A SOCIETY FOR RESEARCH, AWARENESS & SOCIAL DEVELOPMENT

NEWSLETTER

Volume 2, Issue 4, October - December 2019

Save the Environment (STE)

ABOUT US

Save the Environment (STE), founded and registered on 19th November 1990, is a Kolkata based NGO which aims to create awareness, inspire rural communities and works towards a better, sustainable environment-friendly technology. It is lead and run by researchers, social workers, students with a mutual aim to 'Save the Environment'. STE has collaborated with various organizations in the past 29 years such as All India Institute of Hygiene & Public Health, AIIH&PH and India Canada Environment Facility, DRDO Ministry of Defence, Department of Science & Technology (DST), Indian Institute of Management (IIM), Ahmedabad to mitigate the effects of arsenic and provide arsenic-free drinking water. The first step towards this objective was taken in 1977 when an arsenic removal plant was set up in West Bengal, later 60 community type filters and 5, 000 domestic filters were installed and till date over 1,00,000 people have benefitted from these plants. With the help of DST Arsenic/Iron removal plants were set up in various parts of India, 24 Parganas (N) & Nadia districts in West Bengal, Balia district in Uttar Pradesh, Bhagalpur District in Bihar and Agartala in Tripura. Furthermore, a special clinic (2001) and a vocational training centre (2003) set up for people who already were suffering from the ill-effects of arsenic and a hospital for the same will be coming up soon. Not only this, a step towards conservation of rainwater in rural areas was taken up by STE in 2003. To conclude, STE not only uses the common methods to save what's left of the environment but also STE members use their scientific expertise to convert unusable environment resources to usable ones.

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OUR EVENTS

NATIONAL CONFERENCE ON Water Crisis, Public Health and Sustainable Solutions (WCPHS-2019) & First Annual Conference of Save The Environment

Held during October 21st –22nd, 2019

at Indian National Science Academy (INSA), New Delhi

Sponsored by

Water Technology Initiative Department of Science & Technology Govt. of India, National Bank for Agriculture and Rural Development (NABARD) and Agilent Technologies India Pvt. Ltd.

SAVE THE ENVIRONMENT (STE) is a non-profit organization which aims to spread awareness to the society about the environment, health and water. The organization is focused to work for awareness and motivation among rural communities and provide cost effective, energy efficient and environment friendly technologies.

Technological development and subsequent urbanization have led to alarming situations such as climate change and global warming. These two grave issues are often associated with depletion of natural resources including water and has adversely affected human health. There is an urgent need to implement immediate solutions for conservation of the planetary resources. The government has undertaken several programs and designed various policies to tackle these threatening concerns. However, it is important to bring out those governmental programs and policies along with the already available and ongoing research contributions to the civilians for sustainable development of the Nation. Hence, with this perspective, STE organized the national conference with the thematic thrust of enlightening the technological and sustainable solutions to overcome the existing water crisis by bringing together researchers, industry personnel, government authorities and policy makers from all over India who are actively engaged in water conservation and related research.

Save the Environment-A Society for Research, Awareness and Social Development located at Kolkata, West Bengal organized a National conference on "Water Crisis, Public Health and Sustainable solutions (WCPHS-2019)" during October 21st –22nd, 2019 at Indian National Science Academy (INSA), Bahadur Shah Zafar Marg, New Delhi.

The organizing committee of WCPHS 2019 and entire STE family extends its sincerest thanks to Water Technology Initiative, Department of Science and Technology (WTI, DST), Government of India for providing wholehearted financial support to meet the technical necessities of the event. The financial assistance received from Research and Development Fund of National Bank for Agriculture and Rural Development (NABARD) towards publication of journal/ printing of proceedings of the Conference is gratefully acknowledged.
We also wish to thank Agilent Technologies for financial support.

INAUGURATION & LAMP LIGHTING CEREMONY

The event began on an auspicious note, by heading towards the customary lighting of lamp and expressing gratitude towards the Almighty for his blessings on us to conduct the conference. All the dignitaries on dais were invited to come forward and conduct the lamp lighting ceremony.

Honourable Dr. Mahendra Singh-Cabinet Minister of Ministry of Jal Shakti of the Government of Uttar Pradesh graced this event as the Chief Guest and inaugurated this conference. He greatly appreciated the efforts directed by the organizing committee members especially Dr. Kshipra Misra (Convener, WCPHS) for organizing a conference of such a stature. He said that WCPHS will certainly trigger a spark in the minds of young researchers towards some innovative insights and ideas in this area. He also expressed deep concern for the serious environmental problems that our country is currently facing and requested all those present in this conference to collectively work for the problem. Dr. Mahendra Singh especially highlighted that such initiatives should be embarked upon in near future also. It was indeed a very precious moment for all to have such a big dignitary with us.

Prof. Arunabha Majumdar welcoming Honourable Jal Shakti Minister of Government of UP and chief guest of the conference, Dr. Mahendra Singh.

Honourable Dr. Rajendra Singh (Water conservationist & Environmentalist, Tarun Bharat Sangh, Alwar, Rajasthan and recipient of the highly acclaimed Magsaysay award also popularly known as 'The Waterman' or 'Jalpurush of India') also graced the event as the chief guest. Dr. Rajendra Singh enlightened the audience with his words, highlighting the current water crisis situation in India and the initiatives Govt. of India is taking towards improving water quality and associated health issues. He

Honourable Dignitaries-Dr. Rajendra Singh and Prof. K. J. Nath lighting the lamp.

Dr. Kshipra Misra extending her welcome address

accredited the efforts of the organizers for coming up with a conference of such a stature.

Address by Guest of Honour Dr. Sanjay Bajpai, Head, Technology Missions Division (Energy, Water & all other), Department of Science and Technology, India.

Dr. Sanjay Bajpai, Head, Technology Missions Division (Energy, Water & all Other), Department of Science and Technology, Government of India, Dr. A. K. Datta (Former CCR&D, DRDO, New Delhi), Prof. K. J. Nath (Chairman, Arsenic Task Force and Advisor (SISSO) and Prof. Arunabha Majumdar (our patron and Chairman, Indian Water Works Association (IWWA) and Ex-Director-Professor & Head, Department of Sanitary Engineering, AIIH&PH, Kolkata and Guest Professor, School of Water Resources Engg., J.U.) also graced the dice with their distinguished presence. About 250 delegates from different academic as well as industrial organizations participated and presented their papers in the conference on various aspects of research in the allied fields of sciences.

This was followed by a very warm welcome of guests and participants. Accompanying this, a concise yet inclusive and conceptual framework of the "Highlights of STE activities" was projected by Dr. Kshipra Misra (President of Save The Environment, Vice-President of NESA and Former Additional Director, DIPAS, DRDO) to address the gathering.

WCPHS 2019 witnessed an amalgamation of stalwarts in the fields of environment and science and delivered extremely valuable talks that inspired the young researchers among the audience to hold the baton for environment protection with utmost sincerity. WCPHS 2019 was successful in providing a forum for all the experts and stakeholders to share their aspiration towards environmental sustainability. Through conjoint efforts, sustainable solutions towards reducing human exposure to chemicals, developing cost-effective methodologies for water conservation and management was proposed.This was a great initiative taken towards rendering our planet earth greener.

RELEASE OF FIRST ISSUE OF JOURNAL OF STE AND ABSTRACT BOOKLET OF WCPHS 2019

Our Chief Guest of the session, Dr. Rajendra Singh (Jalpurush/Waterman of India) and Guest of Honor, Dr. Sanjay Bajpai, Head, Technology Missions Division (Energy, Water & all other), Department of Science and Technology, India released the first issue of the journal by Save the Environment, International Journal of Environment and Health Sciences whose editor in chief is Dr. Kshipra Misra. This was followed by the release of the abstract booklet of the conference "WCPHS 2019."

Honourable Jal Shakti Minister of Government of UP and chief guest of the conference, Dr. Mahendra Singh releasing the first issue of International Journal of Environment and Health Sciences with other dignitaries on dias.

STE AWARD CEREMONY

Few awards constituted by Save the Environment in order to honour personages who have contributed to society in the fields of environment protection, water conservation and allied aspects were conferred. The two coveted honours, i.e. STE Dr. APJ Abdul Kalam award and STE Dr. Praloy O. Basu lifetime achievement award aim to recognize exemplary contribution to science and environment. The STE Dr. APJ Abdul Kalam award and STE Dr. Praloy O. Basu lifetime achievement award for the year 2019 were awarded to Dr. A. K. Datta, Former CCR&D (M&LS), DRDO, New Delhi and; Prof. K. J. Nath, Chairman, Arsenic Task Force, West Bengal & President at Institution of Public Health Engineers, India, Kolkata. STE, being devoted to environmental protection has defined the Green Excellence awards to endorse distinguished work in arenas of environmental science. This award was awarded to Dr. Alok Adholeya, Senior Director, Sustainable Agriculture Division, IHC, TERI, New Delhi& Director, TERI Deakin Nanotechnology Centre, TERI Gram, Gurugram and; Dr. Rakeshwar Bandichhor, Head, Chemistry-API-PR&D & Vice Chair, ACS-India Chapter (South) Innovation Plaza, Dr. Reddy's Laboratories Ltd., Hyderabad. STE believes that women researchers have great conviction in bringing about solutions and changes to the societal problems and achieves to fortify this by presenting STE Women Excellence Awards. Dr. Susan Titus, Scientist 'G' & Head, Marine Biotechnology, NMRL (DRDO), Ambernath, India and; Dr. Anju Srivastava, Principal, Hindu College, University of Delhi, Delhi were awarded with this award for the year 2019 during the conference.

The STE Water Award was conferred to Prof. Amlan Chakraborty and Dr. Nupur Bahadur. The STE Best Teacher Award was awarded to Ms. Preeti Jain and Dr. Adit Bedi. The STE Innovation Award was awarded to Dr. Vaishali Mishra and Mr. Shrikant Gangwar. Dr. Satinder Brar and Dr. Prosun Bhattacharya received STE International Achiever Award. Prof. Renu Deswal and Dr. Imteyaz Qamar received STE Meritorious Award. These STE awards and recognitions were bestowed upon the awardees by Dr. Mahendra Singh.

Some upcoming and dedicated researchers were accredited for their efforts by Dr. Rajendra Singh who presented the STE Young Researcher Awards. The awardees for this award were presented to: Dr. Priyanka Sharma, Dr. Tanupriya Choudhary, Dr. Anuja Bhardwaj, Dr. Sriparna Dutta, Dr. Manavi Yadav, Mr. Arup Giri, Ms. Jigni Mishra, and Mrs. Rinki Mishra.

The event was then addressed by Dr. Sanjay Bajpai, Head, Technology Missions Division (Energy, Water & all other), Department of Science and Technology, India and; Dr. Rajendra Singh (Jalpurush/Waterman of India) with their knowledge and; shared their perspectives and experiences with the delegates.

SCIENCE EXHIBITION

Our beloved and late President of India, Dr. A. P. J. Abdul Kalam during his address to students on children's day at Vigyan Bhawan (2002) once said “Within the school curriculum/school hours, I want you to contribute to the Mission of Developed India by involving in the student centric activities like Literacy Development, Eco-Care Movement.” His wisdom as words are enough to motivate the students for participation in a conference such as conducted by STE, i.e., WCPHS-2019. A science exhibition was declared open by our esteemed guest Dr. Rajendra Singh on the Day 1 of the national conference. Under the guidance of Dr. Vaishali Mishra and Ms. Shikha Sikka as teachers,; the bright minds of ITL Public school displayed and explained the innovative models for water conservation. Dr. Singh uttered: “We are proud of the school children who have directed immense efforts and prepared some innovative science models and they definitely are appreciated for the same.” Students were highly motivated and keenly participated during the conference.

On the Day 1, the first session was chaired by our respected Chairpersons: Dr. Rajiv Sharma, Director General, Amity Foundation for Science, Technology and Innovation Alliances and Former Advisor, DST, Govt. of India and Dr. Laxman Prasad, Group Director, RKG Group, Ghaziabad and Former Advisor, DST, Govt. of India.

The session began with a keynote address on "The Indigenous Knowledge Systems of Water Management in India" by honourable Dr. Rajendra Singh ji. Over the past few years, he has been playing a pivotal role in addressing issues of climate change and global warming by providing local solutions- by empowering the community through water conservation and recharging of water banks- perhaps the maiden example in the world. During his talk, he especially highlighted that "Today's water problems cannot be solved by science or technology alone. They are instead human problems of governance, policy, leadership, and social resilience."

Subsequently, other keynote speakers also delivered their talk. Dr. Sanjay Bajpai delivered an informative talk on "Enabling Research led Smart Water Innovations and Solutions." The talk focused upon application of new technique on Internet of Things (IoT) and Artificial Intelligence (AI) that can enable and empower the traditional systems with more sophistication and introduce smartness to bring greater effectiveness and efficiency in water supply treatment, distribution and reuse.

Thereafter followed the technical session I, themed as "Designing Chemistry for Environment & Health". It was chaired by Prof. R. K. Mahajan, Former Vice Chancellor, DAV University, Jalandhar and Professor, Guru Nanak Dev University, Amritsar and Prof. S. K. Mehta, Professor, Panjab University, Chandigarh and Director, SAIF, Panjab University, Chandigarh. Dr. Rakeshwar Bandichhor, Head, Chemistry-API-PR&D, Vice Chair, ACS-India Chapter (South) Innovation Plaza, IPDO Bachupally, Dr. Reddy's Laboratories Ltd. Hyderabad, India delivered an invited talk. He explained that the flow technology and the resultant APIs have the potential as a game changer in the pharmaceutical industry in a sustainable manner in comparison to batch mode operations. Prof. R. K. Sharma, Co-ordinator, Green Chemistry Network Centre, University of Delhi and Honorary Secretary, Royal Society of Chemistry, London (North India Section) also delivered a talk and enlightened people about Green Chemistry and how it helps in improving the environment.

Succeeding this, technical session II was conducted and chaired by Dr. Ravinder Kaur, Principal Scientist, Water Technology Centre, IARI, PUSA and Prof. R. K. Sharma, Co-ordinator, Green Chemistry Network Centre, University of Delhi and Honorary Secretary, Royal Society of Chemistry London North India Section. The session included various invited lectures which commenced with a talk by Prof. Arunabha Majumdar, Professor, Emeritus, School of Water Resources, Jadavpur University and Former Director, Professor, All India Institute of Hygiene and Public Health on "Water Safety Plan: Application in Arsenic Removal Units."

Dr. Prashant Singh, Associate Professor Chemistry, DAV (PG) College, Dehradun (Uttarakhand) and District Co-ordinator, Uttarakhand State Council for Science and Technology (UCOST), Dehradun presented a talk on "Implementation of water quality monitoring and surveillance model through project management unit (PMU) in Indian Himalayan region. He briefed about the current status of the program, PMU stating its success in identifying far more than 30,000 drinking water sources which have dried up due to climatic factors in mountainous states of India. Dr. B. K. Shrinidhi, a Brahma Kumari representative enlightened the audience about the activities it is involved in especially in the area of water quality. He explained that human consciousness, thoughts and actions can influence the environmental system around them and thus, self-awareness and a few changes in our lifestyle can contribute in protecting the mother planet.

Further during the session, Dr. Ranjit highlighted about the issues of quality and quantity of drinking water in India and also argued that there is a need of evolving technically and appropriately feasible, economically viable, environmentally and ecologically sound and socially acceptable solutions in water management in India and also aimed to evolve sustainable, equitable and efficient management of India's water resources.

The conference on Day 1 included high tea and lunch for all the delegates and participants. While the lunch break, posters were displayed by the presenters and evaluated by the respective judges. The presenters desirously explained the questions put up by judges and other delegates.

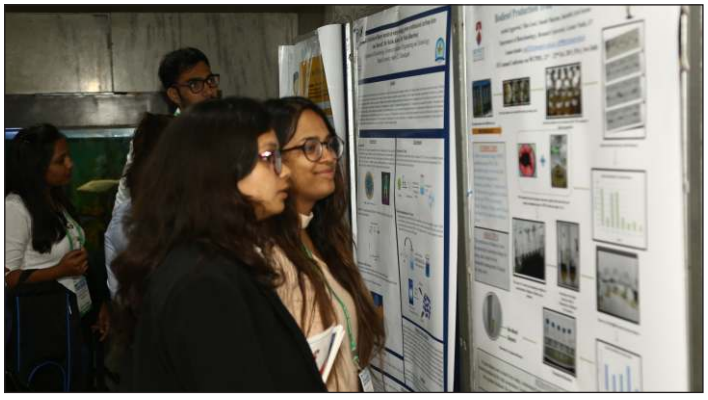
On Day 2, the event commenced with a keynote address by Dr. Nirupama Trehanpati, Professor, ILBS, Delhi and Prof. K. J. Nath, Chairman, Arsenic Task Force, West Bengal and President, Institution of Public Health Engineers, India. The keynote speakers were felicitated by our chairpersons for the session- Dr. Suhel Parvez, Professor and Head, Department of Toxicology, Jamia Hamdard University, New Delhi and Shri Saurab Singh, Chief Functionary, Inner Voice Foundation Community Arsenic Mitigation and Research Organization (CAMRO). Our chairpersons were felicitated by Dr. Kshipra Misra, President, STE for their kind presence.

This was followed by the technical session 3 with the theme- Interdisciplinary Sciences and Technology. The chairpersons for this session were Dr. Dhurjati Majumdar, Former Associate Director, INMAS, DRDO, Delhi and Prof. Ajay Kumar Gupta, Department of Biotechnology, Maharishi Markandeshwar University, Ambala, India. A Keynote address was given by Dr. Neelima Alam on “Enabling research led smart water innovation and solutions”. She is Scientist 'E', Technology Missions Division (Energy, Water & All Other), DST, Govt. of India. Dr. B. Rupini, former Director and Associate Professor, School of Interdisciplinary and Transdisciplinary Sciences, IGNOU, New Delhi, India also delivered a talk signifying the role of interdisciplinary science research for environment sustainability. A tea break was announced in between after which all the delegates assembled to once again assimilate the knowledge delivered by our learned speakers.

The technical session 3, consisted of a parallel forum with the theme- Sustainable Solutions and Innovations. Dr. Susan Titus, Scientist 'G', Head, Marine Biotechnology Department, Naval Materials Research Laboratory, DRDO, Ambernath was first to open the session and delivered a talk on "Innovation & Indigenous Bioremediation Technology for mitigation of Oil Pollution". She described the contributions made by her organization involving her in using marine oil degrading bacteria as an accelerated bioremediation technology to maintain clean and sustainable marine environment. Following her, Dr. Saurabh Jyoti Sarma, Assistant Professor, School of Engineering and Applied Sciences, Department of Biotechnology, Bennett University, India enlightened the audience with a talk describing the potential advantages of a microbial granule (i.e., microbial cells within spherically assembled microbial consortium) based technology for wastewater treatment over the conventional activated-sludge based treatment technologies. Dr. Nupur Bahadur, a Fellow at Water Research, TERI-Deakin Nano Biotechnology Centre, TERI Gram, Gurugram also shared an innovation of TERI named as TERI Advanced Oxidation Technology (TADOX). She explained that this technology being an amalgamation of nanotechnology and advanced oxidation process makes it highly advanced, more efficient, modular, clean and green; leading it to adequate treatment, economical, scalable and integrated among the existing systems and infrastructure. Dr. Vaishali Mishra, Head at Department of Chemistry, ITL Public School described that the practice of "Matka Irrigation" is an efficient and inexpensive irrigation method which is well-suited for semi-arid states of India. It is a sustainable agricultural water management which is cost-effective, eco-friendly and can be used at home, school, offices or field gardening.

The technical session 4 of the national conference was chaired by Dr. Susan Titus and Dr. Ranjana Dixit who is Associate Professor at Ramjas College, Department of Chemistry, University of Delhi. The session began with the lecture delivered by Prof. Abhijeet Mukherji who is Associate Professor (Hydrogeology), Dept. of Geology and Geophysics, School of Environmental Science and Engineering, IIT Kharagpur. Subsequent addresses were delivered by Dr. K. Vijayalakshmi, Vice President of Development Alternatives, Tara Crescent, Qutub Institutional Area, New Delhi and Dr. Jitendra K. Nagar, Assistant Professor at Department of Environmental Studies, Dr. Bhim Rao Ambedkar College, University of Delhi, Yamuna Vihar, Delhi. Dr. Jitendra K. Nagar presented an update on water quality status of Ganga river. Dr. Imteyaz Qamar, Assistant Professor and Brain Korea-21 Fellow at School of Biotechnology, Gautam Buddha University, Gautam Buddha Nagar, India presented an overview of the current scenario and solutions available for water contamination. The session also included other learned professors including Dr. Shoma Paul Nandi, Professor at Department of Biotechnology, Amity Institute of Biotechnology (AIB), Amity University, India; Prof. Renu Deswal, Professor at Molecular Plant Physiology and Proteomics, Botany, University of Delhi, Delhi and; Prof. Bishakh Bhattacharya, Professor & Head, Mechanical Engineering Department, IIT Kanpur.

Prof. Shoma presented her work on the development of a beta-lactamase inhibitor from herbal source and its use against antibiotic resistant *E. coli* which is a common resident of contaminated water. Prof. Renu Deswal explained her work on Seabuckthorn based silver nanoparticles as a formulation for the degradation of azo dyes in contaminated wastewater. Prof. Bishakh Bhattacharya shared his and his team members work on



the design and development of Aquatic Autonomous Observatory (Niracara Svayamsasita Vedh Shala-NSVS) for In situ monitoring and real data transmission for assessing water quality.

PANEL DISCUSSION

The last technical session was the panel discussion which was one of the most important sessions of this conference as there were many fruitful discussions and we had eminent personalities with us as panelists who highlighted about some of the key issues related to water management and the plausible ways of combatting the challenges we are facing today!

Panelists:

1) **Dr. Rajiv Chhibber**-Vice president of External Affairs at Sahajanand Medical Technology Pvt. Ltd.
2) **Prof. Prosun Bhattacharya**-Professor at Ground Water Chemistry, KTH Royal Institute of Technology, Stockholm.
3) **Sh. Saurab Singh**-Chief Functionary, Inner Voice Foundation Community Arsenic Mitigation and Research Org. (CAMRO).
4) **Dr. Malti Goyal**-President & Chief Executive. Climate Change Research Institute. Former Adviser, DST, Govt. of India.

The key topics were:

- ❖ Water Quality and Toxic metal contamination including arsenic in groundwater
- ❖ Water Management for agricultural and industrial applications
- ❖ Wastewater Treatment and Disposal

VALEDICTORY

The valedictory function was conducted by conferring felicitations on winners of oral and poster presentations as well as felicitation of the Members of the Organizing Committee. Honourable Dr. Sanjeev K. Varshney, Head of International Cooperation (Bilateral), Department of Science and Technology, Govt. of India graced the valedictory as the chief guest. He was felicitated by Dr. Kshipra Misra, President STE and thereof, presented the oral and poster awards to the winners. Best Oral Award presented to Dr. Sriparna Dutta, Assistant Professor, Department of Chemistry, University of Delhi. Best Oral Award presented to Ms. Namrata Kamle, SRF, NMRL, Ambarnath and the prizewinner for Best Poster Award was Dr. Kanika Solanki, Department of Chemistry, University of Delhi.

The final curtain on the much successful national conference, WCPHS-2019 was drawn with the vote of thanks on behalf of the entire fraternity, expressed the gratitude and satisfaction regarding the interactive proceedings and extensive networking that had taken place over two days. The entire STE family will continue to spread awareness to the society about the environment, health and water. In near future also, we will organize more of such platforms where the academicians, concerned governmental experts and industrial personals together could proffer an excellent opportunity for collegial interaction with each other to enact sustainable solutions and action plans for water conservation and management.

Plastic Free Zone

Our Honorable Prime Minister, Shri Narender Modi recently addressed the Nation in Mann ki Baat, in August, 2019 and called for efforts to ensure proper collection and storage of plastic to save the environment. He also said, "we will launch a new mass movement against use of plastic". It is apparent that the future generation is intended to benefit from such a drive. They must be educated about various ways to reduce and explore eco-friendly alternatives for plastic usage.

His words of wisdom motivated SAVE THE ENVIRONMENT (STE) team to organize an awareness program, "Plastic Free Zone" on 13th December, 2019 in St. Peter's School, Durgapur. The program aimed to reduce and eliminate single use plastics like plastic bottles, straws, utensils, plastic bags, plastic food packaging and the list goes on. STE organized a slogan competition among the students of different classes on that day. This program was arranged to understand exactly how these items are the greatest contributor to the plastic pollution. STE members have tried to highlight different points on how we can reduce our plastic consumption and it can be replaced with non-plastic alternatives.

"Living in harmony with nature will lead to a better future", as well said by Prime Minister, Narendra Modi. With this note let's pledge to reduce or not use plastic!

FROM THE EDITORS' DESK...

CARBON FOOTPRINTING: A lot more to know!

By Dr. Anuja Bhardwaj, Editor, STE Newsletter

In today's world the most important issue that has drawn momentous concern is the climate change and global warming. We often come across the term "Carbon footprint", when dealing with these issues. However, the major question is that are we really well-acquainted with this term or not? In this article, we have emphasized on the fundamentals of carbon footprint since, it has now become a broader and widely discussed topic with serious implications in our daily lives. However, the depth and clarity of its definition varies widely; probably because the significance of "Carbon footprint" was introduced by various driving forces including the corporate, governmental and NGO initiatives (Wright *et al*., 2011b).

In order to understand carbon footprint, it is important to mention here that "global warming potential" and "carbon footprint" are used interchangeably and are corelated. In some cases, these are considered as two different terminologies altogether. Nevertheless, it is imperative to state that both carbon footprint and global warming potential have significant impact(s) on the climate change whether taken as a collective term or individually. The most common cause of climate change is generation of several greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and other anthropogenic gases excluding water vapor. The accountability of such gases is facilitated by carbon footprint analysis. (Čuček *et al*., 2014). Currently, the levels of atmospheric CO_2 have escalated to 414.7 ppm according to the NOAA's Mauna Loa Atmospheric Baseline Observatory reports published in May, 2019 (Science daily; Carbon dioxide levels in atmosphere hit record high in May:2019.) from 396 ppm as recorded in 2013 (Čuček *et al*., 2014). It is required that the average global carbon footprint per year declines under two tons by 2050 in order to avoid the chance of a 2^0C rise in global temperatures (https://www.nature.org/en-us/get-involved/how-to-help/carbon-footprint-calculator/).

Carbon Footprint

Collectively, *Carbon* and *footprint*, forms the term "**Carbon footprint**". It was Ernest Hemingway who typically used "footprint" in a figurative sense. He defined it as the impact made by an individual's presence or activity. In the mid 1990s, the metaphor, footprint was first used in an energy context by Canadian ecologist William Rees when he and his graduate student Mathis Wackernagel collaborated to establish the concept of an ***ecological footprint*** (Cleveland and Morris, 2014). Ecological footprint is defined as the biologically productive land and sea area required to sustain a given human population expressed as global hectares (Pandey *et al*., 2011). Thereafter, it was applied to a more restrictive term- *carbon footprint*. We may define carbon footprint as the amount of carbon dioxide (CO_2) and other GHG emissions produced by a given human activity, or associated with a certain entity such as a nation, an industrial process, or even an individual person or household. The development of the term carbon footprint was the reverse of ecological footprint, which originated in the scientific literature and then extended to general usage (Cleveland and Morris, 2014). Eventually, with the worldwide emergence of global warming menace, use of carbon footprint became common and independent; although in a modified form. The concept of carbon footprinting gradually was applied as a life cycle impact category indicator known as "global warming potential". Therefore, the present form of carbon footprint may be regarded as a hybrid, deriving its name from ecological footprint, and conceptually being a global warming potential indicator (Pandey *et al*., 2011). Conclusively, carbon footprint is a measure of the total amount of CO_2 and methane (CH_4) emissions of a defined population, system or activity, considering all relevant sources, sinks and storage within the spatial and temporal boundary of the population, system or activity of interest. Calculated as CO_2 equivalents using the relevant 100-year global warming potential (Wright *et al*., 2011a).

Carbon Footprint Analysis

At the global level, to mitigate the negative impacts of climate change, governing authorities around the world have passed legislation to measure and reduce carbon emissions. Among them the most notably are the Kyoto Protocol and the Mandatory Reporting of Greenhouse Gases Rule (Franchetti and Apul, 2012).

The Kyoto Protocol is an international agreement or treaty linked to the United Nations Framework Convention on Climate Change. The Protocol sets legally binding for party nations for the reduction of GHG emissions. It requires the reporting of six gases: CO_2, CH_4, nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6), collectively called as the Kyoto basket. All these gases are considered, while measuring the carbon footprint (Wright et al., 2011b). Under Kyoto, industrialized nations pledged to cut their yearly emissions of carbon, as measured in the six GHGs, by varying amounts, averaging 5.2%, by 2012 as compared to 1990. That equates to a 29% cut in the values that would have otherwise occurred. However, the protocol didn't become international law until more than halfway through the 1990–2012 period. By that point, global emissions had already risen considerably. Some countries and regions, including the European Union (EU), were on track by 2011 to meet or exceed their Kyoto goals, but other large nations were falling tragically short. Moreover, United States and China being the two largest emitters of all had churned out more than enough extra GHGs to negate all the reductions made by other countries during the Kyoto period (https://www.theguardian.com/environment/2011/mar/11/kyoto-protocol). However, the Intergovernmental Panel on Climate Change (IPCC), established in 1988 by United Nations and the World Meteorological Organization for assessing the impact of the greenhouse effect has remained an important agency. IPCC is the world's leading authority on climate change science. It reviews and assesses the most recent scientific, technical, and socio-economic information produced worldwide relevant to the understanding of climate change (Franchetti and Apul, 2012).

Therefore, to assess the negative impacts of climate change in terms of GHG emissions carbon footprint analysis is performed. Carbon footprint analysis is the measurement of GHG-emitting processes, their origins, composition and amounts. The GHG sinks and removal rates should also be included in a carbon footprint analysis to determine the "net" emission rates. The phrase "carbon footprint analysis" is synonymous with the phrase "greenhouse inventory". The word carbon is used because CO_2 is the

predominant GHG being emitted from humans' actions. Yet another GHG emissions, including CH_4 and N_2O, also have significant contributions to global warming. So as to have one unit for reporting results, emissions from these other gases are normalized as mass of CO_2 equivalent (CO_2e) (e.g., Kg of CO_2e or metric tons of CO_2e) (Franchetti and Apul, 2012).

Calculation of carbon footprint

For calculating carbon footprint, the amount of GHGs emitted/removed or embodied in life cycle of the product has to be estimated and added. Life cycle includes all the stages involved for a product such as its manufacture right from bringing of raw material to final packaging, distribution, consumption/use, and to the final stages of disposal (Pandey *et al*., 2011). A life cycle assessment (LCA, also known as life cycle analysis, eco-balance, and cradle-to-grave analysis) (Franchetti and Apul, 2012) is the investigation and evaluation which produces complete picture of inputs and outputs with respect to generation of air pollutants; water use and wastewater generation; energy consumption; GHGs emitted; or any other similar parameter of interest and cost–benefit initiatives (Pandey *et al*., 2011). A schematic of the LCA approach is shown in the Figure 1(Franchetti and Apul, 2012). Therefore, in context to carbon footprinting, LCA estimates the GHGs emitted/embodied at each identified step of the product's life cycle, technically known as GHG accounting. The GHG accounting is accomplished in accordance to certain standards and guidance. Some of these commonly followed standards are described as follows (Pandey *et al*., 2011).

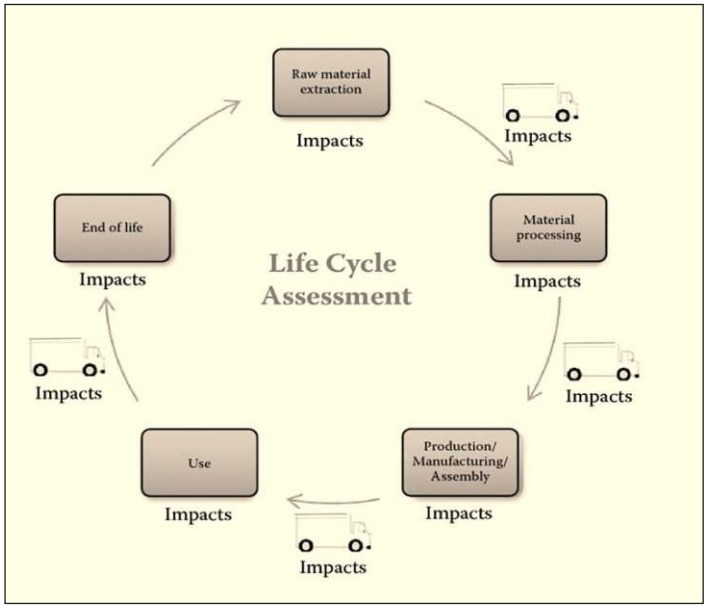


Figure : Life cycle assessment concept illustrating product life cycle and associated impacts. (SOURCE: Franchetti and Apul, 2012).

1. The Greenhouse Gas (GHG) Protocol:

The Greenhouse Gas (GHG) Protocol is a multi-stakeholder partnership of businesses, NGOs, governments, and others convened by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). Launched in 1998, the mission of the GHG Protocol is to develop internationally accepted *GHG accounting* and reporting standards and tools, and to promote their adoption in order to achieve a low emissions economy worldwide. The standards include detailed guidance to assist users with implementation and are freely available on the GHG Protocol website (www.ghgprotocol.org).

The GHG Protocol has produced the following separate, but complementary standards, protocols, and guidelines. These are as stated as below.

- ***GHG Protocol Corporate Accounting and Reporting Standard (2004):*** It is a standardized methodology for companies to quantify and report their corporate GHG emissions. Also called to as the Corporate Standard.
- ***GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011):*** It is a standardized methodology for companies to quantify and report their corporate value chain (scope 3; explained later) GHG emissions, to be used in conjunction with the Corporate Standard. Also called as the Scope 3 Standard.
- ***GHG Protocol for Project Accounting (2005):*** This is a guide for quantifying reductions from GHG-mitigation projects. Also known as the Project Protocol.
- ***GHG Protocol for the U.S. Public Sector (2010):*** It is a step-by-step approach to measuring and reporting emissions from public sector organizations, complementary to the Corporate Standard.
- ***GHG Protocol Guidelines for Quantifying GHG Reductions from Grid-Connected Electricity Projects (2007):*** This is a guide for quantifying reductions in emissions that either generate or reduce the consumption of electricity transmitted over power grids, to be used in conjunction with the Project Protocol.
- ***GHG Protocol Land Use, Land-Use Change, and Forestry Guidance for GHG Project Accounting (2006):*** A guide to quantify and report reductions from land use, land-use change, and forestry, to be used in conjunction with the Project Protocol.
- **Measuring to Manage:** A Guide to Designing GHG Accounting and Reporting Programs (2007): A guide for program developers on designing and implementing effective GHG programs based on accepted standards and methodologies.

Fundamentally, the *GHG Protocol Product Life Cycle Accounting and Reporting Standard* (referred to as the *Product Standard*) provides requirements and guidance for companies and other organizations to quantify and publicly report an inventory of GHG emissions and removals associated with a specific product. The primary goal of this standard is to provide a general framework for companies to make informed choices to reduce greenhouse gas emissions from the products (goods or services) they design, manufacture, sell, purchase, or use. In the context of this standard, public reporting refers to product GHG-related information reported publicly in accordance with the requirements specified in the standard (https://ghgprotocol.org/ sites/default/ files/standards/Product-Life-Cycle-Accounting-Reporting-Standard_041613.pdf). It forms basis for most GHG accounting

guidelines including ISO 14064 (parts 1 and 2) (Pandey *et al*., 2011).

2. ISO 14064 (parts 1 and 2): It is an international standard for determination of boundaries, quantification of GHG emissions, and removal. It also provides standard for designing of GHG mitigation projects (Pandey *et al*., 2011).

3. Publicly Available Specifications-2050 (PAS 2050) of British Standard Institution (BSI): It specifies the requirements for assessing the life cycle GHG emissions of goods and services (Pandey *et al*., 2011).

4. 2006 IPCC guidelines for National Greenhouse Gas inventories: All anthropogenic sources of GHG emissions are classified into four sectors—energy; industrial process and product use; agriculture, forestry and other land use; and waste. 2006 guidelines are an updated version of earlier 1996 guidelines. All countries that are signatory to the United Nations Framework Convention on Climate Change (UNFCCC) are committed to prepare, update, and communicate their national GHG emissions or removal inventories following these guidelines. Therefore, emission or removal inventories of such countries are comparable. UNFCCC however, has not yet made it compulsory to use 2006 guidelines and hence most of the nations are still following 1996 guidelines (Pandey *et al*., 2011).

5. ISO 14025: It is a standard which describes the principles and framework for conducting LCA. The impact data calculated by LCA to assess the environmental performance of a product is documented as Environmental Product Declaration (EPD). EPDs are therefore, a formal and internationally recognized way to present these impact(s) (Wright and Williams, 2011a; https://www.ecomatters.nl/services/lca-epd/epd/). Besides EPD, another concept introduced by ISO 14025 is Product Category Rules (PCRs). PCRs are specific guidelines for the calculation of the environmental impact of products with similar characteristics. By following the requirements in the PCR, a company can develop an EPD (https://www.pre-sustainability.com/download/Life-Cycle-Based-Sustainability-Standards-Guidelines.pdf).

6. ISO 14067 (2018): This document is a revised version of ISO 14067 (2013) and specifies principles, requirements and guidelines for the quantification and reporting of the carbon footprint of a product (CFP), in a manner consistent with international standards on LCA (ISO 14040 and ISO 14044) (https://webstore.ansi.org/Standards/ISO/ISO140402006?source=blog). Both ISO 14040 and ISO 14044, describe the principles and framework for LCA including definition of the goal and scope of the LCA; the life cycle impact assessment (LCIA) phase; the life cycle interpretation phase, reporting and critical review of the LCA, limitations of the LCA; the relationship between the LCA phases; and conditions for use of value choices and optional elements. It doesn't describe the LCA techniques in detail, nor does it specify methodologies for the individual phases of the LCA (https://webstore.ansi.org/Standards/ISO/ISO140402006?source=blog). However, the difference between these two documents is that ISO 14040 provides a general introduction to the principles of LCA and LCI; whereas, ISO 14044 sets out specific requirements (Steele, 2010).

Some countries have developed their own GHG accounting guidelines such as Department of Food and Rural Affair (DEFRA) and Carbon trust in United Kingdom and Environmental Protection Agency (EPA) in USA. Registries and consultancies like World Wildlife Fund Climate Servers, California Climate Registry (USA), The Climate Registry (USA), etc. have formulated their own methodologies based on these guidelines. Almost all of these newly developed guidelines and standards direct accounting for the GHGs emitted during the manufacture, use and disposal of the product, entity, or event and referred to as complete LCA (Pandey *et al*., 2011).

Approaches for carbon footprint quantification

The carbon footprint is calculated for all GHG gas quantities/flux as CO_2eq considering emission factors. There are two approaches followed for quantification of carbon footprint: (i) bottom-up, based on process analysis (PA), and (ii) top-down, considering environment input-output (EIO) analysis. The bottom-up approach subsumes the comprehension of environmental impacts contributed by an individual, product, region or category from the source to the sink. It involves a PA of the environmental impacts of individual products from cradle to grave. However, such an approach is often associated with the issue of a system boundary only on-site. Consequently, it emphasizes on the requirement for identification of appropriate system boundaries. Thus, PA-based LCAs approach has the disadvantage for identification of appropriate system boundary and is based only on-site and most first-order impacts. This approach becomes far fetching for larger entities such as government, households, or particular industrial sectors (Ramachandra and Mahapatra, 2015).

In contrast, the top-down or the environment input-output (EIO) analysis is most commonly applied in economics and provides a majority of the economic activities at sectoral scales. This approach with consistent environmental data aids in a comprehensive and robust way considering all impacts of the whole economic system as boundary. However, application of the top-down approach to assess microsystems such as products or processes is limited, as it assumes homogeneity of prices, outputs, and their carbon emissions at the sector level. Advantage of input-output based approaches is a much smaller requirement of time and manpower once the model is in place (Ramachandra and Mahapatra, 2015).

The best option for an exhaustive and intensive analysis is amalgamation of both PA and EIO methods. Such an approach enables to preserve the detail and accuracy of bottom-up approaches in lower-order stages, whereas higher-order stages requirements are covered by the input-output part of the model (Ramachandra and Mahapatra, 2015).

Greenhouse gas accounting

Greenhouse gas (GHG) emissions accounting is a set of methods and approaches for quantifying GHG emissions in support of climate action planning, implementation, monitoring, evaluation, and reporting. It is mostly a technical exercise requiring data collection, analysis, and management and usually follows established protocols (e.g., GHG protocol) and uses specialized software and databases. GHG emissions accounting is now a specialized area of practice and even has a professional certification through the World Bank (Boswell *et al*., 2019).

In order to keep account of the emissions along the life cycle, the following structured framework is suggested (Pandey et al., 2011) during GHG emissions accounting:

1. **Selection of GHGs**
2. **Setting boundary**
3. **Collection of GHG emission data**

I. Selection of GHGs

Selection of the GHGs covered in calculation depends on the guideline followed, the need of carbon footprint calculation, and on the type of activity for which carbon footprinting is being performed. Although some studies include only CO_2 emissions in carbon footprint calculations, others include the six Kyoto gases. Suggestively, if possible and to have a better picture all the GHG emissions must be considered (Pandey *et al*., 2011).

II. Setting boundary

In context to carbon footprint analysis, boundary denotes an imaginary line drawn around the activities that will be used for calculating carbon footprint. It depends on the objective of footprinting and characteristics of the entity for which footprinting is being performed. It is important to select a boundary so that the organization is totally represented based on legal, financial, or business control. Once the organizational boundary has been established, operational boundary is to be selected. Operational boundary refers to the selection of the direct and indirect emissions, which will be accounted for. To facilitate convenient accounting, tiers or scopes have been suggested (Pandey et al., 2011):

1. All direct emissions, i.e., onsite emissions (TIERS I)
2. Embodied emissions in purchased energy (TIERS II)
3. All indirect emissions, such as those associated with transport of purchased goods, sold products, business travels, energy activities, disposal of products etc., not included in tiers I and II (**TIERS III**) (Pandey et al., 2011).

Figure 2 illustrates the three tiers in carbon footprint estimation. The tiers II and III both include indirect emissions, but tier II refers to the emissions embodied in energy production or (and) purchase, transmission, and distribution caused by the entity under consideration, but end user emissions are out of scope of tier II. Tier III tends to cover all the embodied emissions within the specified boundary. However, tier III has vaguely been defined and accordingly, the most carbon footprint studies limit up to tier II. This is because, it becomes too complex to estimate carbon footprint beyond tier II with accuracy. Also, it is important to be ascertained that to what extent responsibility and control over emissions can be made beyond tier II. For this reason most GHG accounting standards have kept tier III optional. However, in near future, advancements in the tracking and management of emissions in the supply chain is expected to promote tier III accounting and reporting. The exclusion of tier III contributes most significantly to the total CO_2e only for the biggest known emitters such as thermal power plants, cement industries, and transportation. In these cases, tiers I and II can cover 80% of total carbon footprint. Whereas, for most of other processes, only 26% of total carbon footprint could be covered up to tier II. Hence, tier III estimation has been promoted to include relevant sources (relevance can be decided on the basis of size, risk exposure of GHGs, etc.) and deemed critical by the stakeholders. Inclusion of an additional tier IV to cover emissions exclusively related to delivery, use, and disposal of products is also proposed (Pandey *et al*., 2011).

Based on order of emissions covered, carbon footprint has two components namely "basic" or "primary" referring to carbon footprint calculated from direct emissions and emissions embodied in energy purchase, and "full carbon footprint" when all direct and indirect emissions are included. Almost all the carbon footprint studies focus only on GHG emissions; the amount of GHG removal and sequestration appears to be neglected (Pandey *et al*., 2011).

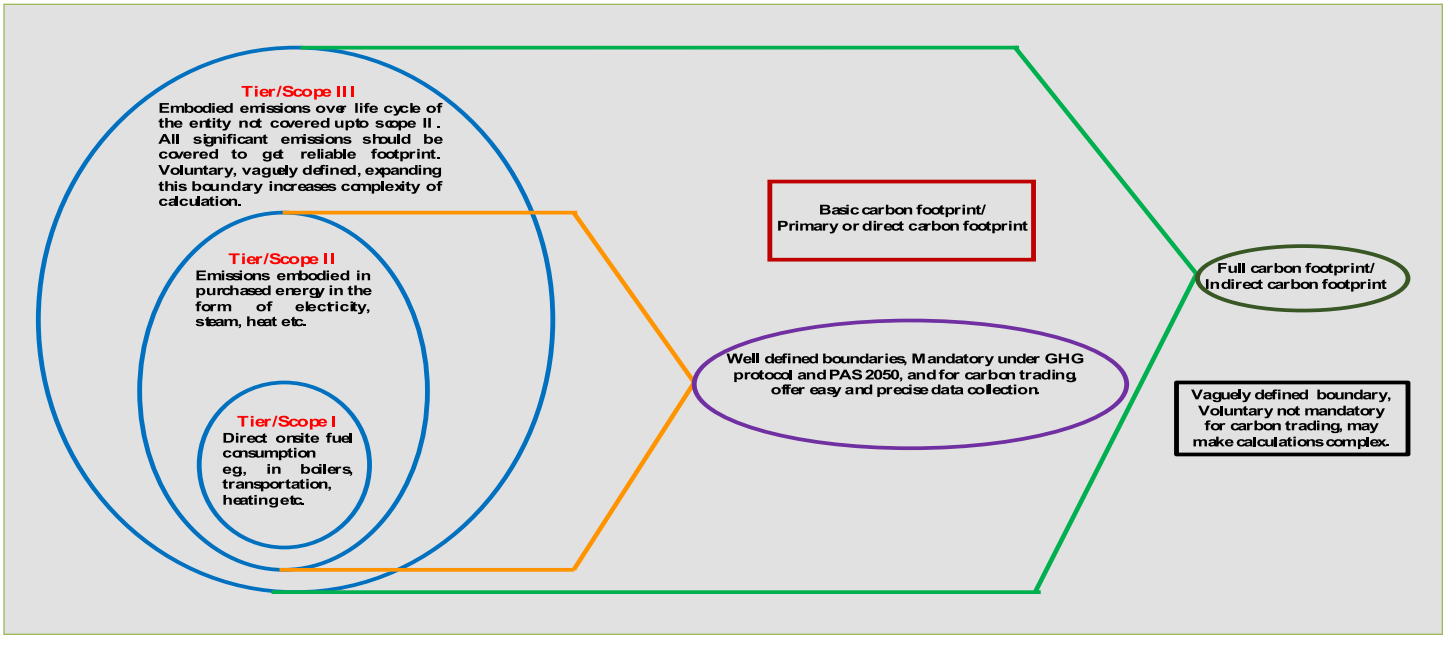


Figure 2: Boundaries for calculation of carbon footprint. (SOURCE: Pandey *et al*., 2011).

III. Collection of GHG data

The GHG data can be collected through direct on-site real-time measurements, or through estimations based on emission factors and models. The choice of appropriate method depends on the objective (mandatory, voluntary, or for internal management), credibility, feasibility as well as on cost and capacity considerations. In general, for products, organizations, and events, emissions are calculated using specific emission factors and models utilizing data on consumption of fuels, energy, and other inputs leading to emissions (particularly CO_2). Emission factors are available for a wide range of industrial processes and land uses in GHG protocol, PAS-2050, IPCC (2006). However, verification is required at different operational and geographical contexts and thus, nation-wise emission factors have been developed and recommended in many countries such as national inventories under UNFCCC, US EPA, UK DEFRA, etc. (Pandey *et al*., 2011).

Considering the other sources other than those estimated by emission factors and models and fugitive emissions, direct measurements should be applied. Direct measurements include optical, chemical, and biological sensors such as photo acoustic infrared sensors or other instruments and techniques like collecting gases of interest in specially designed chambers and analysing through IR spectroscopy for CO_2 and gas chromatography for all GHGs. These techniques have been applied for ground-based measurements whether static, mobile, or aerial. Besides onsite measurement, secondary data sources and databases are now available at global level also. A database of CO_2 emissions from different countries has been developed under global trade analysis project (GTAP). Other reliable data sources can be national GHG inventories and other government offices keeping the data of fuel and energy consumption, International Energy Agency, UNDP etc. Low-cost real-time measurement systems are under development (Pandey *et al*., 2011).

While direct measurements are more accurate and are clearly prescribed in globally accepted protocols, their cost and application may be prohibitive. In such cases, indirect estimations may yield fairly accurate results if developed or modified specifically for a particular region or sector. Customized tools relying on direct measurements as well as on interpolation or expansion of observations to non-measurable fluxes (*i.e.*, emission factors and models) have enhanced practicability for intended users. The GHG protocol customized GHG calculation tools, are worldwide accepted guidance for customizing the tools for calculating GHG flux so as to suit the respective sector or entity. Besides these, continuous GHG monitoring is going on and is being expanded to get broad spatial coverage. For this, advanced measurement and monitoring systems (remote sensing, geographic information system, optical measurements etc.) are now being integrated with individual GHG inventories so as to provide comprehensive and uniform coverage. Scientific community is operating terrestrial and oceanic observation networks to collect GHG data worldwide. FLUXNET, the global terrestrial observing network monitors CO_2, water vapor, and energy at more than 300 sites. These systems cover a very broad spatial area, but the monitoring locations in Asia and Africa are sparse and should be increased in number in order to obtain a reliable global data (Pandey *et al*., 2011).

To overcome the reduction in accuracy of ground-based monitoring network due to patchy distribution, satellites have been launched to monitor sources and sinks of CO_2 and other GHGs with uniform coverage. Remote sensing and geographic information system are extensively in use for large and relatively less accessible areas. Such as those subjected to any natural calamity (hurricane, typhon, etc.). GHG emissions and avoidance embodied in use of renewable energy, recycling of waste, energy recovery from landfills, and other such good management practices, are estimated through prescribed mathematical relations (Pandey *et al*., 2011).

Regarding voluntary personal carbon footprinting, numerous carbon calculators are available online as well as from consultancies. All of these calculators claim to be based on recommended guidelines, but rarely any two of them yield similar outputs for the same set of inputs. This questions the accuracy and credibility of such calculators. Among hundreds of online calculators, some calculate domestic carbon footprint, while others calculate carbon footprint related to specifically travel, food, or other such activities. Very few calculators indicate the use of indirect emissions under tier III. There is no coherence among the input data required for different carbon calculators. Incorporation of information technology to design a personal environmental tracker has been proposed to increase accuracy of such calculators, while household and device level monitoring using specific sensors is gaining popularity in developed countries (Pandey *et al*., 2011).

Carbon footprint initiatives

Retailers are becoming increasingly aware of the opportunities to improve the environmental performance of products and influence purchasing decisions. There are currently various activities to capture and record life cycle data on a range of household products and pass this information on to customers. This offers consumers a better understanding of the environmental impacts of their purchasing choices (Johnson and Gibson, 2014).

Some initiatives display carbon footprinting information on a wide range of products from potatoes to light bulbs. Retailers are beginning to present this kind of information on product labels. Some carbon labels are directly linked to the commitment of actively working to reduce greenhouse gas emissions. In addition to reducing their own carbon footprint, the benefit to retailers is that they are being seen as national and international leaders in engaging consumers on climate issues and helping them reduce their carbon footprint. In the case of one multinational retailer, more than 500 product lines have been or are in the process of being footprinted. A number of private consultancy companies have been set up to offer a carbon footprinting calculation services or software to industry, indicating that the concept has a strong position as a unit of measure in the B2B and B2C market place. Some of these also offer offsetting programs, largely in the form of tree planting (Johnson and Gibson, 2014).

How can I calculate my carbon footprint?

Although adding up one's individual carbon footprint can be difficult, online calculators can do some of the work for you,

giving a rough estimate of your carbon footprint based on the size of your household, the efficiency of your appliances, how much you drive or fly, what you eat, and how much you recycle. This isn't perfect, but it is a good way to measure your activities so you can understand roughly how much CO_2 they generate and take steps to reduce your carbon footprint (http://www.takepart.com/flashcards/what-is-a-carbon-footprint/index.html).

Why you should calculate your carbon footprint?

The carbon footprint is a very powerful tool to understand the impact of personal behavior on global warming. Most people are shocked when they see the amount of CO_2 their activities create! If you personally want to contribute to stop global warming, the calculation and constant monitoring of your personal carbon footprint is essential (http://www.takepart.com/flashcards/what-is-a-carbon-footprint/index.html).

How can I reduce my carbon footprint?

Methods of reducing your carbon footprint include driving more-efficient vehicles (or making sure that your current vehicles are properly maintained), taking public transportation, using energy-efficient appliances, insulating your home to reduce heating and air conditioning costs, consuming food that doesn't require as much transportation, and adopt vegetarian diet over non-vegetarian since, meat has a higher carbon footprint than fruits and vegetables. Individuals and companies can also offset some of their CO_2 emissions by purchasing carbon credits, the money from which can go into projects such as planting trees or investing in renewable energy (http://www.takepart.com/flashcards/what-is-a-carbon-footprint/index.html; https://www.goingzerowaste.com/blog/5-ways-to-reduce-your-carbon-footprint; https://www.honestly.com/blog/reducing-carbon-footprint-work/)

Conclusion

Carbon footprint analysis is a promising tool for the assessment and future implications of the negative impacts of human activities, organizations or any industry which are contributing continuously towards global warming and hence, climate change. Global warming and climate change are two hard-hitting environmental challenges with overwhelming socio-economic concerns. Therefore, in order to establish the concept of sustainability at global level, carbon footprint analysis is essential and ensures a prospective potential in building a healthy environment. So, let's practice reduction(s) in our carbon footprint at individual levels and save our environment.

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UPCOMING EVENT

Science Festival & National Workshop on Environment and Society: Inter-linkages & Co-existence at Hindu College, Delhi to be conducted during **27th to 29th February, 2020** by Hindu College, University of Delhi and Save the Environment - A Society for Research, Awareness and Social Development located at Kolkata, West Bengal.

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Science Festival
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on
Environment and Society: Inter-linkages & Co-existence

27-29 FEBRUARY 2020

Organized by

Hindu College
University of Delhi
&
Save The Environment
(A Society for Research awareness & Social Development)
Kolkata, West Bengal

About Hindu College

HINDU COLLEGE started with a humble beginning in 1899 with a pre-eminent aim to provide modern and nationalist education to the youth of the Country. Since then it has seen enviable growth over the years. After receiving A+ grade in NAAC accreditation, the College has been recently awarded 2nd rank in All India "National Institutional Ranking Framework (NIRF)"2019. Currently, it is not only one of the most distinguished co-educational institutions of our country but is also the College of first choice in Delhi.

Hindu College continues to be an agency of change. It promotes an all-round development of the student by inclusion of such values as scientific temper and respect for each other's culture as a way of life; by promoting the importance of knowledge, and making students visionaries to excel in any profession; and by providing students the widest opportunities to develop their potential to the fullest. Education at Hindu College is aimed at evolving the individual – encouraged through participation in many kinds of co-curricular activities. Most of all, the College aims to produce responsible citizens of the Country.

With the academic expanse of college spanning over all three streams of Humanities, Commerce and Science offering 19 courses, there are more than 30 extra curricular societies that add to the vibrant environment of the Institution. It aims to deliver a perfect platform for academics, management, sports, ethics and politics. To meet the demand of increasing student strength the College has added to its infrastructural facilities, a New Academic Block and a Girls hostel in addition to an existing boys hostel. To promote research at the undergraduate level, the College is soon coming up with a state of the art research centre in its campus.

About Save the Environment

SAVE THE ENVIRONMENT (STE) was founded on 26th January 1989 and got registered on 19th November 1990. In 1992 with the collaboration of WWF (India), the organization started working to combat arsenic poisoning problem of water in the arsenic prone areas of West Bengal. Since then STE has been involved in various project related to combat arsenic problem in India. Some of the main activities of the organization are as follows:

- In 1994 STE with the collaboration of All India Institute of Hygiene & Public Health, Government of India undertook project on arsenic removal to provide arsenic free water. 1st arsenic removal plant installed by STE organization in1997. The plant was inaugurated by the Minister of PHED (West Bengal) on 23rd January 1997.
- A vocational training center was inaugurated for the arsenic patients in 2003 and setting up of a special hospital for arsenic patients is under process.
- Developing a model for sustainability of arsenic mitigation programme in the rural setup of India with the help of Indian Institute of management (IIM), Ahmedabad.
- Already installed about 60-community type Arsenic Removal Plants and have distributed more than 1500 domestic filters so far.
- Since 1997 till date, Arsenic free drinking water has been provided to more than 50,000 people in India.

About the Science Festival and Workshop

During the last two decades, anthropogenic pressures on environment (water, air and soil) have increased at a much greater pace. Humans influence the natural environmental conditions in many ways. For instance, discharge of untreated wastewater into river environment is affecting its water quality as well as aquatic, flora and fauna. Similarly, vehicular exhaust is making air environment poisonous. Also, increasing use of fertilizers and pesticides for crop production are affecting the soil environment. Further, their runoff from agricultural fields is polluting water sources. Poor quality of water, air and soil in turn have adverse effect on human health.

There is a dire need to understand the mutual relationship between environment and society. Research and teaching in this area emphasize that the human relationship to the environment can be biological, economic, political, physical, cultural, chemical, or social. Also, there is a need to ensure that all national infrastructural works and resource (especially water) development ambitions should be undertaken in environmentally sustainable manner so that both can co-exist.

To understand this accord between environment and society in a better way the Departments of Botany, Chemistry, Environment, Physics & Zoology at Hindu College have come together for the first time to celebrate Science in their own way through this platform of Science Festival and National Workshop that covers one of the most pertinent issues of the contemporary world– Environment and Society.

The Science Festival and the Workshop-ESIC 2020 aim to bring together researchers, educators, eminent scientists and various segments of industries to initiate conversations on deep rooted environmental issues, exchange knowledge and ideas to ponder upon the prospective and sustainable approaches to solving environmental problems on the local, national, and global scale. Prompt keynote lectures, oral talks and poster presentations along with a host of other events will be organized to this effect through this three day national forum.

Objectives

- Understand the environmental regulations in India and progress with their implementation
- Explore the nature of inter-linkages between environment and society
- Assess whether the environmental goals and societal resource development needs can co- exist
- Promoting the potentials of cleaner research practices for sustainable development

Thematic tracks

- Waste water treatment and disposal
- Emission control measures for air quality
- Emerging contaminants in water
- Bioprocessing for water treatment
- Strategies for human exposure reduction
- Toxic metal contamination in ground water
- Nanotechnology for water treatment
- Remediation of soil pollution
- Marine environment

Oral & Poster presentations

- The workshop will comprise of oral presentations with a time limit of **10 minutes** each.
- The workshop will also have poster presentation sessions
- The standard poster dimensions are **48x36**
- The best oral and poster presentations will be selected by a three member panel of judges and the selected presenters will be awarded.
- Interested candidates may submit their abstracts through email to **esic2020.du@gmail.com**

Deadlines

Submission of abstract (oral and poster) may be made latest by **January 30, 2020.**

Registration

Registration Fee (non refundable): Applicants are required to pay the registration fee *via* demand draft in favour of Principal, Hindu College payable at Delhi or *via* electronic transfer.
Electronic transfer details:
Account number: 35871122927
Name of the account: Hindu College Fee Account
Bank: State Bank of India **City:** New Delhi **IFSC Code:** SBIN0010433

Registration Fee	Up to January 30, 2020	On spot
Students	500	700
Research Scholars	1000	1200
Academicians	1500	2000
Industry delegates	2500	3000

Other Exciting Events

- Quiz
- Slogan Writing competiton
- Photography and film making competition
- Debate
- Paper presentation
- Hands on training sessions
- Essay Writing competiton
- Oral presentation
- Just a minute (JAM)

For more details and queries on events, please contact:

Dr. Lalit Kumar
Assistant Professor, Department of Physics
Contact No.– 9911378156

ARTICLES ARE INVITED FOR THE

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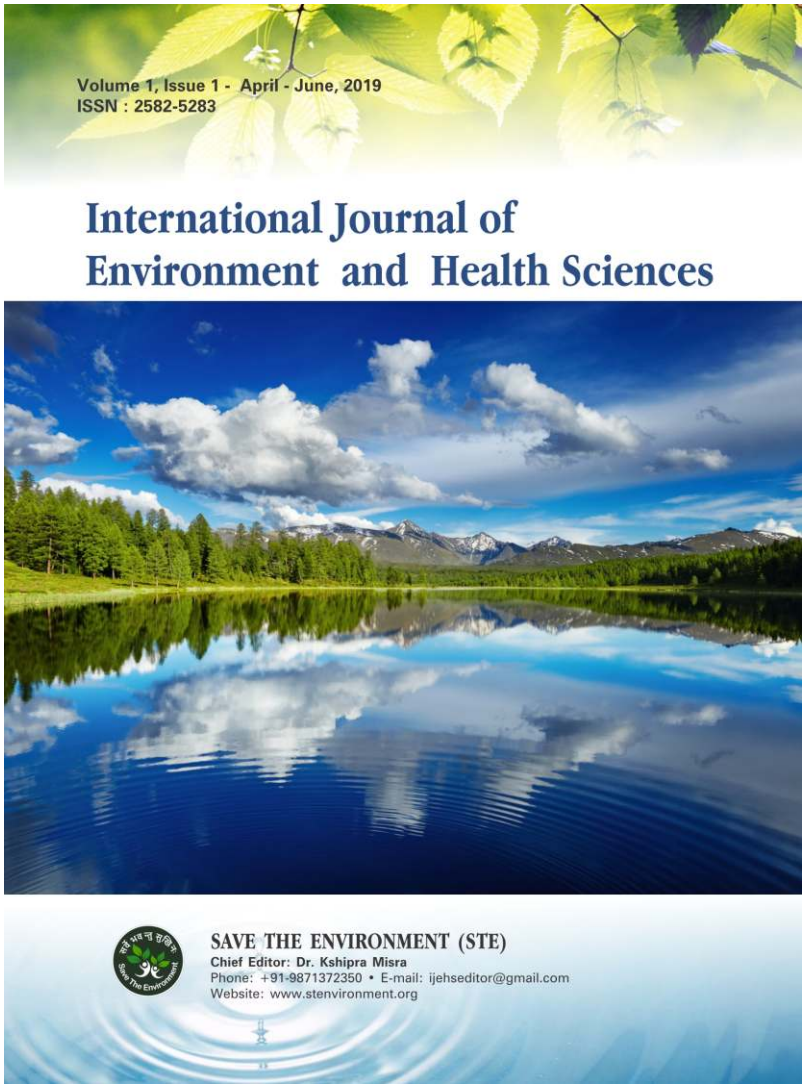

For further details and NOTES FOR AUTHORS, please contact Chief Editor at: ijehseditor@gmail.com

or

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STE Annual Awards 2020

(NOMINATION AND APPLICATIONS ARE INVITED)

LAST DATE 30th SEPTEMBER 2020

Annual Awards of STE are the tangible symbol to signify eminence of contributions made by a person or institution. This boosts the enthusiasm of the contributors who have contributed in different fields of science and social service with their excellence, expertise and approach towards achieving certain goals for the society. Recognition of such extraordinary activities is eventually very important to boost their confidence and to honour them for what they have done for the science and society. STE confers following categories of awards and honours to such eminent personalities.:

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STE Best Teacher Award

STE Dr. Praloy O Basu Life Time Achievement Award

STE Young Researcher Awards

STE Best Ideas/Innovations/Technology for Environment Awards

STE Women Awards

STE International Awards

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Editor, STE E-Newsletter

Ms. Shereen Bajaj
Assistant Editor STE E-Newsletter

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