MARCH 2018

VIEWPOINT

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Environment and Climate Change

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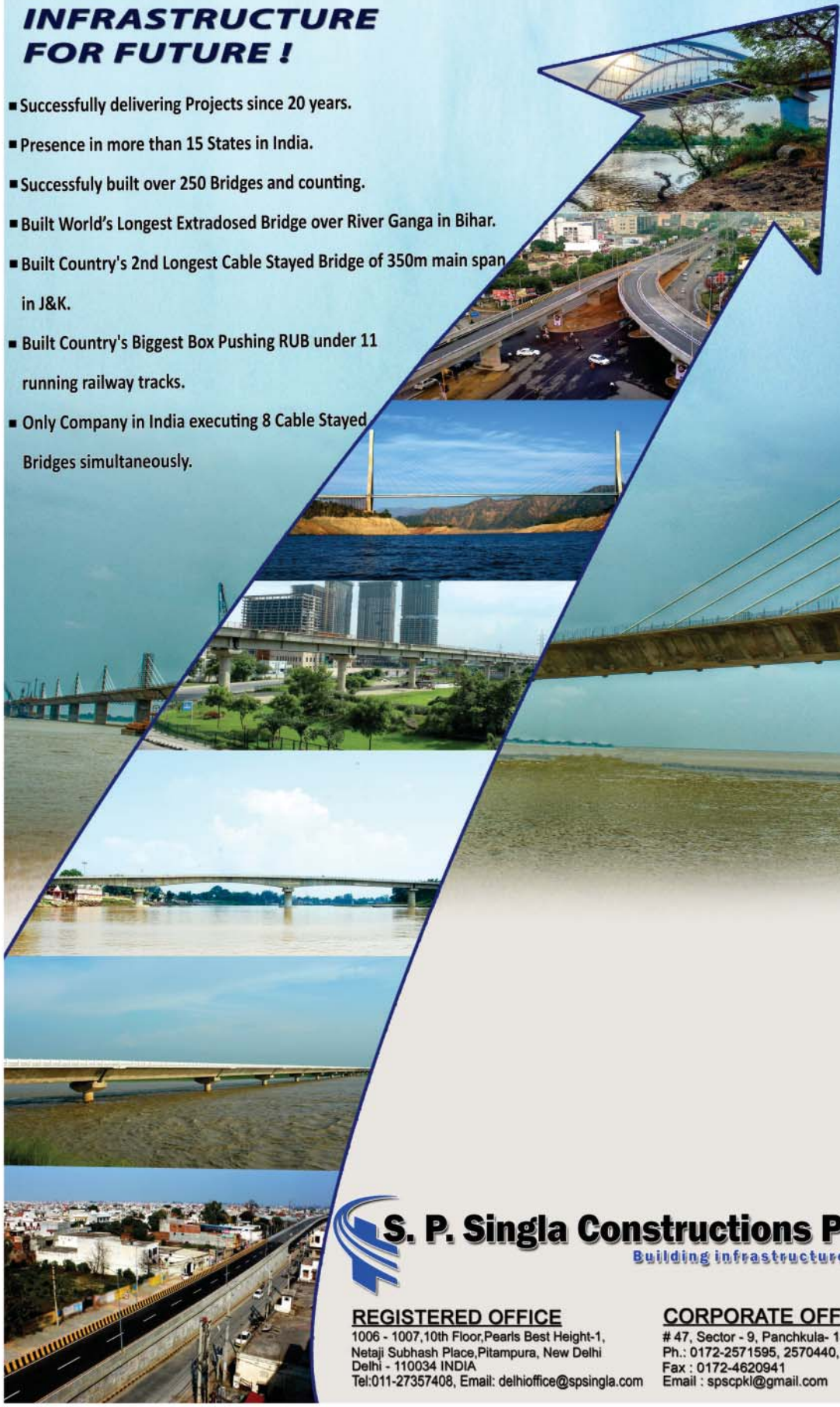

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CONTENTS

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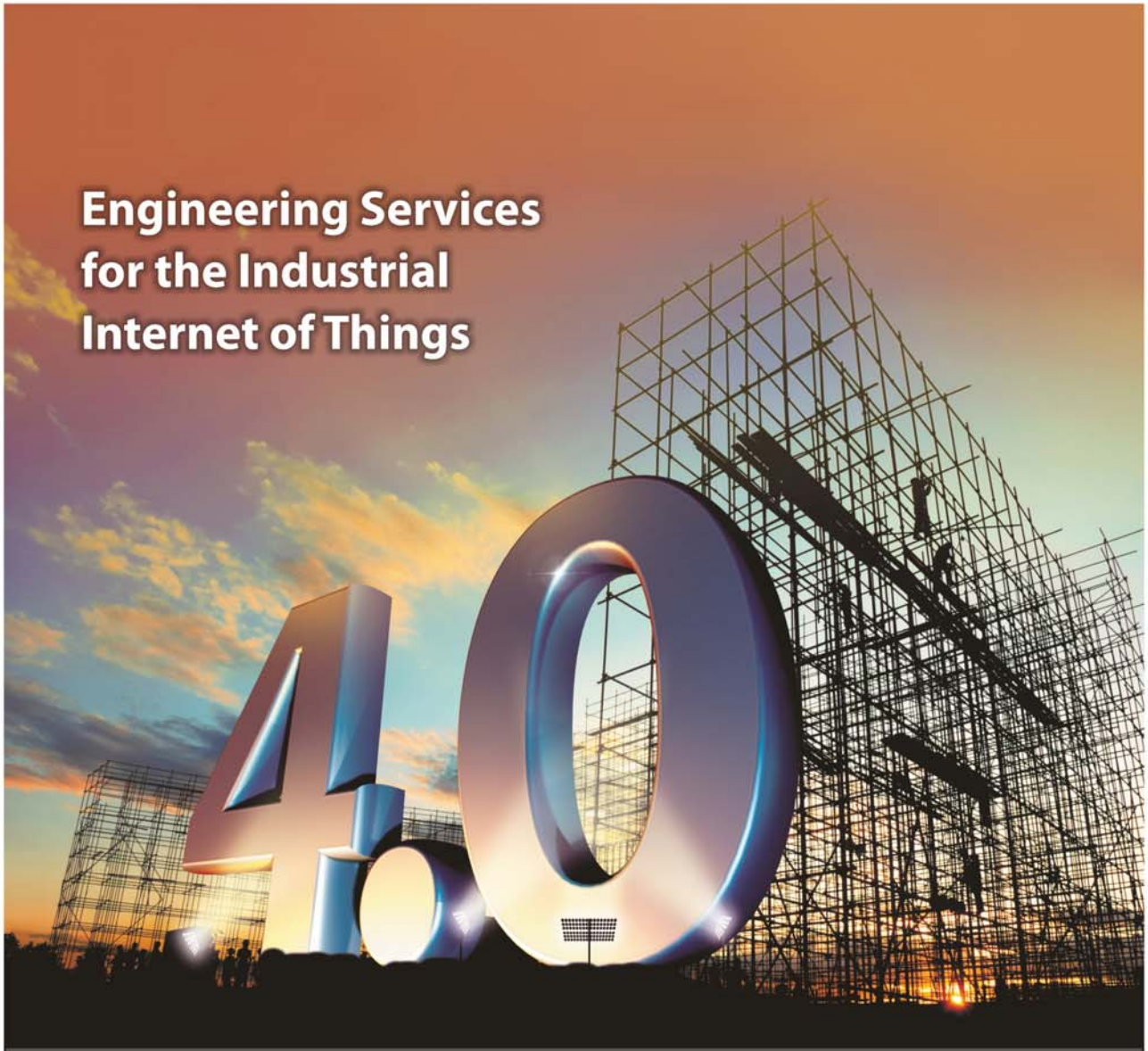

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MESSAGE FROM CHIEF EDITOR

Dear Fellow Consulting Engineers,

*"**Environment &Climate Change**"* aptly comes at the end of a harsh winter in the Northern Hemisphere and heavy precipitation in many countries resulting in disasters the world over; all caused by continued global warming. No science or technology or economic wealth or authoritarian power can thwart the wrath of nature. People in general are rightly apprehensive of what the future has in store for them as far as the environment and climate change are concerned. As per the World Economic Forum Global Risks Perception Survey 2017–2018, among the Top 10 Risks high in the ranking both in terms of Likelihood as well as Impact are Extremer Weather Events and Natural Disasters ("The Global Risks Report 2018").

The deteriorating environment and the climate change on account of pollution caused by humans has been the subject of discussions and debates for years but becomes subservient to economic compulsions, development and growth. Many countries have still to adopt mitigation measures in right earnest. Sustainability needs to be adopted whole heartedly in all spheres of life. Davos like events will keep taking place but India must, for the sake of its own future generations, adopt mitigation measures in all earnestness. It must also exhort others to follow suit.

India has embarked on the *'Swachh Bharat Abhiyan'* (Clean India Mission) on 2nd October 2014. A mission such as that is inseparably linked to the environment and through that to climate change. It is three and a half years old now. What really needs to be evaluated is how many have really understood the necessity of improving and maintaining their environment. The answer could be that lip sympathy is there in plenty but comprehension is another matter. The masses, the politicians, the bureaucrats, et al all must be explained of the direct and indirect impact of climate change caused due to degradation of the environment, of robbing and destroying nature to satisfy man's lust for wealth. It is only when each of them individually and collectively comprehends the true implications, that they will not consider "*The Day After Tomorrow*" as just another movie (first aired in 2004) but as a scenario that effects of climate change can become a reality even during their life time. They need to be explained "what's in it for me" in plain simple language with no scientific jargon so that the message gets driven home. It's only then that they will become a part and parcel of the movement and not offer mere lip service.

"Our Biggest and Essential Asset is Our Earth"

This issue has some thought provoking articles and suggestions for all so that India can fulfill the climate change agenda. As I mentioned in the previous issue, the seminar on "Managing Physical Assets to Deliver Business Outcomes Cost Effectively" drove home the point that Let's all pledge to be an active partner for fulfilling the climate change agenda and save the earth so that posterity is not deprived and denied of their needs.

Happy Reading and Learning

A P Mull

MESSAGE FROM GUEST EDITOR

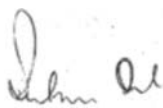
For about 3 decades after independence, India embarked on undertaking developmental activities with little regard to environmental attributes. Thereafter, till the end of the last century, environmental yardsticks were introduced into the project framework as crosscutting issues. In the new millennium, environment, health and safety concerns are being directly integrated into the definition of a project with quantification of environmental risks and costs leading towards environmental remediation. With this realization, it is our pleasure to present to you this Edition of Viewpoint, with the Theme, *'Environment and Climate Change'*. Our call for papers received overwhelming response and the following authors contributed to present together an eclectic bouquet of articles:

- ✓ *Mr. Pradeep Chaturvedi*
- ✓ *Mr. Umesh Shrivastava*
- ✓ *Mr. Anjan Bhattacharya*
- ✓ *Ms. Haimanti Poddar*
- ✓ *Mr. D Dasgupta*
- ✓ *Mr. Mainak Ghosal & Prof. Sabu Thomas*
- ✓ *Mr. P G Venkatram & Mr. C V Sundara Rajan*
- ✓ *Dr. Ronald Valledor Gomeseria*
- ✓ *Prof. Ashvani Kumar Gosain*
- ✓ *Mr. Arvinder S Brara*
- ✓ *Mr. K K Kapila, Dr. P K Nanda, Ms. Tamosi Bhattacharya*
- ✓ Dr. Azad Jain, Dr. Ashaa Jain, Mr. Aniruddh Jain, Ms. Amrusha Jain

We owe our sincere gratitude to all the authors for painstakingly writing the papers, Mr. A P Mull, Chief Editor editing each article and the Secretariat for all its support in publishing the Bulletin.

Have an Enjoyable Reading.

Best Wishes



Sutanu Ghosh

Transitioning to A Climate Resilient Economy

Pradeep Chaturvedi
Vice President
World Environment Foundation

Climate Change Convention, COP Meeting at Paris in December 2015, was a watershed moment in the tortuous history of climate change negotiations. At Paris, the countries of the world decided to establish a framework agreement within which each country would pledge its climate change actions over an agreed period of time (in the first instance till 2030, and then for 5 year periods after that), and then pledge even more ambitious actions for succeeding time periods. India also put into place a transparency mechanism through which countries would periodically report on their climate change actions and the progress towards meeting their pledges. Periodical global stock taking would also be carried out so as to provide the world with an assessment of the level of global action that would need to be taken in order to keep the global temperature rise to less than 2˚C.

India had gone to Paris with the goal of being a part of the global solution to address climate change, and at the same time to ensure that we are able to provide adequate and affordable energy to all our citizens, especially the poorest. The pledge-achieve-pledge more framework provides us the structure to achieve both these goals simultaneously. India had submitted its first INDC (Intended Nationally Determined Contribution) with the pledge that by 2030, it would inter alia:

- Reduce emissions per rupee of GDP by 33-35% as compared to 2005, so as to ensure a good standard of living for all, while also making the Indian people energy efficient and sustainable.
- Ensure that at least 40% of the installed electricity generation capacity is based on non fossil fuels, which would imply that the renewable energy capacity would increase about 10 fold and the coal capacity would double in order to provide enough electricity for all, as well as enable the rapid diffusion of renewable energy.

In New York on the 22nd of April 2016, India and 176 other countries, signed the Paris Agreement, signaling are solve to bring the Agreement into force and to fulfill the pledges. It is now time to initiate action to ensure that it does so.

Climate Resilient Development

UN Sustainable Development Goal 9 deals with Building Resilient Infrastructure and Promotion of Sustainable Industriali sation and UN Sustainable Development Goal 13 focuses on Climate Change related issues. The actions to be taken to achieve both these goals are discussed below:

GOAL 9. BUILD RESILIENT INFRASTRUCTURE, PROMOTE INCLUSIVE AND SUSTAINABLE INDUSTRIALIZATION AND FOSTER INNOVATION

9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all,

9.2 Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries,

9.3 Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets,

9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities,

9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending,

9.a Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States,

9.b Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities, and

9.c Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020.

GOAL 13. TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS

13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries,

13.2 Integrate climate change measures into national policies, strategies and planning,

13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning,

13.a Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible, and

13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized Communities.

The most important issue for engineers is to ensure that a climate resilient ecosystem is created. Whereas, the experts from the globe will try to overcome the climate change actions but it is difficult to attain perfection. They will need climate resilient economy to grow at a fast pace. A large number of businesses have already moved on to climate resilient technologies and are practicing successfully. This topic is of significant importance to consulting engineers as they need to advise and implement programmes for their clients to promote climate resilient economy. Many of these practices are invogue but are not categorized as climate resilient technologies. What is forming the climate resilient technologies and processes are discussed in this paper? Thesteps necessary for moving towards climate resilient development are also discussed.

What is Climate Resilience?

A review of expert opinions and global literature relating to climate change and sustainable development indicate a general consensus on the following terminology.

Climate resilience can be generally defined as the capacity for a socio-ecological system to:

I. Absorb stresses and maintain function in the face of external stresses imposed on it by climate change; and

II. Adapt, reorganize, and evolve into more desirable configurations that improve the sustainability of the system and leave it better prepared for future climate change in practice.

With the rising awareness of climate change impacts by both national and international bodies, building climate resilience has become a major goal for these institutions. The key focus of climate resilience efforts is to address the vulnerability that communities, stakeholders, and countries currently have with regards to the environmental consequences of climate change. Currently, climate resilience efforts encompass social, economic, technological, and political strategies that are being implemented at all scales of society. From local community action to global treaties, addressing climate resilience is becoming a priority, although it could be argued that a significant amount of the theory has yet to be translated into practice. Despite this, there is a robust and ever-growing movement fueled by local and national bodies alike, geared towards building and improving climate resilience.

In actuality, there is still a great deal of abstract discussion and debate regarding a number of subtle nuances associated with the precise definition of the climate resilience prospective, such as:

I. Its relations to climate change adaptation,

II. The extent to which it should encompass action-based verses system-based approaches to improving stability; and

III. Its relationship with the balance of nature theory or homeostatic equilibrium view of ecological system.

Currently the majority of work regarding climate resilience has been centered around examining the capacity for the social – ecological system to sustain shocks and maintain the integrity of functional relationship in the face of external forces. However, there is a growing consensus in academic literature which argues that greater attention needs to be focused on investigating the other critical aspects of climate resilience, which is the capacity for social-ecological systems to renew and develop, and to utilize disturbances and opportunities for innovation and evolution of new pathways that improve the system's ability to adapt to microscopic changes.

Climate Resilience and Environmental Justice: Applications of a Resilience Framework

A climate resilience framework offers a rich plethora of contributions that can improve our understandings of environmental processes, and better equip governments and policy makers to develop sustainable solutions that combat the effects of climate change. To begin with, climate resilience establishes the idea of multi-stable socio-ecological systems. Resilience originally began as an idea that extended from the stable equilibrium view that – systems only acted to return to their pre-existing states when exposed to a disturbance. But with modern interpretations of resilience, it is now established that socio-ecological system can actually stabilize around a multitude of possible states. Secondly, climate resilience has played a critical role in emphasizing the importance of preventive action when assessing the effects of climate change. Although adaptation is always going to be a key consideration, making changes after the act has limited capability to help communities and nations deal with climate change. By working to build climate resilience, policy makers and governments can take a more comprehensive stance that works to mitigate the harms of global warming impacts before they happen. Finally, a climate resilience perspective encourages greater gross-scale connectedness of systems. Climate change scholars have argued that solely relying on theories of adaptation is also limiting, because inherently, this perspective does not necessitate as much full-system cohesion as a resilience perspective would. Creating mechanism of adaptation that occurs in isolation at local, state, or national levels may leave the overall social-ecological system vulnerable. A resilience-based framework would require far more cross – talk, and the creation of environmental protections that are more holistically generated and implemented.

Resilience and Vulnerability

Climate resilient process is established with a number of assumptions and possibilities. Natural disasters and human activities are considered responsible for affecting climate and on the other hand climate change is also causing natural disasters. It is extremely necessary to focus on demographics and activities that are most vulnerable to climate change. These vulnerabilities have also projected that climate change can cause a whole array of negative impacts on Planet Earth. It is extremely necessary for development experts, mainly the engineering fraternity, to have an understanding of these vulnerabilities. Consulting engineers have to be step ahead of the remaining operational engineering workforce and develop a visionary outlook on impact of vulnerabilities.

Vulnerability

Vulnerability is an essential component of the climate resilience discussion because people that are the most likely to experience the majority of negative impacts of climate change are those that are least capable of developing robust and comprehensive climate resiliency infrastructure and response system. However, what exactly constitutes a vulnerable community is still open to debate. IPCC has defined vulnerability using three characteristics: the "Adaptive Capacity, Sensitivity and Exposure" to the effects of climate change. The 'adaptive capacity' refers to a community's capacity to create resiliency infrastructure; while the 'sensitivity' and 'exposure elements' are both tied to economic and geographic elements that vary widely in different communities. There are, however, many commonalities between vulnerable communities.

Vulnerability can mainly be broken down into two major categories: economic vulnerability, based on socio-economic factors; and geographic vulnerability. Neither is mutually exclusive.

Economic Vulnerability

At its basic level a community that is economically vulnerable is one that is ill-prepared for the effects of climate change because it lacks the needed financial resources. Preparing for climate resilience calls for huge investment in infrastructure, city planning, engineering sustainable energy sources, and preparedness systems. From a global perspective, it is more likely that people living at or below poverty line will be affected the most by climate change and would thus be the most vulnerable, because they would have the least amount of resource funds to invest in resiliency infrastructure. They would also have the least amount of resource funds for clean-up efforts after more frequently occurring natural climate change related disasters.

Geographic Vulnerability

A second category of vulnerability is related to geographic vulnerability. The most geographically vulnerable locations to climate change are those that would be impacted by side effects of natural hazards, such as rising sea level and by dramatic changes in eco-system services, including access to food.

The vulnerable communities have one or more of the following characteristics: food insecurity, water scarcity, delicate marine eco-system, fish dependent and small island community.

What is Climate Resilience Building?

The building of climate resilience is a highly comprehensive undertaking that involves an eclectic array of actors and agents: individuals, community organizations, micro-political bodies, corporations, government sat local, state, and national levels as well as inter national organizations. In essence, actions that bolster climate resilience are ones that will enhance the adaptive capacity of social, industrial, and environmental infrastructures that can mitigate the effects of climate change. Currently, research indicates that the strongest indicator of successful climate resilience efforts at all scales is a well-developed, pre-existing network of social, political, economic and financial institutions that is already positioned to effectively take on the work of identifying and addressing the risks posed by climate change. Cities, states, and nations that have already developed such networks are, as expected, to generally have far higher net incomes and GDP.

Therefore, it can be seen that embedded within the task of building climate resilience at any scale will be the overcoming of macroscopicsocio-economic inequities; in many ways, truly facilitating the construction of climate resilient communities worldwide would require national and international agencies to address issues of global poverty, industrial development, and food justice. However, this does not mean that actions to improve climate resilience cannot be taken in real time at all levels, although evidence suggests that the most climate resilient cities and nations have accumulated this resilience through their responses to previous weather-based disasters. Perhaps even more importantly, empirical evidence suggests that the creation of the climate resilient structures is dependent upon an array of social and environmental reforms that were only successfully passed due to the presence of certain socio-political structures such as democracy, activist movements, and decentralization of government.

Thus it can be seen that to build climate resilience one must work within a network of related social and economic decisions that can have adverse effects on the success of a resilience efforts given the competing interests. It is clear that the social and economic scale play a vital role in shaping the feasibility, costs, empirical success, and efficiency of climate resilience initiatives. There area wide variety of actions that can be pursued to improve climate resilience at multiple scales.

Planning Framework for a Climate-Resilient Economy

Projected Green House Gas emissions over the coming decades are likely to contribute to shifts in precipitation patterns, higher temperatures, rising sea level, and more frequent extreme weather events. These changes would likely add to the economy challenges that many community already face. Having a climate-resilient economy – one that can withstand or recover quickly from climate impacts in the short and long terms - is essential to a community's long-term well-being.

Starting to plan now with climate and economic resilience in mind would help the community and its businesses protect themselves against short-term shocks such as storms, reduce the need (and cost) to recover from a shock, incorporate economic resilience into other planning efforts, get a jump start on pursuing new opportunities that might arise as the climate changes, and might even attract new investments in new businesses.

Many community, business, and government leaders recognized the problem and are calling for action to prepare for and adapt to the potential impacts of the changing climate. However, even with tools to estimate a community's vulnerability to specific climate-related threats, it can be difficult to translate these threats into an economic bottom line and identify ways to become more resilient and take advantage of new opportunities. To address this gap, the Environment Protection Agency of USA (EPA) developed a planning framework for a climate-resilient economy (2016) to help communities assess their economic vulnerability to climate change and improve their economic resilience. A pilot community in North Kings Town, Rhode Island, USA tested and refined the framework. The framework consists of five basic steps as described below:

Step One: Organise

a) Establish the assessment team,

b) Define the community of interest, and

c) Set objective for the assessment.

Step Two: Evaluate projected climate change impacts and hazards

a) Select climate change scenarios,

b) Assess hazards, and

c) Select a method for spatial analysis.

Step Three: Identify community assets and their vulnerability

a) Develop an assessment methodology,

b) Identify community assets at risks,

c) Define and apply a local vulnerability scale, and

d) Assess potential positive and negative impacts on economic activity.

Step Four: Analyse overall economic implications for the community

Step Five: Explore options for enhanced resilience and pursue opportunities.

It can be adapted by communities anywhere for their context and can be modified to cover small or large geographic areas and their economies.

The framework can help communities ask the right questions to recognize their economic vulnerabilities and identify ways to be more climate resilient, with a focus on helping the business community prepare for and adapt to projected changes and think creatively about ways to prosper in a changing climate.

It is designed to be flexible so communities with varying levels of analytical expertise, time, and funds can use it. Some communities can use it to get a "big picture" assessment of their vulnerability. Others could use more sophisticated tools such as GIS and other computer based models and a team of experts to map out specific economic impacts or threats and business opportunities.

This framework is observed to be workable under US conditions. If other countries try to use the same template they will have to adopt to their context by involving local experts.

Role of Industry in Promoting Climate Resilient Development

India's industry is also equally concerned and has developed a large number of innovative products that are being produced at continually decreasing rates of GHG emissions.

The globalization of economies makes it mandatory for companies operating in the global economy to take into consideration the international laws and norms related to environment and climate change. Four of the major issues that international companies seek for climate resilient manufacturing and development are:

1. What are the sources and fundamental principles of international environmental law?
2. How can we apply them to real situation?
3. How can we effectively connect with Multilateral Environmental Agreements (MEAs)?
4. What is the link between MEAs and Sustainable Development Goals?
5. Will the Climate resilient approach need flexible regime of corporate and environmental laws after the BREXIT?

One may think that it is asking too much from the industry to spend their time on multilateral environmental agreements. As the businesses have now come centre-stage and being considered as one of the enablers for achieving sustainable development goals they have to really be the prime movers for practical application that supports enforcement of procedures under multilateral environmental agreements.

Environment and Climate Change

Sutanu Ghosh
Managing Director; Ghosh, Bose & Associates Pvt. Ltd., Kolkata

INDIAN ECONOMY

India would like to continue and increase its robust growth over the next 15 years, hoping to increase its economy by 5 times by the year 2030 (over 8-10% growth; $10 trillion). However, it has to keep in mind that the peak oil extraction has already happened in 2005 and coal stocks are dwindling fast, the two principal sources of energy, the prime drivers of industry and growth. Thus innovative methods of exploration and alternate sources are the need of the hour. Deep sea oil exploration, fracking of shale gas, nuclear power with all its baggage and renewables are the probable recourse.

One must remember that India embarked on industrialisation in the early 1950s after independence. Three bills were passed in 1948 including the Industries Act, even before the Constitution.

ENVIRONMENTAL BENCHMARKS

Conversely, environmental interventions commenced only in 1972 following the Stockholm Conference. The Central Board for the Prevention and Control of Water Pollution, now the Central Pollution Control Board was formed in 1974 along with the Water Act, the Air Act in 1981, the Department of Environment, Government of India in 1984, the Environment Protection Act, the Umbrella Act in 1986 and the Notification on Environmental Clearance in 1994. Thus the magnitude of the paradox and the differential is very large.

The inheritance thus includes age old plants bereft of any air pollution or water pollution controls or solid and hazardous waste management, with which we have to live with for compelling reasons.

Retrofitting of pollution abatement systems is easier said than done.

The open cast mines which contribute to area/volume source emissions have caused extensive land denudation and ecological degradation, subsidence, ground water depletion and many other environmental impacts.

We are coming to terms with this existential issue only very recently. The latest notification on environmental appraisal of 14th September, 2006 is a very streamlined, unambiguous document.

TECHNOLOGY ISSUES

Advanced technology is one of the key elements of environmental preservation as this includes ‘at source’ control of pollution. For e.g. adoption of ultra supercritical technology for power plants and gravitating to IGCC in the next 20 years would be a step in the right direction. The requirement of land (< 0.7 acre/MW) and water (< 30 Cusecs/1000 MW), two essential commodities but scarce in resource, has to be optimized. One has to remember that only 0.2% of the water available on earth is available to man for utilization. The rest is contained by icecaps/glaciers/saline sea water or buried very deep.

As regard mining, we need to switch to underground mining with adoption of long wall techniques with employment of delayed sequential blasting techniques. Many of the richest mineral deposits are overlain by the richest of forests.

'End of pipe' solutions, thereafter, are equally important, as reduction of particulate emissions to 30 mg/Nm^3 and adoption of low NO_x burners (LNBs).

Water pollution systems revolve around maximum reuse and recycling, and rain water harvesting, etc.

Solid waste management revolves around High Concentration Slurry Disposal (HCSD) disposal and adoption of HDPE/LDPE geo-membrane lining for such facilities as ash ponds.

Microclimatic issues to address heat island effect through reduction of impervious material and enhancement of porous substance are of paramount importance. Renewables have simply got to play a larger part in all facets of our life.

What we need to do is to do away with our tunnel vision approach and take a holistic approach with a much wider vision encompassing the larger canvas. As the going says, 'Do not lose the forest for the trees'! One way of achieving this towards creating sustainable development is by adoption of the 'Carrying Capacity' approach, whereby the development potential of a region is streamlined keeping in view its infrastructural resources and environmental attributes.

CLIMATE CHANGE

Most climate scientists agree the main cause of the current global warming trend is human expansion of the "greenhouse effect" — warming that results when the atmosphere traps heat radiating from Earth toward space.

The consequences of changing the natural atmospheric greenhouse are difficult to predict, but certain effects seem likely:

- On the average, Earth will become warmer. Some regions may welcome warmer temperatures, but others may not.
- Warmer conditions will probably lead to more evaporation and precipitation overall, but individual regions will vary, some becoming wetter and others drier.
- A stronger greenhouse effect will warm the oceans and partially melt glaciers and other ice, increasing sea level. Ocean water also will expand if it warms, contributing further to sea level rise.
- Meanwhile, some crops and other plants may respond favourably to increased atmospheric CO_2, growing more vigorously and using water more efficiently. At the same time, higher temperatures and shifting climate patterns may change the areas where crops grow best and affect the makeup of natural plant communities.

In its Fifth Assessment Report, the Intergovernmental Panel on Climate Change, a group of 1,300 independent scientific experts from countries all over the world under the auspices of the United Nations, concluded there's a more than 95 percent probability that human activities over the past 50 years have warmed our planet.

The industrial activities that our modern civilization depend upon have raised atmospheric carbon dioxide levels from 280 parts per million to 400 parts per million in the last 150 years. The panel also concluded there's a better than 95 percent probability that human-produced greenhouse gases such as carbon dioxide, methane and nitrous oxide have caused much of the observed increase in Earth's temperatures over the past 50 years.

It's reasonable to assume that changes in the sun's energy output would cause the climate to change, since the sun is the fundamental source of energy that drives our climate system.

Indeed, studies show that solar variability has played a role in past climate changes. For example, a decrease in solar activity is thought to have triggered the Little Ice Age between approximately 1650 and 1850, when Greenland was largely cut off by ice and glaciers advanced in the Alps. However, several lines of evidence show that current global warming cannot be explained by changes in energy from the sun.

CONSEQUENCES OF CLIMATE CHANGE

Global climate change has already had observable effects on the environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner. The effects which scientists had predicted in the past that would result from global climate change are occurring now: accelerated sea level rise and longer, more intense heat waves.

Scientists have high confidence that global temperatures will continue to rise for decades to come, largely due to greenhouse gases produced by human activities. The Intergovernmental Panel on Climate Change (IPCC) forecasts a temperature rise of 2.5 to 10 degrees Fahrenheit (1.39 to 5.56 degrees Centigrade) over the next century.

According to the IPCC, the extent of climate change effects on individual regions will vary over time and with the ability of different societal and environmental systems to mitigate or adapt to change. "Taken as a whole," the IPCC states, "the range of published evidence indicates that the net damage costs of climate change are likely to be significant and to increase over time."

Some of the long-term effects of global climate change are as follows:

- Global climate is projected to continue to change over this century and beyond. The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally, and how sensitive the Earth's climate is to those emissions.
- Because human-induced warming is superimposed on a naturally varying climate, the temperature rise has not been, and will not be, uniform or smooth across the country or over time.
- The length of the frost-free season (and the corresponding growing season) has been increasing in most mid to low latitude countries since the 1980s affecting ecosystems and agriculture.
- Average global precipitation has perhaps increased since 1900, but some areas have had increases greater than the average, and some areas have had decreases. Projections of future climate in most parts of the world suggest that the recent trend towards increased heavy precipitation events will continue. This trend is projected to occur even in regions where total precipitation is expected to decrease. **More droughts and heat waves.**
- Droughts in the vulnerable areas and heat waves (periods of abnormally hot weather lasting days to weeks) everywhere are projected to become more intense. Summer temperatures are projected to continue rising, and a reduction of soil moisture, which exacerbates heat waves, is projected in summer. By the end of this century, what have been once-in-20-year extreme heat days (one-day events) are projected to occur every two or three years over most of the world.
- The intensity, frequency and duration of cyclones/ hurricanes have all increased worldwide since the early 1980s. The relative contributions of human and natural causes to these increases are still uncertain. Cyclone/ Hurricane-associated storm intensity and rainfall rates are projected to increase as the climate continues to warm.
- Global sea level has risen by about 20cm since reliable record keeping began in 1880. It is projected to rise another 2.5 to 10 cm by 2100. This is the result of added water from melting land ice and the expansion of seawater as it warms.
- In the next several decades, storm surges and high tides could combine with sea level rise and land subsidence to further increase flooding in many regions. Sea level rise will continue past 2100 because the oceans take a very long time to respond to warmer conditions at the Earth's surface. Ocean waters will therefore continue to warm and sea level will continue to rise for many centuries at rates equal to or higher than those of the current century.
- The Arctic Ocean is expected to become essentially ice free in summer before mid-century.

RESPONDING TO CLIMATE CHANGE

Climate change is one of the most complex issues facing us today. It involves many dimensions – science, economics, society, politics and moral and ethical questions – and is a global problem, felt on local scales, that will be around for decades and centuries to come. Carbon dioxide, the heat-trapping greenhouse gas that has driven recent global warming, lingers in the atmosphere for hundreds of years, and the planet (especially the oceans) takes a while to respond to warming. So even if we stopped emitting all greenhouse gases today, global warming and climate change will continue to affect future generations. In this way, humanity is "committed" to some level of climate change.

How much climate change? That will be determined by how our emissions continue and also exactly how our climate system responds to those emissions. In 2013, the daily level of carbon dioxide in the atmosphere surpassed 400 parts per million for the first time in human history.

Responding to climate change therefore involves a two-pronged approach:

1. Reducing emissions of and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere ("mitigation");
2. Adapting to the climate change already in the pipeline ("adaptation").

Throughout history, people and societies have adjusted to and coped with changes in climate and extremes with varying degrees of success. Earth's climate has been relatively stable for the past 12,000 years and this stability has been crucial for the development of our modern civilization and life as we know it. As our climate changes, we will have to learn to adapt. While climate change is a global issue, it is felt on a local scale. Cities and municipalities are therefore at the frontline of adaptation. Climate change is starting to be factored into a variety of development plans: how to manage the increasingly extreme disasters we are seeing and their associated risks, how to protect coastlines and deal with sea-level encroachment, how to best manage land and forests, how to deal with and plan for reduced water availability, how to develop resilient crop varieties and how to protect energy and public infrastructure.

ARE WE READY FOR ADAPTATION?

Australian Study questions ability of trees to store carbon

The ability of trees to offset carbon emissions has been questioned after a Western Sydney University study found common Australian trees are unable to store as much carbon as previously thought.

Published in the *Nature Climate Change* journal, the research found that Australia's iconic Eucalyptus forests are likely to need additional soil nutrients in order to grow and take advantage of extra carbon dioxide in the atmosphere.

The findings have significant implications for models used by international climate agencies, many of which assume that rising carbon dioxide will fertilise trees and result in more growth and capture of CO_2 from the air. "The world pays a lot of attention to climate change modelling, including predictions on the amount of carbon that will be stored in trees," explains lead scientist, Professor David Ellsworth, from the University's Hawkesbury Institute for the Environment.

"These reports are based on models and data taken largely from temperate forests where nutrients are in adequate supply, meaning that estimates on carbon absorption do not account for nutrient shortages on forest productivity. "Since many of the world's sub-tropical and tropical forested regions exist on low-nutrient soils, our results indicate that global estimates of carbon storage in forests could be too high."

The research was conducted at Western Sydney University's Hawkesbury Institute for the Environment, at the world's only Free Air CO2 Experiment in native woodland, the innovative EucFACE facility.

Source: MM, 9 March 2017

The Burning Canopy
Climate Change and the Human Environment

Umesh Shrivastava
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Imagine a giant canopy under which a grand feast has been going on for a very long time; so long that those present, duly merry, have forgotten that it started at a certain point in time. In their memory things have always been like this. The finest chefs from around the world have long been busy creating some of the most savoury dishes from a myriad cuisines for the select few who are privileged to be present.

In the kitchens (which are also under the giant canopy), some of the working people begin to feel very hot. Someone realises that their tiny corner of the canopy is on fire. They try to put the fire out, but after a while, the fire resumes. Others, working in other kitchens below the canopy, report similar fires from far-flung regions under the same big umbrella. These fires are reported to the organisers of the feast. After initial disbelief, they conduct close investigations as to how so many areas under the giant canopy could simultaneously be on fire. They conclude that actually the whole canopy is slowly catching fire, though because of its enormous size the fire is not visible, nor the heat palpable, where the party is in progress.

When they report their findings to those enjoying the party, nobody believes them. Someone proposes that the party move to another canopy. The suggestion is taken up, another gigantic canopy is set up quickly, and the feast moves there. While the revelry continues, those working in the kitchens again report fires growing in their respective regions. Investigations reveal that this new canopy is on fire too. However, this time they discover that the deeper reason for it is that the source of the fire is the sheer volume and intensity of heat being generated from the kitchens - which must all be under the canopy. It is so strong that no matter what material is used to make any new canopy, it will ultimately go up in flames.

However, nobody wants the party to stop. So the kitchens must continue their work, and the heat and the fire continue to grow in the wake of denial.

What is described above, in essence, is the greenhouse effect which traps in the earth's atmosphere the carbon (and the heat) produced by human economic activity, forming a shield which blocks the sun's warmth from leaving the atmosphere, thereby heating the earth, affecting its ancient thermal equilibrium.

What is described in the metaphor above is also the perilous denial under which humanity continues to carry on with business as usual, refusing to acknowledge the gravity of the growing danger. This is especially true of leaders of very powerful nations. The recent record shows that India is actually doing more to combat climate change than countries like the US.

Facts on our desktop

Consider some of the more salient facts about climate change in the context of India.

1. There is no scientific debate about the reality of global climate change. Studies show that 97% of scientists are agreed about the reality of global warming and climate change. If there is any debate on the margins it has to do with whether the causes are man-made. Most scientists do not doubt any more that they are. The world crossed the danger mark of 400 ppm of carbon in the earth's atmosphere in 2015 itself. Under the

present trends, whereby the average rise in global temperatures is already 0.8° C more than the pre-industrial levels, by the end of the 21st century the rise could be as high as a catastrophic 4° C.

2. More greenhouse gases like carbon dioxide are now present in the earth's atmosphere than at any point in history. It should be borne in mind that the accumulation of such gases is a bit like a tub filling with water, with the outlet fully sealed.

3. As a result, global temperatures are breaking all records in recent years, 2017 being one of the hottest since the 1880s, when records began to be kept. It is striking that 2017 was not a year which experienced the aggravating El Niño phenomenon, which releases added warmth from the Pacific Ocean.

4. Arctic sea ice has shrunk in size every decade since 1979 by 3.5 to 4.1 per cent. Glaciers have also been in retreat, including in major mountain ranges like the Alps, the Himalayas, the Andes, and the Rockies.

5. Melting ice-caps and glaciers are leading to rising sea levels everywhere. Levels are currently rising at their fastest rate for more than 2000 years.

6. The frequency and intensity of extreme weather events - cloudbursts, heavy sporadic (often unseasonal) rain, floods, heat waves, droughts, forest fires, cyclones and hurricanes - are growing in India and across the world. A few months ago, Hurricane Harvey and Irma descended on the United States and the Caribbean, causing death, severe damage and disruption of life. In India, the incidence of floods and droughts has increased perceptibly as seen by the recent experience of Jammu and Kashmir, Uttarakhand, Bihar, Madhya Pradesh, Rajasthan, Tamil Nadu, Maharashtra, and in the North-Eastern states.

7. South China and South Asia are warming twice as fast as the average global rate. Perennial rivers are becoming seasonal and seasonal ones are drying up altogether. India is one of the most water-scarce regions of the world now. As much as a third of India's power supply may be under threat due to water shortages over the next decade. This includes not merely loss of power in hydroelectric projects due to shrinking river flows, but also reduced thermal and nuclear generation due to shortages of water for cooling purposes, on account of climate change. The impact of falling surface and groundwater levels on agriculture and food security is not detailed here but no less than a quarter of India's arable land is turning into desert.

8. According to the UN, climate change is resulting in a growing refugee crisis as people get displaced from regions of the world - like Bangladesh or the South Sea Islands - exposed to ocean flooding. During the last decade over 20 million people have already been displaced. The increase in such forced climate migration is likely to result in tensions and conflicts over shrinking resources.

9. Ocean acidification is much, much greater than at any point since the onset of the industrial revolution. This is causing enormous damage to aquatic life, such as the bleaching of corals in the Great Barrier Reef, and falls in the fish harvest.

10. While India's population is 16% of the world's, its present share of global greenhouse gas emissions is 7%. However, it is rising. More than two-thirds of energy used in India is still from fossil fuels despite the rising share of renewable (primarily wind and solar) energy in recent years. The place of coal in the generation of electricity continues to be prominent and shall remain so in future, despite the government's ambitious promise of generating 40% of the country's needs from renewable sources by 2030.

Is climate change just another 'environmental' problem 'out there'?

A common mistake is to think of climate change as just another environmental problem 'out there'. Is climate change just another 'environmental' problem, like air or water pollution? Or is it perhaps at the heart of the

planetary ecological crisis, the very *setting* which provides the context for more localised environmental problems like loss of biodiversity, species extinction, extreme and uncertain weather, and air and water pollution?

The answer is the latter. If an approach which befits the challenge of climate change is to take effect in government policies and corporate plans around the world it is necessary that its *nature* and dimensions be appreciated fully. We need much more than the lukewarm initiatives which have come out from the recent COP meetings around the world.

Given that one out of six people on the planet lives here, the transition to a low-carbon economy, if not to a fully decarbonised economy, must happen in India as much as anywhere else.

Climate stability - and not its root cause, endless economic growth - needs to become the overriding goal of humanity if it is to survive as a species into the next century. We are in the midst of a planetary ecological emergency. Unless this realisation dawns on us and appropriate action is undertaken at every level from the cumulative small steps taken by billions of individual consumers and households around the world to the more powerful decisions made by giant corporations and governments at national and global levels, humanity has little other than its ultimate extinction to look forward to.

Let us, in the end, take a different perspective on our globalised world towards the end of the second decade of the 21st century.

Hindus and Muslims are fighting each other in India. Muslims of different denominations are fighting each other across the borders on both sides of India. Sinhala and Tamils cannot see eye to eye in Sri Lanka. Many different wars are going on in West Asia- in Iraq, in Syria and in Turkey. Jews and Palestinians are still at war in the Middle East. In the larger world, North Korea assumes threatening postures from time to time. The Chinese are involved in frequent conflicts in Taiwan and Tibet. The Americans are at war on virtually every continent. And so on.

Each conflict is happening under its own canopy while ignoring the greater fact of the much greater canopy under which all the battles rage.

This greater canopy is on fire. And the time in which it can be contained and put out is fast running out. Not just for Hindus, for Muslims, for Jews, for Arabs, for Christians, et al, but for all humanity. This is an unprecedented crisis for the entire human species, the like of which should make us suspend all wars and change our way of life so radically that we can all live in peace and not have to worry about how the elements unleashed will treat us for our excesses.

'Integrate wasteland with forests in Maharashtra': In an effort to maintain at least 33% forest cover in the state in accordance with the national policy set by the ministry of environment and forests, an RTI activist and green researcher has suggested that all available wasteland in Maharashtra be clubbed along with forest land.

At present, Maharashtra has just about 20% forest cover. If district-wise information of all existing wasteland in the state, including scrub land, saline and alkaline land, rocky and barren land, water-logged land, ravines and sandy areas, among others is added to forest land in accordance with Section 3 of the Indian Forest Act, 1927, then Maharashtra's total forest cover will increase to over 37%, which is good, according to activist Hemant Chhajed who has submitted his suggestions to the state forest department.

It was suggested that clubbing wasteland with forests will help safeguard it from encroachers and land sharks!!!

Source: Times of India, 7 March 2018

Environment and Climate Change - An Indian Perspective

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All over the world no other subject in the recent past has been discussed and debated as much as Environmental sustainability that includes climate change as well. In the past few years the world has witnessed drastic changes in climatic conditions which used to occur once in a while earlier; they have become an annual affair with differing degrees of disastrous consequences on civilisation. Such extreme changes in weather fluctuations and their impact on mankind thereof, has sensitivised the authorities and the public at large towards this - one of the most significant issues for our very own survival. Although concerns over environment, need to preserve natural resources, etc. were talked about, the real thrust came after the Intergovernmental Panel on Climate Change (IPCC) established in 1988 started issuing Assessment Reports on impact of human induced climate change issues. That led to formation of several forums, committees and organisations at global and individual country levels to address specific areas of environment & climate change. Concerted efforts of all these groups have raised the public awareness and also resulted in positive steps towards safeguarding environment. Everyone is now realizing that something needs to be done. However, the ground reality is that the real action taken or initiated at any level is short of the vigour with which the issues are discussed, debated and actions planned, world over. This is primarily due to the syndrome that 'when everyone is responsible, no one is responsible' and also to a good extent, costs involved for developed nations and prioritization of growth (even at the cost of environment) for developing countries. Though of late, incidents like pollution in Beijing or our very own Delhi smog in winter has forced us to realize that time is running out and we must act fast.

The discussions and actions to protect environment can be broadly classified into three main categories, viz. reduction of gaseous pollutants including green-house gas (GHG) emission, solid and liquid effluent management and preservation of nature that includes preservation of natural resources, water bodies, forests, wild life, flora & fauna, etc.

While for a country like India, the key economic priority is to alleviate poverty and uplift the economic condition of poorer sections of society, the dichotomy is that such economic development often leads to environmental degradation. While industrial growth is essential for economic development, the energy and other industries also contribute to about 80% of GHG emission in addition to deforestation and water pollution. Hence, the major challenge for India is to continue with economic development programmes and at the same time preserve environment through renewable sources of energy.

Industrialisation is primarily responsible for most of the issues connected with environmental degradation. Hence, it is imperative, that all stakeholders of industrial development, right from Government/ Regulatory Authorities to the Project Developers and consumers must take cognizance of the environmental impact and shoulder the responsibilities that are necessary to mitigate the impacts. As engineering consultants and technology suppliers provide the know how to build the industry, the onus is also on them to take care of environmental considerations and to offer sustainable designs.

Engineering consultants in their role as a designer and advisor to industries have three major roles to play:

a) Offering innovative, sustainable but economically viable solutions to the industries,

b) Ensuring compliance to environmental regulations by industries, and

c) Balancing the growing concerns of environmentalists and also of common public vis-à-vis industry limitations and Government initiatives that are required to move towards a more environment friendly future.

Several programmes /initiatives across all levels are being pursued to lessen the impact on the environment and that includes more stringent regulations, better public awareness, more efforts towards conservation of natural resources, environment friendly alternative processes, improved system efficiencies, reduction in waste and many more. This paper highlights only the major initiatives connected to industries that are initiated in India, their status and the issues that need to be looked into for better implementation and compliance.

Environmental Degradation - Contribution by Various Sectors

Air Pollution

In general the energy sector is primarily responsible for gaseous pollutants including GHG emission. Agriculture also has a fair share of contribution in GHG emission mostly from livestock farming as per GOI data, of 2015[1,2]. Although industries like Iron & Steel, Copper smelting, Cement, etc. are categorized under heavily polluting, overall contribution of these industries towards GHG emission is much less compared to the energy sector as shown in Fig 1.

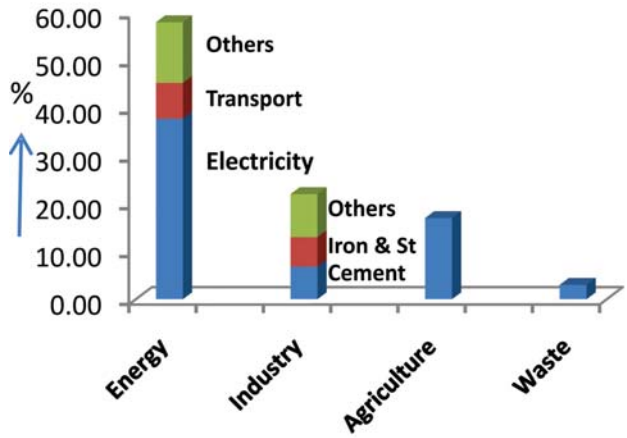

Fig 1: Sector wise GHG emission

Water Consumption & Pollution

Amongst natural resources, water is the most abused and over used natural resource not only in India but all over the world. As a result, water has now become the scarcest commodity. Recent studies show that if the ever depleting water availability issue is not addressed with the due attention it deserves, then very soon many thickly populated areas would become unsuitable for habitation. The recent announcement by authorities of Cape Town, South Africa to cut off city water supply is an indication of the grim reality that is staring at us.

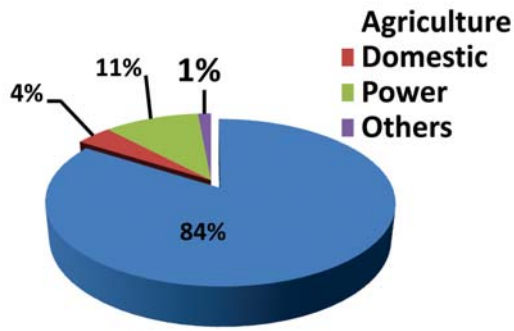

Fig 2: Sectorwise water consumption

Unlike developed countries, irrigation consumes about 84% water in India. Thermal power plants consume about 11%. Domestic consumption is about 4% and balance 1% is consumed by others[3]. The major water consumption, sectorwise, is shown in Fig 2. In addition, water pollution further reduces the availability of quality water and also affects the entire eco system. More than 80% of water pollution is caused by untreated sewage and domestic waste water followed by industrial waste. Other causes are oil spillage from oil tankers and dumping of solid waste like glass, plastic, Styrofoam, etc.

Energy Sector

Electricity Sector

Amongst energy sectors, electricity sector accounts for maximum GHG emission mainly CO_2. Heavy dependence on fossil fuel as the prime source of energy is the main challenge in arresting the ever increasing trend of carbon

foot print. While most of the developing nations are leaning towards gas, India is dependent on coal as it is the only primary energy source abundantly available at a relatively cheaper price. At present coal contributes about 80%[4] of power generation. Its contribution is expected to decline to about 65%[5] by 2040 which would still be very significant. Hence, the challenge is to reduce and contain the pollutants from coal fired power plants and at the same time, explore alternate sources of cleaner form of energy that can substantially reduce the dependence on fossil fuel. Major efforts being made to reduce GHG and other air pollutants emission are:

a) Adoption of clean coal technologies, improving generation efficiency by implementing supercritical/ ultra-supercritical technologies,

b) Introduction of stricter norms by MOEF & CC for air pollution. Revised limits on SOx and NOx emissions are in fact comparable and in some cases more stringent compared to internationally acceptable norms such as The World Bank norms or EU norms, and

c) CO_2 capture and sequestration (CCS) – it is still not implemented but is being actively discussed as the solution to reduce GHG emission. However, sequestration is still an issue to be resolved as the prohibitive cost and energy consumption which in turn generates more CO_2 partly defeats the very purpose of it. Better methods of capturing CO_2 and effective utilization of captured CO_2 rather than merely storing and preserving is the need of the hour and a challenge to engineering fraternity.

Large hydro power and nuclear power plants can provide relatively clean energy but both have their own issues. After the 2013 Uttarakahand flood tragedy, the Expert Review Committee and MOEF & CC did acknowledge the role of large hydro dams in the tragedy. Nuclear power has serious land acquisition issues due to the public's hazard perception, apart from being expensive because of its larger Capex and high gestation period.

The effort in reducing pollution from thermal power plants is supplemented by growing installations of renewable energy plants mainly solar, wind and to some extent biomass greatly supported by GOI mission to install 175 GW renewable energy by 2022 mainly through solar (100 GW) and wind (60 GW). While the focus on solar and wind power is good news for environment, their limitations as reliable and continuous sources of power need to be addressed in order to make renewables as a viable alternative to fossil based power.

The evolution of energy storage (battery) technology as well as its commercial affordability as a viable means to store and supply MW scale energy is extremely critical to support renewable power movement. MW scale battery though available in the market is still under development and would take some more time to fully mature and be available at a commercially competitive price.

The other critical issue for the electricity sector is water consumption. Although water consumption by electricity sector is only a small fraction of the total water consumption, its share amongst industries is substantial as can be seen from Fig 2. MOEF & CC through its recent amendments to environmental norms for thermal power plants have restricted the water consumption by the electricity sector. Once fully implemented, the water consumption in electricity sector is expected to reduce substantially. Water consumption can be reduced by combination of the following measures

a) Conversion of all once through cooling system to closed cooling system, and

b) Implementation of ZLD (Zero Liquid Discharge) system.

Transport Sector

As seen from Fig 1, transport sector comes next as the major source of pollution in which road transport contributes about 90%. Growing menace of pollution from automobiles is being addressed worldwide through:

a) Better public transport system e.g. intercity rails, metro rail, mono rail, etc.

b) Better infrastructure – better and wider road connections, bridges, tunnels, etc. to cut down point to point distance,

c) Better technology and fuel quality upgrade (e.g. using Euro VI grade of transportation fuel) to reduce emission,

d) Smart systems enabling performance measurement and mitigation actions – smart traffic management, IOT based on line pollution monitoring, etc.

e) Electric vehicles - National Electric Mobility Mission Plan (NEMMP) 2020 aims to roll out 5 to 6 million EVs every year starting 2020. NEMMP coupled with recent announcement of GOI to stop manufacturing of IC engine based cars by 2030 are expected to give impetus to the growth of EV. While popularizing EV is definitely an environment friendly move, to make the mission successful the following issues must be addressed:

   i) While pollution in cities will definitely be reduced, detailed evaluation of power source for EVs has also to be done to ensure overall GHG emission does not get adversely affected considering overall efficiency of power supply to EVs vis-à-vis IC engines on per km distance travelled basis.

   ii) Holistic review of socio economic impact on the connected industries such as IC engine based automotive industry, refineries, etc.

   iii) Bringing down the cost of EVs to make it affordable and closer to if not at par with IC engine based vehicles and

   iv) Affordable and easily accessible facilities for fast charging of batteries or perhaps some other innovative means that can make battery charging at par with oil filling in cars in terms of time taken and easy accessibility.

Industrial Sector

With launching of Make in India movement, the thrust is on to expand the industrial sector in India. While it is a welcome move for economic development, expansion of industrial sector will also add to environmental pollution. To counter such negative impact on environment, MOEF & CC has proposed much stricter norms for most of the polluting industries. While regulatory authorities are trying to contain environmental pollution by imposing stricter norms and incentivising energy efficiency through schemes like PAT (Perform, Achieve & Trade), the Industry must collectively explore other options of environmental sustainability by

a) Adopting environment friendly technologies that reduce pollution and waste,

b) Carrying out energy audits and asset management studies and implement recommendations of these studies to reduce carbon foot print. It will also help in implementing PAT scheme.

c) Ensuring solid and liquid effluent management – would go a long way in preserving water and preventing water pollution. Large section of highly polluting industries do not have any effluent treatment plants and dispose untreated effluents to natural water bodies like lakes, rivers. Also measures like Zero Liquid Discharge (ZLD) could minimize contamination of water bodies.

d) Using digital technologies like IIoT, data analytics to monitor and better manage the above initiatives

Agriculture Sector

Agriculture sector is the biggest consumer of water resource. Surface water which is mainly river water accounts for about 50% of agricultural needs. Balance about 50% comes from ground water. Excessive ground water

extraction for agriculture has led to depletion of ground water in many parts of India. India consumes about 2-4 times more water to produce a unit of major food crop than China and Brazil[3]. Thus greater emphasis has to be given to better water management to bring it at par with international benchmark.

Launching of the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) in 2015 with an aim of '*har khet ko pani*' and 'more crop per drop' is a noteworthy development agglomerating many initiatives towards better water availability and efficient water usage. To supplement the movement a structured water management programme with participation from all stakeholders could lead to better sustainable solutions. Some of the focus areas could be:

a) Switching over to more efficient irrigation methods like sprinkler/ drip irrigation wherever possible,

b) Better crop selection strategy – careful selection of crop aligning with soil conditions, ground water level, precipitation, etc., and

c) Use of IOT, digital technology – Arrest leakage in irrigation pipes, use of soil sensors to link moisture content and water release for irrigation, thermal imaging of crops to determine water requirement, etc. are few examples of possible areas of leveraging modern day technologies to improve water conservation in agriculture

Domestic Sector

Domestic sector is largely responsible for water pollution and pollution by unscientific disposal of municipal solid waste (MSW). Indiscriminate dumping of untreated sewage into water bodies and disposal of MSW in dump yards or as landfill are two of the major reasons of pollution. Study shows about 80% of sewage remains untreated and disposed. Similar is the case for MSW. These issues are being addressed through some of the major initiatives undertaken recently like

a) Atal Mission for Rejuvenation and Urban Transformation (AMRUT),

b) Smart city projects,

c) Clean Ganga Mission, and

d) MSW management through *Swachh Bharat Abhiyan*.

Providing basic services (e.g. water supply, sewerage, urban transport) to cities are the main purpose of AMRUT projects. On the other hand, Smart City projects are an effort to leverage information and communication technologies to integrate functioning of a city's assets in a most environmentally sustainable manner in order to improve quality of life and provide impetus to economic growth. 500 cities/ towns under AMRUT mission and 100 cities under Smart City projects are presently being covered. However, there are many challenges being faced in implementation of these projects and those includes regulatory, social, financial issues plus lack of availability of data relating to existing infrastructures and not the least, inadequate availability of personnel with required knowledge base to execute these projects. As a result the project progress is getting affected. Hopefully the learnings from initial phases will help in smoother and faster implementation of subsequent phases of these projects.

Clean Ganga Mission

Clean Ganga mission is another major initiative towards preservation of water bodies. Rejuvenating and making River Ganga pollution free would be a signification step in preserving the environment. However, failure of earlier Mission of Clean Ganga & Yamuna and the slow pace of the present Clean Ganga Mission is a cause for concern.

Success of AMRUT, Smart City projects and Clean Ganga Mission are extremely critical as otherwise India, which is already a water stressed country, would find it extremely difficult to meet its minimum water requirements and to preserve environment since the latter is heavily dependent on pollution free water.

MSW Management

Unscientific disposal has become a major concern all over the world and India in no exception. The *Swachh Bharat Mission* launched in 2014 has rightly identified MSW management as one of its prime objectives. The most prevalent form of MSW disposal is landfill. However, landfill is no longer being seen as an environmentally sustainable solution since it

a) Emits Methane, a more harmful GHG compared to $CO_{2,}$

b) Creates hygiene issues and safety hazard, also requires significant space, and

c) Causes leaching and ground water contamination

Methane emission has prompted India like many other countries to ban use of bio-degradable material as landfill. For sustainable waste management, segregation, preferably at the source is a critical requirement. The segregation ensures that the inert, hazardous wastes/ recyclables are removed and the remaining combustible waste only goes for 'waste to energy' schemes. However, the segregation at source is one of the key challenges for the civic authorities. Also strict compliance to air and liquid effluent pollution standard is extremely important as noncompliance to environmental regulations could defeat the very purpose of WtE projects.

Conclusion

Environment and Climate Change are issues that influence and impact our daily lives and would continue to do so in future as well. Every human activity affects the environment and unfortunately most of it in a negative way. Hence, all round effort with much more vigour is needed to arrest the ever increasing trend of environmental degradation. The good news is continuous campaign and incessant effort by right minded people from all sections of society and increased public awareness have started yielding results albeit slowly. Numerous initiatives have been launched by Governments, Regulatory Authorities and NGOs at international, national, state, regional and zonal levels to clean up the environment or at least to slow down the rate of degradation. Some of these initiatives have taken off well but others are still lagging behind. This paper has made an attempt to highlight only some of the major initiatives in India. Industry is a necessary growth area for economic development, but it also leads to environmental degradation. Though the industries are becoming much more conscious, as reflected in improved compliance to environmental obligations, the time has come for the industries to go beyond mere compliance and take upon themselves the challenge of making the environment a better place to live. That, together with willingness and proactive participation by all would lead to a better and environmentally sustainable 'clean' India.

Acknowledgement

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Climate Change Mitigation and Sustainable Development

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Even at the turn of this century there were sceptics who did not believe that global warming is real and that it is caused by large scale emission of greenhouse gases (GHG), leading to extreme climate conditions of severe drought, forest fires, cyclones, unprecedented precipitation and other natural disasters. This is in spite of the fact that since 1992 the UNFCCC has been studying the phenomenon of global warming and its impact on the climate. Frequent natural catastrophes in recent years in various parts of the world have, however, left them in no doubt that climate change is a serious problem which has to be addressed on immediate basis.

UNFCCC in 1992 called for stabilisation of GHG concentration at levels which would allow natural adaptation of ecosystems, ensure food security, and permit sustainable economic development.

In subsequent years IPCC conducted several studies to understand the role of development on GHG emissions. The results established that there was significant increase in GHG emission concentration in the climate due to development activities. It also established the necessity of adaptation and mitigation strategies to counter the climate extremes and their harmful consequences.

Since the publication of these results in 2000 and 2001, a large number of studies have been carried out on the relationship between climate change and development.

These studies mainly analysed low emission and clean energy scenarios, mainstreaming climate change into development efforts in developing countries and suggesting frameworks of integrated models to analyse these linkages.

The IPCC Fourth Assessment report identified the linkages between climate change and sustainable development and between adaptation and mitigation as cross cutting themes across the Working Group II and III reports. “Summary for Policymakers” of Working Group II (IPCC2007b) stresses the importance of sustainable development in reducing vulnerability to climate change as well as the role of climate in impeding nations’ ability to achieve sustainable development.

The large volume of research carried out thus far and the knowledge generated led to exploring an integrated approach considering the linkages among Adaptation (A) and Mitigation (M) in the context of Sustainable Development (SD). This is referred to as AMSD. AMSD puts sustainable development first as it plays the key role on the level of emissions and consequent climate change responses.

A number of adaptation and mitigation measure have since then been developed to address climate change and ensure sustainable development. A select list of sector-wise adaptations and mitigation measures are given in Tables 1 and 2 below:

Over the past decade frequency of climate change related disasters has been showing an increasing trend. This is a cause for serious concern as this indicates that global temperature is rising and may go out of control in the coming decades. All along, the UNFCCC have been warning that if the global temperature increases by 2˚C or more, sea levels would rise significantly causing many island countries and coastal lands to go below the sea. This would be an unthinkable disaster.

Table 1. Selected examples of Planned Adaptation by Sector

Sector	Adaptation Option/ Strategy	Underlying Policy Framework	Key Constraints and Opportunities to Implementation
Water	Expanded rainwater harvesting; water storage and conservation techniques; water re-use; desalination; water-use and irrigation efficiency	National water policies and integrated water resources management; water-related hazards management	Financial, human resources and physical barriers; integrated water resources management; synergies with other sectors
Agriculture	Adjustment of planting dates and crop variety; crop relocation; improved land management, e.g. erosion control and soil protection through tree planting	R&D policies; institutional reform; land tenure and land reform; training; capacity building; crop insurance; financial incentives, e.g. subsidies and tax credits	Technological and financial constraints; access to new varieties; markets; longer growing season in higher latitudes; revenues from 'new' products
Infra-structure/ Settlement (including coastal zones)	Relocation; seawalls and storm surge barriers; dune reinforcement; land acquisition and creation of marshlands/wetlands as buffer against sea level rise and flooding; protection of existing natural barriers	Standards and regulations that integrate climate change considerations into design; land-use policies; building codes; insurance	Financial and technological barriers; availability of relocation space; integrated policies and management; synergies with sustainable development goals
Tourism	Heat-health action plans; emergency medical services; improved climate-sensitive disease surveillance and control; safe water and improved sanitation	Public health policies that recognise climate risk; strengthened health services; regional and international cooperation	Limits to human tolerance (vulnerable groups); knowledge limitations; financial capacity; upgraded health services; improved quality of life
Transport	Diversification of tourism attractions and revenues; shifting ski slopes to higher altitudes and glaciers; artificial snow-making	Integrated planning (e.g. carrying capacity; linkages with other sectors); financial incentives, e.g. subsidies and tax credits	Appeal/marketing of new attractions; financial and logistical challenges; potential adverse impact on other sectors (e.g. artificial snow-making may increase energy use); revenues from 'new' attractions; involvement of wider group of stakeholders
Energy	Realignment/relocation; design standards and planning for roads, rail and other infrastructure to cope with warming and drainage	Integrating climate change considerations into national transport policy; investment in R&D for special situations, e.g. permafrost areas, deserts, etc.	Financial and technological barriers; availability of less vulnerable routes; improved technologies and integration with key sectors (e.g. energy)
	Strengthening of overhead transmission and distribution infrastructure; underground cabling for utilities; energy efficiency; use of renewable sources; reduced dependence on single sources of energy	National energy policies, regulations, and fiscal and financial incentives to encourage use of alternative sources; incorporating climate change in design standards	Access to viable alternatives; financial and technological barriers; acceptance of new technologies; stimulation of new technologies; use of local resources

Source: IPCC website

Table 2 Selected Examples of Key Sectoral Mitigation Technologies, Policies and Measures, Constraints and Opportunities

Sector	Key Mitigation Technologies and Practices currently commercially available and Practices projected to be commercialised before 2030	Policies, Measures and Instruments shown to be Environmentally Effective	Key Constraints or Opportunities
Energy Supply	Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power (hydropower, solar, wind, geothermal and bioenergy); combined heat and power; early applications of carbon dioxide capture and storage (CCS) (e.g. storage of removed CO_2 from natural gas); CCS for gas, biomass and coal-fired electricity generating facilities; advanced nuclear power; advanced renewable energy, including tidal and wave energy, concentrating solar, and solar photovoltaics.	Reduction of fossil fuel subsidies; taxes or carbon charges on fossil fuels Feed-in tariffs for renewable energy technologies; renewable energy obligations; producer subsidies	Resistance by vested interests may make them difficult to implement May be appropriate to create markets for low emissions technologies
Transport	More fuel-efficient vehicles; hybrid vehicles; cleaner diesel vehicles; biofuels; modal shifts from road transport to rail and public transport systems; non-motorised transport (cycling, walking); land-use and transport planning; second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries.	Mandatory fuel economy; biofuel blending and CO_2 standards for road transport Taxes on vehicle purchase, registration, use and motor fuels; road and parking pricing Influence mobility needs through land-use regulations and infrastructure planning; investment in attractive public transport facilities and non-motorised forms of transport	Partial coverage of vehicle fleet may limit effectiveness Effectiveness may drop with higher incomes Particularly appropriate for countries that are building up their transportation systems
Buildings	Efficient lighting and day lighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves, improved insulation; passive and active solar design for heating and cooling; alternative refrigeration fluids, recovery and recycling of fluorinated gases; integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control; solar photo voltaics integrated in buildings	Appliance standards and labelling Building codes and certification Demand-side management programmes Public sector leadership programmes, including procurement Incentives for Energy Service Companies (ESCOs)	Periodic revision of standards needed Attractive for new buildings. Enforcement can be difficult Need for regulations so that utilities may profit Government purchasing can expand demand for energy-efficient products Success factor: Access to third party financing

Industry	More efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; control of non-CO_2 gas emissions; and a wide array of process-specific technologies; advanced energy efficiency; CCS for cement, ammonia, and iron manufacture; inert electrodes for aluminium manufacture	Provision of benchmark information; performance standards; subsidies; tax credits Tradable permits Voluntary agreements	May be appropriate to stimulate technology uptake. Stability of national policy important in view of international competitiveness Predictable allocation mechanisms and stable price signals important for investments Success factors include: clear targets, a baseline scenario, third-party involvement in design and review and formal provisions of monitoring, close cooperation between government and industry
Agriculture	Improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management to reduce CH_4 emissions; improved nitrogen fertiliser application techniques to reduce NO emissions; dedicated energy crops to replace fossil fuel use; improved energy efficiency; improvements of crop yields	Financial incentives and regulations for improved land management; maintaining soil carbon content; efficient use of fertilisers and irrigation	May encourage synergy with sustainable development and with reducing vulnerability to climate change, thereby overcoming barriers to implementation
Forestry/ Forests	Afforestation; reforestation; forest management; reduced deforestation; harvested wood product management; use of forestry products for bioenergy to replace fossil fuel use; tree species improvement to increase biomass productivity and carbon sequestration; improved remote sensing technologies for analysis of vegetation/soil carbon sequestration potential and mapping land-use change	Financial incentives (national and international) to increase forest area, to reduce deforestation and to maintain and manage forests; land-use regulation and enforcement	Constraints include lack of investment capital and land tenure issues. Can help poverty alleviation
Waste	Landfill CH_4 recovery; waste incineration with energy recovery; composting of organic waste; controlled wastewater treatment; recycling and waste minimisation; bio covers and bio filters to optimise CH_4 oxidation	Financial incentives for improved waste and wastewater management Renewable energy incentives or obligations Waste management regulations	May stimulate technology diffusion Local availability of low-cost fuel Most effectively applied at national level with enforcement strategies

Source: IPCC website

The Paris Agreement therefore calls for limiting global temperature rise to "Well below 2°C." In view of uncertainties in emission scenarios, climate and carbon cycle feedback Yangyang Xu and V. Ramanathan in their article "Well below 2°C: Mitigation strategies for avoiding dangerous to catastrophic climate changes" have interpreted the Paris Agreement in terms of three climate risk categories and have considered Low Probability (5%) High Impact (LPHI) warming in addition to the central (about 50% probability) value. The risk category of dangerous warming is extended to more categories which are defined as: more than 1.5°C as Dangerous, more than 3°C as Catastrophic and more than 5°C as Unknown, which is beyond catastrophic implying existential threats. According to them, with unchecked emissions the central warming can reach the dangerous level within three decades with the LPHI warming becoming catastrophic by 2050.

A three lever strategy has been outlined to limit the central warming below the dangerous level and the LPHI below the catastrophic level both in the near term (<2050) and in the long term (2100). These are:

- The Carbon Neutral (CN) lever to achieve zero net emissions of CO_2
- The Super Pollutant (SP) lever to mitigate short- lived climate pollutants and
- The Carbon Extraction and Sequestration (CES) lever to reduce the level of atmospheric CO_2 concentration

For carbon – neutral development we need to switch over from fossil fuels to renewables such as, solar, wind, nuclear and geothermal sources. CO_2 emission from industrial process will also have to be eliminated. Hence, renewables should be the source of electrical energy and all end use application will have to be electrically operated. Since renewables such as solar and wind are intermittent in nature, storage becomes a key issue.

Batteries, hydrogen production by renewables and pumped hydropower have been identified as possible storage options.

While about 50% of reductions are possible with scaling up of existing technologies, innovations are required to achieve carbon neutrality in a cost effective manner.

Achievement of carbon neutrality also requires change is social attitudes, governance, and market mechanisms such as cap and trade and carbon pricing. It is encouraging to note that around 50 cities 65 business and a number of universities have already initiated actions towards achieving carbon neutrality. Laboratories, such as, California and Stockholm have shown that GDP can be made independent of carbon emissions. Their carbon emissions per GDP have decreased by 20%.

Technology development and innovations from these laboratories have to be scaled up to accelerate efforts for achieving carbon neutrality within decades.

On the issue of Short Lived Climate Pollutants (SLCP), several technological measures are available to reduce SLCPs. These include:

- Providing clean cooking stoves to the poorest three billion of the world.
- Installing particulate filters in all diesel vehicles to reduce emissions and also reduce air pollutants related mortalities estimated at about two million.
- Routine maintenance of gas pipes and banning gas flaring to reduce methane leaks.
- Recovering methane from landfills, sewage treatment plants, and farm manure.
- Replacing HFCs with other available refrigerants that have negligible greenhouse effects.
- Installing catalytic converters in vehicle to reduce emissions of ozone precursors.

As regards carbon extraction and sequestrations a lot of research is needed as there is lack of scalable technologies. However, a number of technologies are being explored which include:

- CO_2 capture in power plants
- Bio char production by pyrolysis and storage in soil.
- Restoration of soil organic pools
- Reforestation and urban forestry

Once the technologies are developed to a commercially viable scale, carbon extraction and sequestration will play a significant role in addressing climate change related devastations.

In conclusion it may be stated that we are passing through a critical time when our very existence is at stake. The silver lining is that the whole of mankind has become aware and actively striving to bring down pollution due to anthropogenic activities to a level suitable for sustenance of life on the planet and to have sustainable development.

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In an article in the TOI, India is 'water stressed' and drifting towards what is technically termed a 'water scarcity condition'. A majority of the populace is either forced to use contaminated water or deprived of access to the resource entirely.

India 'water stressed', can sustain only 1 more drought

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Bengaluru: India is "water stressed" and drifting towards what is technically termed a "water scarcity condition". A majority of the populace is either forced to use contaminated water, or deprived of access to the resource entirely.

As the country prepares for a harsh summer— the India Meteorological Department forecasts temperatures will be 1°C above normal in most parts—the latest information from the Union water resources ministry reveals India can sustain only one drought season, given its live storage. The numbers make for grim reading.

A country is classified "water stressed" if per capita availability is less than 1,700 cubic metres. In India, the reading against this parameter is 1,545 cubic metres. Factoring multiple variables, including population, the ministry predicts availability could fall to 1,341 cubic metres in 2025, and even plummet to 1,140 cubic metres in 2050, which is perilously close to a "water scarcity condition" (per capita availability of less than 1,000 cubic metres). While the current situation can be attributed to successive droughts, the condition is largely a result of overexploitation and pollution. With 68 crore people — 56% of the country's population—relying on groundwater, the government has also been encouraging borewells, installing 9.36 lakh hand pumps in the past four years, in addition to hundreds set up by citizens. Data from the ministry of drinking water and sanitation throws another disturbing fact into stark relief: water in 320 of India's 640 districts is contaminated; pollutants include fluoride and arsenic, and heavy metals—chromium and lead. Contaminated water affects over 6 lakh habitations directly. According to the health ministry, diseases resulting from water contamination have claimed over 18,000 lives in the past seven years.

S S Hegde, senior scientist with the water resources ministry, told **TOI**, "There are two kinds of pollution: geogenic (caused by nature) and anthropogenic (resulting from human activity). Fluoride and arsenic are largely geogenic. But, there is a water problem, largely because of overexploitation. As far as pollution is concerned, some of these chemicals can't be treated with available technologies."

Groundwater reserves have depleted by 50%, and the latest survey by the water resources ministry indicates that 66% of wells have seen a decline in water levels; the rest show a marginal increase.

TIMES OF INSUFFICIENCY

- Per capita live storage: 209 m³
- Per capita water availability: 1,545 m³
- Water stressed condition: 1,700 m³*
- Water scarcity condition: Less than 1,000 m³*
- Prediction for 2025: 1,341 m³*
- Prediction for 2050: 1,140 m³*
- % population dependent on groundwater: 68 crore / 56%
- % population receiving piped water: 48.6 crore / 40.1%
- % groundwater available: 50%
- Districts affected by groundwater contamination: 320 out of 640
- Deaths due to groundwater contamination: Over 18,000 in seven years
- Surface water pollution levels: 40% coliform; 60% faecal coliform
- Summer prediction: 1° C above normal temperature in all parts barring the North East

*Per capita availability

(Source: Ministry of Water Resources | Ministry of Drinking Water & Sanitation | Central Pollution Control Board | Ministry of Health & Family Welfare | IMD)

From Councillors to Eco-Councillors: Engaging with elected representatives on climate resilient cities

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Urban planning is a vast space about a city's people, its infrastructure, its social fibre and its economic prosperity, among other things. It is also about its historical charm (or the lack of it!), its environmental performance, its access to energy, its evolving culture, its aspirations and its changing dynamics in all its forms.

Climate change has an effect on all of this. It is a well-established fact that by acting on climate change agenda, cities can harness environmental, social and economic benefits. That can help ensure more jobs for the citizens, attract foreign investment and generate more revenues for municipal bodies and State Governments - in turn leading to economic growth and sustainable development of societies.

It is also well-known that vision and actions by urban development agencies or municipalities occupy the centre stage of a city's action plan for well-being and positive transformation. Therefore, most of the programmes related to institutional capacity building and improvement of governance at the municipality level focus on municipal officials and field-workers. Unsurprisingly when it comes to projects and programmes which are aimed at building climate resilience of a city and helping the city move towards a low carbon trajectory, it is often left only to the municipal officials to lead the way and be engaged in the process of strategising, policy-making and implementation. In most of these cases, elected representatives or councillors of the city are not involved in these programmes; that is a fundamental issue, one that hinders programmes from being sustainable and their actually seeing some action on the ground.

It is often argued that priorities of the councillors are different. Often the failure to engage with them stems from their lack of understanding of the issues (and underlying opportunities) and the role that they could play in the mainstream climate change agenda within the developmental plans of the locality.

A macro look at the political willingness to effectively address this issue, reveals that in manifestos, most political parties in India mention the intention to be pro-environment and highlight commitments towards climate action. This practice has become prominent since 2008, around the same time when the Government of India announced the National Action Plan on Climate Change. Now, it has gained huge importance with India's commitments made at the United Nations Framework Convention on Climate Change in Paris in 2015 and the ambitious targets on renewable energy (175 GW by 2022 and 350 GW by 2030) that have been laid out. Earlier, access to clean and affordable energy and impact of climate change used to be peripheral issues to development. With the adverse impacts of a warming climate being faced more acutely by the population in a large number of Indian States, election campaigns are often seen to be focusing on such issues. Environmental issues, rural and urban flooding, access to affordable energy, disaster risk management, are often emerging as important themes during elections. Today, sensitised Parliamentarians and Legislators can see these issues rising up as central components that can address both jobs and sustainable development. And this offers great opportunities for climate action to be woven into the core developmental and governance agenda. However, concerted efforts need to be put in to sensitise the old and the new elected representatives so that they can look at the developmental agenda of their constituencies through climate change lens and explore innovative ways of accessing climate finance to implement sustainable projects.

Local city councillors can play one of the most important roles in enabling this transformation at the ward-level. While doing so, they can create more green jobs for local communities and provide more opportunities of alternative

sustainable livelihood for the urban poor. They can also play a vital role in inducing behavioural change among young children, local businesses and citizens at large. They can reach out to the local communities with sustainable municipal services and practices. To realise this potential, they need to be equipped with the right knowledge and tools.

The first step towards sensitising them would be by reframing the risk of climate change as an opportunity to create green jobs, to support development of vulnerable communities, to give citizens access to potable water, affordable and clean energy, to manage wastewater and solid waste better and to reduce pollution. All of this would not only create cleaner and greener spaces but also enhance the quality of life. However, city councillors may not always be aware of how their interventions could have an impact on emissions footprint and the environment of their locality. Efforts need to be made to deepen their understanding of how they can play an active role towards developing a climate smart city and offer a better quality of life to the citizens. These efforts need to be sustainable and rewarding.

To make this possible, as a first step Urban Municipalities could establish a Sustainability Cell or a City Climate Action Centre. Such a Cell equipped with web-based platform and apps can have multiple functions—such as coordination with each of the municipal departments to help mainstream low carbon and climate resilience into their activities and infrastructure programmes, working with other organisations to build capacities of elected representatives and municipal officials, developing a network of experts, NGOs and institutions to help implement innovative projects through innovative project financing, integrating efforts of State Government Departments, providing policy inputs to the State Government, so on and so forth. The Cell can work through a committee and group of experts to conduct sensitisation programmes for the City Councillors. The Cell can help Councillors connect with experts to develop implementable and Sustainable Ward Action Plans. A core group of sensitised councillors can be created who can work individually and collectively to scale up efforts.

To encourage councillors to showcase their action on environment and climate resilience, such a Cell can also join hands with businesses and institutions to launch Green Ward Competition. The competition can cover a wide range of areas such as projects on renewable energy adoption (solar in schools, markets and health care centres), decentralised waste management, waste recycling, green vending zones, creation of greener spaces, restoration of water bodies and canals, eco-friendly community facilities, bio-toilets, organic farming, modular solutions to convert waste to energy, solar enabled water ATMs, solar bus stands, solar-LED street lighting, projects on water efficiency, rainwater harvesting, control of vector-borne diseases, disaster preparedness, alternative eco-friendly livelihood for women, reducing air and water pollution, encouraging eco-friendly mobility, addressing heat island effect, community development programmes. The list is endless. There are a plethora of case studies from across Indian cities which showcase innovative projects supported by city councillors.

Such interventions can spur innovation and boost investment into city's infrastructure. Through a well-coordinated approach elected representatives can delightfully embrace green transformation of localities. The key is to create enthusiasm and genuine interest. The rest would follow.

The views expressed are personal and do not necessarily reflect the UK Government's official policies. The article is based on author's experience of implementing programmes funded by the UK Government on sustainable urban development. She looks after energy, climate change and sustainable urban development programmes of the UK Government at British Deputy High Commission, Kolkata. She was the Team Leader for UK-Kolkata Municipal Corporation Programme on Low Carbon & Climate Resilient Kolkata (https://www.gov.uk/government/news/kolkata-partners-with-the-uk-to-deliver-low-carbon-urban-regeneration).

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Nanotechnology to Mitigate Environment & Climate Change Issues

Mr. Mainak Ghosal[1]

Prof. Sabu Thomas[2]

1.0 Introduction

One of the greatest current environmental concerns, both for the near term as well as for the future, is global warming caused by man-made carbon emissions and its well-recognized impact on *climate change*. A very significant moment in regards to this was when the Paris Agreement on *Climate Change* came into force. With 2016 declared as the hottest year in recorded history and sixteen of the 17 hottest years occurring since 2000, and with climate changes continuing to occur there are serious doubts on the promises made in the 2015 United Nations Climate Change Conference, COP21.

Nano technology is flourishing as one of the newest approaches for *mitigating and* combating *climate change*. Scientists, researchers and innovators are increasingly relying on Nanotechnology to slowly but steadily mitigate *climate change* process. The question arises is as to what is 'Nano Technology'? Nano Technology (NT) is that branch of technology which deals with matter on an atomic, molecular, and supra molecular scale. There have been many successful NT based applications which would otherwise have been almost impossible. For example, anti-scratch paints, anti-bacterial paints, anti-fouling concrete, dirt repellant textiles, clothes that need no ironing, non-reflective glasses, disinfectants, wonder drugs, food packaging, i-pods, nano-missiles, nano-satellites, etc. are only the tip of the ice-berg. Purification and environmental cleanup applications include the desalination of water, water filtration, wastewater treatment, groundwater treatment, and other nano-remediation. Nanotechnology is being used in developing countries to help treat disease and prevent health issues. The umbrella term for this kind of nanotechnology is Nano-medicine."*Nano materials could help us mitigate pollution. They are efficient catalysts and mostly recyclable. Now, they have to become economical for commercialization and better to replace present-day technologies completely*," says Arun Chattopadhyay, a member of the chemistry faculty at the Center for Nanotechnology, Indian Institute of Technology, Guwahati.

2.0 Brief Discussion

Progress of world economy can only be balanced by continuous industrial development supported by sustained agricultural production. The former is related to uncontrolled release of toxic and harmful agents into the adjoining environment and the by-products of farming practices add to it. Both these have adverse effects such as the pollution-related syndrome on living beings and as environmental pollution and need to be mitigated at any cost.

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If corrective actions are not taken then, as rightly highlighted by the Times of India, Mumbai edition of 20th September, 2013 that "*In 1.8 billion years Earth will become too hot as seas will evaporate*". The same paper in the Mumbai edition of 21st October, 2013 stated that the "*World average temperature will rise by at least 4°C by the year 2100 and at least by 8°C by 2200.*" The main sources of air pollution throughout India and the world are emissions from vehicular traffic and industries. The CO_2 released in the operations by some industries are:

Cement industry	1 ton of cement releases 1 ton of CO_2
Power plants	0.82 tCO_2/ MWh
Steel industry	1 ton of steel releases approximately 1.9 tons of CO_2
Paper & Pulp industry	2.5 MT CO_2/Air Dry ton of paper
Aluminum &Metal industry	(1 ton of aluminum releases 21 ton of CO_2),

The fields cultivated by farmers can be a bigger source of contamination than factory effluent if not checked properly. The paddy straw has high nano silica content which animals can't digest. Hence, it is of no use to the farmers unlike the wheat straw, which is used as animal fodder. An estimated 35 million tonnes are set afire annually in Punjab and Haryana alone to make room for the winter crop. The total National Annual Emission for CO_2 from crop residue burning is more than 64 times the total annual CO_2 pollution emission in Delhi. Experts say stubble burning accounts for anywhere between 12% and 60% of Delhi's air pollution and though the National Green Tribunal banned the practice in 2015, implementing the order has turned out to be a difficult task.

Nanotechnology and nano material-driven pollution control strategies are rapidly emerging as a small, but ultra powerful source of solutions for today's vexing environmental problems. *Nano materials* are structures at the nanometer-scale (a nanometer is 10^{-9} meter), a scale, comparable to that of atoms and molecules. Evidence shows that the same substance behaves differently at nano scale compared to its larger-scale counterpart due to differences in Quantum physics and Newtonian physics. First explored for applications in microscopy and computing, nano material made up of units that are each thousands of times smaller than the thickness of a human hair, are emerging as useful tools for tackling threats to our planet's well-being. To help slow the climate-changing rise in atmospheric CO_2 levels, researchers have developed nano CO_2 harvesters that can suck atmospheric carbon dioxide and deploy it for industrial purposes. Many research groups are working to address a problem that, if solved, could be a holy grail in combating climate change: how to pull CO_2 out of the atmosphere and convert it into useful products. Nano particles offer a promising approach to this because they have a large surface-area-to-volume ratio for interacting with CO_2 and properties that allow them to facilitate the conversion of CO_2 into other substances. The challenge is to make them economically viable. Researchers have tried everything from metallic to carbon-based nano particles to reduce the cost, but so far they haven't become efficient enough for industrial-scale application. One of the most recent points of progress in this area is work by scientists at the CSIR-Indian Institute of Petroleum and the Lille University of Science and Technology in France. The researchers developed a nano CO_2 harvester that uses water and sunlight to convert atmospheric CO_2 into methanol, which can be employed as an engine fuel, a solvent, an antifreeze agent and a diluent of ethanol. Made by wrapping a layer of modified graphene oxide around spheres of copper zinc oxide and magnetite, the material looks like a miniature golf ball, captures CO_2 more efficiently than conventional catalysts and can be readily reused, according to Suman Jain, Senior Scientist of the Indian Institute of Petroleum, Dehradun, India, who developed the nano CO_2 harvester.

Jain says that the nano CO_2 harvester has a large molecular surface area captures more CO_2 than a conventional catalyst with similar surface area would, which makes the conversion more efficient. However, due to their small

size, nano particles have a tendency to clump up, making them inactive after prolonged use. Jain adds that synthesizing useful nano particle-based materials is also challenging because it's hard to make the particles of a consistent size. Chattopadhyay says the efficiency of such materials can be improved further, providing hope for useful application in the future.

Apart from Germany, Japan and Korea who have ended up nominating Nanotechnology, The U.S. National Institute of Environmental Health Sciences and others are funding research to evaluate the potential effects of engineered nano particles on health and the environment. Researchers are also creating models to predict nano materials' transport and fate in the environment as well as their potential effects on humans. If concerns that have been raised can be adequately dealt with, nano materials could play a big role in helping cope with environmental challenges in the years ahead.

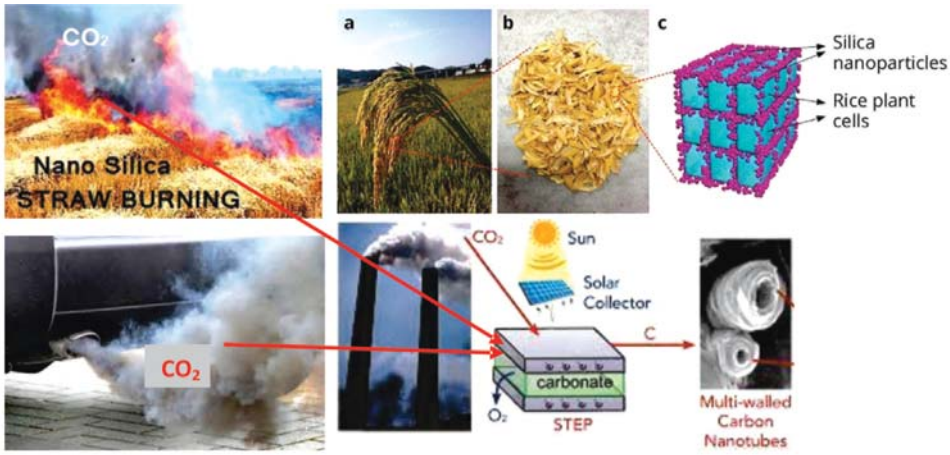

Figure1 Showing Production of Nano materials from Wastes

3.0 Conclusions

Nano materials offer a very interesting property change characteristics and their manufacture and extraction from waste materials could throw light in mitigating environment related problems. However, their commercialisation still remains a challenge with user-concerns not being properly addressed. Since the technology is new, strategies, policies and institutions are needed to work in tandem. However, due to the weak industry-institution linkages, India needs some radical effective mechanisms to nominate nanotechnology. In this context it is to be noted that whereas Reliance and Tata have invested significantly in Nanotechnology research the Indian Government had launched Nano science & Technology Initiative (NSTI) only in 2001 with an initial budget of Rs.6 crores resulting in 'Nano-Mission' in 2007, with an outlay of Rs.1000 crores (which is nothing compared to DST's Budget in 11th 5 Year Plan[2007-12] of Rs.19,300 crores). The Indian Policy revolves around 3 issues namely quantum of investments, distribution of benefits and India's future in this field; Nanotechnological initiatives are found lacking in the first two. With unknown risks looming large in this very new field there is still no 'Regulatory Framework' on the lines of Atomic Energy Regulatory Framework. If this persists for long totally unthought-of nations may come to dominate this field. India must therefore have a coherent strategy, a concerted policy and involve institutions and industry for developing NanoTechnology in all spheres especially to address environmental and climate change issues.

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A Critical Evaluation of Quality Accreditation System for EIA Studies in India- An Engineering Consultants Perspective

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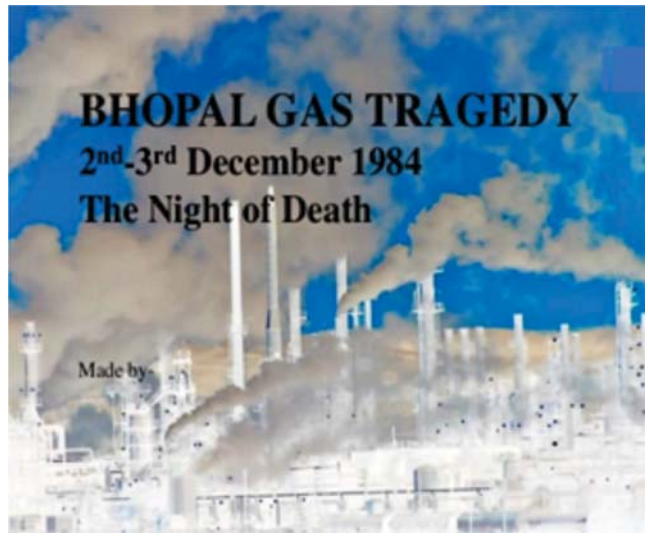
Introduction

The Scheme for Accreditation of EIA Consultant Organizations is a self-evolved, innovatively designed and purposefully driven national initiative and this scheme has no parallels to follow from anywhere in the world (QCI-NABET, 2015). Since the first EIA Notification of 1994 (MoEF & CC, 1994) the quality of EIAs in India have been debated widely, longing for betterment of the State policies and quality systems. Liberalization of Indian economy and large scale participation of foreign companies with International funding has brought in significant positive changes at a very rapid speed. In this context, there was a desperate need to implement a quality system in Indian companies and Indian working environment. As a result, there had been lot of uproar from all quarters to improve quality in all aspects of development. The scope of this technical paper however is confined to the environmental and social studies and the related management systems and practices.

Post Liberalization

During the Post Liberalization period, the overall environmental management capacity of Indian institutions had been extremely poor although it was improving at a snail's pace. The World Banks CEA Study of 2006 (WB, 2006) and the EIA Notification of 2006 (MOEF & CC, 2006) together brought in certain positive changes at the national level. The advent of RTI (MoL, 2005) and large scale infrastructure development further propelled the system to forcibly improve the quality of environmental studies to a certain extent. At that point of time, the concept of Quality Accreditation System for EIA was introduced in India (QCI, 2007). It was formalized with the Version 1 (Revision 6 of the scheme) EIA Accreditation Manuel in the year 2010 (NABET, 2010). This was a revolutionary and path breaking attempt towards achieving sustainable development. Today many countries are stated to be developing an accreditation scheme similar to the one developed and notified as a part of regulatory frame work of India (MOEF & CC, 2016). In fact and in general, the situations of EIA studies had been so bad that India was forced to find a way out with this Quality Accreditation System. As *'necessity is the mother of invention'* hence when the country desperately needed a better system, a good system was developed. This was the time when India had environmental contract workers (EIA contractors) and liasoning agents practically in all parts of the country; the ghosts of that system and practices are still prevalent on a large scale. The desperate CRZ clearance attempt of an international UN approved and Indian Parliament approved Auroville Project (near Pondicherry) for a very small desalination project at the State level is a monumental example of such systems and practices (Auroville, 2014). Even after two long years there has not been any progress in spite of noble attempts with highest level of ethical standards for global well-being as against a system that has much to improve in its day to day governance. The developed countries have never thought of or even dreamt of such an EIA Accreditation Scheme as they never needed it; as they had already stream lined their daily life to sustainable development. An alternate view is that as in many other instances in developed countries, if those countries wanted they would have developed a Quality Accreditation System long ago.

Historic Perspectives for Sustainable Development



The first environmental control in India started with the Water Act (MOEF & CC, 1974) followed by Air Act (MOEF & CC, 1981). However, the EP Act (MOEF & CC, 1986) came into being when India woke up after the Bhopal Gas tragedy in the year 1984 (see Photo1). Further India as a country focused on the coastal environment with the CRZ Notification (MOEF & CC, 1991) followed by EIA Notification (MOEF & CC, 1994). There after as required from time to time many amendments have been made to capture all the identified gaps in the system.

In 2016 Quality Accreditation has been notified as amendment to the EIA Notification (MOEF & CC, 2016). Today India could be in Rank No. 1 in terms of regulations and policies' but the Environmental Performance Index (EPI) of India is nose diving with an index close to Bangladesh. At Davos in 2018 (WEF, 2018) this year, India and Indians have been kite flying with literally everything except in terms of EPI. With more than 300 environmental related legislations at state and central level, the Supreme Court of India had been directing (in fact a certain level of warning) MOEF & CC to appoint a Regulator as the so called Regulator (MOEF & CC with all its subsidiary institutions across India) had been systematically failing till the Year 2013. Today with the improvement of Governance (Good Governance) this seems to be a non-issue for now (bottled-up could be the best word) for the Supreme Court except that the nose diving EPI came out in the open at Davos in January 2018.

Pre EIA Accreditation scenario

While everybody had been busy criticizing the MOEF & CC and green regulations, at one point of time MOEF & CC sought the assistance of the Quality council of India (QCI) to improve the quality of EIAs in India. There have been numerous organizations, individuals, groups and NGOs that have been busy preparing EIAs, mostly of doubtful quality. In such a situation the main task of NABET quality systems has been to free the system of unqualified groups. It is true that a large number of people worked directly and indirectly for developing the scheme to the current level (QCI-NABET, 2015).

Post EIA Accreditation scenario

With the issuance of the 2006 EIA Notification, there were significant changes in the EIAs and environmental clearance procedures in India. For the first time, approval of TOR became apart and parcel of the Environmental Clearance. In 2006 the State level clearances (MOEF & CC, 2006) with the State level committees had also been put in place. Any dilution of EIA requirement and related good practices could bounce back with a heavy clean up (or remedial) cost after a certain period of stillness. It is therefore necessary to improve the Environmental Management (EM) System for better implementation rather than dilution of the EIA requirements.

Positives – Gain

As stated above, until the time of acceptance of Quality Accreditation by the Ministry of Environment and Forest & Climate Change (MoEF & CC) there were numerous consultants preparing environmental reports in India. As the EIA concepts have been evolving over a period of time, majority of the consultants did not keep pace with the changes and hence their work remained as those of an amateur consultant, unclear of the basic concept of EIAs.

Their understanding, awareness and experience were not upto the mark. Although an Accreditation System has been developed, the qualification to do EIA studies is still a highly debatable point as holistically "environment" cannot exclude anything. This is based on the universal truth/fact that the entire humanity is the stakeholder for any action on environment (leading to degradation, conservation, preservation etc) that has a universal (Total and nothing to exclude) appeal and domain.

The prime achievements of the EIA Accreditation System are:

- Quality Accreditation System has brought in a system, order and practice to EIA,
- Currently the numbers of qualified consultants who can prepare and defend EIAs are limited - (158 consultants as on February 5, 2018 (www.QCIN.org.in),
- EIA consultants are brought in to the regulatory frame work and the Accreditation System thus developed is now part of EP Act 1986 (as amended)
- Improved job opportunities for many professionals in the form of 12 FAEs and Sector (Coordinator) Experts,
- EIA Studies have been brought to a much better level of understanding,
- As India is the first country to develop such a system, India has a unique position to lead all other countries, and
- Developers are feeling very comfortable to appoint a consultant from the list which is freely available.

Negatives – Loss

Although a Quality Accreditation System has been developed, this system has numerous inbuilt short comings. If the system stagnates without systematically addressing these issues and does not improve to the next level, things could completely go wrong. With a well developed accreditation system in place, the Developers or Project proponents are comfortable with the list of consultants from NABET' sac credited list. However, some developers failed to acknowledge the promise of **"value addition**" created by the accreditation as the market totally failed to react positively (see Table 1.0). As against one or two professionals earlier, today 12 – 17 experts are necessary to study and prepare an EIA report. Today the **EIA process** necessitates a lot more data collection, analysis and reporting and hence requires more manpower and time. Consequently it costs more. Moreover, even today, the understanding of the EA or EIA process is very low among Developers as they do not give the desired serious attention or value to the EIA and EC. Although an EIA review help immensely in the project planning process, the Developers perceive EIA as another hurdle in the project. All this is not because of the fault of the developers but part and parcel of the inherent systemic fault of environmental governance. Here only good or Sustainable Environmental Governance (SEG) matters to ensure positive end result on the ground based on implementable practical environmental management solutions. Therefore the major drawback of the Accreditation System from a practical point of view is **that the Indian market has failed to react to the value addition** created by the process and as a result the EIA process as required could perhaps not be happening.

Because of all these reasons although the EIAs (Indian) and the ESIAs (International) are technically intended to be the same, the accreditation system has not recognized the importance of social impacts and mitigation measures. By social is implied one of the three prime components of the EIA; in fact it's the core part of an EIA. Any comparison with CSR is incorrect as today's CSR is built totally on a different platform rather more a charity work like 'Gate foundation' it has no other link to EIA process. It cannot be linked to an Environmental Management Plan as it is not linked to project impact mitigation or monitoring or part and parcel of an EMP. The CSR effort is by default targeted to partially fill (in fact short cut) the huge vacuum created by the absence of Social Impact Assessment (as in an international EA process like The World Bank) in the Indian environmental governance.

Table 1 Analysis of Environmental Costs for Category A Projects

Sl No.	Items	Cost before Accreditation System (in million Indian Rupees)		Cost after Accreditation System (in million Indian Rupees)	
		Lower limit	Upper limit	Lower limit	Upper limit
1	Over all Comprehensive EIA Cost (3 Season data)	1.00	4.50	1.00	4.50
2	Rapid EIA Cost (one season data)	0.50	3.00	0.50	3.00
3	Marine Survey Cost before and after (One season)	0.30	1.00	0.50	1.00
4	Marine Survey Cost (three seasons)	0.50	0.80	0.70	1.60
5	Social Survey	0.25	0.40	0.25	0.40

Additional points:
(a) Social Surveys considered as per Indian regulations without stake holder participation and involvement,
(b) Collection of Marine environmental data is a difficult one in comparison to terrestrial data and very few organizations exist even today, and
(c) Only Category A projects are considered for this Technical paper.

In Indian EIAs, the Stake holders are always neglected or ignored and the Public Hearings are totally ineffective for people's participation (only a name sake exercise) in the development agenda of the country. This is not good for a democratic country like India where real power is always with the people. The people (stake holders) must know and have every right to participate and know what exactly is happening around them.

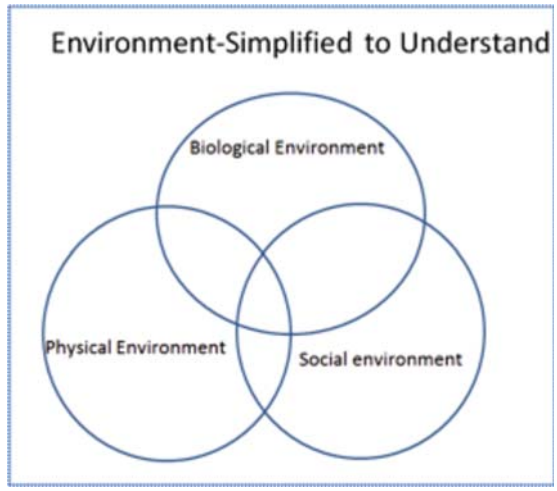


Fig1. Three Part Broad classification

The entire process failed to recognize the Social and Socio-economic environment as the core part of all EIA sectors. Even a Sanctuary is to be protected as a part of human or social environment for human survival on this planet. Such a policy and understanding without considering social environment could lead to the current air pollution type crisis as in the National Capital Region to social (Human) environment. A clear breakdown of an environment for EIA purpose is three fold Viz, (1) Biological environment, (2) Physical environment, and (3) Social environment (see Figure 1).

There were attempts to portray biological environment as ecological environment because by doing so the very purpose of dividing (simplification to learn and understand for common man) into three distinct partsis defeated. In fact the Ecological environment overlaps all the three components. As a result of neglect of the Social component there are several projects in India with an unduly long construction phase of more than15 -20 years (Alappuzha By Pass for example) and the shocking failure as that of the Nano Project in Bengal.

Few important concluding points are:

- Realistically (Practically) there are 17 FAEs as against the 12 FAEs in the list (more expensive),

- The process failed to recognize Hydrogeology (more of Geology) and Hydrology (more of Engineering) as two different expertise's,
- The process failed to address the issue of *'realistic time frame'* for various activities; as on today only for public hearing (45 days are now mandatory) has an inbuilt realistic time frame. In order to avoid manipulation of the system and regulatory frame work to the root, fixing of more realistic time frame[1] is fundamental.
- To coordinate with various organizations such as NHAI to follow EP Act 1986 with the accreditation in place. NHAI has its own environmental qualifications for EIA studies which are not in tune with the EP Act (MoEF & CC, 2016). This needs to be set right/ reconciled for the good of the country.
- To avoid issues like the one of NHAI; there needs to be coordination of all institutions and ministries at Central and State levels to adopt the rule of law framed for sustainable development of the country.

EIA Cost in India

Qualified consultants have been propounding for Quality all the time. On one project it did happened that way, right from holistically addressing all environmental (and social issues also) as all parties were competing to support and work for the project - EIA for the Vizhinjam International Sea Port Project. (VISL[2], 2013[1 to 8]). The QCI- NABET Quality EIA Accreditation System is supposed to be a verdict on quality but the core area - the Fee part has not been addressed till today and hence very disappointing for those who appreciate and abide by the EIA process *in toto*. If one looks at the consultancy fee part, most of the EC clearance obtained during last several years would be 'qualified for EC invalidation' as there are still EIAs done at unbelievably, unrealistically, mysticallylow costs, leaving apart the associated issue of unrealistic time frames for the moment. That implies that all the data input for the EIA report in such an unrealistic situation is questionable. The logic is the mismatch of the consultancy fee and the cost of EIA output as necessary and required under the Act/ Notification. While terrestrial primary data generation alone costs over ₹ 1.50 million per season, the terrestrial environmental data and the marine data generation cost about ₹ 1.00 million per season. However, it is found that the entire EIA s are being carried out at prices as low as ₹ 0.50 million even for one of the Port EIA project (₹ 2.80 million with one season data) of the country with international consultants as advisors. For that port project study the Marine EIA (apart from terrestrial primary data required ₹ 1.50 million per season and Marine data alone cost ₹ 1.00 million per season) is also included. Then the other missing costs such as man month rates for 12 -17 FAEs (₹ 2.0 million) and travel accommodation (₹ 0.5 million), etc. is also required to be included. Table 2.0 proposesa realistic estimate of the EIA fees after consideration of all quality system and time requirements.

Table 2 Typical EIA Cost in India with the Quality Accreditation System in place

Sl No	Items	Fee Estimate (Million ₹)
1	Over all Comprehensive EIA Cost (Three Season data) for Non Marine Projects	10.00
	For Coastal Projects	15.00
2	Rapid EIA Cost (One season data)	4.50
3	Primary Data One Season	1.50
4	Primary Data Three Season	4.50
5	Marine Survey Cost (One Season)	1.00
6	Marine Survey Cost (Three Seasons)	2.50

[1]Context best example– If you need a baby ten months is realistic 'not two months' and if one boasts or claim that he could get a baby in two months it is unrealistic or mystical in nature

[2] In total there are eight references

Impact of Quality Accreditation System for business

The contradiction is that the QCI-NABET system does not agree on the experience of the Accredited Consultancy Organization (ACO). As per the Accreditation System the experience goes/drains out with the professional who did the work. That means as soon as a professional leaves anorganization, the experience of the organization also vanishes. There is thus no meaning of an organizations resources and experience. The experience of the team and the organizations data & knowledge base are not given any consideration. The entire issue is controversial as the tenders and RFPs floated by different organizations only consider the company experience that presumably had already vanished once the professional who was with the ACO, leaves. However, for the NABET mandated EC, the only experience evaluated is based on a professional's CV.

In the absence of such ACO experience the accreditation given to the professional(s) will not work at all. The above is an example and there could be several others of conflicting systems and practices. As against the listed manpower of 12 FAEs as per Accreditation System, realistically 12-17 Experts (Table 1.) are actually required. Man months provided includes field visits and travel time also. One man month is equal to on an average 21 man-days. Remuneration provided does not include expenses for survey's and field work. The estimate is inclusive of normal special studies for projects.

Conclusions and Recommendations

The achievement so far can be stated as unique and unparalleled. Many countries came forward to replicate the process in their respective countries. However, there is substantial work left to complete the EIA Accreditation work In India. Those mentioned here are a few examples. The biggest achievement so far is that all reprobates are isolated and removed for eligibility to do EIA. Alas! many arms of the Government are not respecting the EP Act 1986 after the Notification of Accreditation System (MOEF & CC 2016) and such departments are acting on their own system. The tender documents for DPR must be specially designed to align with the Accreditation System as per the law of the country. The pricing of EIA cost should also be rational and suited to the tasks to be performed.

As mentioned above many departments and organizations are prescribing their own qualifications for environmental expert. The GOI and State governments must be alert to centralize the accreditation system across all ministries, departments, authorities, bodies, etc. There have been misuses of the Accreditation System with selective application based by Government officials across various departments, organizations, etc. A project RFP with estimated price of ₹ 10.3 million was awarded for price as low as ₹ 2.00 million. It does not stand to reason as to how such a drastic difference can be justified. Instead of dropping or eliminating or blacklisting of the consultant, the agency took the position of awarding the job to the same agency forcefully threatening to black list the others incase of non-cooperation. In such instances years of developed and inherited human wisdom fails; common sense and logical thinking vanish into thin air. The least cost bidding should be replaced with Quality cum Cost basis. Only those satisfying the Quality Criteria for doing the environmental studies ought to be qualified and their cost considered. All suggested measures for sustainable development are intended to benefit the population, flora and fauna of the country. In order to maintain the requisite standards the RFPs must include Developers/Engineers EIA cost estimate for all EIAs with broad break up. The accreditation exercise must recognize the Social part (human environment) as the core area of Environmental Impact Assessment (EIA).

Table 3. List of Accredited Professional with Minimal Salary for Typical Project

Sl No.	List of Accredited Professional required	Code	Man months required	Minimum Experience Requirement (years)	Fee (Million ₹)
1	Environmental Coordinator (Team Leader)	EC	2.00	7	0.500
2	Water Pollution Monitoring, Prevention and Control	WP	1.00	5	0.200
3	Air Pollution Monitoring, Prevention and Control	AP	2.00	5	0.200
4	Meteorology, Air Quality Modeling And Prediction	AQ	1.00	5	0.100
5	Land Use	LU	1.00	5	0.100
6	Soil Conservation	SC	0.50	5	0.050
7	Socio Economics	SE	2.00	5	0.200
8	Noise	N	0.50	5	0.050
9	Vibration	V	0.25	5	0.025
10	Solid Waste including MSW and C&D Waste	SW	0.50	5	0.050
11	Hazardous Waste including Plastic & E-wastes and ISW	HW	0.50	5	0.050
12	Bio-Medical Waste	BMW	0.50	5	0.050
13	Geology	HG	1.00	5	0.050
14	Ecology and Biodiversity	EB	0.50	5	0.100
15	Risk Assessment and Hazards Management	EB	1.50	5	0.100
16	1. Groundwater & Conservation (G)	HG	1.00	5	0.100
17	2. Hydrology & Conservation (H)		1.00	5	0.100
			16.75		2.250

The QCI-NABET need to work with regulators to make the necessary regulatory changes such as renaming of EIA to ESIA and to include stake holder consultation and participation as integral part of the Environmental Assessment (EA) process. Such efforts would have a cascading positive impact on public hearing and the EIA process. Although the Accreditation System is professionally desirable but it is still not an attractive destination for highly competent and top ranking Professional's from our professional schools. Even today Environmental consultants are being considered as Liasoning consultants. That is a negative connotation for good environmental governance in India. This accreditation process must also identify key players and their roles and responsibilities in an EIA from concept to commissioning of a project.

The entire Environmental Management System of the country is being implemented with the help of six government and non-governmental institutional players. These six institutional players are **(1) Developer**, **(2) Contractor**, **(3) Consultants**, **(4) Regulator, (5) Stake holders,** and **(6) Judiciary**. The process must identify a set of pure parameters (Formulate a 1000 Parameters for example) that can classify an EIA in to (a) Unacceptable(score < 200), (b) Unsatisfactory, (c) Good, (d) Very Good and (e) Excellent(score >900) and fix yearly awards and recognition's based on the scores. The same organization could have many different scores based on the different EIAs done in the year.

ENVIRONMENTAL POSSIBILISM

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Overview

The environment is everywhere and noticeably our surroundings, however, what does environment mean to us? As per the Environment and Ecology Journal, Environment simply means the natural environment which encompasses all living and non-living things occurring naturally on the planet Earth. However, the term environment derived from the French word "environ", stands for everything that surrounds us or surrounding condition comfortably for all living things and the area we live in.

Photo-1: Upland Environment
(crafted picture from Noel Celis, PDI)

The environment is an ecosystem which consists of all the living and non-living things in a natural setting composed of plants, animals, insects, microorganisms, rocks, soil, water, and sunlight; where all types of ecosystems are categorized into terrestrial and aquatic categories. The terrestrial ecosystems are land-based composed of the upland and the lowland areas, while the aquatic ecosystems are water-based composed of oceans, river, and lakes. The types of the environmental ecosystem we have on Earth are forest ecosystems, grassland ecosystems, desert ecosystems, tundra ecosystems, freshwater ecosystems, and marine ecosystems.

Forest Ecosystems are classified according to their tropical environmental climate or boreal (taiga). In the rainforests diverse flora and fauna flourish in the warm, moisture-laden environment. The trees grow tall and the foliage is lush and dense, with species inhabiting the forest floor all the way up to the canopy. In temperate zones, the trees are of the deciduous, coniferous varieties or a mixture of both; some trees shed their leaves each fall while others remain evergreen year-round.

Grassland Ecosystems can be found in prairies, savannas and steppes; and are typically found in tropical or temperate regions. In the colder areas they are known as the Siberian steppe. However, they share the common climactic characteristic of semi-aridity where trees are sparse or nonexistent, and flowers interspersed with the grasses that provide an ideal environment for grazing animals.

Desert Ecosystems have a low precipitation, generally less than 25 centimeters per year. However, not all deserts are hot, but can exist in the tropics regardless of latitude, and are often windy. Most deserts are sandy and have sand dunes, while others are rocky. The vegetation is sparse or nonexistent, and animal species are highly adapted to the dry conditions.

Tundra Ecosystems are a harsh environment ecosystem - snow-covered, windswept, treeless and the soil is frozen all year-round and is known as the permafrost region. However, every spring and summer, the surface snow melts and provides shallow ponds which attract migrating waterfowls; lichens and small flowers may also be visible in these areas. The Tundra comprises the arctic tundra near the polar areas in lower altitudes and the alpine tundra located on mountains at higher elevations where trees no longer grow.

Freshwater Ecosystems may be found where streams, rivers, springs, ponds, lakes, bogs and swamps occur. It is subdivided into two classes: water which is stationary, known as ponds; and water which flows known as creeks; they are home to more than just fish; algae, plankton, insects, amphibians and underwater plants.

Marine Ecosystems contain saltwater which supports different types of species other than those in fresh water. It is the most abundant type of ecosystem and encompasses not only the ocean floor and surface but also tidal zones, estuaries, salt marshes and saltwater swamps, mangroves and coral reefs.

Climate Change, an Environmental Perspective

Climate Change is occurring all across the globe. The manifestations are different in different areas. Taking the case of the Middle East, its environmental records have been impacted due to Oil and Gas exploration and production resulting in CO_2 contributions to the environment. The mother Earth suffers because of these effects. However, the Middle East government has always worked hard is striving to work towards the reduction of Greenhouse Gas Emissions along with Sustainability Efforts that have been mandatorily implemented.

Climate Change effect for the Middle East is totally different from what is experienced in the Tropical Countries because the Middle East is not impacted in the same manner. However, the increases in the temperatures throughout summer become a nuisance for the normal way of living. As a result, the regions vulnerability due to lack of fresh water makes it dependant on desalination for water supply. It also adds to food insecurity. However, they are working on these issues in the interest of the country's development.

Climate change adaptation is an important factor for a Middle East country which recognise the importance of renewable energy and sustainability. These are now being applied to the built environment through proper design and implementation, whereby, the fight for reducing the ecological footprint in the country, in effect of giving a cheaper, and greener, sustainable and more reliable energy in sustaining and meeting the commitment for a sustainable environment.

As an example towards Climate Change Adaptation commitment in the Middle East is Qatar's National Vision 2030 - ***"The State of Qatar seeks to preserve and protect its unique environment and nurture the abundance of nature granted by God. Accordingly, development will be carried out with responsibility and respect, balancing the needs of economic growth and social development with the conditions for environmental protection."***

Setting the Standards

Since the entire Middle East is arid desert land, hence when sandstorms occur somewhere in the regions, they pollute most of the region, which results in suffocations and health problems. With the massive development throughout the Middle East region, the Air Quality has been mandated and implemented specifically for constructing

built-environment. International Codes and Standards of Practices, e.g. EPA, ASHRAE, USGBC, BREEAM and others; have been adopted for securing and maintaining the Environmental Air Quality (EAQ) and Indoor Air Quality (IAQ) requirement for the community that have been set forth as local standards by the respective Authority Having Jurisdiction (AHJ) for the purpose of sustaining the environment. These sustainable manners of living are helping to adapt to address Climate Change issues.

Oil and Gas explorations and production are the primary sources of Middle East Economy, however, as far as Climate Change is concerned, these contribute to release of a higher percentage value of CO_2 that gets trapped in the Earth's atmosphere and results in Greenhouse Gas Emission effect which results in the climate getting warmer. However, with their initiatives, the government of Qatar is transforming into a knowledge-based economy and making sustainability an integral part of their economy thus, initiating activities towards sustainable infrastructural development.

Systematic Pollution in the Environment towards Climate Change

Pollution of the environment is one of the biggest hazards ever experienced, which human beings are facing today due and contributes to the global climate change. As per the **Environmental Possibilism** theory this happening in every country and affects the human-cultural ecology.

Environmental Possibilism implies that in the system model of human ecology where both the social system and the ecosystem are interacting with each other, the integrity of the system will remain the same because of changes that occur in the structural configuration according to their internal dynamics.

In the process of Oil and Gas exploration and production, carbon is extracted and that causes pollution not only for the country where it is being done but for the whole world. The carbon pollution has been created due to burning fossil fuels where Oil and Gas industry is driving the climate disruption and warming the globe. The adjoining photograph is self-explanatory as to how carbon pollutes the air, and as a principle, the more the sun's energy is trapped, the heat is also trapped, leading to hotter climates.

Photo-2: Air Pollution due to Oil and Gas Explorations

Countries are becoming increasingly aware of the threat that has been posed by pollution, especially airborne pollution from natural, commercial, industrial sources plus Oil and Gas. Governments are enacting legislation that aims at protecting the environment since during the last few decades global environment has gone through serious challenges on how to mitigate and solve the issues as a consequence of climate change.

In any country, increasing population contributes to pressure on resources. Due to dwindling resources on account of focus only on progress and economic needs a country's economic growth results in pollution and causes an undesirable change in the physical and biological operations of air, land, and water - the whole ecosystem that affects the human-cultural ecology in the country and in turn leads to environmental health problems. These might or would be harmful to human life living and working in the country, other species and the industrial process. All this would lead to deterioration of the living condition and cultural assets of the country.

The photographs below are examples of natural pollution as cities grow with consequent environmental health effect on living beings. A human being could or may be exposed to the pollutant in the environment in many ways through the air we breathe, the water we drink, the food we eat and the cosmetics, drugs and other products that we may use.

Environmental pollution is the result of increased production of waste products by the industries, rapid urbanization, and planned, unplanned and at times irresponsible development in the country. Unplanned sewage and waste disposal from industries and cities are environmental pollutants affect the whole community as they cause overall environment pollution.

Photo-3: Strong Winds and Dusty Condition in a Middle East country

Photo-4: Air Pollution-caused by a heavy Sandstorm

The contribution to environmental ecology and human health could affect even those materials/ substances that have been identified for priority consideration for a country. Most Research Development and Scientific developments show a growing concern on the links between health and environment and the practices that have been identified for the economic development in worldwide industrial, land and resources management. However, today's generation has a growing concern for the global environmental degradation brought about by combinations of materials/ substances on account of economic development. The oil & gas, chemical, manufacturing, etc. plants being built, vehicles, etc. all release pollutants into the air, water and soil in the environmental ecology. However, in a built environment, the pollutants are intentionally removed by the management of waste, including the residues produced, from the air and water by pollution control equipment. The pollutants are then changed into less hazardous substances.

Pollution in Environmental Possibilism Theory in Climate Change

The air pollution in the Environmental Possibilism scenario and the overall degradation of soil which is happening in the construction environment and also the other elements of the environment, point to the fact that it is high time to take up initiatives against global obstacles for the sake of the present and future generations and the sustenance of all other organisms we share the Earth with. The ultimate vision is to enhance knowledge about the environment and take the study of environmental science and management in the country to international audience.

The photographs and the preceding discussion show that for the growth of a country like in the Middle East they should proportionately do the heavy-lifting when it comes to tackling climate change and global warming since they are one of the contributors amongst the countries around the globe. The contribution could be by way of mitigating the effects of climate change or funding adaptation to the environment.

The exposure to outdoor air pollutants occurs virtually continuously within the environment but nobody notices it. It also occurs across microenvironments, including indoors - the built environment created in a progressing country. The composition of the mixture and the absolute levels of the air pollutants change, and many different air pollutants are present. The understanding of these exposures is complicated by the fact that the composition is not fully understood. Although most of the major pollutants are known and can be measured many trace species within the environment seem to have not been identified, much less quantified routinely as studied and researched by the authority having jurisdiction in the country.

Conclusion

This overview is intended to know and understands what an environment really is to us and the type of environmental ecosystems we have on the planet Earth that we live on.

What is happening in our environment due to Climate Change is based on research data validated by the Environmental Protection Agency (EPA). Almost 97% scientists agree with the findings and unequivocally voice warnings that human activity is the primary cause.

As per Environmental Possibilism since the climate change on account of adding extra CO_2 and other greenhouse gases in the atmosphere are being contributed around the globe due to the massive infrastructure development and the economic demand, the values of the countries around the world relevant to the human activities must adjust to control the effects of climate change on the environment.

In conclusion, the governments, corporates, industrialists, manufacturers, etc. the world over must strive to adopt and adapt the most effective policies and technologies for protecting the environmental assets and reducing pollution as well as working towards the reduction of greenhouse gas emissions. The Consulting Engineers, Scientists and Volunteers must also contribute to the same and help the governments, et al recognise the imperative of cultivating a sense of environmental responsibility among the public in general and within the industry.

The industrial establishment must be segregated from the urban areas and must provide comprehensive and effective treatment processes so that during an operation, the pollutants get extracted directly and fall within the stipulated norms.

Reducing the footprint of a greenhouse gas more potent than carbon dioxide

Scientists have found a new catalyst that more efficiently converts methane to olefins.Scientists have unlocked a new, more efficient pathway for converting one of our most potent greenhouse gases directly into basic chemicals for manufacturing plastics, agrochemicals and pharmaceuticals.

USC scientists have unlocked a new, more efficient pathway for converting methane — a potent gas contributing to climate change — directly into basic chemicals for manufacturing plastics, agrochemicals and pharmaceuticals.

In research published in the *Journal of the American Chemical Society*, chemists at USC Loker Hydrocarbon Research Institute say they have found a way to help to utilize this abundant and dangerous greenhouse gas, which is generally burnt or flared to produce energy.

Among common greenhouse gases, carbon dioxide is often cited as the largest culprit for trapping heat on earth, contributing to climate change. However, it is not the most potent. That distinction belongs to methane. According to the Intergovernmental Panel on Climate Change, methane traps heat and warms the planet 86 times more than carbon dioxide over a 20-year horizon.

Source: Excerpted from Science Daily, 05 February 2018

What is Ailing Delhi - The Capital City of India

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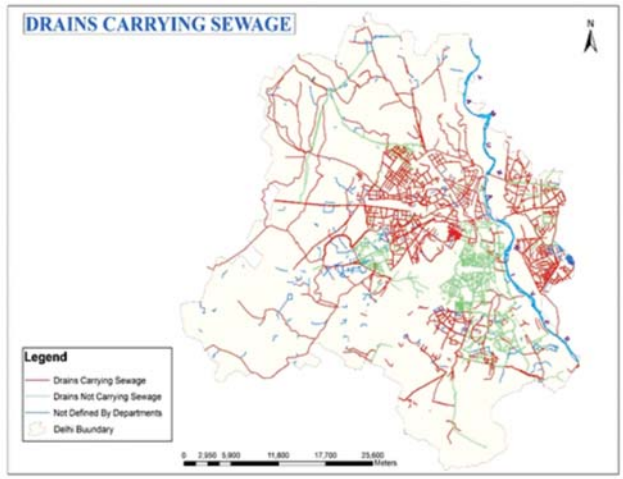
Abstract: *The thousands of corers of rupees and a number of Yamuna Action Plans (YAP) have failed to clean the River Yamuna and the apathy is that all the Yamuna Action Plans (YAPs) that have been formulated and implemented never bothered about what is the state of affairs in the drains contributing to Yamuna (Mini Yamuna) and sadly presumed that if Yamuna is got rid of pollution somehow then all the problems would be over. This article attempts to analyze the issues responsible for the deteriorating condition of River Yamuna and gives brief summary of the issues and possible solutions.*

Introduction

Of late, we as a society, have been very concerned about the ever deteriorating condition of the River Yamuna, especially the stretch passing through Delhi and of course have dumped thousands of crores of Rupees to tackle the pollution but have failed miserably. The basic premise of the solution that has been embarked at is flawed. It has been assumed that if we can somehow tap the sewage just before it finds entry into the River Yamuna then we have done our job and we can claim that we have got Yamuna rid of the pollution. It is very unfortunate that these proponents have never thought as to what would be the fate of the natural drains that are bringing the sewage by collectively running for hundreds of kilometers of length within Delhi and each one of which is practically a mini Yamuna.



1. The Concern

Many people living in Delhi may be surprised to know that NCT of Delhi itself has 201 natural drains that not only collect the surface runoff from their respective catchments and drain them off to Yamuna but also recharge the groundwater of Delhi besides performing a range of environmental functions. As a matter of rule, all these drains should only become active during the Monsoon period and should remain invariably dry during the remaining eight months. However, the reality is starkly opposite. Almost all the natural drains of Delhi are carrying sewage throughout the year as has been depicted in the figure above (in red) that was compiled using the affidavit provided by the various departments who are the custodians of these drains.

2. The Issues

I am at a loss to understand that, in the face of this reality, why we are not bothered when a mini Yamuna equally polluted is flowing day in and day out through many of our localities. Many of them are not only carrying domestic

sewage but also effluent from many unauthorized small scale industries, hospital waste and many such pollutants that are polluting the groundwater as well as the air and thus are responsible for serious health hazards. I would like to provide a small glimpse of a natural drain, the Barapulla drain from INA, close to Jangpura which flows on to River Yamuna, as seen in the picture that was taken in the month of April when this drain should have been totally dry.

The apathy is that all the Yamuna Action Plans (YAPs) that have been formulated and implemented never bothered about what is the state of affairs in the drains contributing to Yamuna (Mini Yamunas) and sadly presumed that if Yamuna is got rid of pollution somehow then all the problems shall be over. Unfortunately, they could not achieve their target, but even if they were to be successful in making the Yamuna free of pollution in this way, it would have been a big failure since the city of Delhi would have remained dirty and uninhabitable. It is a pity that such people never understood that if all the natural drains contributing to Yamuna are made free of pollution then the main Yamuna would be automatically free of pollution without any additional effort.

While working on the formulation of the Drainage Master Plan for NCT of Delhi, I have had the opportunity of analyzing the various issues that are responsible for the deteriorating conditions of Delhi and could think of some of the feasible solutions.

3. The Major Issues and Possible Solutions

3.1 Ineffective handling of sewage

If Yamuna and the drains contributing to it from Delhi stretch have to be made pollution free then it is important that the Delhi Jal Board (DJB) should ensure the following:

- As a policy, no natural or artificial storm drain should be used to carry any sewage. Only treated sewage from Sewage Treatment Plan (STP) of acceptable quality as per CPCB norms to be allowed into storm drains.
- All the drains that are entering into NCT of Delhi (from Haryana, UP, etc.) should also follow the same principal and be only carrying storm water and treated sewage of acceptable quality as per CPCB norms.
- Current practice of DJB of puncturing sewer lines and allowing sewage into storm drain in the event of blockage should be strictly stopped. There have been numerous occasions when punctured sewers have not been plugged for years together. DJB should resort to using latest mechanisms such as supper suckers for de-clogging the sewer lines whenever required.
- No sewage should be allowed to enter the storm drains even from unauthorized colonies; interceptor sewers should be set-up by DJB to trap the sewage coming out of such colonies and take it to the nearest sewer line or STP.

3.2 Storm water entering sewer systems

Another issue that is equally serious as the sewage getting into storm drains is the storm water letting into the sewer lines since the sewerage lines are not designed to cater to the storm water. There have been many

localities that are frequently flooded with sewage because of the sewerage network getting surcharged with the storm water. The following norms need to be imposed:

- ❖ No storm drain should ever outfall into asewer system. This may appear to be something that cannot be even imagined but this is what is happening in Delhi, not in one odd place but in many places.
- ❖ Practice of opening sewer man-holes to discharge local storm water should be banned. Adequate system to discharge storm water should be put in place and public awareness should be increased towards ill-effects of diverting storm water into sewer lines.
- ❖ Majority of house-holds have connected their roof-top drains to the sewer lines. Municipalities should revive the locality level storm drains or alternatively use this water for groundwater recharge at the individual household level, but never allow the roof top water to be connected to the sewer line. Awareness campaign should be carried out to sensitize public in this regard.

3.3 Encroachments on storm drains

Most of the storm drains are being systematically encroached. One such case from Sarita Vihar, Okhla Phase-1 drain is shown in the photograph. Storm drains should be treated as key public assets and no encroachment should be allowed. Departments managing the storm drain should be made responsible for keeping each drain encroachment-free. Special drives to remove encroachments from the storm drains should be taken up.

3.4 Solid Waste or C&D waste dumped into storm drains

Invariably, silt from the road (before or after road sweeping – manual or otherwise) is being dumped into bell-mouths/drains. Construction & Demolition (C&D) waste is also being dumped in storm drains or natural depressions. Such dumping results in reducing the cross-section of the drain which in turn reduces its carrying capacity and creates flooding.

Road sweeping process as well as handling of Construction & Demolition (C&D) waste needs to be completely overhauled. Weight/volume of silt received after street sweeping should be recorded so as to identify roads or segment of road from where more silt is being received and to follow up with a review to ascertain the reason(s) of the same. If need be, possible a forestation exercise should be taken up to reduce silt on the road segment. Similarly, amount of waste likely to be generated from a construction or demolition site should be assessed by the contractor in advance (along with the permission to construct/modify house). C&D waste should be lifted by government appointed contractors and should be dumped at C&D process site.

3.5 Ineffective De-silting of the Storm Drains

Every year Delhi spends crores of Rupees on desilting of the drains but it is unfortunate that the desilting process is not effective. The major reason for this ineffectiveness is that there is no process in place to ascertain that the total length of the drain is desilted. Because even if there is a small segment in between that is still left choked then the whole process is rendered ineffective. Besides the multiplicity of jurisdiction of these drains, the other major reason of ineffective desilting is that many drains are covered fully without having any access for desilting. Thus it is intriguing to understand that how the desilting is carried out under these permanently covered portions; the fact is that these are left to their fate.

For effective desilting, it is imperative that new technologies such as GIS and crowd sourcing should be used for proper monitoring wherein schedule of desilting should be publically displayed and in a manner that is understood clearly by general public. Crucial details such as time schedule of desilting and the amount of silt/debris removed should also be captured and displayed. Effort should also be made to put all the storm water drains under a single agency that should take care of many issues identified above.

3.6 Construction inside storm drains

It is not at all difficult to find instances in Delhi where utilities have been laid inside the storm drains. There have been many instances where pillars of elevated roads/ metro are built inside the storm drains without realizing the implication of such actions. Functioning of the drains is drastically impaired which invariably results in flooding which could have been avoided.

Therefore, no such activity that can result in reduction in the cross-section of drain should be allowed. In the locations where such compromise of the section has happened, adequate measures should be taken immediately to restore the original carrying capacity of the storm drain.

3.7 Disappearing water bodies

Another issue that is equally serious is the continuous shrinking and disappearance of water bodies in Delhi. Water bodies have always been the natural defence mechanism against floods and they also provide innumerable environmental services such as providing groundwater. We need to make sincere efforts to rejuvenate the water bodies. Some of the actions that can be taken immediately are:

- ❖ Dumping of waste into water bodies should be prohibited to maintain ambient water quality.
- ❖ Rainwater from the adjoining areas should be diverted to the water body to ensure that it gets filled up adequately during monsoon.
- ❖ Regular desilting should be undertaken to avoid reduction in storage capacity of the water bodies.
- ❖ No encroachment or unauthorized construction in the water bodies and wetlands should be permitted.

3.8 Conclusion

I am sure that if these actions are taken in earnest then many of the major problems of River Yamuna and Delhi can be solved. In fact, every other city of India also has similar problems and the same strategy can also work for them to make these cities truly SMART.

Cabinet approves a Memorandum of Cooperation between India and France in the field of environment

The Union Cabinet chaired by Prime Minister Shri Narendra Modi has approved the signing of a Memorandum of Cooperation between India and France in the field of environment

The Memorandum of Cooperation will enable establishment and promotion of closer and long-term cooperation between the countries in the field of environment protection and management of natural resources on the basis of equity, reciprocity and mutual benefits, taking into account the applicable laws and legal provisions in each country.

The Memorandum of Cooperation is expected to bring in the latest technologies and best practices suited to bringing about better environment protection, better conservation, better management of climate change and wildlife protection/ conservation

Source: Press Information Bureau, 8 March 2018

How to Improve Delhi's Air Environment Parameters by Actions of Citizens and Government

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Delhi is categorized as one of the most polluted cities in the world, having reached alarming levels of 485 AQI whereas the safe limit for humans is less than 100 AQI. However, there are several practical actions that can help restore the various air parameters to levels that are deemed safe for the health of its habitants.

1. Reduce Traffic based air pollution by starting car pool lanes for cars and other 4 wheelers having 3 or more passengers as widely practiced in various countries to encourage people to travel by pooled cars and four wheelers thus helping to reduce traffic congestion as well as air pollution. Citizens should voluntarily car pool with friends, colleagues, family, members of the housing society, etc. wherever possible.
2. Mark out Bicycle lanes in residential colonies and all roads in Delhi to encourage safe travel by bicycles. Citizens should be encouraged to use bicycle wherever possible. Provide parking areas for Bicycles in all residential, commercial, shopping and industrial areas/ complexes.
3. Encourage greater use of Public Transport by supporting the Metro, overhead rail and bus services to make it convenient for people to travel by public transport affordably and safely instead of their own vehicles. Citizens to shed status aspects and travel by public transport proactively as is prevalent in many countries in Europe.
4. Encourage use of CNG in motor vehicles as it is a much cleaner fuel than petrol or diesel by considerably reducing the road tax and sales tax on CNG filled cars as compared to petrol and diesel 4 wheelers.
5. At least 1400 cars are added everyday to Delhi’s roads. The new cars must be stipulated to be CNG cars only. Petrol cars of less than 5 years to be asked to convert to CNG.
6. CNG filling stations to be increased to meet the demand well in advance.
7. Registration of new cars to be discouraged by enhancing registration charges. No two cars/ 4 wheelers to be owned by one person unless the first one is being disposed and proof of disposal is provided.
8. Encourage 6 axle trucks rather than the typical 4 axle trucks to increase the pay load per truck for reducing the number of trucks on the roads. Trucks destined for other destinations must not be allowed to pass through Delhi but only use the existing bypass facilities. Where bypasses do not exist they must be constructed post haste.
9. Road Signage needs to be drastically improved so that people do not travel extra distance to locate their destination or have to change lanes in the last stretch. All the signs must be signposted at two or three places well before the turning rather than at the last minute, as at present.
10. Road signage should be in full and clear sight of all lanes and not be hidden or their view obstructed by trees, light poles, other sign boards, etc.
11. Mark lanes for traffic going straight or turning left or right. Plan the roads and junctions so that lane changing

is not required in the last 200 m or 300 m, which is to be treated as No Lane Change Stretch. Make the lane changing in that stretch a traffic offence.

12. Signals to be automated and synchronized. The on-duty traffic constable should not change the timings. All signals must mandatorily be programmed to provide adequate time for the Amber phase. Road users to be educated as to what the Amber phase is meant for and what would constitute a traffic offence.

13. Put up warning signs at all junctions/ crossings that no vehicle should enter the junction /crossing unless the exit is clear. Failure to abide by that should be treated as a traffic offence. This will prevent blocking of the junction/ crossing and consequent traffic jams.

14. Heavy vehicles should remain in the Left most lane except when they are to turnright in which case they should move into the right most lane just before the last 200 m or 300 m, which is the No Lane Change Stretch.

15. Quality of roads and their maintenance to be improved in all areas. Complexessuch as Nehru Place need special attention to reduce the time a four wheeler spends travelling on such poor roads.

16. Encourage shared taxi services by developing a taxi sharing website by the Transport Department of Delhi and encourage taxi stands and cabs to offer reduced fares for shared service. These should be in addition to the facilities by OLA and UBER.

17. Solar panels should be encouraged to be installed at existing homes, multi-storey buildings and commercial establishments so that decentralized power is generated with suitable subsidies to make it financially viable for all households. The cost of solar panels has come down considerably and this is already being implemented even in villages in Rajasthan, Africa, etc. and therefore can be certainly done in Delhi. That would enable the retiring of all coal based thermal power plants which are adding considerably to Delhi's air pollution problems and adversely effecting climate change. All new construction to mandatorily have solar power panels.

18. Inverters should be encouraged for back up supply and DG sets not be allowed to be run in Delhi NCR till the AQI level reaches below 200.

19. Thermal Power Plants in Delhi NCR should be stopped from functioning till the AQI level reaches below 200.

20. Burning of leaves, old tyres, plastic, wooden items, etcin the open areas, even within a private compound to be made a punishable offence in NCR with a fine of Rs. 10,000/- per incident and prosecution as this is a major cause for adding to air pollution. Citizens to report such incidents to the Delhi Government numbers, emails to be publicized in newspaper, etc. Composting stations to be planned in existing localities to dispose leaves, other vegetation matter, wet (non solid) kitchen garbage, etc. All new large area constructions to mandatorily have composting facilities.

21. Small portable composting machines, for single households, which can be kept within the house to be developed and made available to the public.

22. Land fill fires are adding to air pollution and specific actions to have proper land fill management to be done by the Government Agency so that no land fill fires occur.

23. The present RO-RO (Roll-on-Roll-off) scheme launched by Indian Railways to carry loaded trucks on goods train to decongest Delhi roads and to reduce air pollution needs to be given a fillip and made compulsory for trucks which would otherwise pass through NCR

24. Stubble burning must be stopped in Haryana, Punjab and Uttar Pradesh by giving farmers compensation from the fund available with respective Government

Changer: The Tool to Calculate GHG Emission from Road Construction and Maintenance



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INTRODUCTION

Increasing threat of climate change has drawn attention towards the relationship between GHG emission, environmental degradation and GHG assessment tools. It is, therefore, necessary to quantify GHG emissions before one can devise measures to reduce it.

In the Indian scenario, transportation contributes to 7.5% of total GHG emission in India. Out of all modes, road transportation alone has a share of 87% [1]. GHG emitted at one point of time and location has a far flung impact on the environment in both temporal and spatial scale. CO_2 once emitted, stays in the atmosphere for more than1000 years.

Environmental degradation and climate change havea two way impact relationship, viz. deforestation - a state of environmental degradation leading to loss of carbon sink thus triggering climate change. On the other hand, with GHG rising @ of 1.8 ppm/ year, the temperature is likely to increase by 4^{o}C by 2100, leading to 1m rise in sea level and increase in sea surface temperature. With rise in ocean temperature, its CO_2 holding capacity will reduce, thus releasing sequestered CO_2 into the atmosphere; intensity and frequency of tropical cyclone will increase, prevent coral reefs from growing and lead to their bleaching. In India, Carbon Dioxide damage[1], as per the World Development Indicators had, in general, shown an increasing trend from 0.5% in 1970 to 3.5 % in 2015 of the Gross National Income (GNI) [3].

India as a nation is committed towards reducing and sequestering greenhouse gas (GHG) emissions. Emission from transportation is likely to increase by 2.7 times from 2015 to 2030 in 'Business as usual' scenario. Efforts are being made in all sectors by the Government to reduce GHG emissions. The Ministry of Road Transport and Highways (MoRTH) has also taken a strong step in road sector by issuing a circular dated 20th November, 2013 on "Improvement of National Highways from considerations of greenhouse gas emissions and life cycle cost". As per the circular, it is recommended in road DPR contracts that the pavement material and technology alternatives should be assessed in the design stage itself and the option with least emission intensity shall be opted. CHANGER is a best suited tool to facilitate estimation of GHG emission of various pavement options and help in informed decision making.

ABOUT CHANGER

Calculator for Harmonized Assessment and Normalization of Greenhouse gas Emission for Roads, abbreviated as CHANGER has been developed by the International Road Federation (IRF)[2] in 2010 with the assistance of

[1] Damage from emissions of carbon dioxide is calculated as the marginal social cost per unit multiplied by the increase in the stock of carbon dioxide. The unit damage figure represents the present value of global damage to economic assets and to human welfare over the time the unit of pollution remains in the atmosphere.

technical partners and has been independently validated by the Swiss Federal Institute of Technology. The World Bank has acknowledged CHANGER as one of the best tools available for global usage in road sector [4].This is the best tool available that helps compare alternate pavement materials, construction methodologies andtechnologies to be used during road construction, maintenance and rehabilitation and choose the most GHG efficient alternative. This in turn helps in reducing the use of scarce fresh natural resources like aggregates, soil, water, fuel, etc.

CHANGER comprises two main modules of Preconstruction and Pavement. Sub modules of Preconstruction are clearing and piling, cut export and fill import transport; sub modules of Pavement are on site impacts, construction materials, materials transport, construction machines. The tool facilitates GHG emission estimation for the whole pavement life cycle comprising of all construction and maintenance activities.

It has been updated and partially Indianised in 2017. CHANGER 2.0.0 the Indianised version has in-built embodied emission factors for CRMB-60, CRMB-55, CRMB-50, PMB-40 and PMB-70 and direct (at different mixing temperatures) emission factors for VG-10, VG-30, VG-40, CRMB-60 and PMB-40 used in India. It also comprises updated India based emission factor of electricity, default emission factors of various polymers, metals, timber, fuel, unbound materials, hydraulically bound materials, bituminous bound materials, etc.

The GHG emission factors are referred from eminent and authentic methodologies, sources and experiments. For example, CO_2 emission factor for fuel is calculated based on its calorific value and density following the good practices of Intergovernmental Panel on Climate Change (IPCC), latest emission factors of materials from University of Bath, U.K. and experiments conducted by IRF and ICT Pvt. Ltd in India, emission factors for electricity from International Energy Agency (IEA) & Central Electricity Authority (CEA) of India, etc.

The calculator has been designed to be material type and quantity based with in-built emission factors. This makes it very easy to be used even by a layman. It is flexible and any of its sub-modules can be used independently.

COMPARATIVE ANALYSIS OF GHG ESTIMATION TOOLS

A comparative assessment of GHG calculators as those can be used in India is given in **Table 1**. It shows that CHANGER is the best tool currently available that can be used for calculating GHG emission from pavement life cycle i.e. pre-construction, construction and maintenance activities. It has a simple yet effective interface and is easy to use. Emission factors are in built and cannot be tampered and hence it provides a common base for comparing projects pan India.

APPLICATION OF CHANGER

CHANGER (version 2.0.0) is the best tool available in India to conduct comparative assessment of various pavement materials and technologies. Quantification of GHG is very important to take informed decision and CHANGER helps in quantifying the GHG emission from various activities that takes place during construction and maintenance of pavement.

A case study has been conducted using CHANGER for pavement construction and maintenance of a 75 km long road located in the Southern part of India. The first 25 km has been constructed as 4 lanes with a carriage way width of 18 m and rest the 50 km has 2 lanes with a carriageway width of 10 m. Three alternate pavement options have been assessed.

Option 1- Flexible Pavement using VG-30
Option 2- Flexible Pavement using VG-40
Option3- Rigid Pavement using GGSB, admixture and synthetic fiber

Activities similar to all the three types of pavement for example pre construction and onsite activities have been

[2] The International Road Federation is a non-governmental, not-for-profit organization with the mission to encourage and promote development and maintenance of greener, safer and more sustainable roads.

excluded from assessment. Due to limited availability of data only pavement construction materials quantity and materials transportation has been taken up for GHG assessment.

Table 1: Comparative Assessment of GHG calculating tools that can be used in India

Software	Stages covered	Availability of emission factors	Methodology	Data Tampering	Representation and user friendliness	Present Status & Compatibility
CHANGER-Indian Version by International Road Federation	Pavement Life Cycle (Construction and Maintenance)	In-built for all items; India based and default	Emission factor based; Input required for quantity and type of materials;	Web based application; tampering of emission factors not possible and hence a common base is provided for comparison pan India	Simple interface and easy to use	Updated embodied and direct emission factors based on latest data from 2011 onwards. Emission factor of India specific materials added in 2017;
ROADEO by Egis for Asia Sustainable and Alternative Energy Program	Pavement Life Cycle (Construction and Maintenance)	Partially available default Emission factors mostly those used in CHANGER, 2010	Emission factor based; Input of activities or design element is required	Excel based and emission factors or methodology can be tampered	Interface not as simple or easy to use as CHANGER	Not updated since 2011.
TEEMP –Road, Clean Air Asia, ADB	Road Life Cycle (Operation, Construction, Maintenance)	Not available	Operation-Emission factor based; Construction-extrapolation based	Excel based and methodology can be tampered	Not easy to use as emission factors has to be entered by user; Construction can also be extrapolated but that gives a blanket approach	Not updated since 2011
Calculator by TERI/ MORTH	Road Life Cycle (Operation, Construction, Maintenance)	Information not available	Emission factor based	Excel based and emission factors or methodology can be tampered	Yet to be used	Development under process (Partially based on 2008 data)

Emission of greenhouse gases is related to the type, quantity and source distance of natural resources being used for construction and maintenance. A comparison of material types and quantity required for the three pavement types (Fig.1) shows that VG-30 requires the highest quantities of materials (39,51,661 MT), followed by that of VG-40 (36,28,697 MT) and rigid pavement (30,94,469 MT).

GHG emissions assessed during construction shows (Fig. 2) that flexible pavement using VG-30 is likely to emit around 146704 tCO2-eq which is 24% more than that of VG-40 and 15% than that of rigid pavement. This variation can be very well supported by the fact that VG-30 is required in more quantity for overlaying than that of VG-40. Also because VG-30 has a higher GHG emission factor than VG-40, as it has lesser viscosity and tend to release more carbon dioxide while heating [5]. Emission from transportation of materials also seems to be

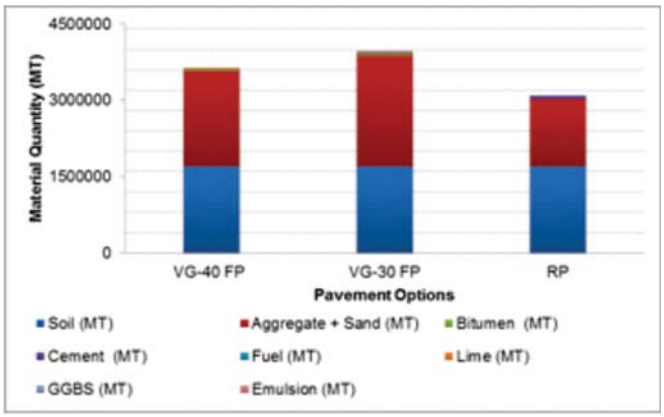

Fig. 1: Material Quantities for three types of pavements

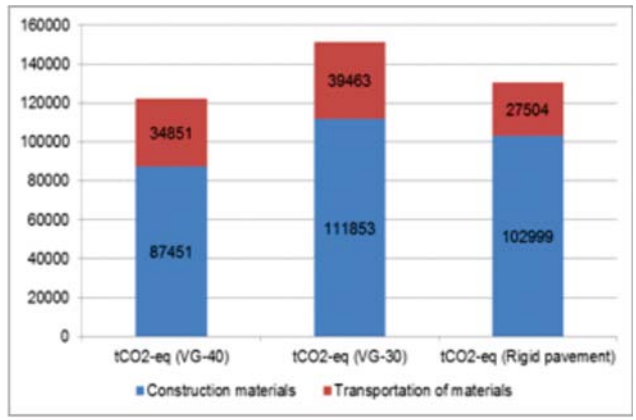

Fig. 2: GHG Emission During Construction

higher for VG-30 as more quantity needs to be transported and hence leading to more consumption of fuel. Rigid pavement emits least GHG in this case because of use of 15% ground granulated blast furnace slag (GGBS) in combination with cement.

Fig. 3 compares the total emission from the three types of pavement during construction and maintenance. With the design period of 21 years, the said road needs to be overlaid in every 10 years in case of VG-40, every 5 years in case of VG-30 and no maintenance is required in case of rigid pavement. Due to increase in frequency of maintenance, GHG emission will be around 2 times more in case of VG-30 than in the case of VG-40. Overall emission for rigid pavement (1,30,503 tCO2-eq) seems to be the least i.e. less by 5% than that of VG-40 (1,36,481 tCO2-eq) and VG-40 is less than VG-30 (182425 tCO2-eq) by that of 34%.

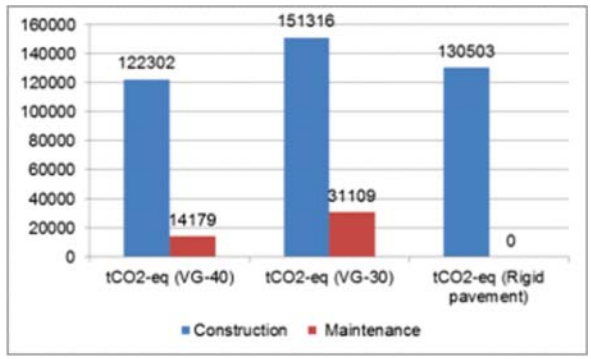

Figure 3: GHG Emission During Construction and Maintenance

The case study shows that the per km emission in case of Flexible pavement using VG-30 is 2432 tCO_2e/km, Flexible pavement using VG-40 is 1820 tCO2e/km and rigid pavement is 1740 tCO2e/km.

CONCLUSION

Tools like CHANGER need to be adopted by professionals for quantification of GHG and enable in soliciting the best alternative having the least carbon footprint.

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Tatva" - IGBC Platinum Rated & SvaGRIHA 5-Star Certified Residence

Dr. (Er.) Azad Jain
Principal Structural Consultant

Dr. (Er. & Ar.) Ashaa Jain
Principal Architect

Ar. Aniruddh Jain; Amrusha Jain, Interior Designer
Azad Jain & Associates, Indore

Tatva- inception was with an idea of creating an identity through architectural expression of an ethos of creation, of a dwelling that is innovative, modern, effective and inspirational in today's world. It appeared that a building that is green could be innovative, aptly suitable to the modern building context and could also result in longevity. The result was creation of a 10,000 sft house built on one acre of land.

With an architectural solution that is apt for today and tomorrow, which is sustainable and resilient and fulfills the vision to build a Green House, an attempt was made to put things together interestingly enough to achieve an IGBC Platinum Rating and SvaGRIHA 5-Star Certified Residence rating.

With an impressive architectural language, the conceptualiers intended to make the residence "*Tatva*" beautiful, energy efficient but with minimal impact on the environment. The relatively high level of sustainability of the home is the result of meticulous design work– not just a fluke.

The concept of "*Tatva*" evokes the image of a 'Green House' taking a step towards futuristic innovation and outstanding techniques making it distinctly the best. This green house is all about conserving natural resources with an eco-friendly concept of Green Building Architecture.

"*Tatva*" is designed to use less energy than standard practice, being a Day-Lit House enhancing Natural Light and Ventilation so beautifully that a cool breeze ventilates all the zones passing through the strategically located Water Pool. It incorporates Double Glazed Unit with tactical shading on East & West direction for Thermal Comfort. Courtyard concept of bringing the landscape inside, takes it to a whole new level. With effective window design each room in the house draws in plenty of Natural Light.

As lighting becomes one of the critical qualities of a building, an engineered approach came up for the

layout.100% use of LED lights with Day-Light sensor integration helped achieving 0.5 Watt per sft consumption against the normal 6-8 Watts.

It is the first project in Central India to get these ratings. Being a luxuriously designed house, economy was achieved by locally sourcing material that have high recycle content and low embodied energy. Over 25% of the total flooring and complete false ceiling was done in gypsum boards had been sourced locally. UPVC Windows and Doors got modeled from scrap wood and FSC Certified plywood was used for furniture. Scraped iron grills and tiles from old house were used efficiently and contributed to resource optimization and material conservation.

It's possible to build a Green Building that does not compromise on architectural aesthetics and functionality. "*Tatva*" being one of them has incorporated different techniques. Putting structural intelligence for minimizing use of RCC, lightweight AAC Blocks reduced the building's dead load by 12%. Innovatively designed structural layout eliminated beam depth achieving beamless structure. Sustainable design is about making your home more comfortable and less reliant on technology, whether that design is contemporary or traditional.

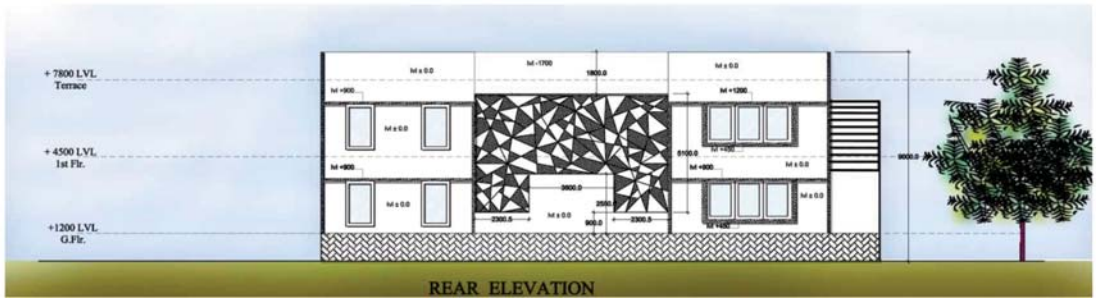
Development of Contextual Landscape with only native trees of 30 different varieties, maximization of shrubs and turf area added to an experience of staying close to nature. It's more of a sustaining landscape which is Drought Tolerant. Moreover to keep water demand for the landscape to a minimum, high efficiency pop-up sprinklers and drip irrigation technique were adopted. All the water through the Grass Open Grid Pavement gets absorbed into the ground thus helping to recharge the ground water.

"*Tatva*" being a small step in designing buildings that are easier on our planet; it has elements which can renew energy. A 2 kW roof-mounted Solar PV System with a Solar Hot Water Plant of 200 lt/ day capacity are installed thus eliminating water heaters. Not only is it capable of renewing energy, it also conserves energy by adopting active water conservation like Low Flow Fixtures and recycled water used for Car Wash and Landscaping. With Zero Waste Generation by in-situ composting and Sewage Treatment Plant even a vegetable garden of 1,000 sft has Organic Farming and Vermi-Composed Manuring.

The conceptualisers, without compromising on architectural aesthetics and functionality, achieved a green building that was economical and luxurious at the same time. What is new about green buildings is that costs can be the same—or less—than building a conventional house. When energy savings, construction quality, and lower maintenance over time are considered a sustainable building really pays back.

The design process comprised creating spaces in the form of cuboids according to the functionality and deriving a form out of it. "*Tatva*" not only is close to nature, but has an architectural language with the play of material, lighting and spatial arrangement. In addition to what the house looks from outside, the interiors have their own charm. The ultimate goal was to make living in it a better experience.

With effective use of material, locating the courtyard within the house and playing with how light enters in, it makes it a house and not just a building.



CEAI NEWS

FIDIC TRAINING COURSES

CEAI successfully conducted FIDIC Training Courses for the general public and in-house programs for the senior executives of DFCCIL and NHSRCL from 12th to 20th January 2018 at New Delhi.

Mr Bogdan Oprea, a FIDIC accredited faculty, conducted the training programs. He has trained extensively for FIDIC as an accredited trainer in Europe, Middle East, Asia, South America and Africa, specializing on FIDIC contracts and the management of claims and the resolution of disputes.

1) OPEN HOUSE TRAINING PROGRAM

Training Course on the module**"Management of Claims and Disputes Resolution"** held on 17th & 18th January 2018 at New Delhi.

A view of the Participants

Ms. S Philip, President CEAI inaugurated the Training.

Senior Executives from major organisations like Project Seabird, RITES Limited, PACE Engineering Consultant-

Distribution of Certificates

Kuwait, Uniquest Infra, LEA Associates, Tata Consulting Engineers, COWI India, International Seaport, Tata Projects, Vedanta, ICT Pvt Ltd et al. attended the program.

The course provided the participants, the necessary detailed knowledge and insights to the claim management and dispute resolution provisions under the FIDIC Conditions of Contract document, 1999 Edition.

2) IN-HOUSE TRAINING PROGRAMS

a) Dedicated Freight Corridor Corporation of India Ltd.

CEAI organised trainings for Senior Executives of the Dedicated Freight Corridors Corporation of India Ltd (a Government of India Enterprise), on the following modules:

- Training on "Practical Use of FIDIC Conditions of Contract" held on 12-13 January 2018. Mr. Somenath Ghosh, Vice President CEAI, inaugurated the program. 43 Executives of DFCCIL attended the training.

DFCCIL Participants

Distribution of Certificate to participants

- Training on "Management of Claims and Dispute Resolution" held on 15-16 January 2018. A significant number of DFCCIL Executives participated in the training.

DFCCIL Training in progress

Distribution of Certificate to Participants

b) National High Speed Rail Corporation Limited (NHSRCL)

FIDIC training for NHSRCL Executives

Mr Bogdan Oprea being presented a memento by Mr Achal Khare, Managing Director, NHSRCL

Training Course on "Practical Use of FIDIC Conditions of Contract" for senior executives of the National High Speed Rail Corporation Limited, a Joint Venture of Government of India and Participating State Governments for Implementing High Speed Rail Projects, held on 19-20 January 2018.

CEAI MEETING WITH ADB PROCUREMENT TEAM

As a follow up to the interaction held between CEAI members and the ADB team on 8th August 2016, a second Interactive session was held with the ADB Procurement Specialist on 12th February 2018 at the CEAI Centre, to discuss the issues related to

Consultancy Contracts for ADB assisted Projects in India.

The meeting was attended by representatives from SMEC, TCE, ICT, STUP, Mott MacDonald, AECOM and other consultants.

During the discussion, members raised the issues being faced by them on ADB funded projects.

TRAINING COURSE ON 'CONSULTING ENGINEERING PRACTICE'

With a view to improve the skill development of new entrants to Consulting Engineering Organisations, fresh engineering graduates and final year engineering students, CEAI has planned to organise a series of training programs for young professionals on different modules. The courses will be conducted by experienced high profile practising consulting experts.

A Session conducted by Mr S C Mehrotra

The first course on Module 1 on the topic 'Consulting Engineering Practice' was organized on 10th March 2018 at CEAI Centre, Vasant Kunj, New Delhi. Young professionals from M/s Voltas Ltd, L&T, B&S Engineering, Civil Baba Consultants, DMA Projects, ICT, Holtec, BARSYL, Chemprojects, PC Designs and other consultants attended the course.

Mr Srikumar Ghosh interacting with the participants

The course was conducted by very senior members of CEAI, Mr Sudhir Dhawan, Mr S C Mehrotra, Mr Alok Bhowmick and Mr Raju Gogia.

LIFE MEMBERSHIP OF CEAI

An Extra-Ordinary General Meeting (EGM) of CEAI was held on 16th December 2017, to revise the Rules for Life Membership. The revised Rules are reproduced below:

Member (Individual) who has been on the roll of the Association for1year and his/ her subscription is not in arrears, may opt to become a Life Member (Individual) after paying one time subscription as under:-

	Age of Member	***Subscription***
a)	*40 to 49 years*	*15 times annual subscription*

Member (Individual) above age of 50 years may opt to become Life Member (Individual) after paying one time subscription as under:-

	Age of Member	***Subscription***
a)	*50 to 59 years*	*10 times annual subscription*
b)	*60 to 69 years*	*5 times annual subscription*
c)	*70 years & above*	*2 times annual subscription*

We invite Members (Individual) to upgrade their membership and pay a one time subscription as above to become a Life Member of CEAI.

MEMBERSHIP SUBSCRIPTION

As per the Memorandum and Rules of Association, the membership subscription for the Financial Year 2018-19 falls due on 1st April 2018. Proforma Invoice towards has been issued to members on 22nd March 2018. Members are requested to pay their subscriptions before 15th April 2018 to enable us to plan our activities for the year.

FOLLOW CEAI ON SOCIAL MEDIA

Members are invited again to follow CEAI on Twitter, Linkedin and Facebook. The purpose is to keep in touch with CEAI activities and share news of **technical advances, topics of interest and CEAI events** and to reach out to more and more people, harnessing the current technology. CEAI is also following all the relevant ministries.

In order to maximise benefit from CEAI membership, **CEAI** members could get more connected and involved in the CEAI action.

For individual members, a short guide to join twitter. Someone more familiar with SOCIAL MEDIA can assist you, if required:

1. *Open the websitewww.twitter.com*
2. *Fill in the details, full name, mobile number/ email and password of your choice and click on sign up/ continue*
3. *You will receive a code on your mobile number/email (whichever you have used to login)*
4. *Choose your display name (you will have to choose a name, not taken already by somebody, suggestions for the same are displayed below)*
5. *You can select your areas of interest or skip this page and get started.*
6. *Your twitter page is open. You can complete your profile on the left side.*
7. *You can tweet by clicking "tweet" on top right corner*
8. *You can find CEAI India by typing in search box and follow it.*

Please join Twitter, make your friends and acquaintances follow you and re tweet CEAI's tweets. Please contact CEAI Secretariat, in case of any query/ assistance.

CEAI INTERVENTIONS

DMRC TENDER NOTICE

DMRC issued a Notice Inviting Tender for a Contract for selection of DDC Consultants for the Phase IV of Delhi MRTS projects. CEAI was concerned that the provisions in the document were likely to eliminate participation of Consulting Organisations from India in the Metro projects.

Construction of Metro Railway projects, whether underground or elevated, have started in India with full vigour only in recent years, leaving aside the first Metro in Kolkata, that was completed in the early eighties. The technology has changed significantly thereafter. Starting with the systematic expansion of Delhi Metro, that brought in new technology, followed by commencement of Metro work in other centres like Jaipur, Chennai, Bangalore, Mumbai, Hyderabad, Lucknow, etc., the Indian Consultancy organisations have had the opportunity of participating in the design of underground, at grade or elevated Metro projects for the track work as also for the Stations. Indian Consultants also got experience in other packages like electro-mechanical, planning and architecture. The Indian organisations are looking forward to gain increasing proficiency in Metro projects, along with the continued development and expansion of DMRC, and other Metro organisations in India.

In view of the above, CEAI wrote to DMRC to review the qualifying criteria for submission of the bids, keeping in mind the National need for strengthening Indian Consultancy capability to a level that, they can emerge as International players in this growing sector all over the world, with rapid urbanisation taking place.

ENGAGEMENT OF CONSULTANTS FOR NHAI PROJECTS

CEAI has been collaborating with NHAI and MoRTH for a number of years to streamline the process of engagement of consultants for their projects and take steps to prevent fraudulent use of CVs.

CEAI has again written to NHAI/MORTH requesting them to get a thorough, impartial and time bound inquiry conducted into this matter, so as to convey the message that award of Consultancy Services will only be on the basis of merit and correct technical weightage.

CEAI also suggested that a system be adopted whereby the bids are submitted in a transparent manner having all the required information, to enable the NHAI team do the evaluation in the correct perspective.

CEAI REPRESENTATIVES MEET WITH THE MINISTRY OF COMMERCE

Ms. S Philip, President and Mr Somenath Ghosh, Vice President CEAI met Mr. Ajay Yadav IAS, Dy. Secretary, Ministry of Commerce on 1st February 2018. Some important points raised during discussions are given below:

a) CEAI with almost 500 member firms and consultants is a Member Association of FIDIC in India. In spite of Engineering Consultancy being a niche area, CEAI does not have a Mentor Ministry. CEAI mentioned that it would be of great assistance if the Ministry of Commerce could fill this gap. Formal support from the Government would enable CEAI members in the growth of their consultancy.

b) International companies have come into the country in large numbers over the last 15 years. For projects, where the Owner feels that international inputs are required, qualification criteria, terms and conditions work to the disadvantage of Indian Consultants.

c) In a similar situation, certain foreign Governments mandated that foreign firms work with their domestic Institutes to review, finalise and approve various design and drawing deliverables. This enabled transfer of technology and Consultants were able to upgrade themselves technologically.

d) CEAI would be interested in participation as part of Trade delegations so that Indian Consultants can be more active in the overseas markets, like Africa, South East Asia, etc.

e) The Ministry suggested that under GATS, India can create some rules to be followed by Indian, as well as, International Service Providers. These Rules can be based on Standards. BIS can be empowered to create such standards and suggest how benchmarking can be done. Indian, as well as, international engineering consulting service providers may be required to be regulated by complying to these standards for doing business in India through a certification or registration process.

f) Mentoring and support through Services Export Promotion Council can be provided to CEAI. The Services Export Promotion Council is organising a Global Exhibition of Services in Mumbai in the near future. It was suggested that CEAI participates in this event.

g) It was suggested that a regulatory mechanism needs to be in place. CEAI could prepare documents on short term regulations and long term standardization in engineering consultancy services. CEAI mentioned that it has prepared a document *'Guidelines for Selection of Consultants and Professional Compensation Structure'*, which is a useful handbook for reference. The same would be provided to the Ministry.

AAI - RFP FOR SELECTION OF CONSULTANT FOR CAPACITY ASSESSMENT STUDY AT INDIAN AIRPORTS

The Airports Authority of India issued a RFP for Selection of Consultant for Capacity Assessment. In the RFP AAI, the criteria for applicants was "*Detailed description of the objectives, scope of services, deliverables and other requirements relating to this Consultancy". It said that 'in case an applicant firm possesses the requisite experience and capabilities*

*required for undertaking the Consultancy, it may participate in the Selection Process either individually (the **"Sole Firm"**) or as lead member of a consortium of firms (the **"Lead Member"**)..... The term applicant (the **"Applicant"**) means the Sole Firm or the Lead Member, as the case may be.'*

In the above RFP, the requirement seemed to be to appoint a consultant individually or in a consortium, with the proviso that the Lead Member solely meets the criteria for selection.

However, CEAI suggested that 'it is desirable that the consultants are either in a Consortium or a JV and their aggregate strengths need to be considered for purpose of evaluation of their proposal. This would be in conformity with the provisions in the "Manual for Procurement of Consultancy and Other Services 2017" issued by the Ministry of Finance, Government of India. Accordingly,' and suggested that wherever the term "Sole Member" or "Lead Member" occur in the RFP, need be replaced by "Consortium or JV".

CEAI also requested that the age limit of the Experts be suitably relaxed depending on the experience of the Expert.

FOR REVIEW OF PAYMENT TERMS FOR LOGISTICS PART IN THE AUTHORITY'S ENGINEER AGREEMENT

Last year, CEAI voiced the collective concern of members involved in NHAI projects as Authority's Engineer (AE) that, payment for logistics (i.e. transportation, duty travel to site, communication and other direct overheads) is linked to the financial progress of the civil work achieved by the Contractor. Often, the Contractor is unable to achieve Project Milestones in accordance with the relevant Schedule of the EPC Agreement, due to various reasons which are not attributable to the Contractor/Consultants. This resulted in significant financial losses to the Consultant due to no fault of theirs.

CEAI understands that NHAI has taken cognizance of this issue with regard to logistics and other costs and has, in a recent RFP, stated the same 'shall be worked out month wise as per actual expenditure'.

CEAI OUTREACH

CEAI continues to expand its outreach by way of providing support to other professional events and promoting its own, to reach out to new members. Some of events are:

- Conference on 'International and Domestic Arbitration: Current Scenario and Way Ahead' on October 26-27, 2018 being organized by India Institution of Technical Arbitrators at Chennai.
- BAUMA CONEXPO INDIA 2018 which will take place in December 2018 at HUDA Grounds, Gurgaon

FIDIC NEWS

FIDIC EC MEMBERS VISIT TO INDIA

The FIDIC Executive Committee members visited India to hold their Executive Committee meeting in New Delhi from 14-16 February 2018. The meeting was being held after the year 2010.

On the occasion of the meeting in New Delhi, a Brainstorming Session was held on Procurement of Consultants and 'Alternate Mechanisms for Procurement of Contractors', a FIDIC publication, at Hotel Claridges, New Delhi. Participants included guests from the Government, the Public Sector, the Multilateral Development Banks viz. the World Bank, Asian Development Bank, JICA and others.

The FIDIC Executive Committee members led by Mr

A view of the participants at the Brainstorming Session

Alain Bentejac, President of FIDIC also participated.

The purpose of the session was to review, brainstorm and come up with suggestions, if necessary, to amend and improve the proposals and reaffirm the guidelines contained in this document.

Important inputs were provided by the participants and by the FIDIC EC members on the need for and aspects of the alternative forms of Contracts. The session was considered very relevant and important, especially in view of the execution of large contracts which are underway, under the significant investment program of the Government of India.

Mr. K K Kapila addressing the gathering

An interaction was also held between the FIDIC EC members and CEAI GC members in the afternoon of 14th February 2018 on the need to work collaboratively in the interest of promoting the Consulting Engineering industry.

A view of the FIDIC EC and CEAI GC interaction

OFFICIAL LAUNCH OF THE 2017 FIDIC SUITE OF CONTRACTS IN LONDON

FIDIC Contracts Committee has updated the FIDIC 1999 Contract documents (Red Book, Yellow Book and Silver Book) and the Second Edition 2017 of each of these three FIDIC contracts was launched at FIDIC Internal Contract Users' Conference held at London on 5-6 December 2017.

FIDIC-ASPAC CONFERENCE 2018

The FIDIC-ASPAC 2018 Conference on'Infrastructure Connectivity in the ASPAC Region' is scheduled to be held on 24-27 June 2018 at Colombo, Sri Lanka.

The theme of the conference is based on expected growth in the region. It is forecast that the Asia's infrastructure market will show an annual growth rate of 7% – 8% in the coming years. At this growth rate, the total infrastructure market, will reach US$ 5.3 trillion by 2025, accounting to 60% of the world total.

Further in the coming decades the investments will be more focused on urbanization worldwide exceeding the money spent in our entire history. Increasingly wealthy and more mobile societies will demand better education as the younger generation becomes the economic leaders of tomorrow.

As Asia Pacific grows and becomes the global economic hub during the next decades, the infrastructure needs across the region will also change rapidly. Robust and sustainable deployment of resources will play a pivotal role in how the economies of the member states in the Asia-Pacific, not only survive but thrive. Particularly the sectors such as Power & Energy infrastructure, Rail & Road Transport, Air Ports

and Harbors, Schools, Healthcare facilities and Communication technology, which will influence priorities and investments in regional infrastructure development. In this context, the need of regional connectivity in the infrastructure development is very much felt in the efficient, effective and sustainable development of the same. With this background the Conference will focus on the following aspects:

- *Future infrastructure requirements in the region*
- *Adopting a regional perspective with infrastructure development*
- *Regional corporation in the infrastructure development*
- *Investment opportunities towards infrastructure development within the region*
- *Regional mechanism for sharing the experience in infrastructure development*
- *Financial and contracting new models and use of Project monitoring tools in large infrastructure investments*
- *The issues common to the region*

For more information about the conference, visit http://www.fidicaspac2018colombo.com

FIDIC INTERNATIONAL INFRASTRUCTURE CONFERENCE 2018

The 2018 FIDIC International Infrastructure Conference will take place in Berlin from 9-11 September 2018. The main theme of the conference will be "Mobility & Smart Infrastructure".

FIDIC Conference registration fees:

- *All fees are indicated in EUR before the mandatory Value-added tax (VAT)*
- *An additional 19% VAT must be included in the total price*

CATEGORIES	REGISTRATION CRITERIA	EARLY BIRD *Until 30th of June 2018*	STANDARD *From the 1st July 2018*	ON-SITE *From the 9th of September 2018*
FULL CONFERENCE REGISTRATION (Sessions + Social Events- Gala Dinner and Welcome Reception)				
FIDIC Member	Member of a FIDIC Member Association, Associate, or an Affiliate Member. Full conference registration allows access to conference sessions from Sunday 9th of September to Tuesday, 10th September, and includes official social events (Welcome Reception, Opening Ceremony and Gala Dinner). Includes all lunches and coffee breaks.	1000	1200	1380
Non-Member	Full conference registration for non-members: Non-Member registration allows access to conference sessions from Sunday 9th of September to Tuesday, 10th September, and includes the official social events (Welcome Reception, Opening Ceremony and Gala Dinner). Includes all lunches and coffee breaks.	1200	1380	1580

CATEGORIES	REGISTRATION CRITERIA	EARLY BIRD *Until 30th of June 2018*	STANDARD *From the 1st July 2018*	ON-SITE *From the 9th of September 2018*
Young Professional (YP)	YPs must be consulting engineering professionals working in a FIDIC member firm and under the age of 40 at the time of the conference. Copy of passport or ID will be requested.The YP registration allows access to conference sessions from Sunday 9th September to Tuesday, 10th September, and includes the official social events (Welcome Reception, Opening Ceremony and Gala Dinner). Includes all lunches and coffee breaks.	850	950	1150
ACCOMPANYING PERSONS (Access to social events only)				
Accompanying Persons	Registration for accompanying partners (or direct family members) of registered participants. The Accompanying Person registration allows partners to attend the following official conference social events (Welcome Reception, Opening Ceremony, and Gala Dinner). Registration as an Accompanying Person does not include access to conference sessions, nor lunches or coffee breaks.	450	500	600
STUDENTS (Access to conference sessions only – Students must be under 26 years of age)				
Students	Individuals registering under the 'Student' category must be university students (associate or bachelor degree) under the age of 26. Proof of the student status will be required during registration and at the conference. Copy of passport or ID will also be requested to confirm the individual's age. This registration only allows access to conference sessions for the 3 conference days. Includes all lunches and coffee breaks.	300	400	500

For more details please visit FIDIC conference website http://fidic2018.org

OTHER NEWS, VIEWS & NOTES

VIEW POINT

The next issue of the View Point will be published in **June 2018.** Based on inputs received from various members, the topics selected for the next 4 issues are:

June 2018	Asset Management
September 2018	Built Environment – Energy Conservation for Utilities
December 2018	Engineering Consultancy for Nation Building
March 2019	Remote Sensing & Remote Monitoring for Engineering Projects

Considering the experience of CEAI members and various stakeholders in the subjects, CEAI would be happy to receive articles on the above theme.

Authors could share their knowledge enriched by the works executed, first hand accounts of the challenges faced, practical issues experienced and the solutions to those, etc. Photographs would benefit our readers for better appreciation of the issues encountered and addressed.

The articles for the June 2018 issue of VIEW POINT need to reach CEAI by 15th May 2018. Articles need to be in Times New Roman 12 with single line spacing on A4 size.

Advertisement in View Point

VIEW POINT is circulated to all CEAI Members, FIDIC, Ministries of the Government of India, Public & Private Sector Undertakings, Construction Firms, Contractors, Consultants, Foreign missions and Funding Institutions in India and other organisations related to or dealing with the engineering profession.

Therefore, advertising in the VIEW POINT gives the advertiser wide exposure and visibility.

The rates for advertisements in VIEW POINT are given below. Due to escalating costs in publishing, the tariff will get revised with effect from 1st April 2018. This is excluding GST @18% or as prescribed, which will be extra:

	Rate Per issue*	Discounted rate at 20% for 4 consecutive issues (from June 2018 to March 2019)*
Back Cover**	Rs. 25,000/-	Rs 80,000/-
Inside Front Cover	Rs. 15,000/-	Rs 48,000/-
Inside Back Cover	Rs. 15,000/-	Rs 48,000/-
Full Page	Rs. 10,000/-	Rs 32,000/-

*GST @ 18% or as prescribed will be added to the above rates.
** Booked till December 2018. Available from March 2019 issue.

FIDIC TRAINING PROGRAMS

CEAI has been organizing in-house training courses on FIDIC Conditions of Contracts on the following Modules for employees of various organisations:

Module 1: Practical Use of FIDIC Conditions of Contracts

Module 2: Management of Claims and Disputes Resolution Under the FIDIC Contracts

The FIDIC contracts modules explain in detail the contracts' clauses and how to practically use the FIDIC contracts in international projects.

Interested Organisations are requested to contact CEAI Secretariat at info@ceai.org.in

Tech Quiz[1]

1. Name the worst environmental disaster in India
   a. Kutch (Bhuj) Earthquake (2001)
   b. Bhopal Gas Tragedy (1984)
   c. Andaman Tsunami (2004)
   d. Barren Island Volcanic Eruption (1991)
2. What is the full form of MIC causing Bhopal Gas tragedy?
   a. Mono Isocyanide
   b. Mono Isochlorate
   c. Methyl Isocyanade
   d. Methyl Isocyanate
3. Name the most comprehensive Act on environment in India
   a. Air (Prevention and Control of Pollution) Act, 1981
   b. Water (Prevention and Control of Pollution) Act 1974
   c. Environment Protection Act, 1986
   d. Forest (Conservation) Act, 1980
4. Name three main pollutants that characterise the ambient air quality of a locality in India
   a. SPM, CO and NH4
   b. PM2.5, SO2, and NO2
   c. RPM, CH4, and CO2
   d. PM2.5, O3 (ground level) and Arsine
5. What is meant by PM2.5 in ambient air?
   a. Particulate Matter (size more than 2.5 micron per cubic meter of air)
   b. Particulate Matter (size equal to 2.5 micron per cubic meter of air)
   c. Particulate Matter (size less than 2.5 micron per cubic meter of air)
   d. Particulate Matter (size less than 2.5 millimeter per cubic meter of air)
6. What is greenhouse effect?
   a. The green house effect is the way the temperature of the our planet is increasing due to emission of air pollutants from manmade greenhouses
   b. The greenhouse effect is the way in which heat is trapped close to the surface of the Earth by "greenhouse gases".
   c. The greenhouse effect is the way in which greenhouse gases from active volcanoes cause the rise of the average temperature of our planet
7. List the green house gases (at least three)
   a. Methane (CH_4), Water Vapour (H_2O) and MIC
   b. Carbon Monoxide (CO), Ammonia (NH_4)and Ozone (O_3)
   c. Sulphur Dioxide (SO_2), Carbon Monoxide and Ammonia (NH_4)
   d. Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (NO_2)
8. What is the current level of atmospheric Carbon Dioxide concentration?
   a. A little over 400 parts per million
   b. 525 parts per million
   c. 359 parts per million
   d. A little less than 500 parts per million
9. Who coined the saying POVERTY IS THE GREATEST POLLUTER?
   a. Prime Minister Narendra Modi in his first speech in Indian Parliament in 2014
   b. UN Secretary General in the recently held (November 2017) **UN**Climate**Conference** in Bonn, Germany
   c. Late Prime Minister Rajiv Gandhi at the first UN Conference on the Human Environment held at Stockholm in1985
   d. Late Prime Minister Indira Gandhi at the first UN Conference on the Human Environment held at Stockholm in1972
10. In the ambient air quality standards in respect of noise, nighttime is reckoned as:
    a. 9 pm to 6 am
    b. 10 pm to 5 am
    c. 10 pm to 6 am
    d. 9 pm to 5 am

The first person who mails the correct answers to CEAI ***info@ceai.org.in*** will get a congratulatory mail and will be acknowledged by publishing his/ her photograph in the next issue.

[1]Contributed by Mr. Sutanu Ghosh, Guest Editor

Answers to Tech Quiz December 2017 issue:

1(c), 2(d), 3(c), 4(a), 5(b), 6(c), 7(a), 8(c), 9(a), 10(b).

Prof. Mainak Ghosal, Consultant, is the winner of the Tech Quiz with full/ maximum marks.

IMRT

India's premier Education Training and Research Institution Dedicated to Rail and Metro Technology

IMRT is founded by Balaji Railroad Systems Limited (**BARSYL**), a Consulting firm specializing in providing niche Technical and Management support for Railways across the globe. At IMRT one of the cornerstones for creating a significant impact on learning is the focus on industry and academia associations. This ensures the latest knowledge from the industry and the most recent research from across the world is integrated into the various programs, be it the flagship program or the specialized programs offered on various industry-critical subjects.

PGPMRT
Post Graduate Program

IMRT's intensive flagship one year program combines the highest standards of academics with a practical approach to help prospective Techno-Managers and Leaders achieve success in the most challenging professional scenarios.

Open Programs

These short-term, high-impact courses are focussed on industry specializations and are designed especially for working professionals who want to meet their own professional objectives as well as their organizational goals. Some of these are: **RAMS for Rail Systems, Project Management of Metro Projects, Introduction to Metro and Rail systems,**

Custom Programs

IMRT designs tailor-made learning interventions for organizations to co-create an innovative curriculum that integrates organizational strategies with the international outlook, experience and diversity of the institution's faculty.

IMRT

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ORGANISER

CONSULTING ENGINEERS ASSOCIATION OF INDIA
Creating Value for Engineers

SUPPORTED BY

National Mission for Clean Ganga (NMCG)
Ministry of Water Resources, River Development and Ganga Rejuvenation
Government of India

Seminar on

RIVER ACTION PLAN, FLOOD MANAGEMENT AND BASIN

27th & 28th July 2018

Shangri-La's Eros Hotel

19 Ashoka Road, Connaught Place
New Delhi 110001

Consulting Engineers Association of India (CEAI) is organizing a Seminar on '***River Action Plan, Flood Management and Basin Development***' on **27th & 28th July 2018 at Shangri-La's Eros Hotel,** 19 Ashoka Road, Connaught Place, New Delhi 110001.

The mission of this seminar is to bring together all stakeholders to consider a holistic approach and discuss the challenges and opportunities make recommendations to the Government.

BROAD THEMES

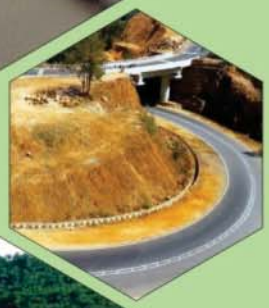
- RIVER BASIN MANAGEMENT
- ECOLOGY AND ENVIRONMENT
- CLIMATE CHANGE IMPACT ON FUTURE FLOOD MANAGEMENT
- FLOOD FORECASTING AND RISK ASSESSMENT
- RIVER REJUVENATION AND POLLUTION ABATEMENT
- INTERNATIONAL EXPERIENCE AND LESSONS LEARNT

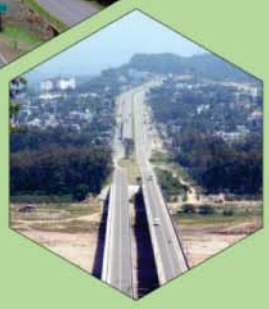
Delegate Fee:

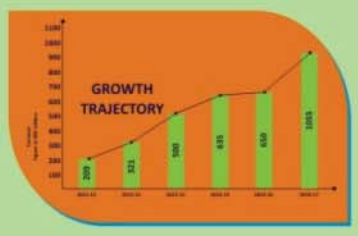
The delegate fees for
CEAI Members -₹ 4000 | Non Member - ₹ 5000 | Students- ₹1500+ *GST @18%*

There is **10% early bird discount** for those registering before **May 31, 2018**.
5% Discount *would be extended if there are* ***5 or more participants from one organization***

For more information please contact
CEAI Secretariat (events@ceai.org.in Tel: 011-26139658)
or visit CEAI website www.ceai.org.in







Rodic

"Build Together, A Better World"

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- Achievers Award 2015 conferred on Mr. Raj Kumar, Chairman and Managing Director, for successfully achieving milestones in the implementation of the AIIMS - Digha Elevated Corridor by the Hon'ble Chief Minister of Bihar Shri Nitish Kumar, on the occasion of 6th foundation day of BSRDCL.
- Rodic Consultants Pvt. Ltd. was featured in "Leading SME of India" published by Dun and Bradstreet.

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