Climate Change Research Institute

Science & Technology Solutions for Sustainable Energy Future

Report and Highlights

2014-17


PEARL - A Foundation F
Educational Excellence
Trans-disciplinary Research Cluster on Sustainability Studies
Lecture Hall-
exe, New Delhi
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Dr. D. P. Agrawal
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AWARENESS AND CAPACITY BUILDING
WORKSHOP
on
Advancing Sustainable Development Goals: Role
of Science, Technology & Innovation
Sh. K. K. Sachdev
Dr. M. P. Narayanan
Sh. Gautam Sen
Dr. (Mrs.) Malti Goel
Dr. Malti Goel
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Dr. Harsh K. Gupta
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2018

—— *Message from the President*

It gives me immense pleasure to introduce three years Activity Report of Climate Change Research Institute. It gives us an opportunity to present important initiatives taken by the Institute in Environment and Climate Change Education for creating awareness and capacity building.

The focus has been on imparting knowledge on topics of key societal concerns related to climate change and sustainability issues. In this effort, in 2017 the institute has successfully held the capacity building workshop on Sustainable Development Goals and discussed the role of Science, Technology and Innovation among youth in colleges who are the future torch bearers of sustainable growth. This project was possible in collaboration with India International Center and Indian Network of Global Compact with no external funding support.

During the year 2015, the institute has set a record of organizing 3rd edition of five days Awareness and Capacity Building Workshop on Carbon Capture, Storage and Utilization highlighting Indian contribution. The proceedings are published by Springer in 2017 and it turned out to among the first 25% of books downloaded in 2017, performing well.

The Institute has been working to create a transformative impact on National and International scene through research for finding science & technology solutions and would continue to address newer and emerging topics of national concern.

I take this opportunity to express thanks to all our honored Governing Council Members, Executive Members and Fellows for their guidance and unstinted support. The Institute acknowledges the commitment and sincere efforts of its staff support for satisfactory results in performing various activities.

I am sure that with the genuine collective efforts, the institute is heading confidently towards sustainable growth.

Dr. (Mrs) Malti Goel
Chief Executive and President
Climate Change Research Institute

Climate Change Research Institute

Report and Highlights (2014 -17)

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Climate Change Research Institute

Report and Highlights (2014 – 2017)

THE SOCIETY

The Climate Change Research Institute is a registered society with the Government of India under the Societies Registration Act of 1860 and under Section 12A and 80G of Income Tax Act 1961. The Institute is registered with *NITI Aayog*, Government of India. It became member of United Nations Global Compact in 2015. The Institute is also Associate Member of Global CCS Institute, Australia.

The Climate Change Research Institute has a mission to disseminate science & technology research in the field of environment and climate change, mitigation & adaptation to stakeholders and policy makers. It educates and informs youth in schools and colleges about the ecosystem changes and consequences of climate change. The Institute is internationally renowned whose activities focus on research for finding out solutions to mitigate climate change impacts, policy advocacy and national priorities. Other activities such as governance issues on scientific & technological measures for implementation of UN Sustainable Development Goals for environment protection and economic growth are undertaken.

The Institute with its scientific back-up has been serving the wide strata of society at different levels. It organizes awareness and capacity building workshops, scientific events of international relevance, lectures, campaigns on topics of scientific & societal interest in energy and environment. It aims to address as many stakeholders as possible through lectures in schools on one hand and discussions & awareness workshops among the students and researchers in colleges on the other. It has a vision is to become a Centre for Excellence in developing human resources and technical capacity building in the area of sustainable development. The Institute brochure is at http://ccri.in/brochure/CCRI-Brochure-2016.pdf.

The Climate SAR Bulletin is published to disseminate scientific information about climate change for education and public good on society related topics.

These efforts of our institute in promoting climate change education and creating awareness on emerging environmental issues are, but a few examples of the many ways in which the Climate Change Research Institute has been working to create a transformative impact on National/International scene.

Vision

To become a Centre for Excellence in developing human resources through technical capacity building in the area of environment and climate change education

Main Objectives of the Organization

- Promoting environment education and teaching in climate change amongst wide strata of society.
- Creating scientific awareness through workshops, conferences, lectures, capacity building programmes on the topics of environment and sustainable development.
- Development of educational tools on emerging topics of societal interest; such as energy, health and water in the climate change context.
- To undertake studies in energy sector, clean coal, carbon capture and utilization, renewable sources for finding science & technology solutions.
- To enter into collaborations with other national, international organizations with similar objectives and also encourage study groups on various environmental aspects.

Mission

- To inform youth in schools and colleges about the ecosystem changes and consequences of climate change through awareness and capacity building on topics of scientific & societal interest such as Energy, Health, Air and Water.
- To work with industry, undertake research & training for helping them to meet their Corporate and Social Responsibility (CSR) targets while reducing CO_2 footprints through imparting national and international knowledge.
- To initiate studies/research on scientific & technological measures for stabilizing the greenhouse gas concentrations in the atmosphere.

Activity Highlights

- ❖ Climate Change Education
- ❖ Awareness Workshops
- ❖ Mentoring and Capacity Building
- ❖ Sustainable Development Goals
- ❖ Knowledge Dissemination and Networking
- ❖ Science Policy Research
- ❖ Education tools & Videos

ECC & EEC LECTURE SERIES

Climate Change Research Institute has initiated a bi-monthly series of lectures on 'Environment and Climate Change' in 2015 (ECC Lecture Series 2015). Topics related to our current understanding of emerging issues in environment, climate change impacts and mitigation measures are covered. In this series participants are invited from schools and colleges as well as different institutions. Lectures are delivered by distinguished domain experts. Details are given below.

➢ Topic: **Future Energy Paradigms for Clean Environment**

The first lecture in the 'ECC Lecture Series 2015'was delivered by **Sh. V. S. Verma, Former Member, CERC** on 13th February, 2015 on 'FUTURE ENERGY PARADIGMS FOR CLEAN ENVIRONMENT' at Indian International Centre, New Delhi. Prof D. P. Agrawal Chairman, Governing Council, CCRI presided over the event. Dr. (Mrs.) Malti Goel, CCRI introduced the series. Many teachers as well as students were among the participants in the lecture. Shri Verma shared his experience in the power sector with the audience and encouraged them, especially students to save electricity in their day-to-day work. Topics like clean energy, energy security and energy efficiency concerns were explained. About 70 participants were present in the event. The lecture was followed by many questions from teachers as well as students and their answers. Students have showed keen interest to attend more lectures in future. Bulletin of **Climate *SAR*** (Climate Science & Research) Vol. 1, No.2 published by the Institute was released and distributed among the participants of the programme.

➢ Topic **'Waste Management Strategies'**

Prof. D. P. Agrawal, Former Chairman, UPSC delivered the 2nd ECC lecture on April 24th, 2015 on WASTE MANAGEMENT STRATEGIES. The event was jointly held with India International Center. Dr. (Mrs.) Malti Goel, Executive Director, CCRI presented the importance of Waste Management in our society. Prof. D.P. Agrawal delivered the lecture in Hindi and gave definition of solid waste and described quantum of waste being generated and its impact on environment, technologies and various options to deal with the waste to wealth. The eminent speaker encouraged students towards cleanliness and to promote Swachh Bharat Abhiyan in our society and locality. Dr. B.C. Sabat, Dept. of Environment, Govt. of N.C.T. also addressed the participants and cited examples of cleanliness from developed countries, stressing on the need of becoming aware and taking action to minimize waste as a habit. Students from various schools shared

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their experiences on the work done in their schools and they promised to do a lot in their locality.

➢ Topic **'CO_2 Sequestration: a fresh outlook'**

The third lecture was delivered by **Prof. Malti Goel, Former Advisor & Emeritus Scientist, and Ministry of Science & Technology**. She presented CO_2 SEQUESTRATION: A FRESH OUTLOOK. The event was presided by Prof. Javed Ahmad, Dean Faculty of Science, Jamia Hamdard. Carbon sequestration has emerged as an option to reduce the concentrations of carbon dioxide getting accumulated in the atmosphere from increasing use of energy being generated from combustion of fossil fuel. It was emphasized that understanding of greenhouse gas pollution and carbon sequestration is necessary to take actions for climate change mitigation and to stop environmental degradation. The Economic, Social and Environmental components need to be considered in an integrated manner to ensure that there are minimum conflicts. Participants were encouraged to think and develop new technologies for CO_2 sequestration in biotic and non-biotic ways. Latest advancement of CO_2 capture from the atmosphere and geo-engineering options for climate control were discussed. Prof. G.D. Sharma, Ex-UGC Secretary, and Prof. Pranav Desai, Center for Science Policy Studies, JNU graced the occasion besides other distinguished participants.

➢ Topic **'Energy and Fossil Fuel'**

Climate Change Research Institute held 4th ECC lecture on 16th October, 2015 delivered by **Sh. Gautam Sen**, **Ex-ED, ONGC** and VP, Reliance on ENERGY AND FOSSIL FUEL at India International Centre Annexe, New Delhi. He explained the concepts of development of Oil sector as a vital energy source in a lucid manner. In his address he laid importance of understanding various energy resources and encouraged students to come forward to work together on new challenges in the field of climate change and environment. Prof. D. P. Agrawal, Former Chairman, UPSC and Chairman GC, CCRI presided over the lecture. Schools participated in the quiz in large number and 70 school children attended the lecture in this event.

ECC lecture series has been unique and it sensitized school students from class IXth to XIIth at grass root level to learn about the contemporary issues related to environment and climate change. Competitions were held among school students to create awareness about environment challenges.

AWARENESS AND CAPACITY BUILDING WORKSHOPS

Climate Change Research Institute has taken a major initiative to organize Awareness and Capacity Building Workshops on Emerging topics related to 'Energy and Climate Change'**.** A series of such workshops have been held on Sustainable Energy, Green Buildings and Carbon Capture, Storage and Utilization among others.

➢ Carbon Capture, Storage and Utilization (CCSU): Towards a Low Carbon Growth Strategy (ACBCCS 2015)

In the series, 3rd Awareness and Capacity Building workshop on **Carbon Capture, Storage and Utilization (CCSU): Towards a Low Carbon Growth Strategy (ACBCCS 2015)** was the flagship event held during July 27-31, 2015 at India International Centre, New Delhi. Increasing CO_2 emissions from different sources and their accumulation is a big concern for climate change scientists. The Carbon Capture and Storage (CCS) is an emerging option to reduce CO_2 concentrations in the atmosphere by capturing it from its point of sources and disposing it away from the atmosphere or its utilization. The CCS can achieve significant CO_2 emission reductions in this manner. International Energy Agency, Paris identifies it as a key option within the portfolio of energy technologies required to reduce greenhouse gas emissions. The five day workshop was inaugurated by Dr. M. O. Garg, Director General, Council of Scientific & Industrial Research, New Delhi. Dr. Anupam Agnihotri, Director, JNARDDC, Nagpur delivered the Keynote Address on Carbon dioxide Management – Aluminium Industry Perspective. Eminent speakers from Institutions across the country both Academia and Industry delivered lectures in the five day's workshop.

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ACBCCS - Feedback

"The CCS programme organized well and provided a platform to contact with the faculty and participants from wide range of back ground from different organizations. Discussions were useful and provided good information how to capture & store carbon in different eco-systems - Prof. P.S.Yadava, Professor, Manipur University, Imphal

"We look forward for such awareness workshop in future" – Mr. Rana S. Chakravorty, Chief of Corporate Communications, Mecon Ltd, Ranchi.

"We need such type of interaction in future. Please, arrange this type of CCUS program every year and connect to as many industrial persons with application part" – Mr. Rupak Kishore, IIT Guwhati

" The workshop has given new dimensions to my research. It was excellent and was associated with various problems and solutions in CO2 sequestration. Stress should be laid on cost effectiveness of the process. Also value added product development from CO_2 sequestration etc. should be studied" - Dr. (Mrs.) Suchita Rai, Scientist-IV, JNARDDC, Nagpur

ACBCCS 2015 - Key Outcomes and Recommendations

✓ The workshop got overwhelming response on all five days and it was a grand success both in terms of profile and content. Participants and research scholars learnt many new things. The workshop has given them new dimension in their research works. It was associated with various problems and solutions for climate change.

✓ Cost-effective technology and value added product development were widely discussed with the participants. The workshop was very effective in terms of CO_2 Sequestration through utilization to address climate change concerns.

✓ Emerging Coal technology such as oxy fuel combustion technology look promising as it would increase efficiency, save water and provide CO_2 rich flue gas which can be directly captured.

✓ During the workshop deliberations a multi-sectoral programme has been suggested for development of ammonia based absorbents for CO_2 capture. The programme needs to be anchored with the participation of Ministries of Power, Chemicals & Fertilizers, Agriculture, Earth Sciences, Steel and Power as well as academic Institution - University of Calcutta.

✓ New technology implementation has to address economics, which sometimes comes down when fuel costs change. There are issues of increasing pollution, global warming and the efficiency of power plants which need to be addressed. We need to do a lot to improve the coal quality in thermal plants working below average.

✓ To meet the challenges of climate change, increasing energy demand and sustainability, an Integrated Research and Development Institute for CO_2 Sequestration studies have to be established in Government/Public/Private partnership and International collaboration.

➢ Awareness and Capacity Building Workshop on Sustainable Habitat & Learning Environment

Climate Change Research Institute jointly with Society for Economic and Education Development and IIC has organized 2nd Awareness and Capacity Building Workshop on **Sustainable Habitat & Learning Environment** on 6th June, 2014 at IIC, New Delhi. **Dr. S.Y. Quraishi**, **Ex-Chief Election Commissioner** presided over the Valedictory Session. Architects, Planners and Health Building Scientists from India, Australia and UK participated. Architectural innovations in modern buildings were presented. Issues for habitat planning, healing character and sustainability were discussed. All participants appreciated outcome of this workshop. In view of frequent climate related natural disasters of various forms around

the globe, resilience has become an important issue which should be taken very seriously in building design. Both Energy and Environment as a theme for deliberation under sustainable habitat should be focused and given priority for sustainable habitat. Participants attended event from different organizations including academia.

➢ AGBRES III
Workshop on Awareness in Green Building Responsible Education in Schools

- ✓ **Green Buildings** are environmentally responsible and are expected to be resource-efficient throughout a building's life cycle. New technologies are constantly being developed to complement current practices in creating greener structures. The common objective of green buildings is to reduce the overall impact of the built environment on human health and preserve the natural environment by reducing waste, pollution and environmental degradation as well as efficient use of energy and water etc.

- ✓ The 3rd awareness workshop on **Green Buildings Responsible Education in Schools (AGBRES-III)** on **'Green Buildings and Smart Cities'** was organized by Climate Change Research Institute in collaboration with India International Centre on 31st January 2014 in IIC New Delhi. **Chief Guest Shri Gireesh Pradhan, Chairman, Central Electricity Regulatory Commission** said that the youth has to look for out-of-the box solutions for addressing climate change concerns in urban planning & design. **Guest of Honour Dr. Arun K. Tripathi**, Director, MNRE apprised about the initiatives of MNRE.

- ✓ The theme of the workshop was introduced by **Dr. (Mrs) Malti Goel**, **Executive Director, CCRI** on Green Buildings and Smart Cities, both having similar concerns. These are; (i) *Energy and fuel saving* - both have to save fuel through improving energy efficiency and maximizing use of renewable energy (ii) *Use of information technology* - use of IT is very important in green buildings as well as smart cities for developing efficient services. (iii) *Improvement in quality of life* - we want to have good cities and good houses; both are linked with human comfort and are addressing environmental challenges. Students from Universal Public School and from various Universities including School of Planning & Architecture actively participated.

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AGBRES III - Key Recommendations

- Green buildings are something which is not very difficult to make. It requires adequate measures in advance and it may add around 10 to 15 percent to the cost of the building. But if we compare that to the overall cost of electricity that will be saved for a long period of time, it is an expenditure which is worth making. In multi storey apartment buildings, innovative green building techniques can be used. Design principles may be different, but there will be enormous savings in the long-term. Information technology has a big role to play.

- India would need about 3000 new towns of about one lakh population to be added each in the next 20-25 years. These can all be designed as **Smart Cities**. We can also retrofit the existing cities, wherever it is possible. Cities are source of GDP growth and globally it is estimated that by 2050, 68% of the GDP of the world will come only from 600 cities. In the Indian context 750-800 million people are going to stay in cities. It will be a huge problem and would require some really fundamental out-of-the-box thinking. No solution is too small. Some of our greatest benefits have come out of very small solutions. Youth should be encouraged to develop innovation in solar energy or green buildings from our Indian perspective.

- India is developing and would build 75%-80% of its infrastructure in the coming years. If we are on a sustainable path, the benefits of that will be enormous. Concept of water management, energy management, waste management will form the core of anything smart whether it's a city, whether it's a building, whether it's a colony. The concept 'smart' will come into play in the urban context, only if three things Water, Waste and Energy are managed smartly along with traffic. Future planning which doesn't take into consideration, these three basic elements is not going to succeed.

- It was pointed out that rehabilitation of sites damaged by environmental contamination could be a better option to start with than any new piece of land where large amount of energy and resource is needed to make the land worthy of building. Rehabilitation could save large amount of energy. Already existing landscape, soil and natural features should be protected. Dimensional planning and other material efficiency strategies should be used to reduce the construction cost.

This series of workshops on Green Buildings is a very good initiative to create awareness among youth. More such workshops should be planned for those in schools to sensitize them to choose science as future career.

ENVIRONMENT AND CLIMATE CHANGE COMPAIGNS

❖ World Earth Day

Climate Change Research Institute has celebrated **Earth Day 2015** on April 24th, 2015 in collaboration with Ministry of Earth Sciences. Theme of the year was 'Clean Earth - Green Earth**'.** On this occasion, the Institute organized an **Inter-school Slogan Writing competition**. Dr. (Mrs) Malti Goel, President, CCRI apprised the students, who participated in large numbers from *Navyug School, Sardar Patel School, New Horizon Public School and Universal Public School*, about the importance of Earth Day, its genesis and current status. An eminent jury evaluated the 53 slogan entries from students of class VIIIth to class Xth from different schools on the topics under the Earth Day theme **Clean Earth - Green Earth** of this year covering topics as below

- ✓ Swachh Bharat Abhiyan
- ✓ Air Pollution
- ✓ Causes & effects of Air Pollution
- ✓ Clean Rivers
- ✓ Waste Management
- ✓ Role of Plantation for CO_2 Sequestration in the atmosphere.

Many slogan entries were displayed during the event. **Shri S. D. Tripathi, Ex-Executive Director-NHPC** headed the Jury for the competition and announced the results of slogan competition.

Awards as per government guidelines were given to the first, second and third winning entries. Certificates were given away to all participants of Inter-school Slogan Writing competition. More than 70 participants were present in the event and showed their concern and interest about Earth and Environment. The support from Ministry of Earth Sciences was thankfully acknowledged.

❖ World Environment Day

2014

Climate Change Research Institute has celebrated World Environment Day on 6th June, 2014. The slogan for the day was '**Small Island States and Climate Change'.** The event was graced by dignitaries **Dr. S. Y Quraishi, Former Chief Election Commissioner, Prof G.D. Sharma Ex-Secretary UGC, Dr Sandeep Chatterjee, Registrar, JNU** among others. The Institute pledged to celebrate WED every year to create awareness and to take some kind of commitment from all that

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they are concerned with the environment and climate change for better future in the earth.

2015

World Environment Day was celebrated on 5th June, 2015 with the theme of the year '**Seven Billion Dreams, One Planet, Consume with care**' at India International Centre, New Delhi. The event was presided by **Prof G.D. Sharma Ex-Secretary UGC. Shri V.S. Verma, Ex-Member CERC, Prof. S. Ahmad, Ex-VC Jamia Hamdard**, Professors and research scholars participated in these celebrations. Chief Guest Prof. Javed Ahmed, Dean (Faculty of Science), Jamia Hamdard University said that not only underground storage but terrestrial sequestration of CO_2 is very important for us. He also gave us many recommendations and guidelines for the way forward. During his speech Prof. Pranav Desai, JNU reminded us that since 5th June, 1972 we have been celebrating **World Environment Day**. He also emphasized that how Economic, Social and Environmental components need to be considered in an integrated manner to ensure that there are minimum conflicts. Speakers shared their knowledge and concern about environment and climate change. About 55 participants from different colleges and institutions were present in both events. Green plants were given as a token of pledge of World Environment Day to all the participants. TERI Press displayed their recent publications during the event.

2016

The Climate Change Research Institute (CCRI) in 2016 celebrated World Environment to create awareness and deliberate ways & means of '**Implementation of Sustainable Development Goals**'. The workshop was held in association with Department of Environment Planning, School of Planning & Architecture. Chief Guest on the occasion was **Dr S. Y. Quraishi, Former Chief Election Commissioner, India**. He said it was one of the first workshops held to focus on **Goal 17** of SDGs in New Delhi. The social and environmental problems in achieving the targets of **SDG 11** and **SDG 12** were discussed among the civil society participants, to evolve strategies on case to case basis.

Special lecture in Environment and Earth Care (EEC) Lecture series on this occasion was delivered by **Shri A. K. Jain**, former Commissioner, Delhi Development Authority, on **Sustainable Green and Smart Cities.** On this occasion, students from School of Planning & Architecture, New Delhi presented their research related to Sustainable Development Goals strategies to enhance the ecosystem services. Dr. Neha Tripathi, Secretary CCRI presented vote of thanks.

❖ World Ozone Day

2015

The CCRI has organized celebrated 'World Ozone Day 2015' on 16th October, 2015 at IIC Annexe. Dr. (Mrs) Malti Goel, president, CCRI apprised school children about the importance of Ozone Day, its genesis and current status of ozone depleting substances. **Prof. D. P. Agrawal Ex-Chairman UPSC** presided over the event. Students from *Amity International School (Saket), DAV Public School (Ashok Vihar), Universal Public School (Preet Vihar), Apeejay School (Pitampura), Navyug School (Motibagh), New Horizon School (H.Nizamuddin), Bal Bharti Public School (GRH Marg), and Balwant Rai Mehta Vidya Bhawan* participated**.** On this occasion Ozone Day Quiz was designed and competition was held on the spot for school students on the topics covering the ozone layer depletion, energy and climate change. First and second prizes to winning entries in the quiz from Universal Public School and DAV Public Schools were awarded by the Institute. The Institute got overwhelming response from the participating school teachers and students. More than 80 participants attended the event.

2016

The CCRI has organized an event for celebrating 'World Ozone Day 2016' on 16th November, 2016 at IIC Annexe. On this occasion a Guest Lecture in the Environment and Earth Care series was delivered by **Prof. P. B. Sharma, Vice Chancellor, Amity University.** "Innovative Solutions to Tackle the Monumental Challenges of Climate Change– Sharing Research & Innovation Experience at Delhi College of Engineering/Delhi Technological University, Rajiv Gandhi Proudyogiki Vishwavidyalaya and Amity University Gurgaon".

The welcome remarks of the programme were given by Dr. (Mrs.) Malti Goel, CEO, CCRI, who apprised the students about the Climate Change challenges and SDGs. Chairman's address was given by the Prof. D.P. Agrawal, Chairman Governing Council, CCRI and Ex-Chairman, UPSC. The lecture aimed at education, stimulation, motivation and encouragement to youth to tackle climate change and to encourage them take up science in their career. Examples to protect the Environment through new scientific innovations were presented. In total 64 students of following schools participated in the programme.

- Ambience Public School, Safdarjung Enclave
- Universal Public School, Preet Vihar
- Navyug Sr. Sec. School, Laxmibai Nagar
- Amity International School, Saket

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SUSTAINABLE DEVELOPMENT GOALS (SDGs)

ACBSDG 2017 -- Workshop on Awareness and Capacity Building in Advancing Sustainable Development Goals: *Role of Science, Technology and Innovation*

India attaches high priority to the 2030 agenda for Sustainable Development which the United Nations adopted unanimously in September 2015, and which has greater significance for the well-being and progress of the human kind. The Climate Change Research Institute organized a two days' workshop on Awareness and Capacity Building on **Advancing Sustainable Development Goals: Roles of Science, Technology and Innovation**. The unique workshop one of the first to discuss role of science, technology and innovation was held on July 27-28, 2017 in collaboration with Global Compact Network India in New Delhi. Distinguished speakers from Government, Academia and Industry addressed the participating youth.

The main objective was to create a platform for describing and sharing ideas for formal or informal scientific research-based, academic, technological and innovative exchanges. The awareness workshop brought together aspiring scholars from academia, industry and management disciplines. Industry participants came forward to share their experience in curtailing CO_2 emissions in their sphere of activity. An overview of the discussions is covered in the **Book of Abstracts** http://ccri.in/pdf/proceedings/ACBSDG-17-Abstract-Full.pdf describing the need for evolving strategies.

A sample **Quiz on SDGs** with multiple choices was given to the student participants. The students from five academic institutions (four being management and one technical) participated in the competition. In the quiz the girls though less in number scored better than the boys. The **Certificates of Participation in ACBSDG 2017** were awarded to the participating students from different universities and colleges.

Participating Educational Institutions in the Workshop and SDGs Quiz

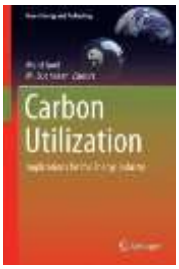
- Amity Institute of Nano-Technology (AIN), Noida, India
- Entrepreneurship & Management Process International (EMPI) Business School, Delhi, India
- Jagan Institute of Management Studies (JIMS), Kalkaji, New Delhi, India
- Institute of Management Studies (IMS), Ghaziabad, Uttar Pradesh, India
- G.L. Bajaj Institute of Management (GLBIM), Greater Noida, Uttar Pradesh, India

HON'BLE UNION MINISTER RELEASED THE BOOK ON CARBON CAPTURE, STORAGE AND UTILIZATION

Shri Suresh Prabhakar Prabhu, Hon'ble Union Minister of Railways, Government of India honored us by releasing the book entitled "**Carbon Capture, Storage and Utilization: A possible climate change solution for energy industry**", eds. Dr. Malti Goel, Dr. M. Sudhakar, Shri R.V. Shahi on 20th January, 2015 at Rail Bhavan. **Shri R.V. Shahi, former Secretary, Ministry of Power** gave special address on this occasion. Eminent personalities from power industry, senior scientists from Ministry of Earth Sciences and Science & Technology participated. The book is published by the Climate Change Research Institute from the Lecture Notes of Awareness and Capacity Building Workshop held on January 15-19, 2013. It analyses how current scientific research on carbon capture, storage and utilization is being pursued throughout the world and presents Indian highlights. The book covers various aspects of carbon dioxide capture, utilization and takes a closer to the earth processes. The event was held in collaboration with TERI Press, New Delhi.

BOOK ON CARBON UTILIZATION: APPLICATIONS FOR THE ENERGY INDUSTRY

The Climate Change Research Institute contributed to the book on '**Carbon Utilization: Applications for the Energy Industry'** edited by Malti Goel & M Sudhakar, published by SPRINGER, in their *Green Energy and Technology Series* 2017. It comprises of lecture notes of the capacity building workshop on 'Carbon Capture, Storage and Utilization: Towards a Low Carbon Growth Strategy in Energy Industry' organized by the Institute. It covers advancements in environment friendly technologies, and carbon dioxide terrestrial & biotic sequestration research options in the context of anthropogenic climate change. Indian contribution to development and diffusion of low carbon technology in the energy industry is described. The key highpoints are;



- Focus on the Science and Technology of Anthropogenic Carbon Dioxide Removal Processes
- Highlights of Indian contribution to CO_2 Terrestrial and Biotic Sequestration options in the context of Climate Change
- Perspectives towards Low Carbon Growth Strategy in the Energy Industry

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IMPARTING KNOWLEDGE – CCRI PUBLICATIONS (2014-17)

- Book of Abstracts for the Workshop on Awareness and Capacity Building in Advancing Sustainable Development Goals: Role of Science, Technology and Innovation conducted on 27-28th July, 2017, India International Centre, New Delhi -11003 have been published.

- Proceedings of the Third Lecture in the Environment and Earth Care (EEC) series, held at India International Centre Annexe on 16th November, 2016 have been brought out. The event was celebrated on Children's Day Workshop on Awareness on Climate Change Responsible Education in Schools participated by many school children of class IX, X & XI from four different schools

- Proceedings of Awareness Workshop conducted on World Environment Day 2016 on the theme *Implementation of Sustainable Development Goals* in collaboration with IIC, New Delhi on June 7th 2016 have been brought out. The Guest Lecture in the Environment and Earth Care Series was on Sustainable Green and Smart Cities.

- Proceedings of Brainstorming Discussion Meeting on *Science Diplomacy in South Asia* organized by the Climate Change Research Institute (CCRI) in collaboration with Trans–Disciplining Research Cluster in Sustainability Studies (TRCSS), JNU on 12th May 2016 at IIC New Delhi have been published.

- Proceedings of Awareness and Capacity Building Workshop on Carbon Capture, Storage and Utilization (CCSU): Towards a Low Carbon Growth Strategy (ACBCCS 2015) was brought out in December. Presentation summary of the speakers and recommendations of the workshop have been published into these proceedings. Copies have also sent to the speakers and well as delegates for their record.

- Pre-Workshop Lecture Notes on *Awareness and* Capacity Building Workshop on Carbon Capture, Storage and Utilization (CCSU)*:* Towards a Low Carbon Growth Strategy (ACBCCS 2015) was published ahead of the workshop with invited speaker's lecture summary and brief background of the speaker. These notes have distributed to participants of the ACBCCS 2015.

- Proceedings of 2nd Awareness and Capacity Building Workshop on *Sustainable Habitat & Learning Environment* held on IIC, New Delhi on 6th June, 2015 was published.

- Proceedings of 3rd Awareness and Green Buildings Responsible Education on *Green Buildings and Smart Cities*, 2014 were published. In the proceedings, all presentation summaries and outcome included and copies distributed free of cost to the participants.

BULLETIN 'Climate SAR'

Climate Change Research Institute brings out a Bulletin of **Climate Science and Research '*Climate SAR'*** for knowledge dissemination among youth especially in schools and colleges. The following issues have been published.

- The first issue of "Climate SAR Vol. I - No. 1 (January - June, 2014) focused on Weather and Climate. This volume was released in the 1st ECC lecture held on 13th February 2015 at IIC, New Delhi and freely distributed to the participants.

- The Second Bulletin of Climate *SAR* (Climate Science & Research) Vol. I, No.2 on Global Warming and Climate Change explained in a very attractive manner for students was released and distributed among the participants in a programme of Earth Day Celebration organized by Climate Change Research Institute on 24th April, 2015.

- Climate Change Research Institute has released the third Bulletin Climate *SAR*, Vol. II - No. 1 (January - June, 2015) on 5th June, 2015 at India International Centre. The theme was Carbon Sequestration.

- The fourth Bulletin of Climate Change Research Institute Climate SAR, Vol. II - No. 2, (July - December, 2015), has Green Buildings as its theme.

- The Climate SAR, Vol. III – No. 1 (January – June 2016) throws light on Paris Agreement on Climate Change and India's Nationally Determined Contributions.

- The sixth Bulletin is Climate SAR, Vol. III – No. 2 (July - December 2016) on UN Sustainable Development Goals and their social targets.

- The Renewable Energy is the theme of Climate SAR, Vol. IV – No. 1 (January – June 2017). The Bulletin was circulated to the participants of ACBSDG.

- The eight issue of Climate SAR, Vol. IV – No. 2 (July - December 2017) describes impacts of Climate Change on Human Health. The Bulletin was released on the occasion of World Environment Day 2018 at the Awareness Workshop on Beating Plastic Pollution.

Vision

To become a Centre for Excellence in developing human resources through technical capacity building in the area of environment and climate change education

COLLABORATIVE ACTIVITIES OF THE INSTITUTE

1. The Madhav Institute of Technology and Science (MITS), Gwalior in collaboration with the Climate Change Research Institute organized the **'National Conference on Green Buildings for Sustainable Development'** at Gwalior. The Conference was held on 19 & 20th March 2015. Dr. Malti Goel, ED, CCRI inaugurated the conference as Chief Guest and delivered the *Address* on ***'Green Buildings in India: Perspectives for Social Transformations'***. The conference was participated by a large number of colleges in the region. Many new insights about the research by college professors were reported.

2. As member of United Nations Global Compact (UNGC) the Institute organized the Awareness Workshop on Accelerating Sustainable Development Goals in collaboration with the Indian Network of Global Compact in 2017.

3. The Institute has organized events and environment campaigns of societal interest and for climate change education among young students in collaboration with the India International Centre.

4. Collaborative programmes are held with other organizations and premier academic institutions.

PARTICIPATION IN IMPORTANT MEETINGS

2015 GREEN TECH – CAS-TWAS Symposium, Chinese Academy of Sciences, Beijing

Dr. (Mrs) Malti Goel, President & Executive Director CCRI attended on invitation **Symposium on Green Technology for Sustainable Development (2015 Green Tech)**, held in Beijing, China on July 23-25, 2015, at Institute of Process Engineering, Chinese Academy of Sciences. Green technology for sustainable development was the main theme. The symposium includes the following topics: 1) Green Solvent and Green Chemistry; 2) Catalytic Reaction and Process Engineering; 3) Biotechnology and Bioprocess; 4) Nanotechnology and Materials; 5) Renewable Energy and Green Technology; 6) Environmental Pollution Control; 7) The Other Related Topics.

Dr. Malti Goel gave the Invited lecture on '**Innovative Solar Policies in India for Sustainable Development'**. She also chaired a Technical Session and visited impressive research laboratories at Institute of Process Engineering. It was an enlightening experience, there were papers presented on the emerging topics of green technology by experts from six countries.

Participation in International UNGC Leadership Summit

Dr. (Mrs) Malti Goel represented the Institute in the **United Nations Leadership Summit MAKING GLOBAL GOALS, LOCAL BUSINESS** held at the UN Headquarters, New York on 22-23 June 2016. Participated by many countries the focus area of the Summit were; A New Era for Responsible Business, New Opportunities and How to Change Mindset.

GCE 2016 - a CAS TWAS Symposium, Chinese Academy of Sciences, Beijing

Dr. (Mrs) Malti Goel participated on invitation in the CAS-TWAS Symposium at Institute of Process Engineering, Chinese Academy of Sciences on **Green Chemistry and Engineering for Sustainable Development (GCE 2016**), Beijing. Green solvents are replacing conventional solvents to minimize their chemical persistence in the environment. Dr. Malti Goel presented an Invited talk on **Recent Advances in CO2 Capture and Utilization for Mitigation of Climate Change: Green Technology Perspective for Industry.**

Indo-Australian Workshop on Development and Application of Low Emission Coal Technologies, Chennai

Dr. Malti Goel was invited to the **Indo-Australian Workshop** Workshop on **Development and Application of Low Emission Coal Technologies for the Indian Scenario** held on 11-12 April 2017, organized by Anna University and CSIRO Australia. She chaired the **Technical Session on CO_2 Capture Technology Development and Applications.**

National Seminar on Carbon Capture and Utilization Technology, IICE Kolkata

National Seminar organized on **Carbon Capture and Utilization Technology** was organized by Indian Institute of Chemical Engineers, Kolkata Chapter on February 24-25, 2017. Dr. (Mrs) Malti Goel was the Keynote Speaker on **Carbon Utilization: A Policy Dilemma or an Emerging Technological Challenge**. The Seminar triggered discussion on the importance of CO_2 utilization technology among the eminent group of chemical engineers.

National Conference on Global Warming and Climate Change, EPCO, Bhopal

Vision

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Dr. (Mrs) Malti Goel, President, Climate Change Research Institute was honored invitee to the **National Conference on Global Warming and Climate Change** organized by Environmental Planning and Coordination (EPCO), Bhopal on November 21-22, 2015 held at **Vidhan Sabha, Bhopal**.

National Conference on Environmental Challenges in the Steel Sector, Tata Steel, Jamshedpur

Dr. (Mrs) Malti Goel, President, Climate Change Research Institute delivered the Guest Lecture on *Catalysing Transformation in Steel Industry towards CCS Enabling Technology* in the National Conference on **Environment Challenges in Steel Sector organized by Tata Steel, Jamshedpur**, 19th February 2016. Indian scenario in steel sector R&D was presented and key environmental challenges for reduction of greenhouse gas emissions were discussed.

AWARDS AND HONORS

- **The Institution of Electronics and Telecommunication Engineer**s honoured Dr. (Mrs) Malti Goel in the IETE Women's Day Celebration Seminar on **Challenges and Opportunities for Women in Science and Technology** on 8th March, 2014, New Delhi.

- International Conference on Environment and Ecology, Kolkata awarded **Fellow** to Dr. (Mrs) Malti Goel for her outstanding contribution in the field of Environment and Ecology on 2nd March 2015.

- Dr. (Mrs) Malti Goel was ***Chief Guest*** **to the Platinum Jubilee Annual Function Celebrations of 'Birla Balika Vidyapeeth', Pilani** on 8th December 2015 as distinguish Alumni of the school.

- **Bharat Nirman** facilitated Dr. (Mrs) Malti Goel with **Build India (Corporate) Award 2015** for recognition of her contribution in the field of Environment on 15th November, 2015, New Delhi.

- **Madhav Institute of Technology and Science** honoured Dr. (Mrs) Malti Goel on the Women's Day 8th March 2016. She delivered Inauguration Address of the **AICTE Course** on "Projected Strategies and Regulations to Address Current Environment Challenges", held at Gwalior.

- **PEARL Foundation Lifetime Achievement Award 2016** was conferred to Dr. (Mrs) Malti Goel in recognition of her outstanding contributions and achievements in the field of Climate Change Research in India at the Award function held at Madurai on 10th December 2016.

Glimpses Of Events

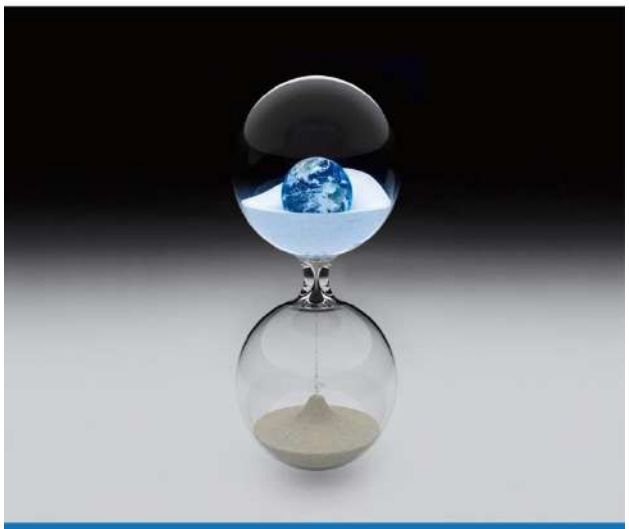
Our Climate *SAR* Bulletins

Climate *SAR*, Vol.1 No.1 (January-June 2014)

Vol. I - No. 1 January - June, 2014

Climate *SAR* सार

Climate Science And Research



Climate Change Research Institute
Science & Technology Solution for Sustainable Energy Future
C- 85 Shivalik, New Delhi 110017

FROM EDITOR

As monsoon arrives, we say what a relief from hot and sultry weather! Monsoon is a welcome season for most parts of the country much needed for agriculture prone states.

As the rain is delayed in this year, I am reminded of a folk-lore in Gujrat, which says, *"It there is a Sunday on the 10th day of the month of Jyesth, there will be no rain and severe famine."* Assuming that year of famine is a year in which rainfall is below normal, the weather data has not proved it yet.

I am wondering was it the reason for below normal rain fall this year. After all Indian traditions have great depth and this is from '*Brihat Samhita*'. Even if we do not know the basis of falk-lore such wisdom cannot be over looked.

We at Climate Change Research Institute have started this bulletin on Climate Science and Research, as "Climate SAR". In this issue we start with 'Weather' and 'Climate'. You learn about weather, seasons and climate. How weather is measured and why weather forecast is made?

Happy reading and send your feedback and suggestions

Malti Goel
Executive Director, CCRI

ABOUT WEATHER

Weather is an important part of our lives. We find that weather controls how and where we live, what we wear and how much energy we consume. Weather is always changing. For example: we say it is raining today, yesterday it was sunny and hot. Weather predictions are made by Meteorologists, who provide us day to day information about weather. Weather changes from place to place. The weather at different locations changes depending on whether it is a hilly area or near the sea cost.

ABOUT SEASON?

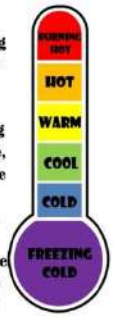
Season is synthesis of weather at a place over a period of three weeks. When similar type of conditions persist we call it a season. For example: Hot, Cold, Rainy or Spring season.

WEATHER FORECAST

Weather forecasting is the application of science and technology to predict the future state of the atmosphere for a given location. Weather forecasts are made by collecting quantitative data about the current state of the atmosphere at a given place. Super computers analyze the data using scientific understanding of atmospheric processes and make a forecast about how the weather will evolve at that place. We can make weather forecast up to one day, three days or ten days in advance using different forecast models.

WHAT IS CLIMATE?

Climate is often spoken about at the same time as weather, but it is something quite different. The climate is the common, average weather conditions at a particular place over a long period of time (for example, more than three weeks). We learn about different climates around the world, when they occur for more than 30 years. Deserts have a hot and dry climate while the Antarctica a has a very cold and dry climate.



FOLK-LORES

Human beings have attempted to predict the weather informally over millennia. There are many weather folk-lores about rainfall, common in different parts of the country as follows.

'When clouds appear like partridge feathers and spread across the sky, thay will not go without shedding rain.'

'When lightning flashes in the Northern sky and the wind blows from the east & oxen under shelter because it sure to rain.'

'When water in the pitcher does not cool, when sparrows bathe in dust and the ants take their eggs to a safer place, you can be sure of a heavy downpour.'

'If the southern wind flows in the months of Megha and Paush (January-February) the summer monsoon is bound to be good.'

'If in the month of Falgun, it rains so much as to wash the Batard tree flowers, If there is lighting in the month of Baisakh and if it is too hot in the month of Jyesth, then there will be no end to rains in the monsoon.' (Gujarat)

'If January is hot and April is cold, early floods are fore told.' (Bengal)

'If there is thundering in the month of any (June-July), there will be no rain for two months.' (Tamilnadu)

'Scorching heat in June indicates heavy rain' (Uttar Pradesh)

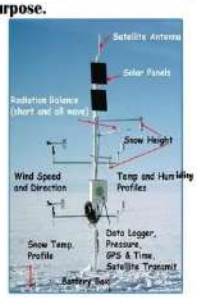
Source : U-PROBE for Weather & Climate, H.N. Srivastava and Malti Goel, DST Publications, 2007.

WEATHER MONITORING

Weather monitoring is done using instruments to measure temperature, relative humidity, pressure, rainfall and wind data. These measurements are carried out at monitoring stations across the globe at a constant time intervals and at diffrent heights. In Addition weather monitoring is done by using the satellites. The satellites revolving in outer space are fitted with powerful cameras which take the photographs of cloud formations in the atmosphere at short intervals and then transmit these photographs to the earth. These satellites also carry a large variety of scientific instruments which keep on collecting weather-related data in the atmosphere and send this information to the meteorological centers of the earth. Instruments to measure air pollution are also provided on board.

AUTOMATIC WEATHER STATION (AWS)

An automatic weather station (AWS) is an automated version of the traditional weather monitoring station. It enables measurements from remote areas as well as local area where manual monitoring in not possible. An AWS consist of a weather-proof enclosure containing the data logger, GPS and the meteorological sensors with an attached wind vane mounted on a mast. In remote places AWS has a chargeable battery which can be connected to a solar panel and a telemetry systemto transmit the data to a central place. The specific configuration may vary from place to place and according to the purpose.



Automatic weather station in a snow clad area

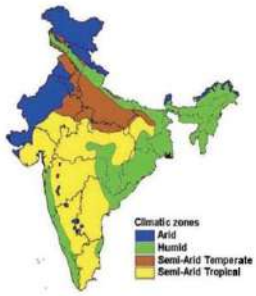
INDIA'S WEATHER

The climate of India resolves into four major climatic types with four sub seasons, winter (December to February), summer (March to May), monsoon or rainy season (June to September), and post-monsoon period (October to November). India has a tropical climate except for Himalayas, Which are more temperate.

The weather has significant variations from region to region. In central region coolest weather lasts from around the end of November to end of February, with mostly sunny days. Fog is common occurence during this period in some parts. The hot weather, when it is dry, dusty and unpleasant, can vary from March and June. South west Monsoon rains occur in most regions of the country between June and September. North-east monsoon rainfall occurs during October mostly in south India.

MICROCLIMATES

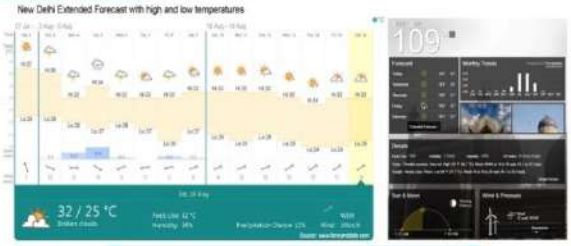
According to traditional Hindu philosophy there are six seasons, each about two months long. These are; Spring, Summer, Monsoon, Autumn, Winter and Shishira. Climate influences give rise to desert in the west, alpine tundra and glaciers in the north, humid tropical regions in the north-east and supporting rain forests in the southwest. Regions have starkly different—yet tightly clustered—microclimates. In India four micro-climatic zones are : Arid, Humid, Semi-arid Temperate and Semi-arid Tropical.



WEATHER IN MEDIA

Weather in Dailies

New Delhi Extended Forecast with high and low temperatures



Weather on Television

Weather Data Analysis

Maximum and minimum temperatures and precipitation data for Leh and Bangalore the two cities of major Indian climate types from January to December, is shown in the climate charts here. India Meterological Department (IMD) is repository of all weather data in the country.

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Climate Science And Research

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FROM EDITOR

'Global Warming refers to rise in the global average surface temperature'.

'Climate Change is about changes in climate patterns, including temperature, precipitation, winds and others'.

STOP Global Warming

What you can do to stop global warming? Start by reducing your Carbon Footprints. Carbon dioxide emission occurs by all your day-to-day activities that consume energy. There are number of things you can do by reducing your energy needs. You can also share information about it with your friends & family, make global warming quiz with your class mates and also be vigilant about the energy use.

In this issue I tell you about global warming, its causes, effects and taking action to stop it. You learn about greenhouse gases and enhanced greenhouses effect. The global warming can lead to climate change, which in turn causes several adverse impacts. It changes ecosystem, threatens health and crops.

Climate Change Research Institute has started this bulletin on Climate Science and Research- 'Climate *SAR*'. By learning about global warming and understanding it, you are in a better position to look for solutions for yourself.

Happy reading and send your feedback to contactus@ccri.in

Dr. (Mrs.) Malti Goel
CEO, Climate Change Research Institute

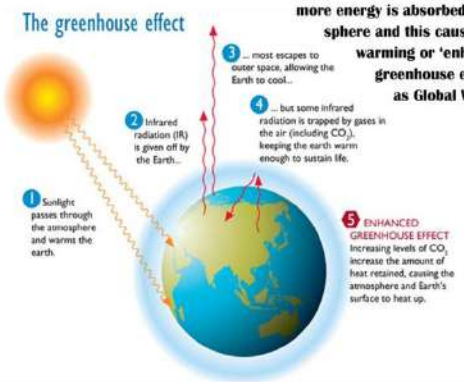
WHAT IS GLOBAL WARMING?

Global Warming is the increase of Earth's average surface temperature. A number of gases emitted from anthropogenic activities are getting accumulated in the atmosphere and giving rise to global warming. These gases trap heat and are causing enhanced Greenhouse Effect. The gases are collectively called greenhouse gases.

GREENHOUSE EFFECT

The Earth's atmosphere is all around us. When sunlight enters the Earth's atmosphere, it warms the land and water. Earth returns the energy to atmosphere in the form of Infrared rays. Some of it is absorbed in air in the atmosphere, while remaining goes back to space. Energy in the atmosphere warms the earth and make it habitable. This is natural greenhouse effect.

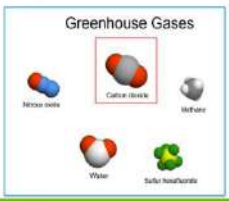
When greenhouse gases are added in the air from anthropogenic activities more energy is absorbed in the atmosphere and this causes more warming or 'enhanced greenhouse effect' known as Global Warming.



WHAT ARE THE GREENHOUSE GASES?

Greenhouse gases are carbon dioxide, nitrous oxide, methane and chlorofluorocarbons (also called c-gases). Carbon dioxide emissions from burning of fossil fuels or from deforestation trap more heat that would otherwise escape from Earth. Even slight increase in atmospheric levels of carbon dioxide (CO_2) can cause a substantial increase in temperature. Other gases are also emitted from industrial activities. These gases remain in air for a very long time.

Water vapor is another greenhouse gas, it is not produced directly by humankind in significant amount and it has a short life time, so can easily condense or evaporate. It does not add to global warming. Sulfur hexafluoride and troposphere ozone are minor greenhouse gases.



CO_2

Carbon dioxide (CO_2=1 carbon, 2 oxygen atoms) is a colorless, odourless and tasteless gas. It is about 1.5 times heavier than air. Under normal atmospheric conditions it is stable, inert, and nontoxic gas. In solid form it is known as dry ice.

The atmosphere contains approximately 0.03 percent carbon dioxide by volume. Nearly all animal life produces carbon dioxide during respiration, which is exhaled. Whereas plant life inhales or absorbs CO_2 from air. It is used in their growth or food production in a process called photosynthesis. When plants decompose, carbon dioxide is released as a by-product.

Scientific analysis and observations suggest that atmospheric concentrations of CO_2 has increased from about 270 ppm (parts per million) in the pre industrial era i.e. 18th century, to 400 ppm in 2012. It is believed that Earth's temperature has risen by 0.89°C.

Some coal consuming industries are finding ways to capture carbon dioxide and storing it away from the atmosphese. This is known as carbon capture and storage.

IS GLOBAL WARMING SAME AS CLIMATE CHANGE?

Global Warming is the increase of the Earth's average surface temperature, due to build-up of greenhouse gases in the atmosphere.

Climate Change is long-term change in the climate due to interactions taking place in the earth dynamical system among atmosphere, biosphere, lithosphere and hydrosphere. It can lead to change in climate pattern.

LIKELY IMPACTS OF CLIMATE CHANGE

- Rising Sea level resulting in inundation of fresh water, marshlands, low-lying coastal areas and islands.
- Changes in rainfall pattern leading to droughts and fires in some areas, flooding in other areas.
- Increased frequency of extreme events on the planet such as frequent severe storms, cyclones, hurricanes, etc.
- Melting of the ice caps on mountains, resulting in loss of habitat like; Polar Bears and Penguins which are greatly endangered due to dwindling polar ice packs.
- Melting of glaciers and water shortage.
- Widespread vanishing of animal populations affecting biodiversity
- Impacting cropping patterns and agricultural practices.
- Spread of vector borne diseases such as malaria to new regions and other health impect.
- Bleaching of Coral Reefs and loss of Plankton due to warming of seas and acidification of sea water.

WHAT YOU CAN DO?

Think about the things you do each day that use energy to reduce your carbon foot prints. All electrical gadgets like TV, computer, washing machine, refrigerator, air conditioners use electricity. The lights also consume electricity. Every time you ride in your car, it uses gasoline. All these are forms of energy and here are some things you can do to help prevent global warming:

- Walk or take public transport to go everywhere and anywhere
- Protect and plant trees as they absorb carbon dioxide and act as carbon sinks
- 3R-Recycle, reuse and reduce the consumption of materials like plastic bottles, paper etc.
- Switch - off lights when you go out of the room
- Change light-bulbs to energy saving bulbs like CFLs and LEDs
- Turn off computers and chargers and unplug them when they're not in use
- Wear warm cloths instead of using heater every time
- Wear lighter clothing when it's hot instead of putting on air-conditioner
- Only do full loads of laundry to save water
- Do not waste water, take shorter showers and use recycled water for gardening
- Reduce air pollution and keep your surroundings clean
- Construct green buildings and use solar energy
- Increased use of renewable energy provides clean energy (free from carbon)

WHAT IS BEING DONE ABOUT GLOBAL WARMING?

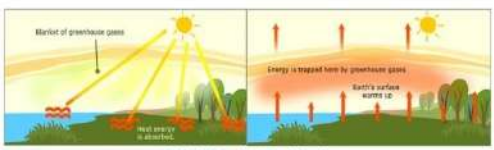
Global Warming and Climate Change are complex phenomena. They offer many challenges to the world communities. Internationally, United Nations (UN) has evoked United Nations Framework Convention on Climate Change, which has been signed by Governments of almost all countries. The UN holds meetings among country representatives to discuss the action and future plans for taking measures to stabilize greenhouse gas emissions.

INDIA'S NATIONAL CLIMATE CHANGE ACTION PLAN

India has announced National Action Plan on Climate Change. It pledges that India's per capita greenhouse gas emissions "will at no point exceed that of developed countries even as we pursue our development objectives".

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Ecosystem
- National Mission for a "Green India"
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change

The program is monitored through appropriate indicators and methodologies will be developed to asses both avoided emissions and adaptation benefits.



Global Warming Explained

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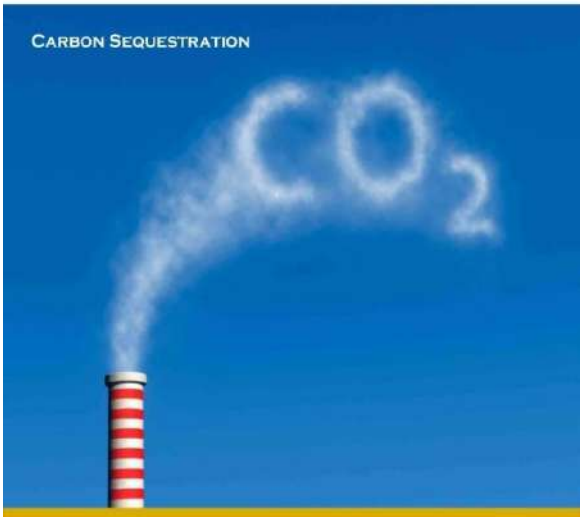
Vol. II - No. 1 January - June, 2015

Climate *SAR* सार

Climate Science And Research



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FROM EDITOR

'Climate Change is about changing in climate patterns, including temperature, precipitation, winds and others'.

Accumulation of greenhouse gas emissions in the atmosphere is giving rise to global warming and climate change. Carbon dioxide emissions occur from combustion of fossil fuels in thermal power plants for generation of electricity. All your day-to-day activities that consume energy also contribute to carbon dioxide emissions.

In this issue I discuss about carbon dioxide removal processes also known as CO_2 sequestration. It involves various ways to reduce the concentrations of carbon dioxide in the atmosphere by fixing it in the biosphere, hydrosphere, cryosphere and lithosphere of the earth system.

Climate Change Research Institute has started this bulletin on Climate Science and Research - '**Climate *SAR***'. In this third issue you learn about CO_2 Sequestration, ways to capture carbon dioxide from the point sources, from the atmosphere and potential ways to fix it.

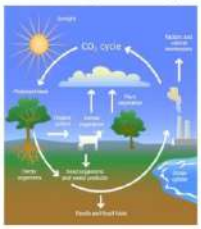
Happy reading and send your feedback to contactus@ccri.in

Malti Goel
CEO, Climate Change Research Institute

WHAT DO YOU UNDERSTAND BY CARBON SEQUESTRATION?

Carbon Sequestration is a climate change mitigation option. It requires sucking of excess carbon dioxide (CO_2) from the atmosphere and storing it away permanently. The CO_2 can also be utilized in producing chemicals and energy fuels.

Carbon Sequestration has been proposed as a way to slow the atmospheric and marine accumulation greenhouse gases, which are being released by burning of fossil fuels for meeting our energy demand.



The Global Carbon Cycle is interaction of CO_2 among Atmosphere, Biosphere, Hydrosphere, Cryosphere and Lithosphere. The terrestrial and atmospheric carbons pools are strongly interacting with are another.

Trees are natural carbon sinks as they take in CO_2 from air, in a process called photosynthesis. Trees effectively break down the CO_2, in the presence of sunlight and release oxygen. Morning walks one pleasing as oxygen content in air is more in the parks.

Fast growing trees are the most efficient way to sequester atmospheric carbon.

A GLOBAL THERMOSTAT

The amount of Carbon Dioxide (CO_2) in the air had been relatively constant until the industrial revolution took place in 1750s. The pre industrial concentration of CO_2 was 280 parts per million by volume (ppmv) i.e. in one million air molecules 280 molecules are of carbon dioxide. In a way this much carbon dioxide maintains the Global Thermostate at an average temperature of 14.43°C.

According to scientific assessments made by Inter governmental Panel on Climate Change (IPCC) the concentration of carbon dioxide has become 400 ppmv in 2014. This is pushing more energy in the atmosphere. To maintain temperature of thermostat, we need to find ways to remove CO_2 from air.

The IPCC assessments further predict that 450 ppmv of CO_2 can give rise to an increase in global temperature by 2°C in 2100. This has been set as an upper limit. Any increase beyond 450 ppmv can prove to be disastrous.

Scientists have developed an air sucking machine to remove CO_2 from atmosphere, so that it can be sold in the market for various uses.

CTO and co-founder Peter Eisenberger in front of Global Thermostat's air-capturing machine.

Do you know a millions of such machines would be required to be place around the globe to bring down CO_2 concentrations in the atmosphere?

HOW TO CAPTURE CO_2 FROM POWER PLANTS?

Thermal Power plants from coal combustion emit higher concentration of Co_2 in the atmosphere. The gases coming out of these plants can have up to 300 times more CO_2 This is mixed with other pollutant and toxic gases. The biggest difficulty in capturing CO_2 is removal of impurities and getting a pure carbon stream.

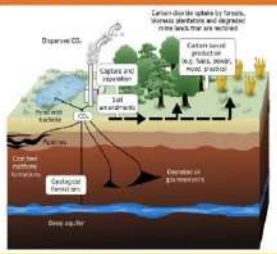
As the exhaust gases are full of pollutants, like NOx, SOx, CO_2 and particulate matter, technologies for capturing of carbon dioxide are developing. There are three ways to capture:

1) Post-Combustion Carbon Capture is to capture CO_2 from the exhaust of a power plant after combustion. It uses carbon scrubber systems and could potentially be applied to all existing power plants.

2) Pre-Combustion Carbon Capture is to convert coal into gas or liquid. Gasification process produces "syngas" from which carbon oxide can be separated, while the hydrogen rich gas is burned as fuel to produce power.

3) Oxyfuel Combustion burns fossil fuels in oxygen medium in place of air. The exhaust emission stream is mainly CO_2 and water vapor with no nitrogen. The water vapor can be separated by condensation, leaving the CO_2 as pure stream to be captured.

Potential options for storage of Carbon Dioxide.



CCRI BEGINS ENVIRONMENT AND CLIMATE CHANGE LECTURE SERIES 2015

Climate Change Research Institute (CCRI) organized the first lecture in the 'ECC Lecture Series 2015', on 13th February, 2015 at Indian International Centre, New Delhi. Many teachers as well as students from Sardar Patel Vidyalaya, Delhi Public School, Mathura Road, Appejay School, Pitampura and Navyug School, Motibag were among the participants in the lecture.

Programme was chaired by Prof. D.P. Agrawal, Former Chairman, UPSC and Chairman, Governing Council, CCRI. He welcomed all the participants and guests to the first lecture aim to educate the youth about the climate change challenges.

Dr. Malti Goel, President & CEO, CCRI gave concept of the Environment and Climate Change Lecture Series and introduced the theme of the lecture.

Sh. V.S. Verma, Former Member, CERC, while explaining the topic of the lecture "Future Energy Paradigms for Clean Environment" said that energy security and energy efficiency are concerns across the world. He shared his experience in the power sector with the audience and encouraged them, specially students to save electricity in their day-to-day work. This was followed by many questions from teachers as well as students and answers.

CCRI CELEBRATES EARTH DAY 2015

Second Lecture in Environment and Climate Change series was delivered by the Chief Guest Prof. D. P. Agrawal, Forman Chairman, UPSC and Chairman GC, CCRI on 'WASTE MANAGEMENT STRATEGIES'. He encouraged students towards cleanliness and to promote Swachh Bharat Abhiyan in our society and locality.

Dr. Malti Goel, CEO, CCRI apprised the students, who participated in large numbers from Navyug School, Sardar Patel Vidyalaya, New Horizen Public School, Amity International School and Universal Public School, about the importance of Earth Day, its genesis and current status.

Inter-School Slogan Writing Competition on
'CLEAN EARTH - GREEN EARTH'

Dr. B.C. Sabat, Dept. of Environment, Govt. of N.C.T. of Delhi shared his experiences and stressed on the need of becoming aware and making cleanliness a habit. Students from various schools also shared their experiences on the work done in their neighborhood.

Awards and Certificates were given away during the event held on 24th April 2015 at India International Centre to the winners and participants of Inter-school Slogan Writing competition. Eminent persons Mr. Gautam Sen, Ex-Executive Director, ONGC, Shri S. D. Tripathi, Ex-Executive Director-NHPC among others were present.

(The event was sponsored by Ministry of Earth Sciences and IIC)

Third ECC Lecture is on 'CO_2 Sequestration: A fresh outlook' by Dr. Malti Goel on 5th June, 2015

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Climate *SAR* सार

Climate Science And Research

GREEN BUILDING

Climate Change Research Institute
Science & Technology Solutions for Sustainable Energy Future
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FROM EDITOR

'Climate Change is about change in the climate patterns resulting from global warming due to anthropogenic changes'.

Accumulation of greenhouse gas emissions in the atmosphere is giving rise to global warming and climate change. Carbon dioxide emissions occur from combustion of fossil fuels in thermal power plants for generation of electricity. Depleting resources and increasing industrial and building activity are causing environmental degradation on the Planet earth.

In this issue I discuss about Green Buildings. A green building should be able to reduce its carbon footprints in the environment during its construction, operation and occupation. It saves on energy, water and material resources and is favorable for healthy environment.

Climate Change Research Institute has started this bulletin on Climate Science and Research- 'Climate SAR'. In this issue you learn about what is a green building, what makes it green, its benefits and how do you certify a building that it is green.

Happy reading and send your feedback to contactus@ccri.in

Dr. Maiti Goel
Climate Change Research Institute

WHAT IS A "GREEN BUILDING"?

Green Building, Green Rating and Green Economy are currently 'buzz' terms for non – greenhouse gas emissions related growth and development. A Green Building functions using an optimum amount of energy, consumes less water, conserves natural resources, generate less waste and create spaces for healthy and comfortable living, as compared to conventional buildings. Increasing use of renewable energy and a solar rooftop is desirable in a Green Building.

Green Buildings are high performance buildings. They protect and restore human health and environment during operation.

WHAT MAKES A BUILDING "GREEN"?

A building is environmentally responsible and resource-efficient throughout its life-cycle. These objectives incorporate design concerns of economy, utility, durability, and comfort.

Green buildings use sustainable materials in their construction (e.g., reused, recycled-content, or made from renewable resources) create healthy indoor environments with minimal pollution (e.g., reduced product emissions) and have landscaping that reduces water usage and is in harmony with external environment (e.g., by using native plants that survive without extra watering).

HOW DO BUILDINGS AFFECT CLIMATE CHANGE?

The energy used to heat or cool and power our buildings leads to the consumption of large amounts of energy, mainly from burning fossil fuels - oil, natural gas and coal - which generate significant amounts of carbon dioxide (CO_2), the most widespread greenhouse gas. Buildings contribute 14-40 per cent of the total carbon dioxide emissions.

Reducing the energy use and greenhouse gas emissions produced by buildings is therefore fundamental to the effort to slow the pace of global waeming. Buildings may be associated with the release of greenhouse gases in other ways, for example, construction and demolition debris that degrades in landfills may generate methane gas, and the extraction and manufacturing of building materials also generates greenhouse gas emissions.

WHAT ARE THE BENEFITS OF GREEN BUILDING?

The successful adoption of green building strategies can maximize both the economic and environmental performance of buildings. Benefits of Green buildings are:

- Using less energy, water saving and recycling of resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environment degradation

HOW IS GREEN BUILDING RELATED TO SMART CITIES AND SUSTAINABLE DEVELOPMENT?

Smart city development serves the economy, the community, and the environment by supporting healthy communities, create jobs and economic prosperity without burdening future generations with environmental degradation. Sustainability, or sustainable development, is the ability to achieve continuing economic prosperity while protecting the natural systems of the planet and providing a high quality of life for its people.

Green buildings help in achieving the objectives of both smart cities and sustainability.

WHY SHOULD WE CARE ABOUT GREEN BUILDINGS?

Buildings account for about 70%-80% of a city's electricity consumption, nearly 40% of its energy use and close to 40% of all its greenhouse gas emissions according to the Energy Information Administration, USA. Compared to standard buildings, green buildings have been shown to approximately

- Lower maintenance costs by over 10%
- Reduce energy use more than 25%
- Lower greenhouse gas emissions by 33%
- Significantly increase occupant satisfaction

HOW A GREEN BUILDING IS CERTIFIED.

Two green building rating systems in India are being used by design professionals as:

LEED: Leadership in Environmental and Energy Design is building rating system adopted by commercial buildings in India. It is developed by Indian Green building Council in association with Confederation of Indian Industry. Buildings are rated as Platinum, Gold and Silver.

GRIHA: Green Rating for Integrated Habitat Assessment is a green building 'design evaluation system', and is suitable for all kinds of buildings in different climatic zones of the country. GRIHA rating system consists of 34 criteria categorized under various sections such as Site Selection and Site Planning, Conservation and Efficient Utilization of Resources, Building Operation and Maintenance, and Innovation points. All future buildings in India are expected to meet GRIHA requirements and award points on a scale of 100.

Eight of the 34 criteria are mandatory, four are partly mandatory, while the rest are optional. Each criterion has a number of points assigned to it. Different levels of certification (one star to five stars) are awarded based on the number of points earned. The minimum points required for certification is 50.

New Lecture Hall Complex, IIT Delhi

New Lecture Hall Complex at Indian Institute of Technology is GRIHA rated Green Building at New Delhi. Indian building Congress has also awarded the architect for its Design.

ECC LECTURE SERIES - 2015

Third Lecture on "CO2 Sequestration : A Fresh Outlook"

Climate Change Research Institute organized third lecture in the Environment and Climate Change (ECC) series 2015 on 'World Environment Day'. The lecture entitled 'CO_2 Sequestration: a fresh outlook' was delivered by Prof. Malti Goel, Former Advisor & Emeritus Scientist, Ministry of Science & Technology on 5th June, 2015 at India International Centre, New Delhi.

Fourth Lecture on "Energy and Fossil Fuel"

The fourth lecture in the Environment and Climate Change (ECC) series 2015 on 'Energy and Fossil Fuel' was delivered by Shri. Gautam Sen, Executive Director, ONGC on October 16, 2015. He explained the concepts in a lucid manner. Chief Guest on the occasion was Prof. D. P. Agrawal, Former Chairman, UPSC and Chairman GC, CCRI.

ECC Lecture Series was attended by a large number students from various schools.

ACBCCS 2015

Awareness and Capacity Building in Carbon Capture, Storage and Utilization:

Towards a Low Carbon Growth Strategy

A capacity Building workshop on Carbon Capture Storage and Utilization was recently organized by Climate change Research Institute at India International Centre, New Delhi from July 27-31, 2015. In the inaugural address Dr. Madhukar O. Garg (DG, Council for scientific & Industrial Research) said Power, Transportation and Industry are major sources of carbon dioxide. In this five day workshop delegates nominated by various stakeholder agencies participated. Technical Sessions focused on CO_2 utilization and industry perspectives. It was recommended that a pilot facility be set up for testing results of CO_2 capture.

The concluding session held on 31 July 2015 was chaired by Shri R.K. Sachdev (Ex-Adviser Min. of Coal). An open roundtable discussions on CCSU: acceptance as a low carbon strategy was held.

For more information about Green Building solutions.

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Climate Science And Research

INTENDED NATIONALLY DETERMINED CONTRIBUTION

CLIMATE CHANGE - PARIS AGREEMENT

PARIS2015 COP21·CMP11

SOLUTIONS COP21 PARIS 2015

Climate Change Research Institute
Science & Technology Solutions for Sustainable Energy Future
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FROM EDITOR

'Climate Change is about change in the climate patterns resulting from global warming due to accumulation of greenhouses gas emissions from anthropogenic activities'.

Increasing carbon dioxide and other greenhouses gas emissions occurring from increasing combustion of fossil fuels for generation and demand of electricity are resulting in global warming. Climate change is therefore a global phenomena.

In this issue I discuss about the Paris Agreement and intended Nationally Determined Contribution (INDC) to climate change, under the International process to negotiate actions to be taken about climate change mitigation. Each member country to United Nations Framework Convention on Climate Change was required to give its INDCs before the Paris meeting held in December 2015.

Climate Change Research Institute has started this Bulletin on Climate Science and Research - 'Climate SAR' to disseminate information about climate change. In this issue you learn about the international processes and negotiations taking place for taking control measures under United Nations.

Happy reading and send your feedback to contactus@ccri.in

Dr.(Mrs) Malti Goel
President,Climate Change Research Institute

ABOUT UNFCCC

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty evoked in the UN Earth Summit held in Rio de Janeiro in 1992 and came into force in 1994.

The ultimate objective of the Convention is to "stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system." It stated that "such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner."

194 countries have signed the UNFCCC showing near universal agreement that there is a problem and that action is required against climate change.

The treaty itself is not legally binding as it does not set mandatory limits on greenhouse gas emissions for individual countries. Conference of Parties (COPs) meet every year since 1995 to negotiate and decide control measures. Kyoto Protocol was introduced as an enforcement mechanism in 1997.

COP MEETINGS

Conferences of Parties (COPs) to UNFCCC are meeting of Annex-I and non Annex-I countries. In these meetings negotiation for the ways to stabilize global greenhouse gas concentrations in the atmosphere continues.

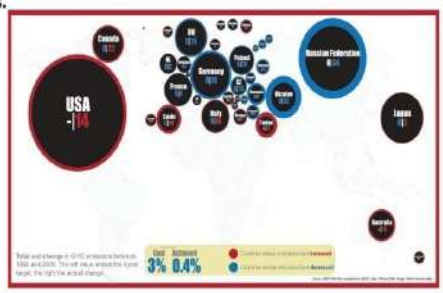
S. No.	Meeting Date	Location	COP
1.	28 March – 7 April, 1995	Berlin, Germany	COP1
2.	8 – 19 July, 1996	Geneva, Switzerland	COP2
3.	1 - 10 Dec 1997	Kyoto, Japan	COP 3
4.	2 - 13 Nov 1998	Buenos Aires, Argentina	COP 4
5.	25 Oct - 5 Nov 1999	Bonn, Germany	COP 5
6.	13 - 24 Nov 2000	The Hague, The Netherlands	COP 6
7.	29 Oct - 9 Nov 2001	Marrakech, Morocco	COP 7
8.	23 Oct - 1 Nov 2002	New Delhi, India	COP 8
9.	1 - 12 Dec 2003	Milan, Italy	COP 9
10.	6 - 17 Dec 2004	Buenos Aires, Argentina	COP 10
11.	28 Nov - 9 Dec 2005	Montreal, Canada	COP 11
12.	6 - 17 Nov 2006	Nairobi, Kenya	COP 12
13.	3 - 14 Dec 2007	Bali, Indonesia	COP 13
14.	1 - 12 Dec 2008	Poznan, Poland	COP 14
15.	7 - 18 Dec 2009	Copenhagen, Denmark	COP 15
16.	29 Nov - 10 Dec 2010	Cancun, Mexico	COP 16
17.	28 Nov - 9 Dec 2011	Durban, South Africa	COP 17
18.	26 Nov - 7 Dec 2012	Doha, Qatar	COP 18
19.	11 - 22 Nov 2013	Warsaw, Poland	COP 19
20.	1 - 12 Dec 2014	Lima, Peru	COP 20
21.	30 Nov - 11 Dec 2015	Paris, France	COP 21

WHAT IS KYOTO PROTOCOL?

The Kyoto Protocol was adopted in Kyoto, Japan on 11 December 1997 in COP-3 and entered into force on 16 February 2005. There are currently 192 Parties to the Protocol.

The Kyoto Protocol is first climate binding treaty with the objective of the UNFCCC to fight global warming by stabilizing greenhouse gas concentrations in the atmosphere. The Protocol is based on the principle of Common But Differentiated Responsibilities (CBDR). The obligation to reduce current emissions was with developed countries during the period 2008- 2012, to bring 5.2% reduction over 1990 level of greenhouse gases in the atmosphere.

Clean Development Mechanism (CDM) was adopted for fulfilling the Kyoto Protocol targets. The CDM allowed industrialized countries to invest in climate-friendly projects in developing countries and earn carbon credits in exchange. Initially set up by the Kyoto Protocol, has been instrumental for private-sector funding in clean energy projects in developing countries through host driven approach and help industrialized countries to meet their emissions reduction targets.



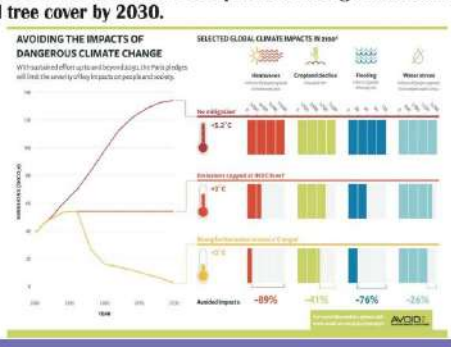
POST KYOTO PHASE

Further to the negotiations for Kyoto Phase II (Phase I ended in 2012) in COP-17 in Durban and under the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP), all Parties were invited to initiate or intensify domestic preparations for their Intended Nationally Determined Contribution (INDCs) towards achieving the objective of the Convention for an agreement in Post Kyoto negotiations.

Parties were required to communicate to the UN Secretariat their INDCs well in advance of COP 21 in a manner that facilitates the clarity, transparency and understanding of the INDC.

INDIA'S INDC: SUBMISSION ARE;

To reduce emissions intensity of its GDP by 33-35% by 2030 from the 2005 level, to achieve about 40% cumulative electric power installed capacity from non-fossil fuel-based energy resources in the same timeframe, and to create an additional carbon sink of 2.5 to 3 billion tonnes of CO_2-equivalent through additional forest and tree cover by 2030.



PARIS AGREEMENT

An historic agreement to combat climate change and unleash actions and investment towards a low carbon, resilient and sustainable future was agreed by 195 nations in Paris.

The Paris Agreement for the first time brings all nations into a common cause based on their historic, current and future responsibilities. The Agreement will become operational in 2020.

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

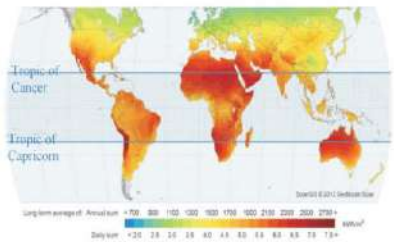
The agreement's main aim is to keep a global temperature rise in this century well below 2 degrees Celsius and to drive efforts to limit the temperature increase even further to 1.5 degrees Celsius above pre-industrial levels.

The 1.5 degree Celsius limit is a significantly safer defense line against the worst impacts of a changing climate.

INTERNATIONAL SOLAR ALLIANCE

Two other major initiatives to fight climate change were launched in COP 21 meeting at Paris – one was by the US and France on INNOVATION on how to fight global warming and climate change, and the other was by India on the SOLAR ALLIANCE. Indian Prime Minister Shri Narendra Modi played a leading role by launching the International Solar Alliance (ISA). ISA will provide a special platform for mutual cooperation among 121 solar-resource-rich countries in the world.

ISA's Mission and Vision is to work like a life-giver to mankind, where global community including bilateral and multilateral organizations, corporate, industry, and other stakeholders can make a positive contribution to the common goals of increasing utilizing of solar energy in meeting energy needs of ISA member countries in a safe, convenient, affordable, equitable and sustainable manner. The foundation stone of ISA Headquarters has been laid in Gurgaon.



Expected members of International solar alliance (on basis of their geographical location)

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Climate Science And Research

SUSTAINABLE DEVELOPMENT GOALS

Climate Change Research Institute
Science & Technology Solutions for Sustainable Energy Future
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FROM EDITOR

SUSTAINABLE DEVELOPMENT GOALS

'Climate Change is about change in the climatic patterns resulting from global warming due to accumulation of greenhouses gas emissions from anthropogenic activities'.

The Paris Agreement on Climate Change has been signed on the Earth Day April 22, 2016 by the leaders from 175 Countries. The Nationally Determined Commitments (NDCs) agreed in the summit held in Paris in December 2015 will be achieved during the period 2020 – 2030. Sustainable Development Goals are adopted by United Nations in September 2015, also to be achieved by 2030.

In this issue I discuss about the Sustainable Development Goals (SDGs) which were adopted by the United Nations in September 2015. Built on the Millennium Development Goals, the 17 SDGs aim to end poverty, fight inequality and injustice as well as to tackle climate changes by the year 2030. You too can get involved to make the world sustainable.

Climate Change Research Institute has started this Bulletin on Climate Science and Research - 'Climate SAR' for wider dissemination of information about climate change and environmental education. In this issue you learn about the 2030 sustainable development agenda taking place under United Nations.

Happy reading and send your feedback to contactus@ccri.in

Dr.(Mrs) Maiti Goel
Climate Change Research Institute

WHAT ARE THE GLOBAL GOALS?

The Sustainable Development Goals (SDGs), also known as global goals are build on the Millennium Development Goals (MDGs that the world committed to achieve by 2015). The MDGs adopted in 2000, aimed at the issues that included removing poverty, hunger, disease, gender inequality and access to water and sanitation. Progress has been made on the MDGs, showing the value of a unifying agenda underpinned by goals and targets.

The new SDGs are the broader sustainability agenda, go beyond the MDGs, to address the root cause of poverty and the universal need for development that works for all the people. The 8 MDGs are now expanded into 17 SDGs with 169 sub goals, and these are adopted by United Nations in September 2015. The SDGs as depicted below will determine the direction of developmental work for the countries in the next 15 years.

UNITED NATIONS SDGs

UN Secretary-General Ban Ki-moon has called the creation of the new global goals "the most transparent and inclusive consultative process in UN history."

By providing concrete goals, the sustainable development agenda will mobilize action from across the sectors and across the world. Governments, businesses, foundations, academics, civil society groups, entrepreneurs, and many others can leverage their strengths and resources to help achieve some or all of the goals.

Hon'ble Prime Minister of India Mr. Narendra Modi Said at the UN Summit "Today, much of India's development agenda is mirrored in the Sustainable Development Goals...

Since Independence, we have pursued the dream of eliminating poverty from India. We have chosen the path of removing poverty by empowering the poor. We have placed priority on education and skill development."

Pope Francis says "There is an opportunity to use these global goals as a tool to shape our work based on our values of solidarity, subsidiriarity, stewardship and options for the poor so we can improve our planet through transformative actions and prayers at national level."

HOW CAN I GET INVOLVED?

The world has the resources, the know-how, and the technology to create a prosperous sustainable future, but we need to unlock the will and the investments to make it happen. All of us – from governments to companies to citizens – have the opportunity to get involved, and together, we can make progress happen.

Everyone can play a role in translating the goals from words on paper to change around the world. You can contribute by reducing consumption of electricity, water and materials.

To learn more and to connect with the UN - Visit:
www.un.org/sustainabledevelopment

UNITED NATIONS CLIMATE PARTNERSHIPS FOR THE GLOBAL SOUTH

It is a new initiative to build partnerships among south-south countries to implement the Paris Agreement on Climate Change and the 2030 Development Agenda. The Southern Climate Partnership Incubator aims to foster partnerships among the Global South. The new initiative was launched in conjunction with the signature ceremony of the Paris Agreement held on April 22, 2016 at UN headquarter in New York, where it was signed by representatives from 175 countries.

HOW CORPORATES ARE RESPONSIBLE IN SDGS?

Corporates have the reason, means and tools to facilitate the Sustainable Development. Corporate Social Responsibility – CSR – has a potential to support the achievement of MDGs and now Sustainable Development Goals – SDGs due to their similar objectives and benefits with those of MDGs. All businesses -big or small can get involved. This was the agenda of UNGC Summit 2016.

The Climate Change Research Institute has become a member to United Nations Global Compact (UNGC). The ten principles of UNGC evolve around human rights, labor, anti-corruption and environment. It encourages the development and diffusion of environmentally friendly technologies and suggests that businesses should undertake initiatives to promote greater environmental awareness.

CEO, CCRI was invited to the UN Global Compact Leaders Summit, held on 22-23 June at United Nations headquarter, New York. The summit was an important milestone for jump-starting business actions on the new sustainable development agenda 2030. At the summit, companies of all sizes and from across the world showcased how they are innovating their operations and strategies to advance the SDGs. A large number of government representatives, NGOs and students also participated in the summit.

CCRI CELEBRATES WORLD ENVIRONMENT DAY

Environment and Earth Care (EEC) Lecture Series 2016

Climate Change Research Institute (CCRI) in a Scientific Social Responsibility Initiative organized second EEC lecture 2016 and an Awareness Workshop on the theme Implementation of Sustainable Development Goals (SDGs) on the World Environment Day jointly with Climate Change & Human Settlement Centre, SPA and IIC, New Delhi on June 7th, 2016. It is one of the first such workshops held in India on SDG17.

Shri A. K Jain, Ex-Commissioner (Planning), DDA delivered the Environment and Earth Care lecture on the Sustainable Green and Smart Cities.

On this occasion Inaugural address was delivered by Dr. S.Y.Quraishi, Former Chief Election Commissioner of India who highlighted the need for reducing consumption and conservation of natural resources. He cherished this initiative of the Institute and

Distinguished Participants

released the bulletin Climate SAR Vol. II no. 2 Green Buildings.

Dr. S.Y.Quraishi, Former Chief Election Commissioner of India

In his special address Prof. D.P. Agrawal, Chairman of the Governing Council of CCRI stressed on the importance of waste reduction and management as an important SDG strategy.

Dr. (Ms.) Malti Goel, President & CEO, CCRI introduced the theme and said that we are committed to take actions for reducing carbon footprints by application of science & technology. SDGs provide a vast canvas of activities and science can play an important role. Prof. Meenakshi Dhote, Head CCHSC, DEP presented "Urban & Environment Planning Strategies" and their role in implementation of SDGs.

Ms. Maya Gupta, Principal DPS, Preet Vihar receiving ECC 2015 Award from Dr. D.P. Agarwal and Dr. Malti Goel

The Principals of best performing schools in the environment campaign held for children in 2015 were awarded by CCRI.

Prof. Meenakshi Dhote, Head Environment planning, SPA, Delhi

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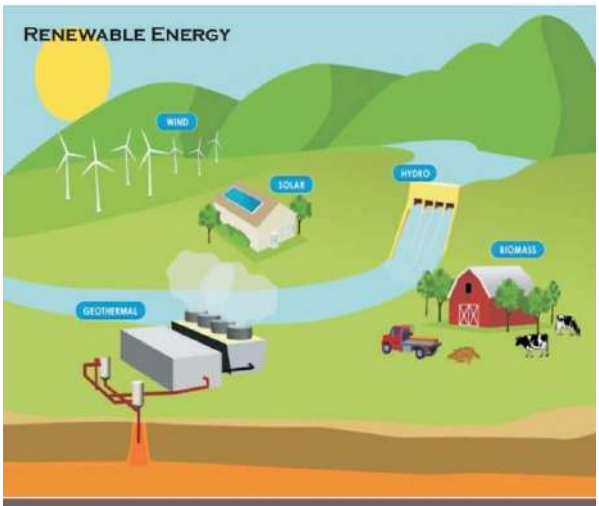
Climate Science And Research



Climate Change Research Institute
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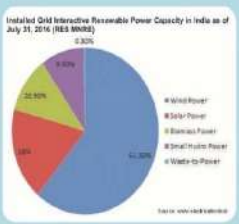
FROM EDITOR

"Nature cannot endure a sudden change, without great violence"

- F. Rabelais, 1534



For combating manmade climate change we need to find scientific & technological solutions. Application of these would demand economic and political actions. India's Nationally Determined Commitments (NDCs) agreed in the Summit held in the Paris during December 2015, demand that 40% of the electricity installed capacity should be met from renewable energy sources by 2022.

In this issue I describe renewable energy sources and systems including solar, wind, biomass and others, which can reduce carbon footprints during generation of electricity. India's targets and achievements in solar and wind energy are briefly discussed.

Climate Change Research Institute has started this Bulletin of Climate Science and Research – 'Climate SAR' for wider dissemination of information about climate change and environmental education. In this issue you learn about the alternative sources of energy for meeting our future energy demand.

Happy reading and send your feedback to contactus@ccri.in

Dr.(Mrs) Maiti Goel
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WHAT IS RENEWABLE ENERGY?

Electricity extracted from natural resources like Sun, Wind, Biomass and others that are eternal or replenished quickly is called Renewable Energy. Solar energy, wind energy, geothermal energy, hydro energy, ocean energy and biomass energy are the examples.

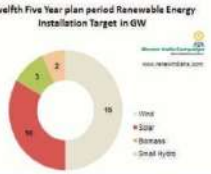
The first and foremost in exploring the promise of renewable energy sources is in utilizing energy from the sun. In 2014, the world relied on solar energy capacity of 185 GW, while renewables accounted for almost 22% of global electricity installed capacity. The IEA Medium-Term Renewable Energy Report 2015 foresees that this share becoming at least 26% in 2020. Germany, China, Japan, USA and Italy are five top solar PV countries.

INDIA'S POTENTIAL TARGETS

As part of its national climate change policy India's ambitious target for 2022 is to achieve 175 GW of renewable energy capacity.

India has an estimated renewable energy potential of about 900 GW from commercially exploitable sources viz. Wind – 102 GW (at 80 meter mast height); Small Hydro – 20 GW; Bio-energy – 25 GW; and 750 GW solar power, assuming 3% wasteland (PIB 18-December-2016). India currently has an installed power capacity of around 308 GW, with over 46 GW of renewable energy capacity, contributing around 14% to the installed capacity. Total installed capacity is expected to reach 850 GW in 2030.

The target is to achieve 40% power generation capacity based on renewable energy technologies by 2022. This could mean around 350 GW by 2030.



RENEWABLE ENERGY

There are many forms of renewable energy. Most of these renewable energies depend in one way or another on sunlight. Wind and hydroelectric power are the result of differential heating of the Earth's surface which leads to air flows causing wind. Changes in precipitation occur as the air is lifted in the regions of higher temperature.

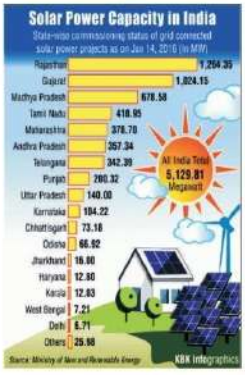
DIRECT SOLAR ENERGY

Solar energy is the direct conversion of sunlight into electricity and heat. The sun's energy is enormous and can be collected and converted in different ways. The range is from solar water heating with solar collectors for domestic and industrial use to the complex technologies of direct conversion of sunlight to electrical energy using photovoltaic (PV) cells or mirrors and boilers. According to BP Statistical Energy Survey world's installed capacity of solar energy was 185GW in 2014 requiring an investment of 316b$ US.

Solar electricity in India

Solar electric power in India is a fastest growing industry, the solar grid has reached a cumulative capacity of 8,626 megawatts (MW) in December 2016. The states of Rajsthan, Gujrat, Tamil Nadu and Andhara Pradesh are the leading states in Solar PV installations. Rapid growth in deployment of solar power is recorded and updated monthly on the Ministry of New and Renewable Energy (MNRE) website. Government has set a target of 100 GW solar installed capacity which included 40 GW from Solar PV Rooftop by 2022.

In addition to large-scale grid connected solar PV initiative, India is continuing to develop the use of off-grid solar power for localized energy needs. During 2015 - 118,700 solar home lighting systems were installed and 46,655 solar street lighting installations were provided.



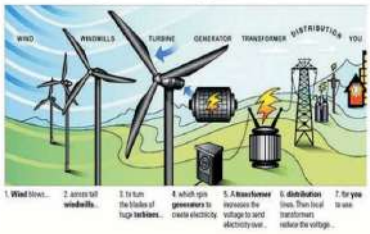
INDIRECT SOLAR ENERGY

Wind Energy is indirect solar energy. When exposed to sunlight the movement of air is caused by differences of temperature at the Earth's surface and due to varying temperatures at different heights. Wind energy has been used to pump water in ancient times and for grinding applications. In modern times wind energy is mainly used to generate pollution free electricity.

Big wind machines of two megawatt capacity on land and bigger offshore machines of more than six megawatts are being developed to produce significant amounts of electricity.

The First wind farms in India were set up in coastal areas of Maharasahtra (Ratnagiri), Gujarat (Okha) and Tamil Nadu (Tuticorin) with 55 kW Vestas wind turbines in early 1990s. The current capacity has crossed 28,000 MW, with India becoming the fourth largest installed wind power capacity in the world after China, USA and Germany. The potential for wind farms in the country has been reassessed from 49,130 MW to 302,000 MW at 100m Hub height. In the year 2015, the MNRE has set the target for Wind Power generation capacity to reach 60,000 MW by the year 2022.

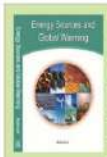
Offshore Wind Policy has been announced in 2015 and presently weather stations and LIDARs are being set up by The National Institute of Wind Energy (NIWE) for wind monitoring at different heights at some locations.



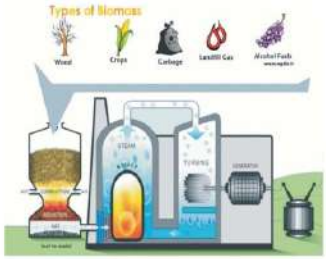
Biomass Energy is the term for energy derived from wood, plants or other waste materials. Energy in this form has been very commonly used throughout the world. Unfortunately the direct burning of dry wood for cooking and warmth is not environmentally friendly as it releases copious amounts of carbon gases into the atmosphere and is a major contributor to unhealthy air. More modern forms of biomass energy are; methane gas generation or steam turbine cycle for fueling electric power plants, and production of ethanol for automobiles.

Source of this biomass can be from agricultural and forestry residues, industrial wastes or crops grown solely for energy purposes. New technologies of Thermo-Chemical Conversion and Bio-Chemical Conversion have been developed for control of greenhouse gas emissions.

Direct combustion technology is the simplest and most common method of capturing the energy contained within biomass. In such power plants, biomass is burned to produce steam that runs a turbine to produce electricity as well as heat. Biochemical Conversion takes place at room temperature.



In the midst of uncertainties about climate change, the international community has assigned energy as the highest priority for its role in global warming. It is becoming obvious that whatever is the magnitude of human induced climate change in future, the resource base of the earth is in danger and energy is deeply connected with the resource base. The book has 16 chapters in 4 sections.



OTHER FORMS OF RENEWABLE ENERGY

Energy from hydro potential, ocean tides, ocean temperature & waves, and from the thermal gradients inside the earth are other forms that can be used to generate pollution free electricity.

Hydroelectric Power

Hydroelectric energy uses the gravitational potential of elevated water. Dams or reservoirs are constructed at river sites and water is made to fall from a certain height to generate electricity. Depending on the size of storage and penstock we can have large, small and micro hydel plants.

India has a hydro potential of 150 GW electricity capacity. Much of it is yet to be achieved. Technologies are well understood but on-site problems and difficult terrains pose great challenges.

Ocean Electricity

Tidal energy is extracted from the ocean tides. Tidal waves have regular periodicity of 12 hrs 25 minutes. According to moon position relative to earth, two high tides and two low tides (705 in one year) occur at a given point on the earth. To harness the energy of tidal waves, low head axial turbines are required in large number.

Ocean thermal energy is harnessed from the difference in temperature of water at different depths. Solar energy heats the upper layers of water. At a depth of 1km, temperature may fall by 20°C or more. Ocean thermal energy conversion (OTEC) relies on conversion of this heat energy into electricity. India has built a one MW OTEC plant along the southern coast of Tamil Nadu.

Ocean wave energy is the energy released by ocean waves caused by their movement. Depending on the amplitude or range of a wave the amount of electricity can be generated. The energy flux can vary from 50 to 70 kW/m for a wave of amplitude 2-3 m and periodicity of 10 sec.

Geothermal Power

Earth is hot inside, with temperature increasing 20-30°C per km below earth surface in the Crust. In certain areas the geothermal gradient (increase in temperature with depth) is high enough to exploit it to generate electricity. However this is possible only at a few locations on the Earth.

When the temperature gradient is small, geothermal energy can be used as heat with the help of heat pumps to heat a building in winter and cool it in summer. It can also be used for other small scale industrial applications. When temperature gradient is higher, electricity generation unit can be built.

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FROM EDITOR

Changing Weather or Climate impact our health and well being. Increase atmospheric temperature due to Global Warming makes existing diseases worse and adds new diseases because of the new pathogens introduced. Steps should be taken either for climate change mitigation or reducing exposure for minimizing the impact on our health.

In this issue I describe the climate change impacts on human health and scientific assessment of health risks. The Government of India proposed ***National Mission on Climate Change and Human Health (NMCC&HH)*** *and its main objectives are capacity building of population and training for Health services.*

*Climate Change Research Institute has started this Bulletin of Climate Science and Research – '***Climate SAR***' for wider dissemination of information about climate change and environmental education. In this issue you learn about the health related issues of climate change.*

Happy reading!
Please send your feedback to contactus@ccri.in

Dr.(Mrs) Maiti Goel
President, Climate Change Research Institute

OUR CHANGING CLIMATE

Weather and Climate affect human health in many ways. Changes in climate particularly, changes in weather extremes affect the environment and threatens human health and well-being. Climate change makes many existing diseases and conditions worse, and introduces new virus, pests and vector borne diseases. The most vulnerable are; children, the poor and those with a weak immune system and older people with underlying health conditions. They are at increased risk from adverse health effect.

Global Warming and Climate Change are physical manifestations of growing human influences on Planet Earth. Weather is state of the atmosphere at any given time and location. Climate is average weather condition that persists for several years. Climate Change is the change observed in climatic patterns over a longer period.

From 1880 to 2012, the average global temperature has increased by 0.85°C. To address climate change the Paris Agreement was adopted on 12 December 2015 at the COP21 held in Paris. It came into force on 4 November 2016 and all countries agreed to work towards limiting global temperature rise to well below 2 degrees Celsius, and to strive for 1.5 degrees Celsius.

Observed climate change impacts resulting from rise in atmospheric temperature include varying precipitation pattern, rising sea level, occurrence of heat waves, floods & droughts and other extreme events. We need to develop strategies to reduce greenhouse gas emissions for mitigation of climate change. It would require actions from household, transport, agriculture etc.

HOW DOES CLIMATE CHANGE AFFECT HEALTH?

The impacts of weather and climate change on human health are becoming cause of concern. Weather and climate affect the survival, distribution, and behavior of mosquitoes, pests, and rodents that are disease carriers. Climate change impacts air, water and food quality with implications for human health and well-being. Main impact parameters are described below.

Air Quality Impacts: Pollution in the air affects mortality and morbidity due to respiratory, cardiovascular and circulatory diseases. In 2010, more than 7% of the global burden of disease was due to inhalation of various air pollutants.

Heat Waves: An extreme weather event of high temperature episode, affects more the vulnerable population giving rise to increased mortality.

Vector-Borne Diseases: Climate Change is giving rise to birth of new pests and viruses, resulting in dengue, swine flu, Chickengunya and others.

Water-Borne Diseases: Extreme events such as floods, give rise to water borne climate-dependent infectious diseases like typhoid, cholera etc.

Food-Borne Diseases: Climate change such as drought, affects crop yield and shift in cropping patterns affecting peak infection rate, malnutrition etc.

Incidences of aggravation of mental health problems are seen.

DO YOU KNOW?

In the United States, the Government has created a high level **President's Task Force on Environmental Health and Safety Risks to Children** for protecting the current and future generations and helping to ensure opportunities for the development of healthy, more resilient children. A large number of activities are initiated to support the work of the Task Force. The Task Force collects examples from public to share information about their work being done to raise awareness and encourages others to adapt similar policies.

India has proposed a **National Mission on Climate Change & Human Health (NMCC&HH)** to address the health related aspects of climate change. It attempts to integrate health problems with eight ongoing Missions on Climate Change namely, Sustainable Habitat, Sustainable Agriculture, Water, Himalayan Ecosystems, Biodiversity, Solar, Energy Efficiency and Strategic Knowledge.

The new Mission has a goal to reduce health vulnerability to climate change and extreme weather events. Its objective is to build capacity of the population and train health services to take action for protection of people from climate change vulnerabilities. It is also proposed to introduce the subject in the course curriculum of School Children.

What you can do?

With the onset of Winter Season the pollution in the air is growing and the high incidences of respiratory problems are reported in the hospitals. It is seen that fine particles when inhaled affect lungs, heart and weaken our immunity system. How one can protect himself or herself;

I. Avoid going out when pollution is high
II. Keep the doors and windows tightly closed
III. If you have to go out, then
   a. Cover your nose and mouth with handkerchief
   b. Use Mask (N95)
   c. Avoid traffic congested areas

LINKAGE WITH SUSTAINABLE DEVELOPMENT GOALS (SDGS)

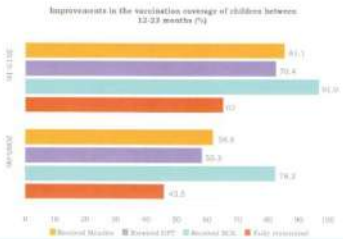
SDG 3: Ensure healthy lives and promote wellbeing for all at all ages

The Sustainable Development Goal 3 aiming at protecting our health is one of 17 UN Global Goals that make up the **2030 Agenda Sustainable Development**. Ensuring healthy lives and promoting the well-being for everyone is essential for sustainable development.

Over the years significant strides have been made globally, resulting in increased life expectancy and reducing some of the diseases associated with child and maternal mortality. Progress is being made on increasing access to clean water and sanitation, reducing malaria, tuberculosis, polio and other diseases. However, new research indicates there is fall in rural productivity across the globe by 5.3% due to climate change since 2000.

Climate change induced health concerns therefore require more efforts to address many different, persistent and emergent health issues for achieving the targets of SDG3. Also the greenhouse gas emissions are needed to cut down to lessen the pace of Climate Change. We need to clearly identify the indicators at the intersection between the Environment and Health for corrective actions.

PROGRESS MADE IN THE AREAS OF FAMILY PLANNING, MATERNAL HEALTH AND CHILD HEALTH



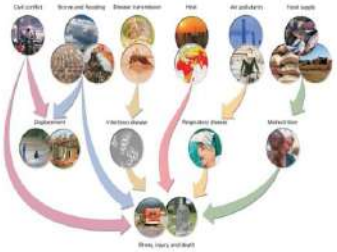
SCIENTIFIC ASSESSMENT OF HEALTH RISKS

Recent studies in Lancet medical journal suggest that climate change is affecting the health of all populations around the globe. The health risks arise from the interactions of three factors: (1) how climate change will alter the ecosystems that support mosquito populations; (2) who is exposed most to these changing weather patterns; and (3) the underlying vulnerability of the exposed populations.

Scientific Assessment would help in taking measures for improving air, water quality and in finding solutions for minimizing the adverse impacts on human health and preventing diseases. Future rate of health impacts is a function of baseline health status, expected changes in exposure, response function of the vulnerable population.

For some health impacts, the ability to understand the relationships between climate related exposure and health exposure impacts is limited due to complex relationships between local temperature change, air pollutants, unsafe food consumption and contaminated water supply.

India should make a scientific assessment for determining health impacts in each of its six climatic zones with different geographic coverage.



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