

Newsletter of the

# DIVECHA CENTRE FOR CLIMATE CHANGE

**Future Earth: National Committee of Future Earth India workshop II**

**Sustainability, research and innovation Congress 2021**

**Outreach and interaction with stakeholders Bangladesh and Mauritius**

**The need for ecosystem restoration**





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# FROM THE CHAIR

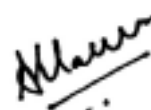
Greetings!

Now, it is more than a decade after Divecha Centre for Climate Change was established in 2009. During this period, the Centre has carved out its unique identity as a centre, inter-linking science and policy for sustainable development. This is essential to enable societies to face challenges posed by the global environmental and climate change and to identify potential solutions. The Centre has remained vibrant and has made several significant advancements. The notable accomplishments include establishment of the South Asia regional office of the international long-term science-cum-policy programme “Future Earth” at the Centre. The regional office for the South Asia has its domain spanning over the SAARC countries, Myanmar and Indian Ocean Island countries. This provides an umbrella program for climate scientists and social scientists in the region to come together and exchange the knowledge for sustainable development under changing climate.

The past global secretariat leadership model of “Future Earth”, though allowed rapid global coverage, but suffered from lack of coordination, geographic bias, and most importantly a lack of any direct leadership from the global south, thereby creating challenges for its maturity and transition into a truly global presence. Four out of the five global hubs were based in North America and Europe, which collectively represents only 15% of the global population. Critical decisions that affect the global operation of the organization were thus made without sufficient diversity of perspectives. In this context, Divecha Centre for Climate Change proposed to establish a “Future Earth” Global Secretariat Hub South Asia” in the spirit of enhancing and expanding the vision, reach and impact around the world. “Future Earth” by realising the lack of representation from the global south, has recently announced three additional global secretariat hubs in addition to the existing five global hubs. The eight “Future Earth” Global Secretariat Hubs are: Global Secretariat Hub Canada, Global Secretariat Hub China, Global Secretariat Hub France, Global Secretariat Hub Japan, Global Secretariat Hub South Asia, Global Secretariat Hub Sweden, Global Secretariat Hub Taipei, and Global Secretariat Hub USA. The Global Secretariat Hub South Asia will be hosted by Divecha Centre for Climate Change. “Future Earth” South Asia regional office will continue to function at the centre.

A global secretariat hub of “Future Earth” at Divecha Centre will be a quantum jump for the centre as we will be involved in policy making at global level. The centre will continue to influence policy making at international, national and regional scales through active dialogue between scientists, policy-makers and the general public and also by providing advanced training to students and young professionals and creating awareness among policy makers spanning across several nations.

The Centre will continue synergizing physical sciences and social sciences to define new roads for sustainable development under a changing climate.



S. K. Satheesh



## NATIONAL COMMITTEE OF FUTURE EARTH INDIA WORKSHOP II

The third and last meeting of the Future Earth National Committee-India (NC-India) convened by the Future Earth South Asia Office to help assist the NC in better engagement and planning was held on Zoom on 6 April 2021. Many crucial decisions regarding the functioning and immediate action plans of the NC were made during the meeting as highlighted below.

The National Committee members decided to work as four thematic Working Groups - Climate, Ecology and Biodiversity, Health, and Water-Energy-Food Nexus. Further planning and activities will take place within the Working Groups. The Climate Group decided to organize a webinar series in August and September, divided into four sub-themes: 1. Climate Change Science, 2. Climate Change Impacts, 3. Vulnerability and Adaptation to Climate Change, 4. Climate Change Mitigation. The Ecology and Biodiversity Group decided to focus on Land Ecosystem Restoration as a starting point, and to meet on a monthly basis to understand and convey various perspectives on current

status, problems and requirements to do with land ecosystem restoration. The Health Group decided to plan their activities and events according to the upcoming 2021 Global Conference on Health and Climate Change. They planned on connecting with the Future Earth Knowledge Action Network on Health.

It was decided that one coordinator and one policy analyst / researcher need to be hired for NC India collectively. The idea of a Synthesis Centre was also considered as one that could be pitched to various potential institutes and universities that can host them. The roles of Future Earth South Asia Office with regards to the NC India were also discussed. A few Government representatives were listed as potential stakeholders to be involved with Future Earth National Committee-India's activities. It was decided that this list would be further populated by all NC members and the Chair for every Working Group. Further communication was discussed to create a group email for ease of communication.



## SUSTAINABILITY, RESEARCH AND INNOVATION CONGRESS 2021 (SRI 2021)



Panelists during an SRI2021 session titled “Science for Stockholm+50: Mobilizing for the 2022 UN High-Level Meeting”

The Sustainability Research and Innovation Congress 2021 (SRI2021) was the world’s first transdisciplinary gathering in sustainability – a space of fierce advocacy for sustainability

scholarship, innovation, collaboration and action. The first in an annual series that united global leaders, experts, industry and innovators to inspire action and promote a transformation



**Future Earth South Asia hosting a Future Earth National Committee-China session on “The Current Situation and the Prospect of Sustainable Development Goals in China”, at SRI2021, June**

in sustainability.

SRI2021 provided a unique opportunity for diverse audiences to connect with the global sustainability community, learn about the latest sustainability science, create novel networks and partnerships, explore new ideas, gain visibility, inspire and be inspired. In the light of the COVID-19 pandemic, the Congress launched as a live virtual event with a diverse and innovative online program. In addition to the 100+ sessions available throughout the day and night, thanks to the global reach of SRI and partners, the SRI2021 Online Package included exclusive events and services.

Future Earth South Asia assisted Team SRI in hosting the following online sessions:

- Earth Commission Synthesizing Science to Underpin Science-Based Targets for our Global Commons

- A Dialogue Forum: To Distill from Experiences of Stakeholders, Scalable Strategies for Disaster Risk Reduction and Societal Resilience Building
- The Regional Dimension of Future Earth and its Role for a Sustainable World
- Showing leadership in sustainability science: Lessons from the Global South and beyond the academy
- The Current Situation and the Prospect of Sustainable Development Goals in China

Future Earth South Asia also helped Team SRI as session checkers for 30 sessions in total. Additionally, Future Earth South Asia and Divecha Centre for Climate Change sponsored the participation of Anasuya Gangopadhyay, Ph.D. candidate at the Divecha Centre for Climate Change.



# Community OUTREACH



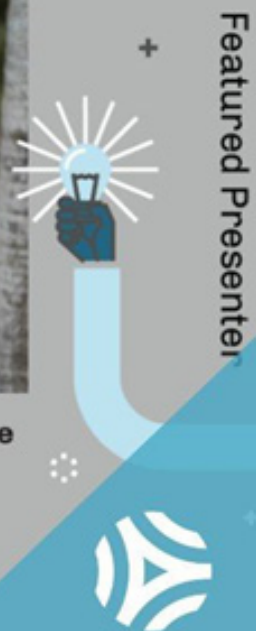
## WORKSHOP AND NETWORKING

### EPIC-Asia Meeting June Check-In and Updates

30 June 2021  
2:00 - 4:00 am utc  
9:00-11:00 am indochina time



**Kay Phanthuwongpakdee**  
EPIC-Network



Kay Phanthuwongpakdee, Coordinator, EPIC-Asia Network, in the flyer for the EPIC-Asia Meeting in June

The Educational Partnerships for Innovation in Communities – Network (EPIC-N) is a nonprofit association with members all over the world and

the EPIC-N's mission is to unite the human capital of universities with local governments, and communities, to improve the quality of life and

social wealth for all involved. The network does this by supporting the application of the EPIC-N model, which brings together the greatest resources in academia — professors, students, laboratories, research libraries, existing curriculum — and creatively draws them together to tackle the biggest challenges in local communities.

The EPIC-N Board has agreed to prioritize the UN Sustainable Development Goals in all its programming. Since the EPIC-N model directly supports various United Nations Sustainable Development Goals (SDGs), it is suggested that

universities will have a higher impact ranking if they undertake a working EPIC-N Model in their projects.

Future Earth South Asia connected with the EPIC Asia Network during SRI2021 and was invited to attend its monthly check-in meetings with other stakeholders in the Asia region. After attending the first check-in meeting, it was decided that there is potential for the EPIC-N Model to be applied in the South Asian context. The Office will continue participating in monthly check-in meetings and introducing members in its own network to the EPIC-Network to explore options for collaboration.



## **WATER RESOURCE MANAGEMENT IN SIKKIM**

Future Earth South Asia organized a meeting with key stakeholders from Sikkim, including officials from the State Forest Department and Department of Science and Technology, researchers from Sikkim University,

representatives from organizations like the Integrated Mountain Initiative and ECOSS, and others, to discuss areas of concern with regards to water resource management in Sikkim and potential collaboration to address



them collectively.

Dr. Smriti Basnett, Co-Director Future Earth, opened the meeting by introducing Future Earth to all attendees. She described that Future Earth advocates for Transdisciplinary approaches in Research and the Future Earth South Asia Office convenes stakeholder participation in the field of Water Security, Food Security, Air Pollution and Health. Under the Water Security theme, Dr Basnett highlighted that the main objective of this meeting was to help various stakeholders network to strengthen science-society-policy linkages while undertaking research

on water resource management in Sikkim.

Session I of the meeting started with a brief introduction from the different government departments and institutions regarding their work and current research activities in order to update the current water resources management research in the state. These included presentations from the Department of Science and Technology and Climate Change Cell, Rural Development Department, Forest Department, NGO ECOSS, and Sikkim University.

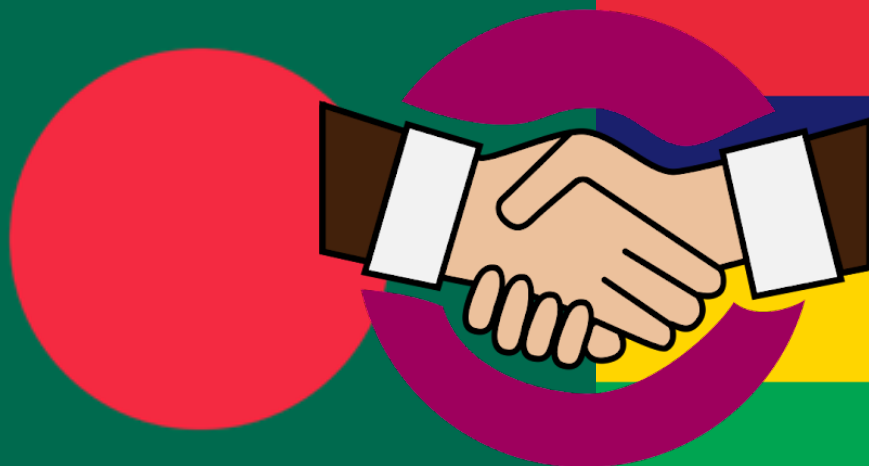
This was followed by presentations on



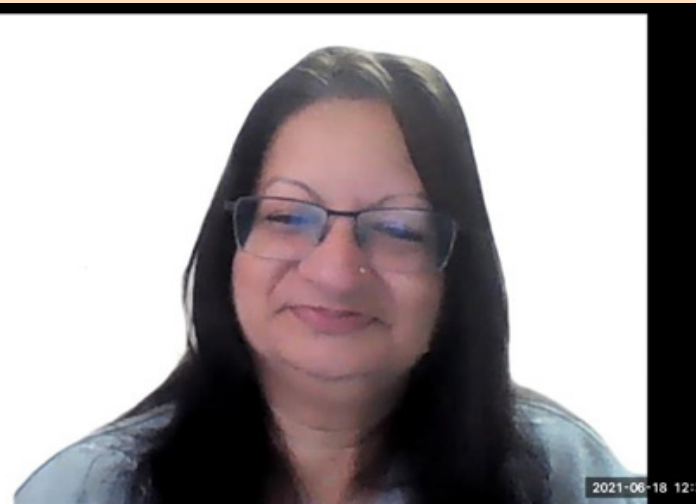
Mr. P. D. Rai, President, Integrated Mountain Initiative (Left) and Dr. D. Manjunatha, Indian Forest Services, Sikkim (Right)

the current research being conducted at the Centre of Excellence, Sikkim University, which included: glacier mass balance studies, quantitative and qualitative analysis of water and glacial hazard studies A potential

study plan the RateyChu project was shared which would look into the



## OUTREACH AND INTERACTION WITH STAKEHOLDERS BANGLADESH AND MAURITIUS



**Dr. Md. Samiul Ahsan Talucder (Left), Associate Professor, Sylhet Agricultural University, Bangladesh and Dr. Sunita Facknath (Right), Professor, Faculty of Agriculture, University of Mauritius**

Future Earth South Asia arranged a meeting with Dr. Mohammad Samiul Ahsan Talucder, Associate Professor, Sylhet Agricultural University, Bangladesh and Dr. Sunita Facknath, Professor, Faculty of Agriculture, University of Mauritius, on 18 June 2021, after initial interactions during SRI 2021.

The objective of the meeting was to introduce them to Future Earth

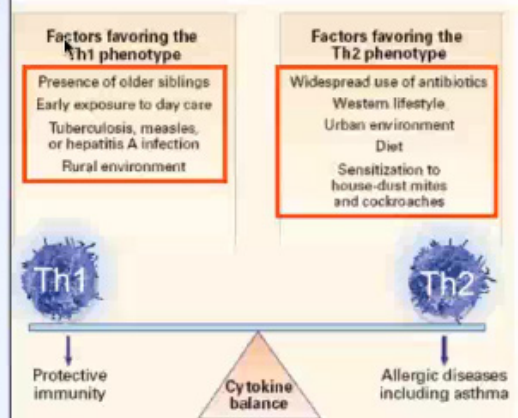
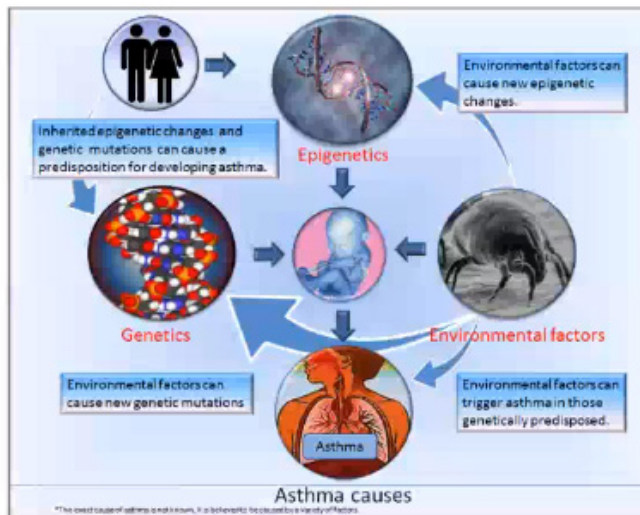
South Asia and invite them as key resource persons from their respective countries. An overview of the regional office, its objectives, past activities and planned future directions were presented to them.

A stakeholder listing exercise was initiated with both invited guests and a detailed discussion about various aspects about potential collaboration took place during the meeting.



## ROLE OF ENVIRONMENTAL ISSUES IN THE PREVENTION AND CONTROL OF ASTHMA

### Why does one develop asthma?

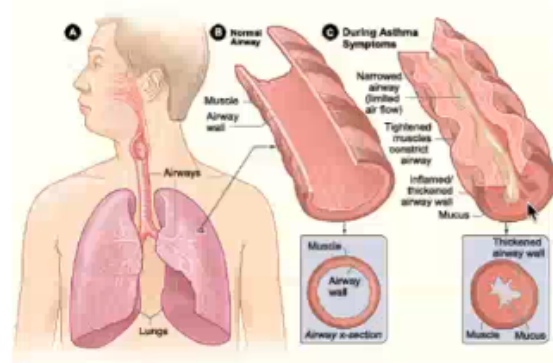


Dr. B V Murali Mohan Senior Consultant Pulmonologist and Academic Director of the Departments of Internal Medicine at Narayana Hrudayalaya, Bengaluru, presenting his talk on 27 May 2021

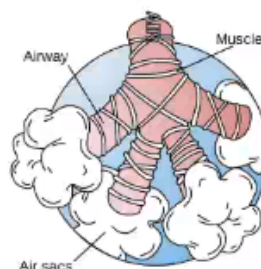


Typical of asthma are 3 features

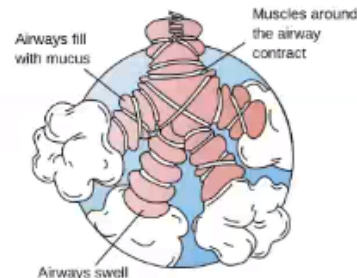
- (1) bronchospasm
- (2) mucus secretion
- (3) airway mucosal inflammation.



Before an asthma episode



After an asthma episode

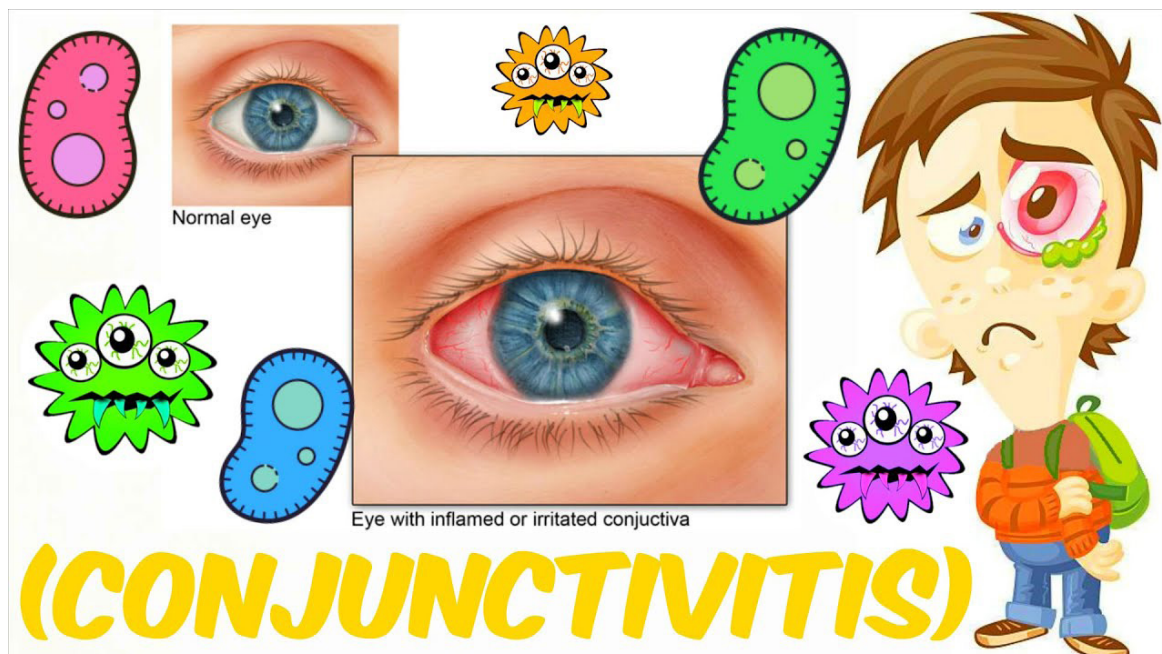


Dr. B. V. Murali showing his slide

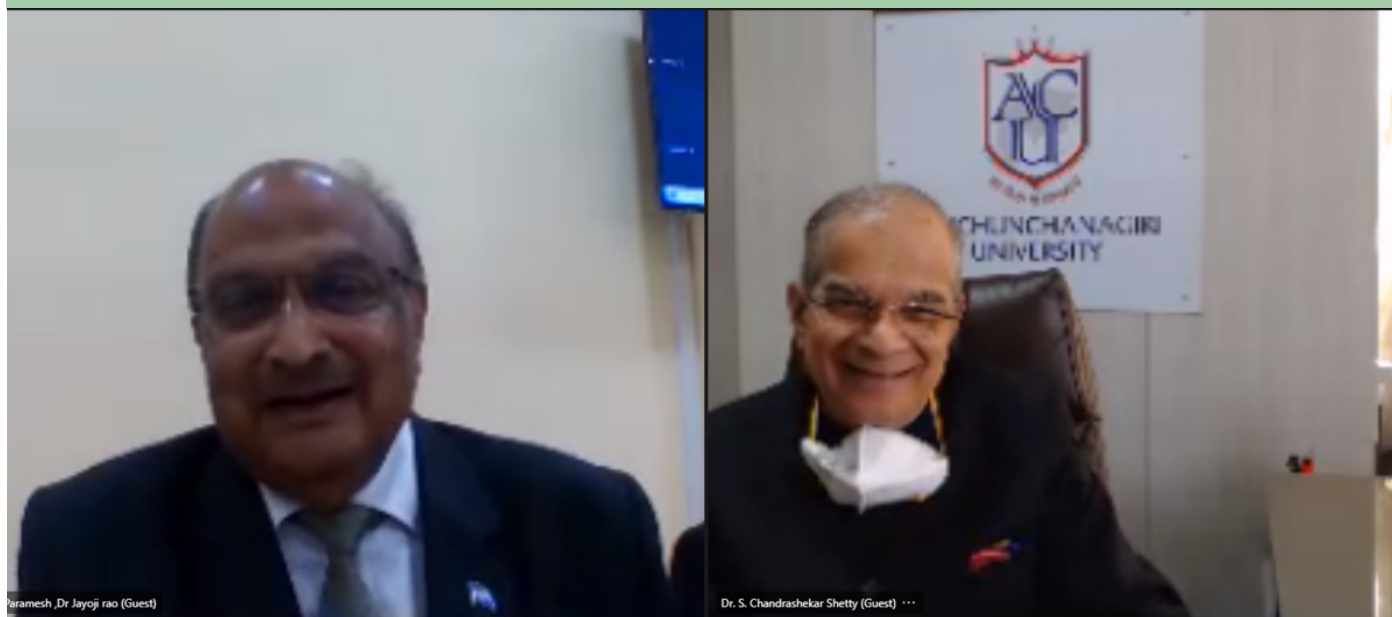
Divecha Centre for Climate Change IISc, COMHAD India and Lakeside Education Trust jointly organized a webinar on 27 May 2021, on “Role of Environmental Issues in the Prevention and Control of Asthma”. Dr. B. V. Murali Mohan, Senior Consultant Pulmonologist and Academic Director of the Departments of Internal Medicine at Narayana Hrudayalaya, Bengaluru, the speaker said that asthma is an earliest onset non-communicable disease with significant psycho socio economic health care burden.

The feature of the disease is the (1) Bronchospasm (2) Airway inflammation causing swelling (3) Excess mucus secretion causing

airway obstruction. He also mentioned the predominate triggers are Aeroallergens, Pollutants and Viral infections. He stressed the need for environment control as a basic issue in the prevention and control of asthma apart from taking medicine regularly with proper technique and inhalation method is the best way along with good night sleep and traditional food habits.



## DESIRED ENVIRONMENT CHANGES IN THE PREVENTION CONTROL OF EYE DISEASES



Prof. Dr. S. Chandrashekar Shetty (Right), Vice Chancellor, Adichunchanagiri University, BG Nagara, Karnataka and Dr. H. Paramesh (Left), visiting Prof. at Divecha Centre for Climate Change, IISc

Divecha Centre for Climate Change IISc, with COMHAD India and Lakeside Education Trust on 24 June 2021 organized a webinar on “Desired Environment Changes in the Prevention Control of Eye Diseases and The Need for Ecosystem Restoration”

by Prof. Dr. S. Chandrashekar Shetty, Vice Chancellor, Adichunchanagiri University, BG Nagara, Karnataka. “Environment is anything that is not me”, a definition often attributed to Albert Einstein. The term is extended to include population (demography),

abiotic (physical), biotic, domestic, politico-cultural, socio-economic, legal and the built environment.

People are exposed to risk factors in their homes, workplaces and communities. Prof. Chandrashekar

encapsulated as to how the environment impacts our health. Air pollution, inadequate water, sanitization and hygiene, chemicals, radiation, community noise, climate change in addition to occupational risks plays a major role in impacting

## **Inadequate Water and Sanitation Trachoma Management**



**Surgery**



**Antibiotics**



**Facial  
Cleanliness**



**Environment  
Changes**

Prof. Dr. Chandrashekar presenting his slide

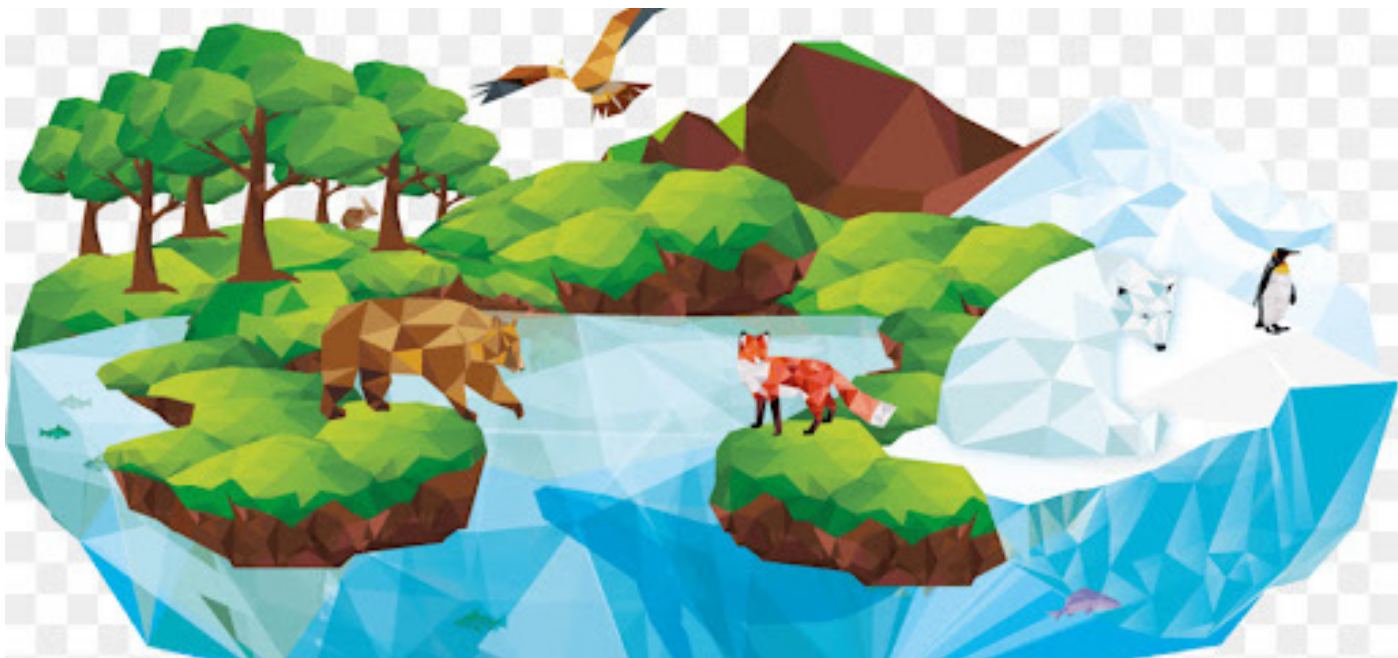
our health. These cause diseases such as cancer, diabetes, malaria, respiratory infections, ischemic heart disease that are mostly non-communicable and cause death.

Many of these environmental influences impinge and impact the eye in many ways. The major environment influences are in relation to life expectancy and population, global warming and greenhouse gases, UV radiation and ozone layer, domestic and cultural environment. The environmental changes play an important role in the causation of inflammatory, infective, metabolic,

degenerative and neoplastic changes in the eye. The effects will be mainly on the lids, conjunctiva, cornea, lens, choroid and retina.

Prof. Chandrashekar concluded his talk by indicating that political, bureaucratic, professional and collective will of the people is required to bring in appropriate policy plans, programs with best practices. He said that specific objectives with a plan of action and timeline is most essential to achieve positive environment changes to prevent and control eye diseases.





## NEED FOR ECOSYSTEM RESTORATION

**World Environment Day : Ecosystem Restoration**  
**DCCC IISc. / COMHAD / LET June 24<sup>th</sup> 2021**



Divecha Centre for Climate Change  
 Indian Institute of Science  
 Bangalore-12



### **“The Need for Ecosystem Restoration”**

**Prof. Dr. H. Paramesh**

**MD, FAAP(USA), FIAP, FIAMS, FIAA, FICAAI, FPAI**

- Pediatric, Pulmonologist, Environmentalist, Bengaluru
- Visiting Professor, Divecha Center for Climate Change, Indian Institute of Science (IISc.) Bangalore
- Visiting Professor Adichunchanagiri University
- Chairman - Lakeside Education Trust
- Member WHO-NGO Climate - Health Working Group, GENEVA
- Lead: Future Earth Health Related Sensitization of South Asia
- President COMHAD India Chapter
- drhparamesh@gmail.com



Dr. H. Paramesh, visiting Prof. at Divecha Centre for Climate Change, IISc presenting his slide

Prof. Dr. H. Paramesh visiting Prof. at Divecha Centre for Climate Change,

IISc., organized a webinar on “The Need for Ecosystem Restoration” on

24 June 2021.

There are nearly 431 world ecosystems, 278 are natural forest land, grass land, snow region etc. The ocean is the largest existing ecosystem on our planet and a source of livelihood for over 3 billion people. The need for ecosystem plants and animals are essential for ecological processes and promotion of lives and there is urgent need to protect our ecosystem from:

- (1) Air pollution
- (2) Global warming
- (3) Climate change for the survival.

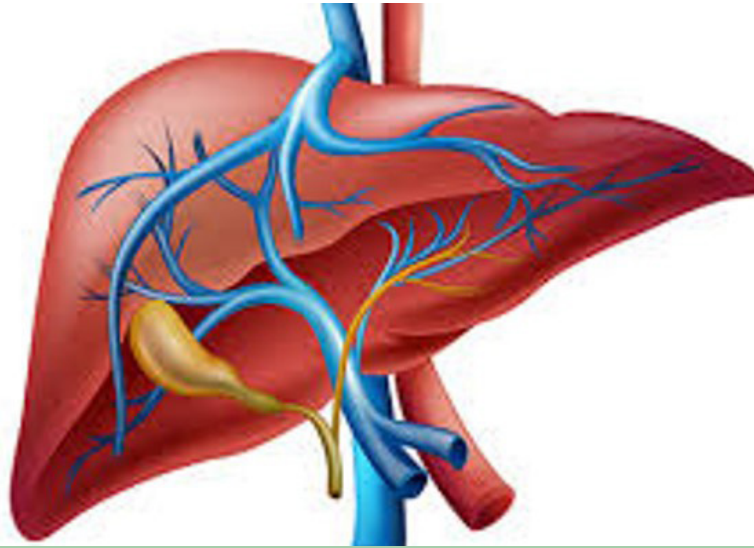
We produce 3 times more green house gases than mother earth can manage and currently we are at Catastrophic phase with CO<sub>2</sub> 400-450 ppm and Temp 1.2°C – 2.7°C. If temp increases to 2.2 – 4°C Irreversible damage occurs and at 5°C - 6°C rise in temperature extinction of all lives on earth happens.

To prevent this catastrophe we need to identify:

1. The source and cause of pollution to reduce it at any cost
2. The quality education of all the stake holders like Energy, Water sanitation and Hygiene, Agriculture, Transport, Land use planning, Labour, Housing and Industry
3. Convince the policy makers, economic gain from green species spending one rupee to maintain park will benefit you with 34 rupee in health

save cost to the society.

4. Reduce the carbon footprint to 2 tons per person/ year to keep the temperature less than 2°C by the end of the century by
  - (a) Reduce use of personal cars
  - (b) Promote use public transport
  - (c) Promote use of electronic car
  - (d) Reduce long haul air transport
  - (e) Encourage reducible energy
  - (f) Use low carbon in renovation of house
  - (g) Encourage vegetarian diet
  - (h) Improved cooking equipment
  - (i) Renewable based heating
  - (j) Encourage indoor plants
5. Let us encourage our National Mission for Clean Air (NMCA) project for our survival



## PREVENTION AND CONTROL OF LIVER DISEASES



Dr. Naresh Bhat (*Bottom row center*), Chief of Gastroenterology & Hepatology, Aster CMI Hospital, Bengaluru

Divecha Centre for Climate Change IISc, organized a webinar on “Desired Environment Changes in the Prevention & Control of Liver Diseases” by Dr. Naresh Bhat, Chief of Gastroenterology & Hepatology, Aster CMI Hospital, Bengaluru.

Liver is an organ with complex functions, several environmental factors can affect it including infections and other toxins cause liver and

systemic disease.

The liver filters the blood coming from the digestive tract, before passing it to the rest of the body. The liver also detoxifies chemicals and metabolizes drugs. It also detoxifies the environmental toxins and allergens. The liver produces bile to digest fatty acids and help to eliminate wastes like ammonia and urea. The liver also makes proteins important for



blood clotting and other functions.

Dr. Bhat portrayed some main causes of liver diseases in India such as early onset of Indian Childhood Cirrhosis by accumulation of excess copper in the liver due to copper cooking utensils. Arsenic is responsible for liver fibrosis in Non-Cirrhotic Portal Fibrosis in North India and Aflatoxin fungus growth

caused by contaminated groundnuts are some other examples of liver disease in India. He also pointed out that drug induced liver injury caused liver inflammation.

He presented a case study on liver disease caused by 'Khat' plant in Yeman. Khat chewing which is a social custom in the region caused

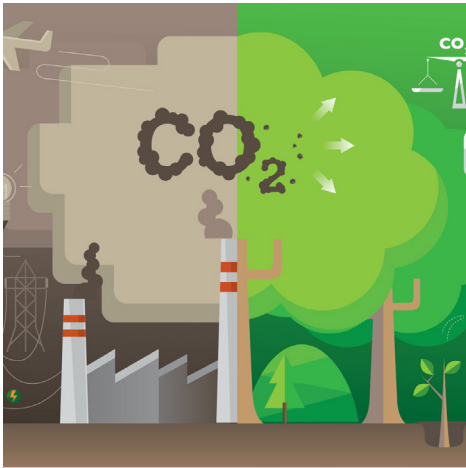


Dr. Naresh Bhat presenting his slide

autoimmune hepatitis. He questioned the credibility and safety of herbal and natural supplements for liver health. He indicated that certain herbal drugs are safe up to a certain extent by helping to reduce liver enzymes, but majority of herbal drugs are unsafe to use as they cause toxins. These toxins are caused by heavy metal contamination, adulteration and poor manufacturing contaminants while preparing the drugs. Dr. Bhat highlighted that Non-alcoholic fatty liver disease and Non-alcoholic steatohepatitis have now become a global epidemic. He outlined the role of obesity and non-obese

people contributing to Non-alcoholic fatty liver disease. He listed a few risk factors that causes the metabolic syndrome and insulin resistance. He also highlighted how obesity is linked to cancer.

He concluded that one can prevent liver disease and 40% of cancer cases by practicing- traditional food habits, regular physical exercises, avoiding tobacco, limited alcohol usage, using the medicine prescribed by the family doctor and having vaccine for Hepatitis A & B while looking out for hepatitis C and E disease.



## GLOBAL ALLIANCE OF UNIVERSITIES ON CLIMATE



Participants in panel discussions: Photo source - Tsinghua University website

Global Alliance of Universities on Climate (GAUC) held a virtual conference on 29th and 30th June 2021 to discuss “Pathways to Net Zero Emissions and Carbon/Climate Neutrality.” The conference started with a policymakers session. This session outlined the main objectives of the conference. There were also online discussion sessions on Net-zero technologies, Net zero and

carbon neutrality in the United States and China, Net zero pathways and policies, and Net-zero, growth, and justice. These four sessions were chaired by Bob Ward, Policy and Communications Director, Grantham Research Institute on Climate Change, and the Environment and ESRC Centre for Climate Change Economics and Policy. The virtual conference also included pre-recorded presentations

and keynotes.

In the policymakers session, Xie Zhenhua (Special Envoy for Climate Change, China) highlighted that all countries have different timeframes to achieve carbon neutrality. John Kerry (Special Presidential Envoy for Climate, United States) mentioned that we need common but differentiated goals for countries. Emmanuel Guerin (Executive Director for the International Group at the European Climate Foundation (ECF)) added that what we see now is critically important. It is not just an exercise in cutting greenhouse gas emissions. It is an exercise to put that goal at the very center of economic strategies and policymaking, and politics. Patricia Espinosa (Executive Secretary, United Nations Framework Convention on Climate Change) stressed that our goal this year is clear, we must achieve success at COP26 for the planet. Chairing the policymakers' session, Nicholas Stern, Chairman of the Grantham Research Institute on Climate Change and the Environment at LSE, and Chair of GAUC's Academic Committee, mentioned that young people are a source of tremendous inspiration. He added that GAUC is a crucial route to enhance and channel the next generation's enthusiasm, collaboration, and expertise.

This session was followed by a panel discussion on "Net-zero technologies." Anasuya Gangopadhyay (Indian Institute of Science), Frank Jotzo (Australian National University), Rupert Myers (Imperial College

London), Brand Wessels (Stellenbosch University), Xiu Yang (Tsinghua University), Romildo Toledo Filho (Federal University of Rio de Janeiro) presented new technologies related to wind power smoothing, green hydrogen, decarbonising cementitious materials, sustainable residential construction, nature-based climate solutions, and cement industry sector in Brazil. It was evident from the discussion that most of the countries are supportive of these new technologies. In the session, Net-zero pathways and policies, Myles Allen (University of Oxford), Ryoichi Komiyama (University of Tokyo), Bronwyn Claire (University of Cambridge), Guy Midgley (Stellenbosch University), Ashwin Seshadri (Indian Institute of Science), Steven Barrett (Massachusetts Institute of Technology) took part in a discussion on carbon neutrality, long-term energy strategy, policy opportunities risks of afforestation, cumulative emissions accounting, and zero environmental impact aviation.

In the concluding session, Net zero, growth, and justice, the need for strong, sustainable, inclusive, and resilient growth in the 21st century was discussed. The importance of just transition was also discussed in the session. The panelists were hopeful that 2021 would be a turning point for a prosperous and sustainable future where economic recovery from pandemic, growth, innovation, climate, and environmental benefits would be much more robust with the world acting together.



# RESEARCH HIGHLIGHTS



# ENVIRONMENTAL IMPACT OF COVID-19 IN INDIA

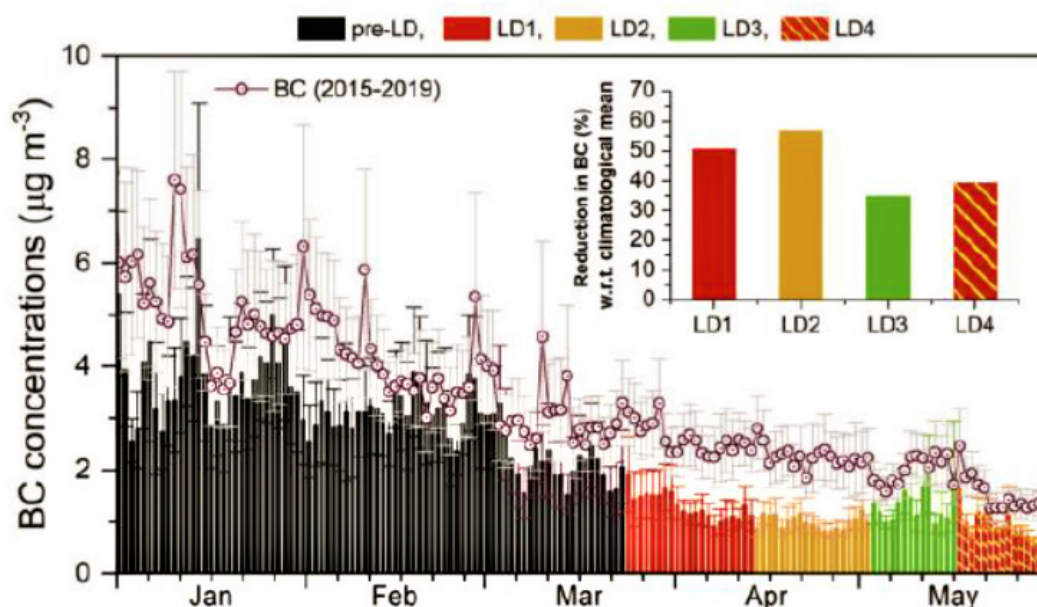
Continuous analytical measurements using well-calibrated instruments across a national network of observatories have revealed an unprecedented reduction in anthropogenic emissions, especially those of the short-lived climate forcing agents such as aerosols and oxides of nitrogen during the COVID related lockdown in India. A special section of the 25th January 2021 issue of the journal “Current Science” contained 11 papers devoted to the research on the above environmental impacts across India.

The spectacular reduction in the ambient concentration of black carbon (BC) aerosols, emitted primarily through the automobile exhaust has quantified for the first-time the impact

of the transport sector on environment. The concentration of aerosols in urban conglomerates became comparable to that in rural environment and stayed so until the partial unlock started (figure below). The papers showed that the impact was almost simultaneous, with most of the reduction occurring within the first one week of the lockdown.

Besides providing scientific information of environmental impacts of the lockdown this compendium provides valuable scientific data for urban planning and national-level policy making.

*Reference:* Environmental Impact of COVID-19 , Current Science, 120, 25 January, 2021, 241-447



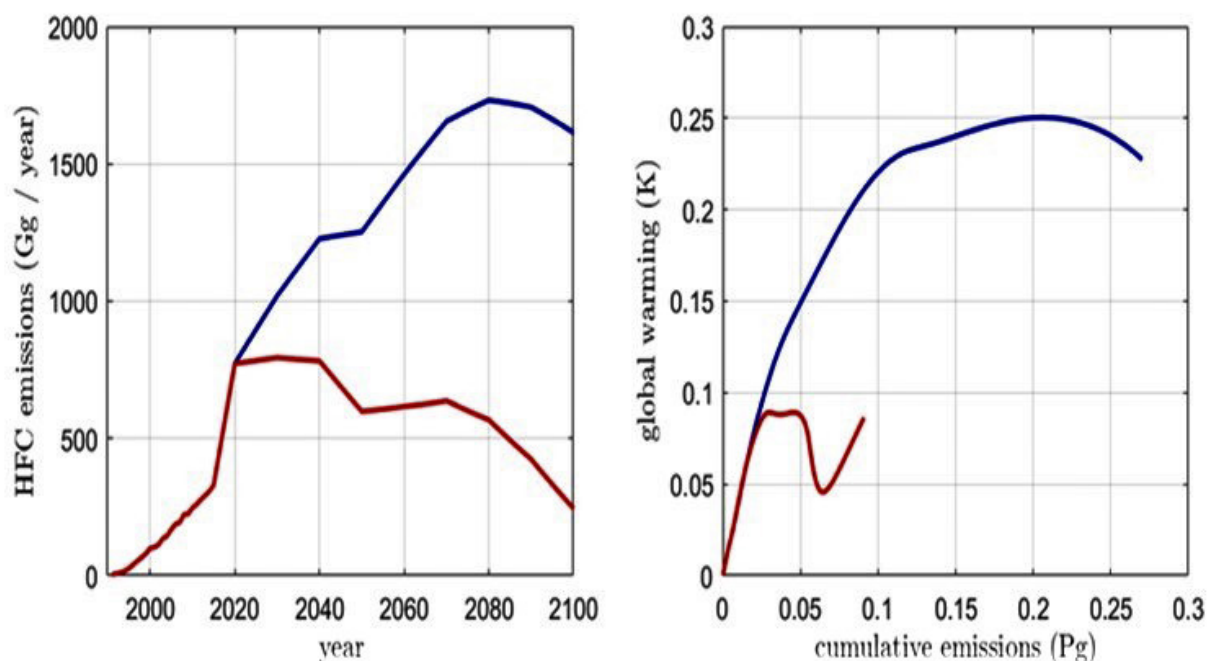
**Figure:** Time series of the daily mean values of BC (shown by the colored histograms) over India (averaged for all the stations) during January–May 2020, shown in different colors for pre-LD, LD1, LD2, LD3 and LD4 periods. Corresponding multi-year (2015–2019) averaged time series of daily mean BC over India are also shown (open circles). The vertical bars through the means are standard errors. The inset figure shows the reduction (in percentage) in BC during different periods of lockdowns (in 2020) with respect to the corresponding long-term average (2015–2019) BC

# ARE CUMULATIVE EMISSIONS ADEQUATE TO PREDICT GLOBAL WARMING?

The international negotiations to limit global warming became easier when it was shown that the global warming is linearly proportional to the cumulative emission of carbon dioxide. In a recent paper, Prof. Ashwin Seshadri at Divecha Centre for Climate Change has published a paper to show that the cumulative emission approach may not work for gases with a smaller residence time. The residence of carbon dioxide is more than 100 years but many other greenhouse gases like hydrofluorocarbons have a much shorter residence time. For such gases, the global warming will depend both on cumulative emissions and how rapidly the emissions are reduced.

In this paper the author has shown that global warming depends upon the residence time of the greenhouse gas and the time scale over which the greenhouse gas is reduced.

*Reference:* Seshadri, A. K., Cumulative emissions accounting of greenhouse gases due to path independence for a sufficiently rapid emissions cycle. Climate Dynamics, 2021, <https://doi.org/10.1007/s00382-021-05739>



**Figure:** Global warming vs cumulative emissions for a basket of hydrofluorocarbons (HFCs: 125, 134a, 143a, and 32) having mean effective atmospheric lifetime of approximately 15 years is shown in the right panel for the emissions scenarios in the left-side panel



