

Newsletter of the

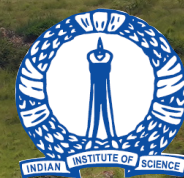
DIVECHA CENTRE FOR CLIMATE CHANGE

The 18th annual Jeremy Grantham Lecture

United Nations Climate Change Conference of the Parties at Egypt

Climate's Global Youth Climate week on Net-Zero Carbon future

Environment and climate change quiz program at Challakere





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Editors: S. K. Satheesh, J. Srinivasan and K. Krishnamoorthy

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FROM THE CHAIR

Greetings!



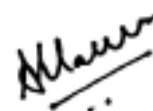
Climate change is expected to have an impact on the habitats of some species. Even minor variations in average temperatures can have a substantial impact on sensitive ecosystems. There are just two options: adapt or relocate to more suitable environments. A concept known as the 'bio-climatic envelope', which is the range of temperatures, rainfall, and other climate-related factors in which a species presently thrives, is used to determine the impact of climate change on species. Climate change will cause considerable shifts in the positioning of climatic envelopes. While a major fraction of the species is vulnerable to habitat loss due to climate change, some species will adapt to the new environment. Species with tiny populations and minimal migration capabilities are more likely to suffer as a result of rapid climate change. By 2050, most species on our planet will encounter climatic conditions unfamiliar to them.

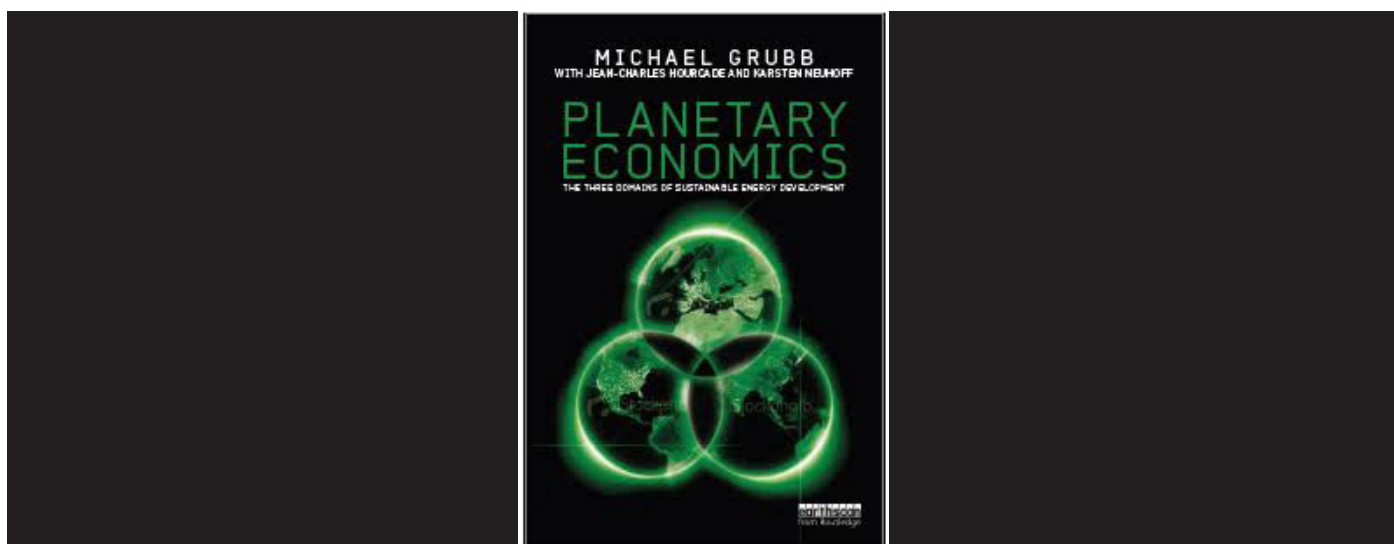
Healthy ecosystems and biodiversity are fundamental to life on Earth. According to a report from the Intergovernmental Science-Policy Platform on Biodiversity and Eco-system Services (IPBES), around 1 million species are under threat of extinction. Approximately, 0.1% of all species will become extinct each year. There are around 2 million distinct species on our planet. That means 2000 extinctions will occur every year.

One such example is the disappearance of the fishing cat. The main threat to fishing cats is habitat destruction due to anthropogenic activities and climate change. Most of India's wetlands are at risk of destruction due to human settlement, drainage for agriculture, pollution and logging. Another concern is the shortage of its primary food, fish, which is mostly caused by unsustainable fishing activities. Other threats include retaliatory and target killings; due to human-animal conflict. The dwindling numbers of frogs, native freshwater fishes and birds pose a loss of prey to the fishing cat. However, a study by the Fishing Cat Project using camera traps has revealed that the human theft was the more predominant cause for the large loss of fishes than the fishing cats. Another problem identified by the Fishing Cat Project was habitat loss due to land re-utilization.

All these point to the urgent need of advance actions to protect the fishing cat from the threat of extinction due to spread of human activities, as well as climate change.

S. K. Satheesh

A handwritten signature in black ink, appearing to read 'S. K. Satheesh' with a stylized flourish at the end.



THE 18TH JEREMY GRANTHAM LECTURE



Prof. Michael Grubb, energy and Climate Change, University College London, delivering the Jeremy Grantham lecture on 5 November 2022

Divecha Centre for Climate Change organized the annual Jeremy Grantham Lecture on “Planetary Economics and the challenge of climate change” by Prof. Michael Grubb, Energy and Climate Change, University College London, on 5 Dec 2022. Climate change is one of the greatest challenges we face in the 21st Century so far, and the progress has been wholly inadequate.

Prof. Grubb talked about his book Planetary Economics, encompassing

some key lessons from twenty years of debate on technology and economic dimensions of global energy and environmental problems, and from corresponding policy efforts. He asserted that part of the problem has lain in a frequently insufficiently broad understanding of the underlying economic dimensions. He outlined a new wider economic framework to explain how climate and energy challenges can be tackled more effectively – whilst containing energy



Prof. Satheesh and Prof. J. Srinivasan felicitating Prof. Grubb

bills. It maps out three domains of decision-making each of which involves different actors, and processes and for which our understanding rests on different theoretical foundations. Each operates at different scales of time and social entities.

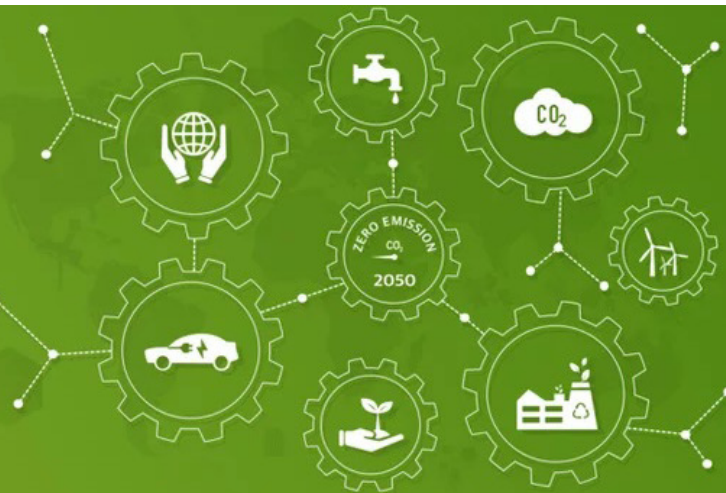
The unique characteristic of energy and climate change is that the issues raised span all three domains in approximately equal measure. The

policy implication is the need for three distinct pillars of action. Far from competing, these different pillars are complementary and hence only packages spanning all three are credible, economically efficient, and environmentally effective – and hence, politically stable. This wider perspective on policy also offers foundations for new international approaches, focusing upon areas of potential benefits from collaboration.



The question and answer round at the end of the session

NET ZERO



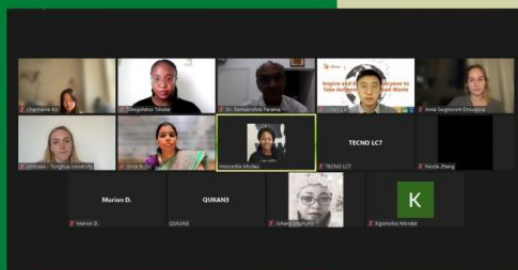
CLIMATE'S GLOBAL YOUTH CLIMATE WEEK ON NET-ZERO CARBON FUTURE



Dr VR PARAMA

CLOSE THE LOOP

*Global Youth
Summit
Highlights*



INNOCENTIA MODAU



LIU JICHEN



Speakers who took part in the webinar

Ms Girija R, research scholar at DCCC, is a part of the Close the Loop initiative formed by a group of youth climate leaders from GAUC (Global Alliance of Universities on Climate) member universities. This initiative was undertaken under GAUC's Climatex program which

encourages youth leaders to address the climate change crisis. Close the loop hosted a session dedicated to waste management in urban areas at Global Youth Summit on net-zero carbon future convened by the Global Alliance of Universities on Climate on 3 November 2022.

The event entitled “Tell me what you waste and I’ll tell you who you are: pathways to close nutrient loop in urban areas through integrated waste management” under the theme Climate x Nature, Food and Biodiversity aimed at adopting a participatory approach in order to work on people cognitive perception of waste. The event hosted a panel discussion wherein the experts coming from different fields discussed the challenges, solutions, and pathways to sustainably prevent and reuse biodegradable waste like food scraps and waste.

The panel had the following speakers:

1. Jichen Liu founder and CEO of clear plate, an app rewarding people for reducing their food waste.
2. Innocentia M. project manager

WWF South Africa

3. Dr. V.R. Ramakrishna Parama expert and practitioner on waste management, former professor at the University of Agricultural Sciences, Bengaluru, India

The panel discussion was followed by the team presentation on the initiatives taken under the project. The event adopted a manifesto to get the support from the public for their effort to closing the loop through resource recovery and recycling

ORGANIZED BY



3 NOVEMBER
(THUR)



12:00PM –
1:30PM (UTC)



ANDREEA DIANA
MANOLACHE
Tsinghua
University



CHARMAINE KO
Columbia University



TSHEGO FATSI
TSHOKE
Stellenbosch
University



ANNA
SEIGNOVERT
Sciences Po



GIRIJA R
Indian Institute of
Science



Food4Climate: Youth Innovations for a Better Tomorrow

4 November 2022

Mumbai 17:30 | Bangkok / Jakarta 19:00 | Singapore 20:00
Seoul / Tokyo 21:00

FOOD INNOVATION CHALLENGE



Ms. Girija, Research scholar, DCCC (*Centre*) delivering her talk in the webinar

Ms. Girija, Research scholar at DCCC was invited as a panelist for the event - ProVeg Food Innovation Challenge webinar held on 4 Nov 2022. This webinar was hosted by ProVeg International as a co-initiator of the inaugural Global Youth Climate Week by Global Alliance of Universities on Climate (GAUC) and to welcome

COP27. ProVeg had invited student representatives from Tsinghua and Indian Institute of Science to share their efforts on alleviating the effects of climate change and engaging youth in this cause.

Ms. Girija, in her talk, highlighted the impact of food systems on climate. How

the components across the value chain from production till consumption are adding to climate change effects. For instance, how synthetic fertilizers are adding to greenhouse gas emissions. Then she emphasized on the waste produced across the value chain and the greenhouse gas emissions from these waste. She highlighted on how food security issue is not about the availability but the accessibility. There is enough food produced to feed our global population but nearly 828 million people globally still go hungry. This is because $\frac{1}{3}$ of the produced food is not consumed and getting wasted, ending up in landfills. This presents an alarming carbon footprint, 4th largest specifically methane from the decomposition of these wastes.

Ms. Girija discussed on how we can grow our food through sustainable

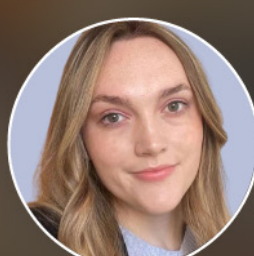
practices - using organic sources for fertilizers, grow more with less like going for dryland farming in water scarce areas, cutting the value chain like the mediators in between and facilitating direct market linkage from farm to the consumers there by reducing the food mile. She explained how going higher on trophic level will lead to energy loss and hence the importance of bottom of the pyramid organisms- producers in supporting the life forms. She discussed some of the promising approaches to reduce climate change effects like – purchasing locally grown food, promoting millet, and using pulses as protein substitute. She showed that food systems and climate are interrelated. Food system has an impact on climate and climate change has an impact on food system.



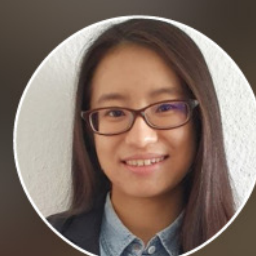
Shirley Lu
ProVeg



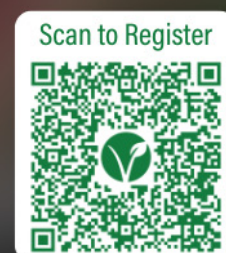
Girija Ramkrishna
Indian Institute
of Science



Andreea Manolache
Tsinghua University



Fellicia Kristianti
Innova
Market Insights



Panelists in the “Food innovation Challenge” program

Global Youth Summit on Net-zero Future

Sustainable Sourcing (Recycling) of Battery Components

4 NOVEMBER 2022, 10:00UTC

Sustainable sourcing and recycling of battery components

Policy in line

Battery Waste Management Rules, 2022

- Section 2 (ii) – These rules apply to all types of batteries regardless of chemistry, shape, volume, weight, material composition and use.
- Section 4 (1) – EPR – It will be producers' responsibility to recycle or refurbish the battery which they introduce in the market.
- Section 4 (3) – Waste battery collected by the producer shall not be sent for landfilling or incineration.
- Section 4 (12) (ii) – Producer shall ensure safe handling of battery.
- Section 5 – Consumer responsibility for discarding waste battery.
- Functions and Guidelines for Recyclers and refurbisher are defined.
- Functions of State Pollution Control Board, Labelling requirements.

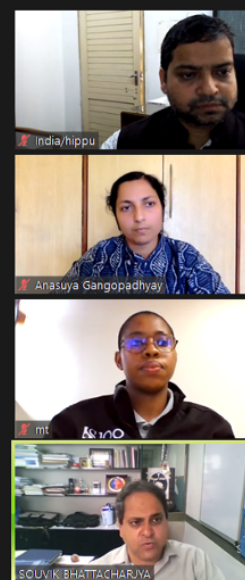
Recovery Target of Min. % of total Weight of Battery

S.No.	Type of Battery	Recovery target for the year in percentage		
		2024-25	2025-26	2026-27 and onwards
1.	Portable	70	80	90
2.	Automotive *	55	60	60
3.	Industrial	55	60	60
4.	Electric Vehicle	70	80	90

Min. use of recycled materials in new of Battery

S.No.	Type of Battery	Minimum use of the recycled materials out of total dry weight of a Battery (in percentage)			
		2027-28	2028-29	2029-30	2030-31 and onwards
1.	Portable	5	10	15	20
2.	Electric Vehicle	5	10	15	20
		2024-25	2025-26	2026-27	2027-28 and onwards
3.	Automotive	35	35	40	40
4.	Industrial	35	35	40	40

* Battery used only for automotive starter, lighting or ignition power



Mr. Souvik Bhattacharjya from TERI, delivering his talk in the webinar

Divecha Centre for Climate Change, Indian Institute of Science, along with Stellenbosch University, South Africa and Australian National University, Australia, organized a webinar on "Sustainable sourcing (recycling) of battery components: A necessity for renewable growth" on 04 November 2022 as part of Global Youth Summit on Net-zero Future. The three panelists Dr. Naga Phani Aetukuri from IISc, Mr.

Souvik Bhattacharjya from The Energy and Resources Institute (TERI) and Dr. Hippu Salk Kristle Nathan from Institute of Rural Management Anand (IRMA), presented their current research and case studies on next generation energy storage devices.

Decarbonization of the energy sector is essential to achieve globally agreed Sustainable Development Goals

(SDG), specifically SDG 13 as well as SDG 7 (UNDP, 2022). Renewable energy installations, like wind and solar, are increasing exponentially to support sustainable electricity production globally. However, weather dependent renewable generation is variable. Balancing demand and supply in a renewable rich electricity grid is complicated. Research indicates that large energy storage systems guide hourly scale grid management with current storage options including pumped hydro storage, compressed air storage and battery storage. Additionally, greening of the transportation sector requires electricity storage systems. Lithium ion (Li-ion) batteries are proven to be highly efficient in terms of short-term energy density and are considered suitable for meeting gaps in future storage requirements (Triple Pundit, 2021). Sourcing of Lithium, Cobalt and Nickel for battery manufacturing is necessary. However, mining for these elements is not sustainable. Further, the demand for these elements is going to be far more than the supply. This imbalance may result in battery price surge which would slow down the adaptation of green energies. Further, harvesting the valuable minerals from waste batteries has much less greenhouse emission than primary mining. Recycling of Li-ion batteries will aid in attaining the sustainable development goal as well as “net zero” target. Whilst recycling technologies for Li-ion batteries is in the forefront of new start-ups and current global business, still a larger proportion of used batteries continue to be disposed of in landfill

and dismantled in ways that impact human health. The implementation of battery recycling is trans-disciplinary, requiring agreement between various stakeholders including manufacturers, consumers, mining industry professionals, academia, advisory panels, climate change experts, battery retailers and recycling companies.

There were 26 participants in the event. One of the guests, Mr. Souvik Bhattacharyya presented a very interesting analysis on battery lifecycle. One of the participants, Chantel Ndhlovu wanted to know the motivation behind the event. Panellists elaborated that we are in a point of transition from pre-Renewable to Renewable era and in this juncture, it is essential to discuss recycling issues related to renewables to address future ecological catastrophe. The discussion on such transdisciplinary topics is essential not only to address ecological issues but to help create circular economy of batteries. Some of the participants appreciated the insightful discussion on the topic as well. The three panelists highlighted the current issues uniting representatives across the global community.

This was followed by a discussion on the actions to be considered by current and future policy makers, leaders, manufacturers, consumers, and scientific community. The main conclusions were:

1. Recycling of Li-ion battery is a relatively new technology. We need to find out the recycling technology that is most effective with respect to

environmental and energy footprint.

2. Large scale battery recycling can help in reducing recycling cost.

3. Recycling techniques vary for different battery technologies. So as a community to streamline the recycling process we must start producing any two suitable types of batteries.

4. Li-ion batteries have all the components mixed up with each other. They also have plastics in them. So, it is difficult to dismantle and recycle batteries.

5. Centralised recycling may not work due to logistic issues. Hence, decentralised recycling must be encouraged.

6. Reduce battery use is also another aspect that came up in the discussion. Although, in the supply side we need to recycle batteries, the use needs to be reduced from consumer side.

7. Possibility of second life for old EV batteries must be considered

8. There is a necessity to decouple the material consumption from the economic growth.



SECURE & SUSTAINABLE ENERGY



Sustainable Sourcing (recycling) of Battery Components: A Necessity for Renewable Growth



4 NOVEMBER
(FRI)



10:00AM -
11:30AM (UTC)

ORGANIZED BY



ANASUYA
GANGOPADHYAY
Indian Institute of
Science



CINDY
SMITH
Australia National
University



MAKELLE
THABILE PITJO
Stellenbosch
University





COP27

**SHARM EL-SHEIKH
EGYPT 2022**

UNITED NATIONS CLIMATE CHANGE CONFERENCE OF THE PARTIES (COP27)



Post-session networking at a side event at the World Health Organization pavilion with Dr. Chadia Wannous (*Back row: 8th from left*), Steering committee member of OneHEALTH, Future Earth Health Knowledge-Action Network

The 27th session of the United Nations Climate Change Conference of the Parties (COP27) was held from 6 November to 20 November 2022 in Sharm El Sheikh, Egypt. As an official observer of the UNFCCC, Future Earth had both an onsite and virtual presence throughout the conference. Researchers from the Future Earth network participated

in and held various events and released key reports and research for supporting negotiations. Smriti Basnett and Jency Maria Sojan from Future Earth Global Hub- South Asia, hosted by Divecha Centre for Climate Change, presented the major work of Future Earth and the South Asia hub at the Future Earth exhibit on 16 and 17 November 2022. Researchers,



A glimpse of the Future Earth Exhibit booth at COP27

entrepreneurs, students, government officials, and heads of NGOs working on Climate Change visited the exhibit and learned about the organisation and its activities.

Leading global experts from the natural and social sciences released the 10 New Insights in Climate Science 2022 report (an annual synthesis of the latest climate change-related

research for the international science-policy community) with UNFCCC Executive Secretary Mr. Simon Stiell on 10 November at COP27. The 10 New Insights in Climate Science is a joint initiative of Future Earth, the Earth League, and the World Climate Research Programme. It presents key insights from the latest climate change-related research this year and responds to clear calls for policy guidance during this climate-critical decade.

The COP27 was a great space for connecting and collaborating with those making changes worldwide. It provided an important space for science, business, and civil society actors to connect. The COP27 historic agreement to initiate and enforce loss and damage funding is based on the realisation that climate change has multiple cascading risks, which are increasingly dangerous, especially for the most vulnerable communities.



[Left] Smriti Basnett, Deputy Director of Future Earth Global Hub South Asia, and [Centre and Right] Jency Maria Sojan, Science Officer at Future Earth Global Hub South Asia, interacting with visitors at the exhibit



ENVIRONMENT AND CLIMATE CHANGE QUIZ PROGRAM AT CHALLAKERE



Dr. H. Paramesh, Visiting Professor, DCCC, delivering his talk to school children on 29 Nov 2022 at Challakere campus, IISc.

The Divecha Centre for climate change has been conducting an annual program on environment and climate change for the benefit of school and college students for the past 14 years. This program was disrupted during 2021 due to the COVID pandemic. In 2022 the Centre conducted a program for the benefit of school students at the Challakere campus of the Indian Institute of Science. About 250 students and teachers from 28 schools around this campus participated in the program on 29 November 2022. The program began with a popular lecture in Kannada on health and environment by Dr. H. Paramesh, an eminent pulmonologist

and visiting Professor at DCCC. Dr. Paramesh highlighted the impact of air pollution and climate change on health and discussed the need for a sustainable lifestyle to minimize our impact on the environment. After this talk a quiz was conducted by Prof J. Srinivasan, Distinguished scientist at DCCC. During the quiz, every school was asked one question related to climate and the environment. The students participated enthusiastically in this activity and in the discussion that followed. The teachers were glad that their students became aware of the issues related to climate and environment.



SUSTAINABLE MOUNTAIN DEVELOPMENT SUMMIT XI AT LEH, LADAKH



Youth declaration presented to Honorable Minister, Shri Bhupender Yadav, MOEFCC during the inaugural session of SMDS-XI

Sustainable Mountain Development Summit (supported by Divecha Centre for Climate Change) was hosted by Sustainable Development Forum of Ladakh and Ladakh Hill Development Council at Leh, Ladakh from October 10 to 12, 2022 with the theme 'Harnessing Tourism for Sustainable Mountain Development'. Over 500 delegates from mountain states, IMI members, representatives from Divecha Centre for Climate Change (DCCC), and Ladakh participated in the summit. Honourable Minister,

MoEFCC- Shri Bhupender Yadav graced the inaugural session as Chief Guest. Shri Jamyang Tsering Namgyal Hon'ble MP, Ladakh graced the occasion. The summit was preceded by the 5th Himalayan Youth Summit with the theme 'Sustainability and Entrepreneurship' which had youth participants from various Himalayan states. The youth declaration was presented to the Honourable Minister, MoEFCC during the inaugural session of SMDS-XI. The proceedings of SMDS X (held in Darjeeling in 2021),

the report and prints of which were supported by Divecha Centre for Climate Change, which highlighted the need to locate “One Health in the Indian Himalayan Region” context was also released by the Hon’ble Minister. Dr. Harshwanti Bisht delivered the

Dr. RS Tolia Memorial lecture for 2022. A renowned mountaineer from Uttarakhand, Dr. Bisht was one of the first women to scale the Nanda Devi and the first woman to be elected as President of the Indian Mountain Federation.



SMDS-X report on “One Health” released by Shri Bhupendra Yadav (*Centre*), Honorable Minister, MOEFCC, Government of India.

(*From left to right*) Jigmet Takpa, PCCF Ladakh, Dr. Pawan Kotwal, Principal Secretary Forest, Tashi Gyalsen, Chairman/CEC, Advocate, Hon’ble Minister, Shri Bhupender Yadav, Jamyang Tsering Namgyal, MP Ladakh, Lt. Gen Anindya Sengupta, GOC 14 Corps, PD Rai, President IMI



Smriti Basnett from Future Earth South Asia Hub, Divecha Centre for Climate Change Interacting with MP Ladakh, Jamyang Tsering Namgyal (*Centre*) and Sajid Dorokhan (*Right*), Filmmaker and Vice President Grand Himalaya, Leh Ladakh, during a side event.



MOUNTAIN LEGISLATORS' MEET - 2022



In the picture (*Left to Right*): Executive Councillor-Leh, Thiksay Constituency, Stanzin Chosphe; Dr. Sumit Sharma and Reben Gargel, UNEP; Rigzin Spalbar, Former Chief Executive Councillor (CEC) Ladakh Autonomous Hill Development Council (LADHC) and Member GC IMI; Mr P.D Rai, Former MP Sikkim and President IMI; Advocate Tashi Gyalson, Chairman/CEC LADHC; Amba Jamir, GC IMI and SMDF-Nagaland; Ms. Priyadarshinee Shrestha GC-IMI, Dekila, Coordinator (IMI), Smriti Basnett, Dy Director Future Earth Asia, DCCC and IMI-Sikkim; Roshan Rai, GC IMI-Darjeeling, Executive Councillor-Leh Stanzin Chosphe, at the Assembly House, Leh (LAHDC), 11 October, 2022. The Mountain Legislatures meet concluded with a declaration to amend the Rules of Extended Producers' Responsibility (EPR) as applicable for the Mountain States.

One of the main side events of SMDS XI was the Mountain Legislators' Meet. The Mountain Legislators' Meet

2022 was centred around the issue of Extended Producer Responsibility: Policy to Practice, to counter plastic

pollution. The meeting was held on October 11, 2022, at the Assembly House, Ladakh Autonomous Hill Development Council, Leh (LAHDC) and chaired by Chief Executive Councillor of LAHDC and had a presence of President, IMI, 23 Council Members, Mayor of Dehradun, representatives from Divecha Centre for Climate Change (DCCC) and other dignitaries.

Dr. Sumit Sharma from UNEP gave an overview of the current EPR policy and Ms. Priyadarshinee Shrestha (IMI) presented on the brand audit findings conducted in Leh along with Ms. Preeti Chauhan. Existing gaps for implementation of the EPR framework in mountain states were also highlighted. The Leh declaration adopted by MLM 2022 sought to

amend the rules of Extended Producer Responsibility (EPR) framework as applicable for the Mountain States.

This was a corollary to the Declaration of the MLM held in Darjeeling in 2021. This was endorsed by other Mountain States' Legislators and MPs which will be followed by a meeting with the officials of the MoEFCC for seeking an amendment to the EPR framework to bring in mountain specificities.

The follow-up of the meeting and the next Mountain Legislators' Meet was announced to be hosted by the Divecha Centre for Climate Change in June 2023 at the Indian Institute of Science, Bengaluru.



The Mountain Legislators' Meet was chaired by Advocate Tashi Gyalsen, Chief Executive Councillor of Ladakh Autonomous Hill District Council (LAHDC)

TRAINING PROGRAM ON AEROSOLS AND CLIMATE



Participants and speakers who took part in the aerosol and climate training program held between 5 to 16 Dec 2022

Divecha Centre for Climate Change conducted a two-week training program on “Aerosols and Climate” at the Indian Institute of Science, Bengaluru from 5 to 16 December 2022.

There were 20 lectures that covered the basics of atmospheric aerosols, their health and climate implications, areas such as aerosol radiative forcing, bioaerosols, monsoon and air quality, remote sensing of aerosols, atmospheric instrumentation, and the effects of aerosols on turbulence, optical communication, and ocean productivity. The lectures were given by the faculty and scientists at Divecha Centre for Climate Change and Indian Institute of Science Education and Research Thiruvananthapuram and

were attended by 43 students from all parts of India.

The participants actively took part in the 30 hours of hands-on tutorial sessions in the afternoon hours, that covered Mie scattering models, satellite remote sensing, radiative transfer computations, a visit to the aerosol research laboratory, and introduction to aerosol modelling. The programme witness intense interaction between the participants and the speakers as well active participation in the tutorials.

RESEARCH HIGHLIGHTS

LOSS OF GRAZING BY LARGE MAMMALIAN HERBIVORES CAN DESTABILIZE THE SOIL CARBON POOL

Grazing ecosystems make up about 40% of the Earth's land surface (nearly 50 million km²), storing vast amounts of carbon (about 500 Pg) in the soil. One crucial aspect in this soil carbon storage is through grazing by large mammalian herbivores. While we increasingly understand the role of large mammalian herbivores on the size of the soil carbon pools, we know relatively little about their effects on an equally important aspect – stability.

For this, we established long-term monitoring plots by experimentally denying herbivores to graze by putting fences (see Figure for one such plot). In these grazed-and-fenced treatment-and-control plots, we estimated the soil carbon and nitrogen pools annually from 2006 to 2021.

We found that soil carbon and nitrogen pools fluctuated 30-40% more in the

fenced plots where animals were absent, compared to the grazed plots. Through multiple lines of evidence – phase-space analysis and structural equation modelling, we find that soil carbon and nitrogen pools were more stable through lower fluctuations in the presence of herbivores than under fenced plots.

With continuing decline in large mammalian herbivores across the globe, their influence on soil carbon stability can have unintended negative consequences for the global carbon cycle. So, protecting the herbivores that keep the soil carbon stable should remain a key priority for mitigating climate change and carbon stewardship.

Reference:

“Loss of grazing by large mammalian herbivores can destabilize the soil carbon pool” by Dilip G T Naidu, Shamik Roy, Sumanta Bagchi.

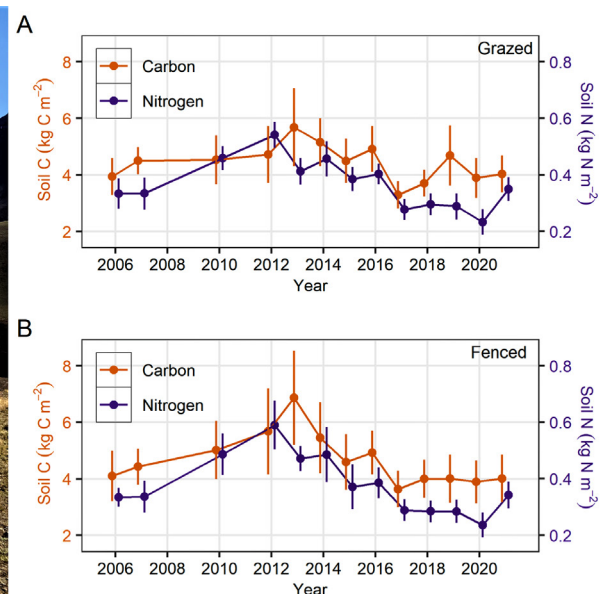


Figure: Change in soil carbon and soil Nitrogen

LAND-ATMOSPHERE INTERACTIONS AT A SEMI-ARID REGIONS IN THE DECCAN PLATEAU

The exchange of heat, moisture, and momentum between the Earth's surface and the atmosphere is commonly discussed under the climate jargon "land-atmosphere interactions". It is one of the most important parameters regulating the regional weather (at short time scales) and climate. Such interactions are essentially related to the dynamics of the atmospheric boundary layer (ABL), the region of the atmosphere in contact with the Earth's surface and extending to a few hundred meters to a few kilometres (depending on the time of the day and the season). The surface energy imbalance between the incoming solar radiation and the outgoing terrestrial radiation is manifested in various forms such as the evaporation of surface water/soil moisture, heating of the land surface and the soil layers beneath it, energy

storage in the vegetation etc, and hence are specific to the surface type and the local meteorology. Accurate knowledge of land-atmosphere interactions and the role of ABL dynamics are essential inputs needed in closing the surface energy balance in high-resolution climate models. However, the lack of sufficient in-situ observations leads to large uncertainties in model simulations. Long-term energy and mass flux measurements over different environments and their time-series comparison with various data sets are required to resolve it.

Multi-year meso-meteorological data from the climate observatory set up in the second campus of IISc at Challakere, a semi-arid environment in the Deccan Plateau have been used by researchers from Divecha Centre for

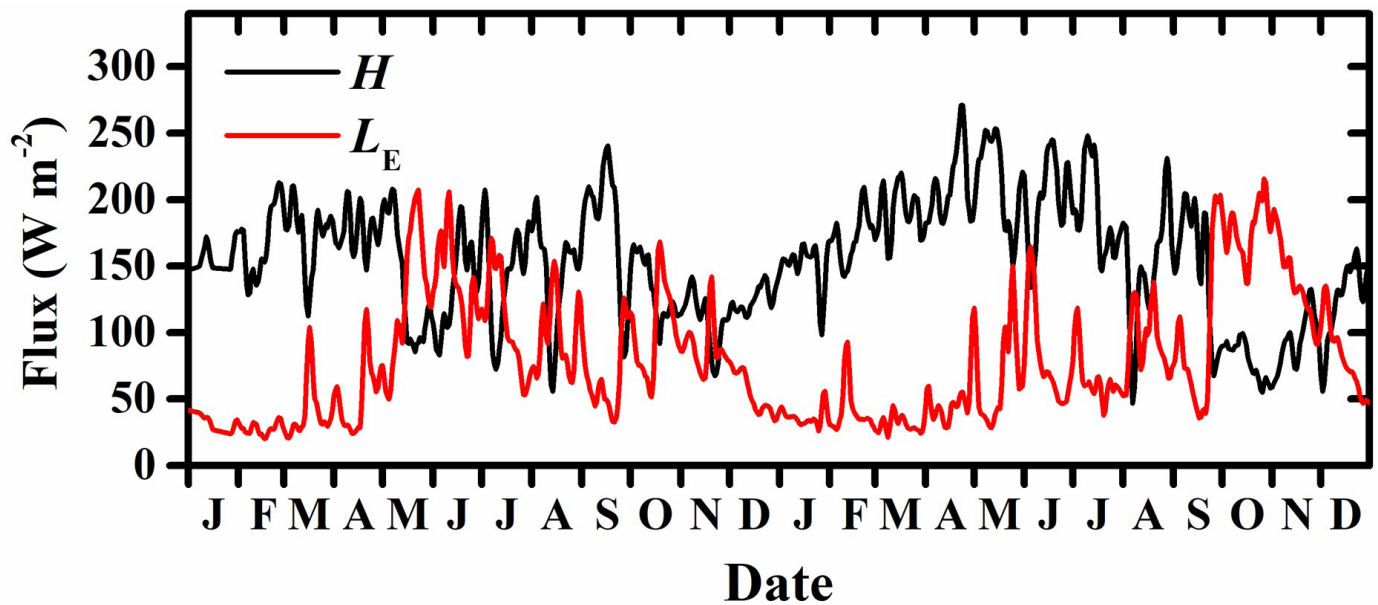


Figure 1: Time series of daily mean values of sensible heat flux (H , red lines) and latent heat flux (L_E , black lines) obtained from the ground observations at Challakere. The x-axis label marks the first letters of the months during the measurement period, starting from January (J) 2018 through December (D) 2019

Climate Change, IISc and Indian Institute of Science Education and Research, Thiruvananthapuram for understanding these processes in detail. Two-year measurements of atmospheric and soil parameters using multiple sensors mounted on a 32-m tall meteorological tower as well as below the soil surface were analyzed, which revealed an anomalous partitioning of surface energy. Irrespective of the seasons, the soil moisture, and its response to rainfall, as well as the surface roughness drive the land-atmosphere interactions and along with the net radiation, play crucial roles in deciding the magnitude of surface fluxes. Contrary to the previously reported results over the Indian region, this study revealed that the surface energy fluxes are partitioned more to sensible heat rather than latent heat

(see Fig. 1). Energy balance closure was observed to be inversely proportional to the height of the roughness elements and their scatter around the measurement site. The measurements also revealed large differences in the rainfall duration and intensity and land-atmosphere interactions compared to reanalysis data (Figure 2). These findings will improve the ABL schemes in climate model simulations over the dry regions in the tropics.

Reference:

Anand, N., Satheesh, S. K., & Moorthy, K. K. (2022). Land-atmosphere interactions at a semi-arid region in the Deccan Plateau. *Journal of Geophysical Research: Atmospheres*, e2022JD037211.

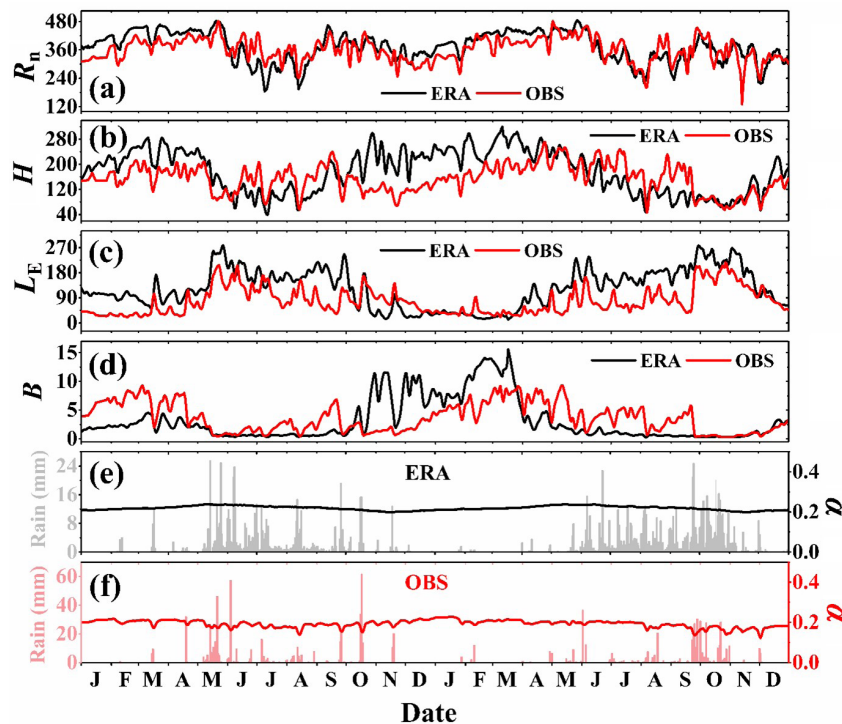


Figure 2: Daily time series of (a) net radiation (R_n), (b) sensible heat flux (H), (c) latent heat flux (LE), (d) and Bowen ratio (B) from observations and ERA5 reanalysis; (e) rainfall and surface albedo (α) from (e) ERA5 reanalysis and (f) observations. All parameters except rainfall were subjected to 7-point moving average smoothing. ERA5 reanalysis data are marked using ‘ERA’ and observational data by ‘OBS’. The x-axis label marks the first letters of the months during the measurement period, starting from January (J) 2018 through December (D) 2019

