https://labs.iitgn.ac.in/eeel/>

Research at Energy, Environment and Exposure Laboratory (EEEL) focuses on various aspects of energy, environment, and human exposure. The lab aims to understand the complex interdependence between the energy, environment, and human exposure.

ENERGY SYSTEMS RESEARCH LAB

<https://iitgn.ac.in/research/fuelcelllab/facilities.php>

The motivation behind the Renewable Energy laboratory facility is to provide a broad range of experimental experience to undergraduate and graduate students in renewable energy. This facility comprises high-quality experimental setups in wind, thermal and solar energy. This experimental facility includes a thermal energy storage training system, solar concentrator training system, wind energy training system and solar PV training and research system. A fuel-cell test system and a heat transfer experimental module have been procured.

HYDROGEN AND CARBON MONOXIDE SAFETY LAB

The facility is a hydrogen and carbon monoxide safety laboratory with dedicated industrial ventilation that is designed to automatically respond to events involving an increase in hydrogen or carbon monoxide concentration, thereby preventing accidents. The laboratory has facilities for building, testing and demonstrating fuel cell systems and subsystems. Gas chromatography and mass spectrometry facilities enable the gas analysis to determine the performance of catalysts and catalytic reactors that are used in fuel cell systems. Within this facility, the group has developed diesel reformers for marine fuel cell system applications (design patented), methanol fuel processors for stationary power applications and ethanol reformers for various end-use applications. Other equipment that is important to this research & development activity include mass flow

controllers, data acquisition systems and sensors, and the laboratory is well equipped to handle this research.

A research group at the lab is working in CO₂ conversion technologies where CO₂ is used to reform methane to generate synthesis gas. The process can be further modified to prepare hydrogen, methanol, gasoline etc. Other than this, work on CO₂ electroreduction materials, gas purification technologies is also ongoing. The lab houses gas chromatographs, mass spectrometer, catalyst synthesis facilities, adsorption-desorption equipment.

MACHINE INTELLIGENCE AND RESILIENCE LAB

<https://mirlabiitgn.github.io/>

The Machine Intelligence and Resilience laboratory is an interdisciplinary lab working on the various aspects of climate change and variability, climate extremes, and resilience of built and natural systems. Key projects that the lab is undertaking include:

1. Developing physics guided super-resolution approach and evaluation strategies for downscaling earth system model outputs
2. Physics guided data science approach for predictive understanding of hydrological processes
3. Evaluating resilience of critical infrastructures under evolving threats
4. Modelling the spread of Covid-19 in congested cities.

PHOTONIC SENSORS LAB

www.photonicsensorslab.com

The Photonic Sensors laboratory specialises in photonic sensing for interdisciplinary applied research. Near-infrared and mid-infrared tunable diode laser spectroscopy (TDLS) are used to develop high-sensitivity detection platforms for industrial safety applications and ambient air quality monitoring. The lab develops accurate and robust systems for long-term and automated measurement systems that can be mounted on vehicles to make real-time measurements over large urban areas. Work on UAV-mountable systems for vertically-resolved measurements non-invasive, time-resolved measurement of bacterial growth by measuring the emitted carbon dioxide are also ongoing. Bacteria contribute to greenhouse gas emissions and it is therefore meaningful to develop compact detection systems to monitor their growth. The lab has also demonstrated early detection of growth suppression due to the addition of antibiotics. Finally, the strain-sensitivity of Fiber Bragg gratings (FBGs) used to measure the bend angle of fingers of the human hand helps quantify the extent of recovery during stroke rehabilitation.

POWER SYSTEMS AND SMART GRID LAB

<https://naran.people.iitgn.ac.in/research/>

Power Systems and Smart Grid laboratory focuses on the research in smart distribution grids/microgrids and integrating distributed generations and energy management. The lab is equipped with a fully digital real-time power engineering simulation platform consisting of Opal-RT (OP4508 F11-3+1) real-time digital simulator - OP5600 and customised modular hardware and firmware for hardware-in-the-loop (HIL) and rapid control prototype (RCP) studies in power systems and smart grid-related research activities. The lab is also equipped with power systems simulation packages - PSCAD, CYMDIST and GAMS Optimisation tools. National/international collaborative projects majorly support research activities.

WATER AND CLIMATE LAB

<http://vmishra.people.iitgn.ac.in/water&climate/>

The Water and Climate laboratory focuses on Hydrologic modelling, Remote Sensing, Climate Change, Drought, Floods, and Heat Waves Methods and techniques: Modelling, Statistical analysis, Data analysis. The current research work is on drought and water availability in India under current and future climate.

WATER AND ENVIRONMENT TECHNOLOGY LAB

The Water Environment Technology (WET) laboratory deals with hydrogeochemistry, contaminant transport and bioremediation experiments. The overarching objective of my research is to ascertain, broaden, comprehend, and develop various dimensions of the fate,

transport and remediation of geogenic, micro, microbial, and emerging contaminants.

WATER ENERGETICS LAB

<http://jaichander.people.iitgn.ac.in/wel/>

The Water Energetics laboratory focuses on modelling and experimental testing of energy-efficient desalination and water treatment technologies towards drinking water production and industrial effluent recycling. Some of the projects underway at the lab include:

1. Improved design of air-gap distillation systems for off-grid desalination
2. Optimal resource (membrane area) allocation in multi-stage RO through equipartition of entropy generation
3. Electrodialysis system development for brine splitting aimed towards industrial effluent reuse

WATER RESOURCES ENGINEERING LAB

<https://civil.iitgn.ac.in/wre-lab/>

The Water Resources Engineering laboratory has the following equipment for teaching purposes: a hydraulic bench, pitot tube, Reynold's apparatus, sharp-crested weir (notch), Bernoulli's apparatus, venturimeter and orificemeter, nozzle meter, hydraulic tilting flume, basic hydrology apparatus, free and forced vortex flow apparatus. In addition to the above, a river tray with a levee breach facility, an automated hydraulic tilting flume, and a piping system to study transients are being used for research purposes. A 3D velocity measurement device, Acoustic Doppler Velocimeter, is used in the flume experiments.



3. Grants and Awards

With the aim of encouraging urgent research on Covid-19 and its societal impact, the KPCSD established the **Covid-19 Research Awards** for research by IITGN faculty and students on all aspects of the pandemic. The awards are designed to encourage research that advances understanding of the pandemic and its psychological, educational, economic and societal impact. Four research works mentioned below were selected for the award.

A chronicle of SARS-CoV-2: Part-I - Epidemiology, diagnosis, prognosis, transmission and treatment by **Manish Kumar, Kaling Taki, Rohit Gahlot, Ayushi Sharma, and Kiran Dhangar.**

A cross-sectional study of psychological wellbeing of Indian adults during the Covid-19 lockdown: Different strokes for different folks by **Anupam Joya Sharma and Malavika A Subramanyam.**

Dynamics of psychological responses to Covid-19 in India: A longitudinal study by **Anvita Gopal, Anupam Joya Sharma, and Malavika A Subramanyam.**

First proof of the capability of wastewater surveillance for Covid-19 in India through detection of genetic material of SARS-CoV-2 by **Manish Kumar, Arbind K Patel, Anil V Shah, Janvi Raval, Neha Rajpara, Madhvi Joshi, and Chaitanya G Joshi.**

The Centre funded a project related to Covid-19: "**Weekly Surveillance of Wastewater for SARS-CoV-2 Gene Detection in Gandhinagar for Pandemic Curve Monitoring**". The objectives of the project, led by **Prof Manish Kumar** of the Earth Sciences discipline, were to detect and quantify variation in the genetic material of SARS-CoV-2 in the various wastewaters of Gandhinagar to understand the pandemic situation, to maintain weekly resolution of the data for three months in genetic material loadings in the wastewater treatment plant at different stages and different time period, to establish applicability of Wastewater Based Epidemiology (WBE) for Covid-19 surveillance as a potential tool for public health monitoring at the community level and to understand the pathogen diversity (viral and bacterial) from wastewater in order to establish early signs of WBE as a prediction tool.

KPCSD provided a seed grant to **Prof Amit Arora** and **Prof Madhu Vadali** for the proposal "**Golden Plastic - Turning plastic waste into local businesses through 3D printing**". The seed funding proposal is related to a larger funding proposal for the project titled "Golden Plastic" submitted to the DST Indo-Portugal Bilateral joint call in collaboration with Instituto Superior Técnico (IST), Portugal. The seed grant is expected to facilitate preliminary feasibility studies and proof-of-concept prototypes at IITGN.

4. Practice

IIT Gandhinagar has undertaken several sustainable campus initiatives. The conceptual framework of campus planning emphasised consideration of sustainability factors, which in turn informed the development of the master plan and campus development.

4.1 PROJECTS AND CONSULTANCIES

Faculty members at IITGN are engaged in several consultancy and internal projects, relating to sustainability with a combined project value of approximately INR 2.2 crores. The number of consultancy and internally funded projects at the Institute relating to sustainability increased by nearly 65% as compared to the year 2019-20.

Prof Nipun Batra and his team are working on scalable energy disaggregation, sensing and analytics. Prof Atul Bhargava is working on methanol and natural gas-powered fuel cell systems. Prof Udit Bhatia provided regional training on Climate Science and Modelling in collaboration with the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), for capacity building of government officials. He has also undertaken regression analysis of different infrastructure facilities for Dholera Industrial City Development Limited. Prof Bhaskar Datta is working on a project to generate useful products through human waste processing.

Prof Manish Kumar has worked on monitoring groundwater quality for industrial setups and undertook evaluation of Net Present Value and environmental damage in monetary terms for illegal limestone mining in selected regions of Gujarat. Prof Vimal Mishra and his team are working on projects related to climate change, in collaboration with agencies such as the MoEFCC, and Gujarat Energy Development Agency (GEDA) to assess risk and uncertainty for critical railway infrastructure due to impacts of climate change and implications of Covid-19 on Gujarat State from climate change perspective.

Prof Sameer Patel is working on a project to investigate the exposure to airborne pollutants and risk of airborne transmission of pathogens in built environments. Prof Amit Prashant is undertaking solar and wind energy-related projects. Prof Sudhanshu Sharma focuses on biomass pyrolysis/ gasification to produce methane rich gas.

Water

Principal Investigator	Name of the project	Industry name
Udit Bhatia	Regression analysis for sewage treatment plant civil works, project facilities, and EMI	Dholera Industrial City Development Limited (DIDCL)
Manish Kumar	Groundwater quality monitoring for Ambuja setup in Mehsana	Ambuja Intermediates Pvt. Ltd
Manish Kumar	Groundwater quality monitoring for Gopinath Chem-Tech Ltd setup in Mehsana	Gopinath Chemtech

Pollution and Waste Management

Principal Investigator	Name of the project	Industry name
Bhaskar Datta	Generating useful products through human waste processing	ReMaterials

Climate Change

Principal Investigator	Name of the project	Industry name
Udit Bhatia	Institutionalising capacities on climate change, regional training on climate science and modelling, 2021	MoEFCC and GIZ

Vimal Mishra	Implications of Covid-19 on Gujarat state from climate change perspective	GEDA
Vimal Mishra	Risk and uncertainty assessment for critical railway infrastructure due to impacts of climate change	MoEFCC

Energy

Principal Investigator	Name of the project	Industry name
Nipun Batra	Developing techniques for scalable energy disaggregation	Jio Platforms Limited
Atul Bhargav	Design consultancy on methanol and natural gas powered fuel cell systems	Thermax Limited
Amit Prashant	Foundation consultancy for development of proposed 10 GW RE (wind and/ or solar) projects in Great Rann of Kutch, Gujarat	National Thermal Power Corporation Limited (NTPC Ltd)
Amit Prashant	Remedial measures of slope failures at 5 MW solar power plant of GIPCL	Gujarat Industries Power Company Limited (GIPCL)
Sudhanshu Sharma	Biomass pyrolysis/ gasification to generate methane rich gas	Atmos Power Pvt Ltd

Natural resources, wildlife and ecosystems

Principal Investigator	Name of the project	Industry name
Manish Kumar	Study report for evaluation of Net Present Value and environmental damage in monetary terms for illegal limestone mining in Junagadh and Gir Somnath district	Gujarat Pollution Control Board (GPCB)

The following internally funded sustainability projects are ongoing at the Institute:

Principal Investigator	Name of the project
Nipun Batra	Scalable sensing and analytics for sustainability
Sameer Patel	Investigating the exposure to airborne pollutants and risk of airborne transmission of pathogens in built environments

4.2 CAMPUS SUSTAINABILITY

Sustainability is a key focus at IIT Gandhinagar, which encompasses a broader perspective, in addition to incorporating sustainability components in campus design and development. The campus has been conceptualised keeping in mind the long-term objectives as well as present and future needs. The master plan complied with the National Building Code 2009 of India, including the 'Approach to Sustainability'. The buildings have been built to Green Rating for Integrated Habitat Assessment (GRIHA) for green buildings and large area developments and Energy Conservation Building Code (ECBC) standards. The guiding principles of the master plan included the following: a) complete and absolute respect for the environment at both micro and macro levels and b) respect, conserve and where possible, recycle resources.

IIT Gandhinagar campus is committed to the maximisation of water reuse across the university. It has several water-saving and recycling features that promote sustainability. The Master Plan emphasised sustainability in campus water management and adopted several innovative water management practices. Infrastructure details and guidelines meticulously ensure reducing, reusing and recycling of resources and reducing the ecological footprint of the Institute (reducing the site dependency on the city's resources). The Institute has several features including low-energy sewage treatment, rooftop solar photovoltaic plants, solar water heaters, biogas plant, energy-efficient lights, motors and pumps, use of natural sunlight in corridors, passive cooling systems, a pedestrian-friendly campus and others that serve as evidence to the Institute's aspiration to be sustainable. Energy efficiency and solar power generation are aligned with the National Missions on reducing carbon emissions and enhancing solar energy capacity.

The Institute's sustainable maintenance practices include waste segregation at source, conversion of organic waste to manure, recycling paper, and thermocol waste amongst others.

VITAL STATISTICS (YEAR 2020-21)

Water

Volume of water used at the Institute: Inbound (treated or extracted water): 3,02,068 cubic metres

Volume of wastewater recycled using STP: 48477 cubic metres

Percentage of recycled water: 16%

Waste

Amount of waste generated : 345 metric tonnes

Amount of waste recycled : 304 metric tonnes

Amount of waste sent to landfill : 41 metric tonnes

Percentage of waste recycled : 88%

Energy

Total energy used : 26383 gigajoules

Total energy used from low-carbon sources : 2439 gigajoules

Percentage of energy used from low-carbon sources : 9.3%

SUSTAINABLE FOOD PRACTICES AT IIT GANDHINAGAR

The Institute encourages sustainable food practices and supports young entrepreneurs working in the area of agriculture. The Institute strives to responsibly manage the food supply chain and engages in programs and initiatives that contribute to lower environmental impacts.

Eat Right Campus Award: IITGN was awarded the Eat Right Campus Award with a five-star rating from the Food Safety and Standards Authority of India (FSSAI) for two successive years. The audit is done based on a checklist of the following five parameters: a) Compliance to food safety and hygiene; b) Healthy diets; c) Food waste management; d) Promotion of local and seasonal foods on campus, and e) Promotion and awareness on food safety and healthy diets in and around campus.

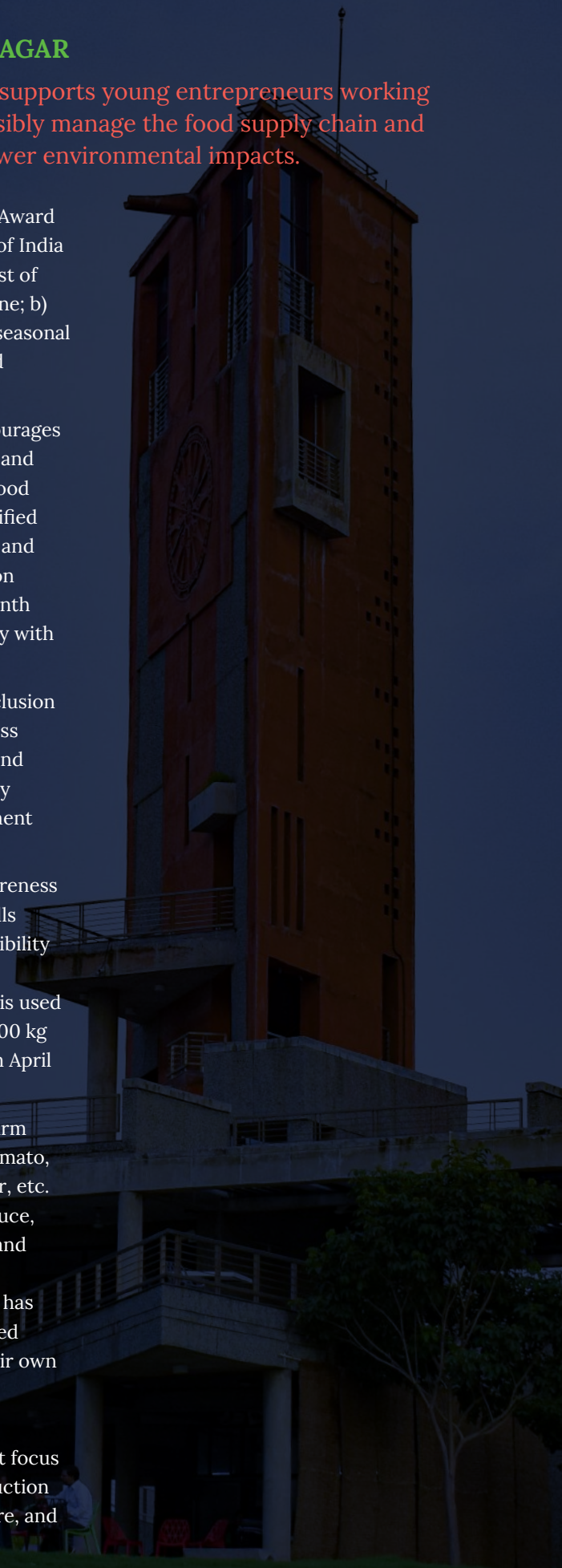
Sustainable, healthy, and affordable food choices: The Institute encourages efforts to ensure healthy eating practices for the campus community and high-quality services at all eating establishments on campus. All the food establishments on campus use fortified foods (+F) such as double fortified salt, rice, wheat flour, oil, and milk, to further enhance food nutrition and are required to have a valid FSSAI licence. The Institute also focuses on healthy food habits; the menu served in the mess is tailored every month by the student mess council for a balanced diet that provides the body with essential nutrition.

Mess operations: IITGN promotes local and seasonal foods by the inclusion of such vegetables and fruit items in the monthly mess menu. The mess contracts have specifications and guidelines to ensure a sustainable and balanced diet. The quality of the foodstuffs and eatables is specified by the Institute, and subject to inspection by the Commercial Establishment Management Committee (CEMC).

Tracking of food waste: The mess committee regularly conducts awareness programs to reduce food wastage. Notice boards inside the dining halls display the amount of daily food wastage to create a sense of responsibility among the community. Food wastes (wasted food, peels of fruits and vegetables etc) of the Mess are sent to the biogas plant. Excess if any is used in compost pits for the preparation of compost. A total of about 20, 000 kg of food waste was collected in both the messes for all four meals from April 2020 to March 2021.

Kitchen garden and organic farming practices: The IITGN organic farm grows several varieties of vegetables, such as cabbage, cauliflower, tomato, brinjal, potato, cucumber, bottle-gourd, ladyfinger, spinach, coriander, etc. and also cultivates special vegetables like broccoli, kale, zucchini, lettuce, pumpkin, etc. Farm activities are being expanded by growing millets and wheat. Community members participate in the volunteer programme and contribute to the organic farm activities. The organic farm group has delineated spaces in housing areas for kitchen gardens and encouraged residents to actively participate and grow vegetables and fruits of their own choice.

Sustainable agriculture and food-related startups: IIT Gandhinagar Innovation and Entrepreneurship Centre (IIEC) supports startups that focus on digital and technical transformation in the agriculture sector, reduction of food waste, analysing and reducing the risk associated in agriculture, and water sectors.



5. Education

The Institute offers several graduate and undergraduate courses on sustainability. Nearly **300** students registered for these courses over the past year. The Centre aims to undertake curriculum development at IITGN by implementing modules on sustainability in existing courses and advance education on sustainability nationally and globally. The Centre also promotes student, academic and research exchanges on sustainability with institutions across the country and abroad.

The Institute conducted several workshops and short courses focused on sustainability. These were designed to provide a knowledge-sharing platform to initiate and strengthen research networking as well as explore the possibility of joint research projects and training in the area to help society with sustainable solutions.

5.1 LIST OF COURSES

The following graduate and undergraduate courses related to sustainability were offered in 2020-21:

CE 201: Earth Materials and Processes

Course instructor: Prof Vikrant Jain | No. of credits: 4 | Total no. of students who enrolled for the course (Semester I 2020-21): 32

The central theme of this course is to teach earth materials and processes, including structure of solid earth, rock cycle, types of rocks and its engineering properties, soils: processes of formation, soil profile and soil types, geophysical methods of earth characterization, concept of plate tectonics, sea-floor spreading and continental drift, origin of oceans, continents, mountains and rift valleys, earthquake and earthquake belts; dynamic behaviour of earth surface and role of hydrosphere: river processes, surface water hydrology, hillslope processes, catchment erosion processes, coastal processes, groundwater and karst processes; applications in Civil Engineering and Environmental Management.

CE 202: Sustainability and Environment

Course instructor: Prof Vimal Mishra and Prof Udit Bhatia | No. of credits: 3 | Total no. of students who enrolled for the course (Semester II 2020-21): 30

This course introduces the concept of sustainability covering several areas such as humanity and environment, the evolution of environmental policy, climate and global change, climate processes: external and internal controls, biosphere, soil and sustainability, biodiversity and ecosystem functions, physical resources: water, pollution, minerals, environmental and resource economics, modern environmental

management, systems of waste management, sustainable energy systems, sustainable infrastructure, embodied energy, life cycle, sustainable materials and construction, problem solving and tools of sustainability.

CE 308 : Water Resource Engineering

Course instructor: Prof Udit Bhatia | No. of credits: 3 | Total no. of students who enrolled for the course (Semester I 2020-21): 28

The course introduces hydraulic and hydrologic processes including control volume approach, continuity, energy, momentum, introduction to hydrology, precipitation, evaporation, and infiltration, surface runoff, streamflow routing; and provides an introduction to pipe flow, open channel flow and groundwater flow.

CE 605 : Remote Sensing of Land and Water Resources

Course instructor: Prof Vimal Mishra | No. of credits: 4 | Total no. of students who enrolled for the course (Semester II 2020-21): 15

The course delivers an overview of remote sensing, electromagnetic radiation principles, remote sensing data collection, geometric correction, image enhancement, image interpretation, image classification, band transformation, thermal infrared remote sensing, change detection, feature extraction, monitoring of land and water resources, accuracy assessment, remote sensing of soil, vegetation, water, and urban areas, object oriented classification, and spectral indices.

CE 611: Advanced Engineering Hydrology

Course instructor: Prof Vimal Mishra | No. of credits: 4 | Total no. of students who enrolled for the course (Semester I 2020-21): 6

Various topics such as hydroclimatology, water balance, understanding hydrologic change, statistical representation of hydrologic data, flood frequency analysis, understanding frequency of droughts, hydrologic design, hydrologic time series analysis, parametric and non-parametric trends, spectral analysis, wavelet analysis, uncertainty analysis, hydrologic modelling, and hydrologic forecasting are covered in this course.

CE 633: Water Resource Systems: Planning and Management

Course instructor: Prof Udit Bhatia | No. of credits: 4 | Total no. of students who enrolled for the course (Semester I 2020-21): 28

The course deals with Water Resource System modelling: system components, planning and management, modelling of water resource systems, supply and demand curves. introduction to optimization for water resource systems with an introduction to modelling constraints in water resource planning and management, linear programming solution strategies and stochastic programming for reservoir operation problem; applications in water resource management, network modelling for water resource systems and river basin planning and floodplain management including screening models, floodplain management, urban stormwater management, integrated water resource management frameworks, and best practices and opportunities in resilient design.

EH 602: River Morphology and Ecology

Course instructor: Prof Vikrant Jain | No. of credits: 4 | Total no. of students who enrolled for the course (Semester II 2020-21): 5

This course introduces river science, geomorphic concepts, river basin approach, drainage network, river processes and morphology; hydrological, sedimentological and ecological characteristics and their interrelationship in different channel patterns; dynamics of alluvial rivers; different classification approaches in fluvial geomorphology and its applications, glacio-fluvial interaction, river response to climate, tectonics and human disturbance, ecosystem based approach to stream management, concept of river health and environmental flow (e-flow).

EH 605: Modelling of Earth System and Sustainability

Course instructor: Prof Rishi Narain Singh | No. of credits: 4 | Total no. of students who enrolled for the course (Semester I 2020-21): 10

The course explains the purpose of mathematical modelling in earth system science and its methodology;

mathematical representation of the earth system and its components; equilibrium algebraic models: energy and mass balance at earth's surface, Thermodynamics and chemical reactions in earth system; growth and decay ODE models: biogeochemical cycles; transport process PDE models: advection and diffusion processes in the earth system; distribution of events: probability distribution of disaster events; control of risks in earth system: optimization models, sustainability models; numerical algorithms.

EH 608: Biodiversity Conservation and Sustainable Development

Course instructor: Prof Chhavi Nath Pandey | No. of credits: 4 | Total no. of students who enrolled for the course (Semester II 2020-21): 29

This course provides an overview of elements and levels of biodiversity and its significance, biodiversity conservation, ecosystems and ecosystem diversity, policies and legal framework for obtaining environmental clearances for developmental projects; biodiversity conservation and Sustainable Development - concept, United Nations Sustainable Development Goals and Targets; biodiversity conservation and community; stakeholders, social, economic and political process vis a vis conservation; Sustainable Development for a wildlife landscape - man-animal conflicts, wildlife friendly infrastructure and development; dependence of local communities on natural resources; Joint Forest Management, and participatory approaches to the management of forests and wildlife.

ES 632: Energy Systems

Course instructors: Prof Jaichander Swaminathan and Prof Atul Bhargav | No. of credits: 4 | Total no. of students who enrolled for the course (Semester II 2020-21): 10

This course is an introduction to the system and economic tools for energy systems; conventional power generation technology with the related fundamentals; renewable and emerging clean energy systems and technologies; solar thermal energy technology; photovoltaic technology; hydro-power, wind, geothermal, marine, and biomass energy systems; advanced energy storage; oxyfuel combustion, carbon capture and storage, cleaner coal technologies.

ES 635: Water Quality Engineering

Course instructor: Prof Manish Kumar | No. of credits: 4 | Total no. of students who enrolled for the course (Semester I 2020-21): 12

This course is based on fundamental theory and application of the physical and chemical processes in water and wastewater treatment: introduction to

water quality parameters, standards, fundamentals, optimization and design of various processes for water treatment: sedimentation, softening, disinfection, reactor design, ozone contactor design, air stripping, membrane processes, and ion exchange.

HS 515: Politics of the Environment

Course instructor: Prof Ambika Aiyadurai | No. of credits: 4 | Total no. of students who enrolled for the course (Semester I 2020-21): 38

The course offers foundational knowledge of environment and society: changing notions of nature/ environment, human impacts on environments and vice versa; colonialism and environment: mis/use of natural resources and green imperialism; conservation and development: contradictory relations with environment, ecological equity and justice. Human-animal relations: trust and domination, animal icons and animals in urban society. Environmental movements: local struggles, resource control, social inequity and injustice. Green capitalism and neoliberal environmentalism: markets and commodification of nature.

IN 304 : Ancient Indian Technology

Course instructor: Prof Alok Kumar Kanungo | No. of credits: 4 | Total no. of students who enrolled for the course (Semester I 2020-21): 37

This course covers a range of issues from Archaeology to Ethnography of use of stone, ceramic and glass in pre-modern India. This course alerts students to the contextual nature of technologies and how different societies respond to different needs within the environmental, material and cultural constraints and involves a number of experimental studies and visits to the surviving traditional industries. History of ancient Indian technology; surviving traditional technologies in India; raw materials used in Palaeolithic technology: rocks; Palaeolithic technology: evolution of stone tools through time; stone working: stone objects (grinding stone, beads etc.); shell, bone and antler working; ceramic production: pottery and terracotta; glass making and working; furnaces/ kilns.

5.2 WORKSHOPS AND SHORT COURSES

Several workshops, short courses and programmes were organised at the Institute focused on sustainability during the past year.

Active Tectonics & Earthquake Geology: A tool for Seismic Hazard Assessment

By Prof Javed N Malik, Professor, Department of Civil Engineering, IIT Kanpur from 21 to 30 September, 2020
The talk discussed Paleoseismic study, a common practice in many countries like the United States, Japan, New Zealand etc. which have provided significant data towards recognition of individual paleoseismic (old earthquake) events, behaviour of individual active fault segment, rate of faulting; reconstructing the history of large magnitude earthquakes and their repeat time etc.

Nature Inspired Design

By Prof Sanjay Jain, Dean, Faculty of Architecture & Design, SAGE University from 20 March to 24 April, 2021
Nature is a treasure trove of the information sources that could be used by us to discover and derive inspiration from her processes, systems, structures and forms. Nature can provide us with new approaches to look at the problems as it is believed that in an unfathomable span of 3.8 Million years, Nature has resolved most of its problems of varying complexity, scale and diversity. The major objectives of the course were to understand the way Nature works as a vast information resource, to learn and gain insights; to study natural species as a system and underlying processes that life has created for propagation of life through evolution, adaptation and symbiotic relationships; to understand biomimetics as an approach to design with sustainability, resource management and as a focus on constant evolution and improvement and the process of proactive interaction of the “why” of the natural materials, forms and processes in all its nuances.

3030 STEM organised by Centre for Creative Learning, IIT Gandhinagar

<https://ccl.iitgn.ac.in/3030stem/episodes.html>
3030 STEM is an online program, focusing on basic conceptual understanding and critical thinking of Maths/Science. It is launched by the Central Board of Secondary Education and is offered by the Centre for Creative Learning, Indian Institute of Technology Gandhinagar in collaboration with the Indian Institute of Science Education and Research, Pune. 3030 STEM is sponsored by Vigyan Prasar, Department of Science and Technology.

- The Story of Bugs | 3030 STEM Season 2 Episode 4 focused on food chain, animal diversity,

environmental science, sustainability, resources of earth, etc.

- रोटी, कपड़ा, मकान | Science of Food, Shelter Cloth 3030STEM Season 2 Episode 5 focused on polymers, fertiliser, Green Revolution, synthetic fibres and plastics, etc.
- The World of Plants | 3030 STEM Season 2 Episode 10 focused on photosynthesis, environment, biomimicry, ecosystem, etc.

- Life of Microbes | छोटी सी बात | 3030 STEM Season 2 Episode 11 focused on microorganisms, ecosystem, biodiversity, evolution, plant nutrition, etc.
- The Story of Water | पानी की कहानी | 3030 STEM Season 2 Episode 12 focused on conservation of water, water cycle, etc.



6. Events and Outreach

Several events in the field of sustainability were conducted during the past year. Five major events including Sustainability Fair, WIN-WATSAN Webinar Series, Indo-UK virtual conference on Water Vulnerability, National Power Systems Conference and World Water Day. Fourteen webinars under KPCSD Sustainability Seminar Series and ten lectures in various disciplines at the Institute, which were almost double in number compared to 2019-20, promoted awareness and facilitated networking among researchers and professionals engaged in sustainability. These events were attended by a broad range of stakeholders including industry professionals, NGO representatives, government officials, academicians and researchers. The Centre also strives to promote sustainable solutions in the public and private sphere, disseminate conceptual and practical knowledge, training materials and create awareness on sustainability through several events organised throughout the year.

6.1 SUSTAINABILITY FAIR 2021

The Centre hosted its third annual Sustainability Fair online on 26 March, 2021, on the theme of “Renewable Energy and Water Resources.” 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.

6.2 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 14 to 16 December, 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. Some of the panellists include Prof Raghu Murtugudde, Prof Prosun Bhattacharya, Dr Shyamnarayan Dave, Prof Upal Ghosh and Prof Daniel D Snow. 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. The event provided an interdisciplinary platform to present and discuss the most recent innovations, trends, concerns, practical challenges, and solutions adopted in the fields of wastewater, surface water, and groundwater.

6.3 WIN WATSAN WEBINAR SERIES 2020: INNOVATIONS AND EMPOWERMENT FOR SUSTAINABLE WATSAN SOLUTIONS

The event was conducted as a six part series, from 3 September through 8 October, 2020. It was organised in collaboration with WIN Foundation, Arid Communities & Technologies, Centre for Environmental Planning and Technology (CEPT), IIT Bombay, and IIT Kharagpur. Leading innovator-practitioners from premier institutions, social organisations and startups, presented their actual innovations. The series also provided a platform to the Water and Sanitation community to interact with various leaders and experts in the domain, with opportunities to collaborate. Prof Jaichander Swaminathan, Programme Head for Water at KPCSD presented “Water Treatment and Desalination: Addressing bottlenecks in energy and materials”. Prof Manish Kumar and Prof Chinmay Ghoroi demonstrated innovations in materials for water treatment such as biodegradable low-cost materials for contaminant remediation, and nanoscale surface modifications for disinfection.

6.4 21ST NATIONAL POWER SYSTEMS CONFERENCE (NPSC 2020)

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 17 to 19 December, 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.

6.5 WORLD WATER DAY 2021

The Dr Kiran C Patel Centre for Sustainable Development, in collaboration with the International Association of Hydrogeologists - Indian National Chapter, organised an event to celebrate World Water Day 2021, on 22 March, 2021. The event included two keynote talks by domain experts. A total of 91 people attended the session.

6.6 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 water, pollution, climate change, 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 Água 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 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 practice 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.

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

6.7 LECTURES ON SUSTAINABILITY

Flash droughts present a new challenge for subseasonal-to-seasonal prediction, Earth Science SPARK Seminar Series

By Shanti Shwarup Mahato, PhD student, Earth Sciences, IITGN on 30.6.2020

Flash droughts are a recently recognized type of extreme event distinguished by a sudden onset and rapid intensification of drought conditions with severe impacts. They unfold on subseasonal-to-seasonal timescales (weeks to months), presenting a new challenge for the surge of interest in improving subseasonal-to-seasonal prediction. The existing prediction capability for flash droughts and what is needed to establish their predictability was discussed.

Where dogs gossip and owls are shamans: Multispecies relations and indigenous ideas of nature, organised by Humanities and Social Sciences

By Sahil Nijhawan, a conservation anthropologist and an Honorary Research Fellow at University College London (UCL) on 21.8.2020

This lecture discussed the myriad ways in which different human societies conceptualise the natural world and how such conceptions influence their interactions with it. The speaker drew upon classical anthropological literature to introduce different modalities of human-nature relations. Based on the speaker's long-term ethnographic research with the Indigenous Idu Mishmi people of Dibang Valley in Arunachal Pradesh, the way in which hierarchical animism shapes local conceptualisations of and interactions with the animal world was illustrated.

Sanitation in India - Exploring the links between waste, caste and the environment, organised by Humanities and Social Sciences

By Kanthi Swaroop, PhD student, IIT Bombay on 9.10.2020

Sanitation policies are complex suggestions over competing straightforward mainstream solutions, community sanctions, traditional caste logics and their conception to humiliate and stigmatise sanitation workers. The talk highlighted how the critical analysis on national sanitation policies like Swachh Bharath Abhiyan (SBA), National Urban Sanitation Policy (NUSP) or Prohibition of Employment of Manual Scavengers and their Rehabilitation Act, 2013 (PEMSR) advance our scholarship to discern the entwined relationship of caste and the environment. The speaker engaged and reflected on the scholarly treatment on this subject to date while drawing from fieldwork experience in Hyderabad.

Groundwater arsenic in the Himalayan mega river basin aquifers: Sources and processes, Earth Science Lecture Series

By Prof Abhijit Mukherjee, Associate Professor, Department of Geology and Geophysics, and School of Environmental Science and Engineering, IIT Kharagpur on 13.10.2020

Arsenic (As) is a ubiquitous element in the Earth's crust. Elevated levels of geogenic As are encountered in global groundwater and the extent of pollution varies from local to more regional and/or continental scale. One of the important outcomes of present research reveal that the occurrence of As in each geographic location is related to geogenic controls like tectonics, geology, geomorphology and hydrology, as well as human influences like land use patterns and needs area-specific attention to assess its controls and challenges for mitigation. The talk discussed a holistic approach for mitigation of the exposure risks from As in the affected regions.

Probabilistic seismic hazard: A foundation for modern earthquake design and risk assessment, Sabarmati Young Researcher Seminar Series

By Dr Abhineet Gupta, Director of Resilience Research at One Concern Inc on 16.10.2020

In order to effectively design buildings and infrastructure to withstand earthquakes, it is crucial to first quantify how much ground shaking can be expected at the building site. The Probabilistic Seismic Hazard Assessment (PSHA) methodology to develop hazard maps that represent the level of ground shaking for different return periods was discussed, taking into account seismic sources and ground motion propagation. The role of research in the latest technologies like remote sensing and machine learning to reduce impacts from future disasters and improve community resilience was also discussed.

A point-of-use, non-electric, affordable SEP-based water filter designed via surface engineering of silica particles, Chemical Engineering Seminar Series

By Dr Deepa Dixit, Postdoctoral Fellow, IIT Delhi on 22.10.2020

The speaker presented a simple and low-cost surface engineered particle (SEP) based filter which is developed via alkali treatment of locally available soda-lime-silica particles. The developed SEP based filter can be used as a portable, non-electric, gravity-driven Point-of-Use (POU) water disinfection system. In rural and urban slum areas of developing countries where no water purification system exists prior to consumption, the easy-to-implement and affordable SEP-based

gravity-driven non-electric point-of-use water purifier (materials cost ~ 0.25 USD) can be used to protect millions of lives from water borne diseases.

Geomorphic characterization of a seasonal river network in semi-arid western India, Senior Researchers Colloquium

By Dr Sonam, Research Associate, Earth Sciences, IITGN on 18.12.2020

Process-based hydro-geomorphic understanding of dryland rivers is vital to analyse river's sensitivity to future hydroclimatic changes. Further, management based on geomorphic understanding is required to protect and restore such river environments considering deteriorating environmental conditions and increasingly scarce water resources. This work presents a process-based classification of an arid river using stage-1 of the River Styles Framework. It involves identification, interpretation, and mapping of River Styles for the Sabarmati river system to address the following questions: (1) What controls the diversity and pattern of River Styles in the Sabarmati River basin?; (2) How and why does the Sabarmati River respond to differing forms of external disturbance at different positions along the longitudinal profile?; (3) How do insights into river classification and evolution provide a useful resource base to support sustainable management and monitoring activities?

Large scale production of graphene for photovoltaic applications, Senior Researchers Colloquium

By Dr Siva Sankar Nemala, DST-SERB postdoctoral fellow, Physics, IITGN on 19.2.2021

Graphene, ever since its inception in 2004, has been termed as a wonder material. Its high mechanical strength, combined with its unique electrical conductive properties, has attracted a lot of attention from both scientific as well as the industrial community. The incorporation of these unique properties of graphene into photovoltaic systems can help generate a new set of energy conversion systems like counter electrodes for dye-sensitised solar cells, transparent power windows, and steel based flexible solar cells for rooftop applications. This talk is based on producing graphene by large scale and eco-friendly exfoliation (high shear and high pressure) routes and using them in house produced graphene to develop high performance photovoltaic systems. The photovoltaic systems produced on modification with graphene show good improvement in terms of transmittance, and efficiency.

A potential synergy between Heritage Tourism and Sustainable Development targets: An insight on Naga burial sites, organised by Archaeological Sciences Centre and Humanities and Social Sciences

By Dr Alino Sumi, Postdoctoral Fellow, Archaeological Sciences Centre, IITGN on 3.3.2021

Graves and burial sites are emblematic reminders of ancestral history; and the Naga ancestors' share of legacy for what holds sacred to them in preparation for their life's final journey will be studied through engagement of collective memory as one of the markers for revitalization of cultural identity. It is also considered that the engagement of ecomuseums with the community will help them identify, conserve and celebrate their heritage. It is worth noting that burial sites to foster sustainable development in Nagaland is an untouched sphere and this study is also an attempt to address how the repatriation of Naga patrimonial objects from museums and institutions around the world will bring back respect, dignity and identity of the Nagas while ensuring long-term sustainability, improved-livelihood, local control and renewed interest of their heritage.

Climate, environment and the Indus Civilization: Insights from the land, water and settlement and TwoRains Projects, organised by Archaeological Sciences Centre

By Prof Cameron Petrie, Reader in South Asian and Iranian Archaeology, Department of Archaeology, University of Cambridge on 27.3.2021

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.

7. Affiliated Faculty

As on 31 March, 2021



AMBIKA AIYADURAI
Assistant Professor,
Humanities and Social Sciences
Research interests: Wildlife
conservation, Indigenous peoples,
Northeast India, Social and
environmental justice, Himalayan
borderlands



K. CHELVAKUMAR
Visiting Professor,
Mechanical Engineering
Research interests: Solar power:
cell physics, panel production,
off-shore installations, Solar power
economics and finance, Finance and
management for engineers, Healthcare
finance and engineering mechanics



NIPUN BATRA
Assistant Professor, Computer
Science and Engineering
Research interests: Machine
Learning, Air quality, Energy



MICHEL DANINO
Visiting Professor,
Humanities and Social Sciences
Research interests: Archaeology
and history of ancient India, history
of Indian science and technology,
Indian knowledge systems, Indian
heritage, Cultural education



ATUL BHARGAV
Associate Professor,
Mechanical Engineering
Research interests: Fuel cell
systems, Hydrogen energy, Energy
systems, Micro-grid



CHINMAY GHORI
B. S. Gelot Chair Professor,
Chemical Engineering
Research interests: Particle
engineering, Cohesive powders,
Surface engineering, Wetting and
antibacterial surfaces/ bacterial
adhesion, Drug formulation, Nano-
materials for drug delivery/ controlled release,
Solid-phase reactions for functional materials, Water
treatment



UDIT BHATIA
Assistant Professor,
Civil Engineering
Research interests: Critical
infrastructures resilience, Internal
variability, Hydrometeorological
extremes, Physics guided Machine
Learning for hydrological processes



ARUP LAL CHAKRABORTY
Associate Professor,
Electrical Engineering
Research interests: Laser
spectroscopy, Air quality
measurement, Mid-infrared lasers



VIKRANT JAIN
Professor, Earth Sciences
Research interests: River science,
Earth surface processes, Climate
Change impacts and rivers future,
Sustainable stream management,
Flood hazards



MANISH KUMAR

Assistant Professor, Earth Sciences
Research interests: Pathways of contamination in freshwater system, Build-up and wash off of micro and emerging pollutants,

Sources of the urban pollution, Sustainability of urban water cycle under changing climate regime, Development of pollution assessment tools, Remediation technique and management



CHHAVI NATH PANDEY

Visiting Professor, Civil Engineering
Research interests: Carbon sequestration of coral reefs of Gujarat, Status of grasslands of Saurashtra and Central Gujarat,

Potential area mapping for mangrove restoration in South Gujarat, Kachchh and Saurashtra



ACHAL MEHRA

Visiting Professor, Humanities and Social Sciences and Coordinator, KPCSD

Research interests: Online media, Media management, Investigative reporting, Media law, Media ethics, Censorship, International communications, Comparative media systems, Mass media and society



NARAN PINDORIYA

Associate Professor, Electrical Engineering

Research interests: Electricity market, Smart distribution grid/ microgrids, Grid integration of distributed renewable energy resources and energy management



SUDHANSHU SHARMA

Assistant Professor, Chemistry
Research interests: Materials, Electrochemistry, Catalysis



VIMAL MISHRA

Associate Professor, Civil Engineering and Co-coordinator, KPCSD

Research interests: Climate Change, Climate variability, Hydrologic modelling, Extreme climatic events, Global food and water security



JAICHANDER SWAMINATHAN

Kanchan and Harilal Doshi Chair Assistant Professor, Mechanical Engineering

Research interests: Thermodynamic optimization, Heat and mass transfer, System-level analysis, Optimization, Effluent treatment, Zero liquid discharge



PRANAB KUMAR MOHAPATRA

Professor, Civil Engineering

Research interests: Hydraulics and water resources engineering, Transients in pipe flow, Transients in open channel flow, Frequency domain analysis in pipe flow



STAFF

FALGUNI TAILOR

Project Manager, KPCSD

DR KIRAN C PATEL



The Dr Kiran C Patel Centre for Sustainable Development at IIT Gandhinagar has been established with a generous endowment from Dr Kiran C Patel, a distinguished cardiologist, entrepreneur and philanthropist based in Tampa, Florida, USA.



Dr Kiran C Patel Centre
for Sustainable Development
Indian Institute of Technology
Gandhinagar, Palaj, Gandhinagar 382055

• Tel. +91 79 2395 2121

• csd@iitgn.ac.in
• csd.iitgn.ac.in

