

Newsletter of the

DIVECHA CENTRE FOR CLIMATE CHANGE

The 2nd Governing Council Meeting: Future Earth

Contribution of DCCC in Vaishwik Bharatiya Vaigyanik Summit

The 16th Jeremy Grantham lecture on climate change

MAIRS Workshop on Climate Resilience in Agriculture





CONTENTS

From the Chair News and Events:

- 1. The second Governing Council Meeting of Future Earth: South Asia**
- 2. Delineating Groundwater Security of India: Where Science Meets Policy**
- 3. Contribution of DCCC in Vaishwik Bharatiya Vaigyanik Summit**
- 4. International Conference on Himalayan Cryosphere**
- 5. Webinars for teachers and high school students**
- 6. The 16th Jeremy Grantham lecture on climate change**
- 7. Wildfire and ecosystems: what will happen in the future?**
- 8. MAIRS Workshop on Climate Resilience in Agriculture**

Research Highlights:

- 9. Indian monsoon derailed by a North Atlantic wavetrain**
- 10. Optimal targets for India's per capita electricity use and energy mix**

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FROM THE CHAIR

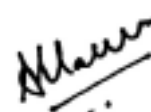
Greetings!

Today, with increasing human and livestock population worldwide, the dire need for sustainable food security is a major goal of any development plan. It is well recognized that climate and agriculture are closely coupled. Thus, the main strategies to tackle the impacts of climate change (such as increasing temperature, CO₂ levels, erratic rainfall, extreme weather etc.) include (i) practices for improving soil health so that it serves as an effective carbon sink, (ii) using farm wastes productively, (iii) adopting scientific farming system, and (iv) adopting conservative farming practices. The vast diversity between and within various agro-climatic zones in India is a major challenge to incorporate regenerative and sustainable practices. The knowledge of climate change pattern such as shift in spatio-temporal distribution of rainfall and droughts and temperature regimes need to be integrated with development of major local crops in each agro-climatic zone. Such organic farming practices would help in reducing poverty, improving farmers income, mitigating climate change, building resilient farming systems, enhancing food security and providing the best ecosystem services leading to reduction in GHG emissions, sequester carbon in soil, and build soil health and ecosystems, simultaneously aiding in achieving a number of sustainable development goals (SDGs). Our research group working on agriculture and climate change are aimed at achieving the above goals.

This year, the centre organised two international workshops on “Agriculture and Climate Change”. First, an Asia regional workshop to discuss digital solutions to accelerate adaptation to climate change in agriculture brought together farmers, research scientists, and private sector to debate different approaches to climate adaption in agriculture. The second, a workshop on “Climate Resilient Agriculture” was organized online by Divecha Centre for Climate Change in association with Future Earth, South Asia. Currently, the Centre is also collaborating with TERVIVA - an organization is founded around ten years ago to bring and expand the pongamia tree industry into mainstream agriculture from its history of Ayurvedic and reforestation practices.

We wish success to all in their fight against COVID-19 and let us all hope to get out of this grim situation at the earliest.

S. K. Satheesh

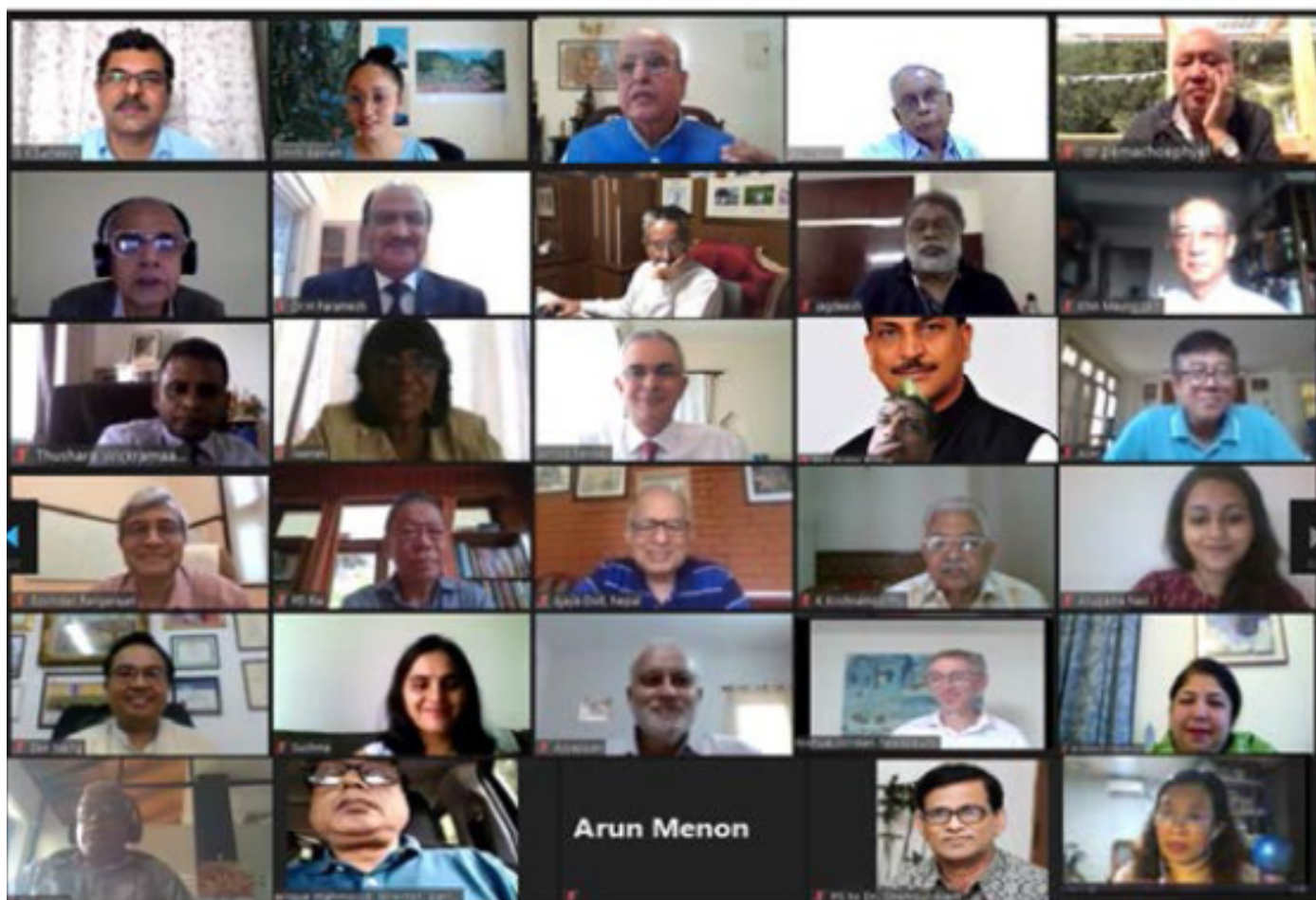


THE SECOND GOVERNING COUNCIL MEETING OF FUTURE EARTH: SOUTH ASIA

The Governing Council of Future Earth South Asia met online for its 2nd meet on 6 October 2020, with Dr K. Kasturirangan on the chair and 29 participants, including delegates from Bangladesh, Bhutan, India, Myanmar, Nepal, and Sri Lanka, as well as the Executive Director of Future Earth from Colorado, USA. The event

included discussions on major updates, priority setting and a working plan for the program, in the form of perspectives from the Chair, the Directors of Future Earth and Future Earth South Asia, from GC members and from Invited Guests.

Prof. S. K. Satheesh, Director, Future



Attendees:

29 Attendees (pictures): [Left to right, row-wise]: Row 1 – Prof. S. K. Satheesh, Dr. Smriti Basnett, Dr. K. Kasturirangan, Dr. R. Srinivasan, Dr. Pema Choephyel. Row 2 - Prof. J. Srinivasan, Dr. H. Paramesh, Mr. Prithvi Raj Singh, Mr. Jagdeesh Rao Puppala, Dr. Khin Maung Lwin. Row 3 - Dr. W. A. R. T. Wickramaarachchi, Dr. Jaanaki Gooneratne, Dr. Arnico Panday, Mr. Rajeev Pratap Rudy, Mr. U. Tin Maung Aye Htoo, Row 4 - Dr. Govindan Rangarajan, Mr. P. D. Rai, Mr. Ajaya Dixit, Dr. K. Krishnamoorthy, Ms. Anupama Nair. Row 5 - Dr. Zaw Naing, Sushma Bharadwaj, Dr. S. Ayyappan, Dr. Josh Tewksbury, Dr. Shirin Sharmin Chaudhury, Dr. D. M. Athula H. Senaratne, Personal Secretary, Bangladesh Parliament, Arun Menon, Personal Secretary to Dr. Shamsul Alam, Dr. Ohmar Khaing.

Earth South Asia, opened the meeting by welcoming the Chair, Invited Guests and Council Members. Dr. Govindan Rangarajan, Director, Indian Institute of Science (IISc), welcomed all attendees. He noted that countries in the South Asia region face common problems with special regards to climate change and highlighted the importance of Future Earth South Asia to bring all countries and their efforts to tackle these issues together. Dr. Josh Tewksbury, Executive Director, Future Earth, began by acknowledging the Regional Office for its contribution to Future Earth, as well as its suggestions for the currently undergoing structural changes in the Future Earth

global network. He also emphasized the need for organizations like Future Earth to address the need for translating knowledge into action.

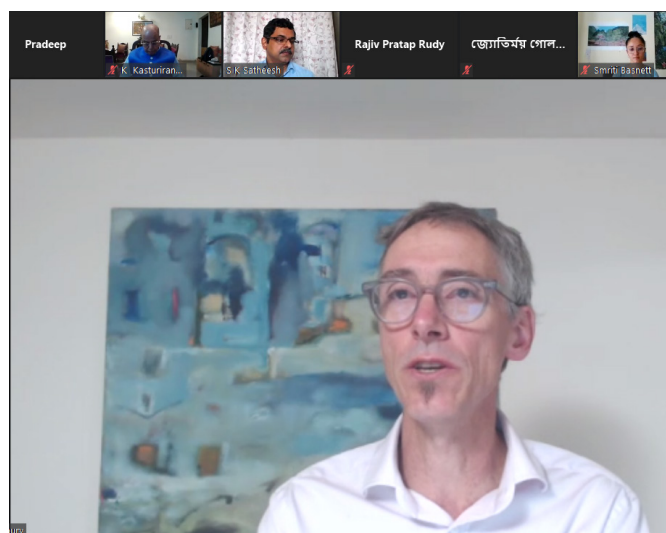
In the Introductory address, Dr. K. Kasturirangan reminded all participants of the four focus areas: Food, Air, Water, Health (FAWH) that were given priority during the first Governing Council meeting. Prof. Satheesh, Director, Future Earth South Asia highlighted the need to developing a new economic model—one that works for the people and the planet. He concluded by emphasizing the main goal of Future Earth South Asia: delivering solutions-oriented knowledge



Dr. K. Kasturirangan, chairing the GC Meeting on 6 October 2020.

for sustainable responses to challenges faced by society, and the importance of interaction between researchers and policymakers and public officials in decision making processes.

Dr. Josh Tewksbury, Executive Director, Future Earth observed that each country has its own organization of science. The Future Earth aims to help that voice grow in each country. He remarked that Future Earth South Asia is far ahead of many regions in terms of integrating different



Dr. Josh Tewksbury, Director, Future Earth, delivering his talk in the meeting.

disciplines and stakeholders, although large gaps still exist between creation and uptake of evidence, which merits significant changes in behavior. He ended his presentation by expressing his excitement to work with the community to support a broader voice for different parts of the world.

Dr. Smriti Basnett, Co-Director South Asia presented the key highlights from (i) the 1st GC meeting; (ii) the Preparatory Meeting held on 6 September; and (iii)

the results of the Online Survey with reference to the Theme and Stakeholder Mapping. Dr. Basnett presented the results of the online survey, where a majority of GC members were interested in working on issues related to climate change adaptation, water-energy-food nexus and influencing policy level changes.

Dr. Shirin Sharmin Chaudhury, Hon'ble Member of Parliament and Speaker, Bangladesh, described various initiatives undertaken by the Bangladeshi Government to increase the availability and access to agricultural



Dr. M. Rajeevan, Secretary, Ministry of Earth Sciences, Government of India, making his presentation in the meeting.

subsidies, credit, and food to the people of Bangladesh. Dr. Pema Choephyel, Former CEO, Bhutan Trust for Environmental Conservation, Bhutan, presented an overview of development of agriculture and water management in Bhutan.

Mr. Rajiv Pratap Rudy, Hon'ble Member of Parliament, India, expressed his interest in focusing on water security, drawing from experiences in his constituency in

the state of Bihar. He spoke about the recent spates of flooding that occurred in his constituency, which most people never expected in that area, and how damaging they have been. He linked this problem with siltation, deforestation, and groundwater depletion, describing how food and health security are being threatened by these processes.

Mr. P. D. Rai, President, Integrated Mountain Initiative (IMI), and former Member of Parliament, India, gave examples of a few networks where stakeholders have been interacting on the kind of issues being spoken about in the Future Earth South Asia GC. He expressed his interest in addressing issues of water security in the Northeast region of India and concluded by remarking that Future Earth has an immensely important mandate and that he hopes that all available resources within this network will be used to address these issues at the parliament level or within regions like the northeast.

Dr. M. Rajeevan, Secretary, Ministry of Earth Sciences, Government of India, pointed to the need for good collaboration between all member countries, with more frequent dialogues and discussions between GC members and stakeholders to exchange data, knowledge and expertise. Mr. Jagdeesh Rao Puppala, Anchor and Curator, Foundation for Ecological Security, India, explained the need for ecological governance, and insights acquired from regular interactions with communities in various rural areas regarding an Agro-ecological continuum and employment generation in rural areas. He also emphasized on the need for activities undertaken by Future Earth to be aligned with government targets, and he offered

to connect with existing networks of practitioners in India for the program. Mr. Prithvi Raj Singh, Managing Trustee, Jal Bhagirathi Foundation, India, suggested building institutions and communities through stakeholder engagement. Mr. Ajaya Dixit, Executive Director, Institute for Social and Environmental Transition, Nepal, observed that the risk profile in South Asia is increasing and remarked that springs are drying up in the Himalayan region, leading to water, food and health insecurity. Dr. Arnico Panday, Ullens Education Foundation, spoke about how data collection and analysis regarding air pollution has developed over the past six years, and the status of air pollution in various parts of Nepal. He also spoke about his experience with getting various households to switch to cleaner and more efficient technology.

Mr. U. Tin Maung Aye Htoo, Deputy Director General, Myanmar, listed some food security related goals of his government and highlighted the need to improve the status of irrigation in Myanmar. Dr. Ohnmar Khaing, Board Member, Center for Economic and Social Development, Myanmar, suggested that ongoing strategies in Myanmar could be combined, that Future Earth could bring them together, and that she and her colleagues would be happy to help with these efforts. Dr. Khin Maung Lwin, Advisor, National Water Resources Committee, Myanmar spoke on the challenges imposed by the pandemic on Myanmar. Dr. Zaw Naing, Managing Director, Mandalay Technology, Myanmar, remarked about recent changes in agricultural systems with regards to land rights and highlighted the problems. of low profitability of the agricultural sector.

Dr. Jaanaki Gooneratne, Food Scientist and Nutritionist, Sri Lanka, indicated that Sri Lanka needs to focus on making agriculture more profitable and climate-smart, and including smart water management systems and weather-based decision management. Dr. Wickramaarachchi Director, National Plant Quarantine Service, Ministry of Agriculture, Government of Sri Lanka, noted that Sri Lanka is a net food importer. He concluded by noting that policy and research in Sri Lanka are not aligned with one another. Dr. Athula Senaratne Fellow and Head, Environmental Economics Policy Research, Institute of Policy Studies, Sri Lanka, added that agricultural development in Sri Lanka has been policy-driven, although what needs changing is a focus from policy whereby food security is equated with self-sufficiency in cereal crop production.

Drawing attention towards the COVID-19 related cases in Asia, Prof. J. Srinivasan, Distinguished Scientist and Former Chairperson, Divecha Centre for Climate Change, pointed out that there were significant variations between countries in the region in terms of the number of cases per million people. He suggested that it would be important to know why such variations exist between countries in the region and understand what Sri Lanka has done right to control the spread of COVID, and how others can learn from it.

Dr. K. Krishnamoorthy Distinguished Visiting Scientist, Centre for Atmospheric and Oceanic Sciences, Indian Institute of Science, noted that during the COVID pandemic various positive environmental benefits were observed despite the setback on economic growth. The lockdown provided unequivocal

evidence of large improvements in air quality and visibility, thus presenting a unique opportunity for climate and environmental scientists to make accurate assessments of anthropogenic emissions. He concluded by saying that this would require close integration of scientific research with policy making, developing innovative pathways for sustainable development, and that he hopes to see the Future Earth South Asia office be involved in this interface. Dr. Josh Tewksbury, Executive Director, Future Earth, expressed his appreciation for all the work done in the South Asia region so far. He urged that the Governing Council of the South Asia region and

that could work well in other countries in the region, and that international efforts such as Future Earth could serve as a mechanism to exchange such knowledge. Biotic stresses such as pest attacks and disease have been on the rise. He concluded by expressing his hope for the development of good science-based technology farming practices that can support not just traditional farmers, but also new players in the sector. Dr. H. Paramesh, Pediatric Pulmonologist and Visiting Professor, Divecha Centre for Climate Change, said that the nexus between good health, good air, good water, and nutritious food is very important. He observed that 70 percent of mortalities related to pollution are due to air pollution, another 20 percent due to water pollution and the remaining 10 from chemical, food and soil pollution. Dr. R. Srinivasan, Lead, Water Solutions Lab, Divecha Centre for Climate Change, Indian Institute of Science noted that annual per capita availability of water is already less by 1700 cubic meters in India, Pakistan, and Mauritius. Although many countries in South Asia are in the water safe category, they have problems associated with changing quantity, quality, and variable distribution.



Dr. S. Ayyappan, Chancellor, Central Agricultural University, Imphal, delivering his talk in the meeting.

member countries should explore how regional work can support global research projects and communities.

Dr. S. Ayyappan, Chancellor, Central Agricultural University, Imphal, remarked that food security is an overarching mechanism in the region, especially since biodiversity is contiguous between the countries. He noted that there are many varieties in food production systems successfully in place in India


Prof. Satheesh, Director, Future Earth South Asia summed up the highlights of the meeting and suggested that Future Earth Activities and Knowledge sharing be conducted online. Dr. K. Kasturirangan noted the views expressed by all members and invited guests during the meeting will be valuable inputs to the deliberations and suggested steps for future action.

DELINEATING GROUNDWATER SECURITY OF INDIA: WHERE SCIENCE MEETS POLICY

Divecha Centre for Climate Change, Indian Institute of Science, Bengaluru, organized an online seminar on “Delineating Groundwater Security of India: Where Science Meets Policy” on 15 October 2020. Prof Abhijit Mukherjee, Associate Professor (Hydrogeology), Dept. of Geology and Geophysics, School of Environmental Science and Engineering, Indian Institute of

Technology (IIT) - Kharagpur, gave a talk on the policies and interventions of groundwater security in India.

The significance of ensuring groundwater security is no-where more evident than in South Asia, specifically India. Huge groundwater-dependent population, uncertain climate-reliant recharge processes, transboundary upstream



Delineating Groundwater for future India:
*Where science meets human practices
and policy interventions*

Abhijit Mukherjee
Indian Institute of Technology (IIT) Kharagpur

Hydrogeology at IIT Kharagpur

APA
Advanced Policy
to Hydroscier

abhijit (External)

Prof. Abhijit Mukherjee, Associate Professor (Hydrogeology), Dept. of Geology and Geophysics, School of Environmental Science and Engineering, Indian Institute of Technology (IIT) - Kharagpur, delivering his talk on 15 October 2020.

water sources, major geogenic-sourced, non-point contaminants, archaic irrigation methods and human practices, and indiscriminate land-use changes with urbanization, have rendered the Indian groundwater scenario to become a global paradigm for water scarcity, for both quantity and quality.

Using a combination of ground-based

in-situ groundwater level data, satellite-based estimates of groundwater storage, numerical analyses and simulation of global models on groundwater storage changes and artificial intelligence, long-term, decadal-scale groundwater quantity changes over the Indian subcontinent was delineated. For the first time, estimation of the volume of existing usable groundwater across Indian states

shows rapid depletion in Assam, Punjab, Haryana, Uttar Pradesh, Bihar, and West Bengal. Prof. Abhijit highlighted some of the factors that results in groundwater drought such as introduction of water-intensive high-yielding crops, extensive flood irrigation, shifting to water intense cash crops and severe groundwater exploitation. He pointed out that all these practices have resulted at the cost of non-renewable loss in groundwater volume at an alarming rate.

observed and satellite-based estimates due to various factors such as irrigation, energy, domestic and industries. It shows that the highest groundwater storage depletion rates occur in states like Assam, Rajasthan and Uttar Pradesh. A water-affluent state like Assam has lost ~2% of its usable groundwater resource in last one decade and is in the brink of suffering drought and famine in impending years. In contrast, scenarios of groundwater replenishment, potentially caused by policy interventions are observed from these analyses. Rejuvenation

Prof. Abhijit gave an overview of the



Prof. Abhijit Mukherjee presenting his slides.

of groundwater storage in western and southern parts of India suggest that proper, pervasive groundwater governance may optimistically lead to possibilities of transforming the country from a “groundwater-deficient” to “ground-water sufficient” nation and providing sustainable water availability. The work has significantly contributed to support and evaluate the Government of India missions like MNREGA on groundwater rejuvenation in India, which potentially influenced country-wide

artificial recharge programs.

Prof. Abhijit concluded his talk by outlining some groundwater policies such as large-scale water management structures, rejuvenating dry riverbeds, recharging canals, man-made ponds and tanks, rainwater harvesting and restricted power for agriculture can replenish groundwater deficiencies.

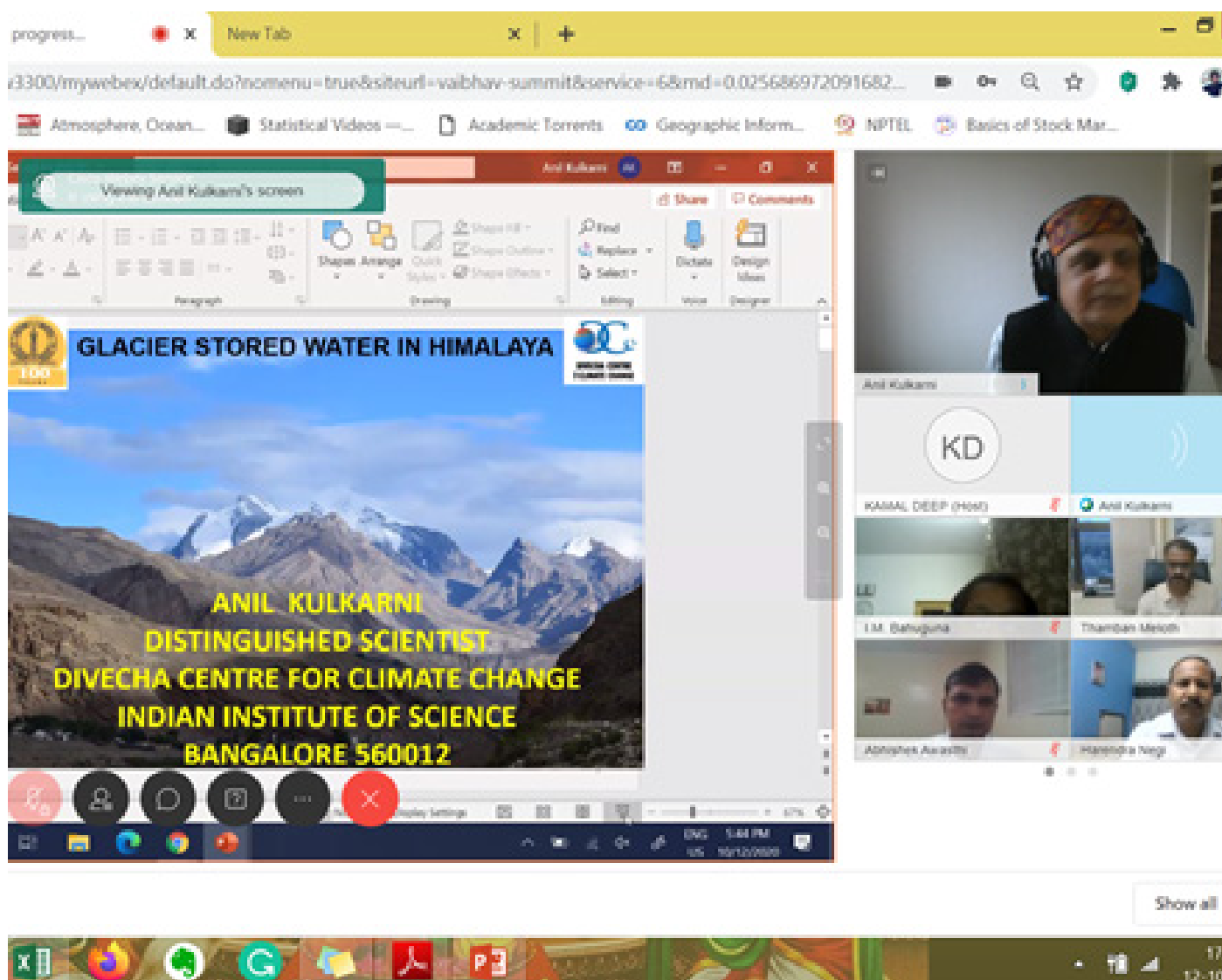
CONTRIBUTION OF DCCC IN VAIBHAV SUMMIT

Vaishwik Bharatiya Vaigyanik (VAIBHAV) Summit was organized by the Government of India as a collaborative initiative by Science and Technology (S&T) and Academic Institutions on 12 October 2020.

The VAIBHAV initiative aims at bringing a comprehensive roadmap to leverage

the expertise and knowledge of global Indian researcher for solving emerging challenges. The Overseas and Resident Indian scientists will be brought together to create an ecosystem of Knowledge and Innovation.

Dr. Anil V. Kulkarni, Distinguished Scientist, DCCC, along with Prof. Prasad



Dr. Anil V. Kulkarni making a presentation online on glacier stored water in Himalaya during VAIBHAV summit on 12 October 2020.

Gogineni, Alabama University, led the VAIBHAV SUMMIT Session V13-H3-S3 on “Estimation of glacier volume in Himalaya”.

The session discussed one of the grand challenges of Himalayan studies – quantifying the glacier-stored water in the

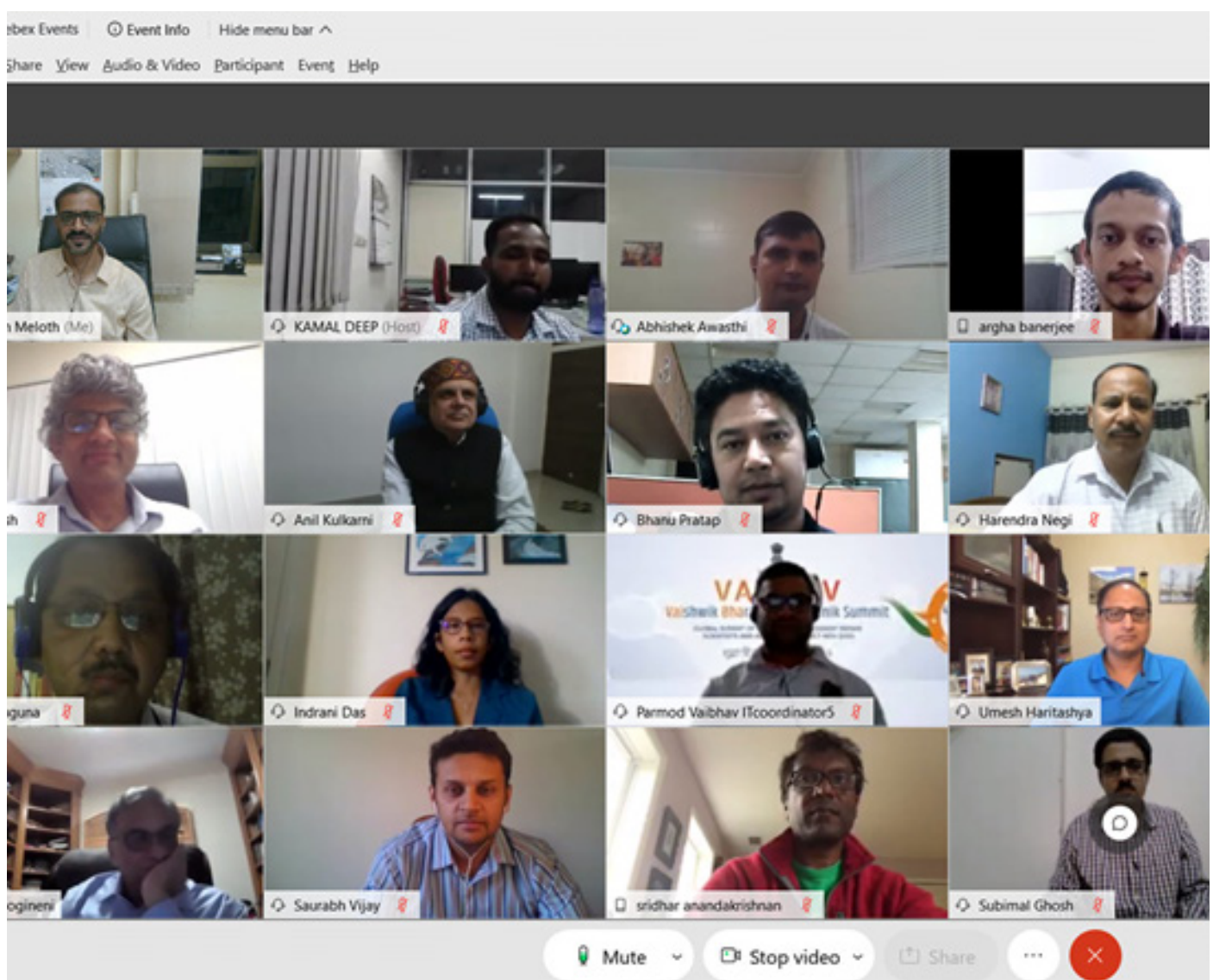
Himalayas, which would decide future sustainability of major Indian rivers like Indus, Ganga and Brahmaputra.

The session was attended by 14 experts across the leading institutions in India and abroad. Further, 67 glacier researchers attended the meeting.

The uniqueness of the proposal is to develop airborne radar to measure glacier thickness and demonstrate under highly challenging Himalayan conditions.

The program also aims to develop models to estimate glacier store water and the impact of the melting glaciers on different Himalayan river basins.

Therefore, the proposed concept would need extensive collaboration among technologists and scientists in India and abroad.



The Panelists were discussing the program on glacier stored water during VAIBHAV Summit.

INTERNATIONAL CONFERENCE ON HIMALAYAN CRYOSPHERE (ICHC-2020)

Divecha Centre for Climate Change organized the “International Conference on Himalayan Cryosphere” from 19-23 October 2020. The online conference provided a platform to address the latest scientific advancements in understanding the state of the Himalayan cryosphere and its effect on water security and policy. It brought together around 55 presenters and 300 registered participants from various institutes and disciplines across

the globe. The conference consisted of eight technical sessions covering the wide array of scientific advances and interdisciplinary research in the field of Himalayan Cryosphere.

The conference was inaugurated by Prof. S. K. Satheesh (Chairman, DCCC) on 19 October 2020. This was followed by the keynote lectures by the eminent scientists in Glaciology, including Drs



Participants of International Conference on Himalayan Cryosphere - 2020 webinar held from 19-23 October 2020.

Tobias Bolch (University of St. Andrews, UK), and Anil V. Kulkarni (Distinguished Scientist, DCCC) and Umesh Haritashya (University of Dayton, USA).

In the first technical session of the conference, “Remote Sensing and Cryosphere Observations”, various applications of remote sensing data

in studying glacier dynamics were discussed. Dr. I. M. Bahuguna (Space Application Centre, ISRO) provided insights into the cryospheric program of ISRO covering aspects of snow cover mapping, glacier dynamics, glacier facies, and runoff modelling and hydropower potential.

The second technical session, “Snow Cover and Snow Depth Studies” dwelt into the usage of optical data in snow cover area estimation and microwave data in snow depth retrieval. It also highlighted the multi-sensor data fusion to acquire the snow information at good spatial and temporal scale. Dr. H. S. Negi (Snow and Avalanche Study Establishment) provided a comprehensive overview of research related to snow cover area, depth, grain size, contamination, surface temperature and albedo.

Following, the third technical session, “Glacier surface velocity, volume and stored water” discussed the methods to estimate glacier surface velocity using feature tracking and interferometry, and volume using a laminar-flow method and volume-area scaling relations.

Further, in the fourth technical session “Cryosphere and Climate Change”, historical and future changes in the climatic conditions in Himalaya were discussed. Dr. Rajiv Chaturvedi (BITS, Goa) provided insights into the observed and future climate change in the Himalayan region. The need of high-resolution climate modelling strategies was addressed to better understand the changing climate regime.

In the fifth session “Glacier Mass Balance”, Dr. M. F. Azam (IIT, Indore) provided the overview of mass balance studies on Himalayan glaciers and identified research gaps. Following, the session “Glacier melt and Isotopic studies” delved into the various modelling techniques and isotopic studies that estimate the contribution of snow and glacier melt in Himalayan rivers. The presenters discussed the studies from Indus and Ganga basins where snow

and glacier melt were observed to be significant, especially in the summer and monsoon seasons. These studies indicate the impact of cryospheric resources on water availability in the mountains and thus would be helpful for local communities.

The technical session “Cryosphere: risk assessment and mitigation” addressed the hazards posed by the expanding glacier lakes, possible outburst floods and the snow avalanche in the mountainous region highlighting the usefulness of such studies in the mitigation strategies.

Furthermore, the scientific advances that are useful for policy makers and benefit mountain communities were discussed in the final technical session “Climate Science and Policy Making”. Here, ideas to strengthen the network for in-situ data collection through a collaborative approach, capacity building programs of research and academic institutes and implications for building hydropower projects in Himalaya were discussed.

Overall, the conference served as a platform for novel frontiers, interdisciplinary research ideas, mitigation strategies, policy recommendations and future prospects related to the science of Himalayan Cryosphere by eminent scientist, early career researchers and students.

WEBINARS FOR TEACHERS AND HIGH SCHOOL STUDENTS

Divecha Centre for Climate Change conducted webinars for high school teachers and students on 28 Oct 2020. The First Webinar was delivered by Prof. J. Srinivasan, Distinguished Scientist, Divecha Centre for Climate Change, Indian Institute of Science, on “The Science of Climate Change.” This was followed by a webinar on “Myths and Reality of Covid-19 and the Way Forward,” by Dr. H. Paramesh, Leading Paediatric

Pulmonologist and Visiting Professor, Divecha Centre for Climate Change, Indian Institute of Science. About 18 schools participated and more than 100 members attended the online talks. Some of the schools that participated were Daffodils Foundation for Learning, K. V.-Hebbal, Air force school-Murugeshpalya, Air Force School-Hebbal, K. V.-IISc, Shiksha Sagar, Soundarya International, Sindhi School, National public School-

The image is a promotional poster for a webinar. On the left is a portrait of Prof. J. Srinivasan, a middle-aged man with grey hair, wearing a light-colored striped shirt and a grey jacket. To the right of the portrait is a graphic with a blue sky and white clouds background. At the top right, a yellow banner contains the word 'Webinar'. Below this, the title 'The Science of Climate Change' is written in large, bold, black letters. At the bottom left, an orange box contains the text: 'Prof. J. Srinivasan', 'Distinguished Scientist', 'Divecha Centre for Climate Change', and 'Indian Institute of Science'. At the bottom right, a blue box contains the text: '28 Oct 2020 @ 3:30 pm'.

Webinar on “The Science of Climate Change” by Prof. J. Srinivasan on 28 October 2020.

Rajaji Nagar, Vidya Sagar, K. V. MEG, and Samhita Academy.

Prof. J. Srinivasan spoke about the scenarios with respect to the threat from climate change Vs COVID-19. He said that Climate Scientists had warned policy makers the need to mitigate climate change more than 30 years ago which was ignored completely. After the outbreak of COVID-19, politicians all

over the world were forced take tough decisions using epidemiological models that were not accurate. This experience will enable them to take tough decisions in the future even if the predictions of climate models have uncertainty. Environmental changes such as air quality and health, soil, water, climate change and ozone hole depletion are all inter-related and climate change plays a major part. In the last 20 years, the world

dealt with six significant threats namely SARS, MERS, Ebola, avian influenza, and swine flu for which vaccines were found. But for the novel corona virus pandemic as of today no vaccine has been found and global mortality rate has considerably increased threatening global security. The climate crisis and the COVID-19 pandemic are linked. The preconditions that raise the death rate from COVID-19 are made worse by the

fossil fuels. In the 21st century human beings may have an irreversible impact on earth's climate.

Prof. Srinivasan concluded his talk by citing that we can prevent the irreversible impact by reducing the CO₂ emissions to the atmosphere.

Dr. H. Paramesh, Pediatric Pulmonologist and Visiting Professor, Divecha Centre



Webinar on
28 Oct 2020 @ 3:30 pm

Myths and Reality of Covid-19 and the Way Forward

Dr. H. Paramesh
Leading Pediatric Pulmonologist and Visiting Professor
Divecha Centre for Climate Change
Indian Institute of Science
28 Oct 2020 @ 3:30 pm

Webinar on “Myths and Reality of Covid-19 and the Way Forward” by Dr. H. Paramesh, on 28 October 2020.

for Climate Change, gave a talk on the ongoing pandemic COVID-19. He gave an overview on how the disease spreads and what are the factors contributing to spread of the deadly disease. He also highlighted the risk factors involving mortality rates. The novel Corona virus spreads from droplet infection from one human to another. Any person in close contact at a distance of less than 6 meters with someone like influenza like illness is exposed. Currently there is no vaccine available for this disease.

Dr. Paramesh suggested some important that one should follow to further prevent the spread of COVID-19 such as maintaining social distancing, avoiding crowded places, avoiding touching of eyes, nose and mouth and handshakes and to follow respiratory etiquette and proper hygiene. He concluded his talk by urging people to follow the guidelines recommended by authorities.

THE 16TH JEREMY GRANTHAM LECTURE ON CLIMATE CHANGE

The 16th Jeremy Grantham lecture on Climate Change on “Towards a universal theory of plant and ecosystem function” was delivered online by Prof. Iain Colin Prentice on 26 November 2020. Prof. Prentice proposed a new theoretical framework to describe the core processes of plant and ecosystem functions. Terrestrial ecosystems take

up a quarter of anthropogenic CO₂ emissions. These ecosystems dominate the hydrological cycle on land. He showed some of the recent successes of this approach in developing new formulations for photosynthetic capacity, stomatal function, carbon dioxide exchange and transpiration at the ecosystem scale, and terrestrial carbon

The Jeremy Grantham Lecture 2020
The Divecha Centre for Climate Change, Bengaluru

Land-atmosphere exchanges of carbon, energy and water: new theory and next-generation models

Iain Colin Prentice FRS
Chair in Biosphere and Climate Impacts & Director of the Leverhulme Centre for Wildfires, Environment and Society, Imperial College London
Honorary Chair in Ecology and Evolution, Macquarie University, Sydney
High-End Foreign Expert, Department of Earth System Science, Tsinghua University, Beijing

including unpublished results by:

Wenjia Cai (Imperial)
Yunke Peng (ETH)
Ning Dong (Macquarie, Imperial)
Nick Smith (Texas Tech)
Han Wang (Tsinghua)
Muge de Boer (Utrecht)

The 16th Jeremy Grantham lecture on Climate Change was delivered online by Prof. Iain Colin Prentice on 26 November 2020.

uptake at the global scale. Prof. Prentice emphasized the need to understand ecosystem carbon exchanges and their role in global carbon cycle. He said that the mathematical models mostly work on predicting the future rather than understanding the past. He indicated that eco-evolutionary optimality is the key source of predictability in biological systems which invokes the power of natural selection to eliminate suboptimal traits or combinations of traits. The explosive growth of data, from large compilations of field measurements traits

and rates, through eddy-covariance flux measurements of carbon dioxide and energy exchanges between ecosystems and the atmosphere, to global atmospheric measurements of carbon dioxide and satellite-derived data on green vegetation cover is the foundation to describe the core processes of plant and ecosystem functions. He concluded his talk by highlighting the theory of ecosystem functions that is emerging based on eco-evolutionary optimality hypotheses combined with biophysical constraints.

WILDFIRE AND ECOSYSTEMS: WHAT WILL HAPPEN IN THE FUTURE?

Wildfire is part of the natural system and is essential for maintaining habitat and species diversity in numerous ecosystems. However, recent extreme wildfire events have been a serious threat to biodiversity and conservation efforts. Prof. Harrison emphasized the current understanding of what determines the occurrence and intensity of wildfires and assess how far existing fire-enabled vegetation models incorporate this

understanding.

In this talk, she explored the paradox that there appears to be an overall decline in the area affected by wildfires while at the same time the size and intensity of individual fires is increasing. Where wildfires collide with human societies, the costs in terms of losses of property, livelihoods and lives are escalating. Wildfire is often expected to increase

The screenshot shows a Zoom meeting with five participants in the top bar: Spoorthi, Iain Colin Prentice, S.K. Sathesh, Sandy Harrison, Adithya Kaushik, and shoibalc. The main presentation slide has a yellow header with the Leverhulme Centre for Wildfires, Environment and Society logo and several university logos (Imperial College London, King's College London, Royal Holloway University, University of Reading). The title 'Wildfire and ecosystems: what will happen in the future?' is prominently displayed in white text over a dark, smoky background. Below the title is the speaker's name, Sandy P. Harrison. At the bottom of the slide, the website www.centreforwildfires.org and Twitter handle @centrewildfires are listed, along with the Leverhulme Trust logo.

Prof. Sandy P. Harrison, Leverhulme Centre for Wildfires, Environment and Society and Department of Geography and Environmental Science, University of Reading, UK presenting her talk on 26 November 2020.

in a warmer world, but this is based on extrapolating measures of “fire danger”; that depend only on weather. Ecosystem properties that influence fuel loads, flammability and post-fire recovery are equally important. The State of art fire models do not perform well because they do not incorporate what we know about the real controls of fire.

Prof. Harrison concluded her talk by outlining the current understanding of future changes in wildfire regimes and how we can make these projections more reliable.

MAIRS WORKSHOP ON CLIMATE RESILIENCE IN AGRICULTURE

A workshop on Climate Resilient Agriculture was organized online by Divecha Centre for Climate Change in association with Future Earth South Asia on 3-4 Dec 2020. Prof. S. K. Satheesh, Director, Future Earth South Asia, inaugurated the workshop.

Dr. S. Bhaskar Assistant Director General, Agronomy, Agroforestry and Climate Change, India, spoke about

some national schemes and programs to address climate change in India. Dr. G.N.S Reddy Kalpasiri farms and foods Pvt. Ltd., spoke on “Tree based farming system for dryland agriculture”. He said that landscapes can be transformed with judicious mix of tree crops and livestock in rain fed farming. Trees can help to reclaim degraded land faster. He presented a case study where degraded land had been converted to agricultural



Attendees of the MAIRS Climate Resilience Agriculture workshop held on 3 - 4 December 2020:

Left to right, row-wise]: Row 1 - Prof. S. K. Satheesh, Prof. J. Srinivasan, Dr. Rohini Mattoo. Row 2 - Dr. Sulochana Gadgil, Dr. G.N.S. Reddy, Dr. Nareppa Nagaraj. Row 3 - Dr. Seshagiri Rao, Dr. Bhaskar. Row 4 - Dr. Samuel Abiven, Dr. Kumara Swamy A.S., Dr. Sonam Tashi. Row 5 - Dr. Umashankar N., Dr. Madhav Karki, Dr. P.C. Abhilash.

land in a span of few years. Dr. Madhav Karki Executive Director, CGED-Nepal, opined that the current production system is harming the environment. He highlighted some issues and constraints to food and nutrition security in Nepal. Mr. Seshagiri Rao, Vice President, Natural Remedies, spoke on “Climate Resilient Farming systems - Making it happen”. He showed how parameters such as soil moisture, soil nutrients are measured using sensors in real time. Simulations are used to examine the climate resilience based on 100 years of data. He argued that large trials on farm plots are necessary as farming systems are complex.

Dr. Samuel Abiven, Laboratoire de Géologie, Département de Géosciences, Ecole Normale Supérieure, France, spoke on “Biochar systems as carbon storage technique in agriculture”. Biochar is charcoal that is produced by pyrolysis of biomass and is used as a soil ameliorant for both carbon sequestration and soil health benefits. Biochars can increase soil fertility, water holding capacity and crop productivity. He presented the results from a field trial conducted by his team in Mandya district of Karnataka. Dr. Sulochana Gadgil, former Professor, Centre for atmospheric and oceanic sciences, IISc, spoke about the need to focus on agricultural systems that adapt to climate variability. She argued that the adverse impacts of drought remain as large as ever, whereas the benefits of good rainfall years have been declining. She illustrated her talk with examples of work done in the Pavagada region. Dr. P. C. Abhilash, Institute of Environment and Sustainable Development, Banaras Hindu University spoke about adaptive agricultural practices. He defined adaptive agricultural practices as a set of

agricultural practices developed by local farmers in Mirzapur district of eastern Uttar Pradesh to adapt or adjust to the changing socioeconomic, ecological and climatic conditions. He discussed the climatic and nutritional significance of wild crop and vegetable varieties that are beginning to be cultivated in the region. Prof. Kumaraswamy, Department of Agronomy and Education, University of Agricultural and Horticultural Sciences, Shivamogga talked about strategies at the global and farm level. The main farm-level strategies include using soil as a carbon sink, using farm waste productively, adoption of an Integrated Family Farming System. Dr. Umashankar Nagaraju, Department of Agricultural Microbiology, University of Agricultural Sciences, Bangalore gave a brief overview of three important roles that microbes play in agriculture. He explained how microbes’ function as bio-fertilizers and how microbes promote plant growth directly as well as through biocontrol. He discussed the synergistic effects of chitosan and bio-control agents on foot rot disease management in finger millet. Chitosan is used in agriculture as a bio-control agent that induces host plant resistance and acts as a natural defense mechanism. Dr. Sonam Tashi, College of Natural Resources, Royal University of Bhutan began his talk by speaking about a few important ways in which agriculture and climate change impact each other. Dr. Tashi argued that organic farming helps mitigate climate change, builds resilient farming systems, reduces poverty, enhances food security and provides ecosystem services. Prof. Srinivasan gave a brief overview of the talks given by all the speakers and hoped that many of the good practices and examples that were presented would be adopted in the future.

RESEARCH HIGHLIGHTS



INDIAN MONSOON DERAILED BY A NORTH ATLANTIC WAVETRAIN

Indian summer monsoon rainfall is remarkably stable. The interannual variation in the seasonal mean rainfall is around 10%. During the period 1901 to 2015 there were 23 years when the summer monsoon rainfall was 10% below the long-term mean. Among these 23 drought years, 13 years can be linked to years when the sea surface temperature in the eastern equatorial Pacific was above normal. These are called El Nino years. The remaining 10 droughts are not linked to El Nino and hence many scientists have been wondering if there were any external trigger during these years. In a recent paper published in the journal SCIENCE, Pritam Borah (Grantham fellow), Prof. Venugopal (DCCC) and Prof. Sukhatme (DCCC) have shown that in these 10 years the north Atlantic Ocean was unusually cold,

and the circulation anomalies induced by the cold north Atlantic is associated with a decrease in rainfall over India during late August and early September. In El Nino years the major decrease in rainfall occurs in July. The authors of this paper were able to unearth the difference between two kinds of drought because they used daily rainfall data instead of the traditional approach that used monthly or seasonal mean rainfall.

Reference: Indian monsoon derailed by a North Atlantic wavetrain by P. J. Borah, V. Venugopal, J. Sukhatme, P. Muddebihal and B. N. Goswami, SCIENCE, 270,1335-1338,2020

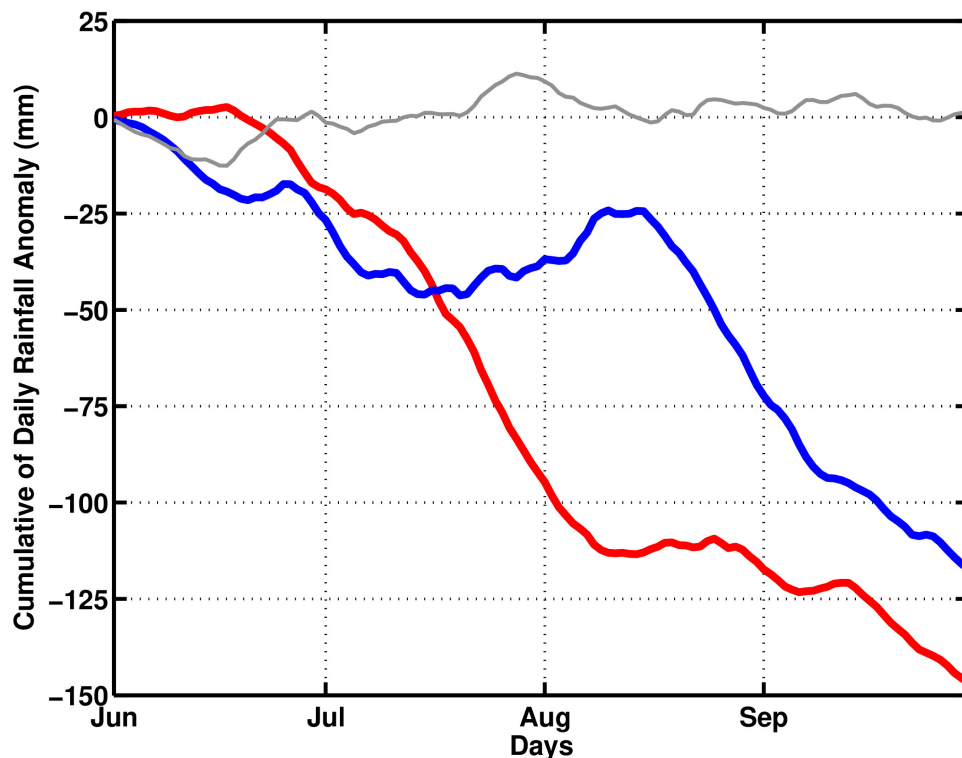


Fig: Cumulative departure of daily rainfall in Central India during droughts that occur in 13 El Nino years (Red line) and those that occur during 10 non-El Nino years (Blue line). The normal years is shown in gray.

OPTIMAL TARGETS FOR INDIA'S PER CAPITA ELECTRICITY USE AND ENERGY MIX

India has an ambitious plan to reduce its dependence on coal for electric power generation. Can renewable energy meet the all the electricity needs of India in the future? To predict the demand for electrical power in the future, there is a need to relate the energy use to human development index. In a recent paper, Gopi Rethinaraj (DCCC) and Dilip Ahuja have argued that India can achieve significant improvement in human development from the present level without imposing a large energy footprint. They have shown that the relation between human development index and electrical energy consumption per capita varies a lot between different states in India. Kerala has a much higher human development index than

Gujarat although the electrical energy consumption in Kerala is less than one third of that in Gujarat. They suggest a target of 1500 kWh per capita by 2030 and 2500 kWh per capita by 2050. To meet these goals, the total installed electrical power generation capacity has to reach 500,000 MW by 2030 and 750,000 MW by 2050. They discuss the ability of wind, solar and hydropower to meet these goals without depending too much on power generation by coal or nuclear.

Reference: Optimal targets for India's per capita electricity use and energy mix by Gopi Rethinaraj T. S., and Dilip Ahuja, Current Science,119,1620-1626,2020

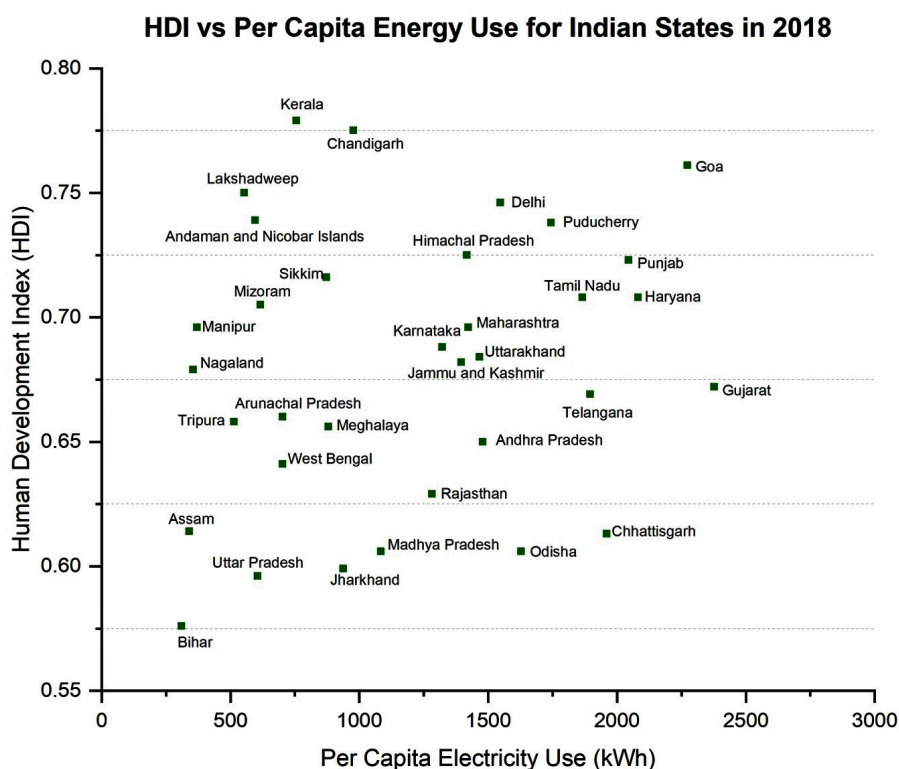


Fig: The variation in Human Development Index (HDI) as a function of electricity use per capita in different states of India.

