

Shashwat

Volume 6 | Issue 7 | December 2020

Let Nature Be

“Rejuvenating Resilient Habitats”



A GRIHA Council Publication

COVER STORY

- Solar Energy as a Strategic Tool for Assisting Indian Defence Sector
- Can Green House Be Dream House?
- Outgrowing Efficiency
- Avoiding Industrial Disasters: Toxic Gas Leaks and Beyond

FACE-TO-FACE

- Daniel Christian Wahl
- Olga Chepelianskaia
- Neelkanth Chhaya

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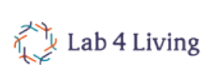
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PRESIDENT, GRIHA COUNCIL

In the past year, the COVID-19 pandemic caused widespread disruption across the globe with severe repercussions in terms of human health and economic activity. The lasting impact on economies and living standards will likely persist for the foreseeable future and it is therefore essential that we work together towards recovery and a resilient tomorrow. When we emerge from the pandemic, the world will have changed, and yet several challenges, especially those posed by climate change, will remain. It will take our continued efforts and cooperation in order to build a secure and sustainable future.

This year's edition of the SHASHWAT magazine – "Rejuvenating Resilient Habitats", explores the themes of preparedness and resilience and the possibilities for building systems that are better equipped to deal with crises. To this end, GRIHA Council recently launched the Building Fitness Indicator (BFI) tool, providing guidance based on the standard practices followed across the globe by the World Health Organization (WHO), Occupational Safety and Health Administration (OSHA), and the Ministry of Health and Family Welfare (MoHFW) in managing exposure to COVID-19.

GRIHA has been a catalyst for the widespread adoption of green development in India and is seen as an effective agent of change in addressing issues related to air quality, the protection of biodiversity and the pressing need to reduce greenhouse gas emissions. It has evolved to evaluate resource efficiency at the design, construction and operations stages, catering to both new buildings and the existing built environment. Over the past year, despite the pandemic, GRIHA Council has been involved in multiple activities in its endeavours to promote the sustainability agenda beyond the administration of its rating systems.

GRIHA Council along with Airports Authority of India (AAI) has

organized a tree plantation drive – "Chhaya" to create awareness on greening cities and fuel sustainable development across the country. "Prayaas", an effort towards cleanliness, was a clean-up drive conducted to generate awareness and drive action while the "Paryavaran Rakshak" programmes were conducted to sensitize RWAs to environmental issues related to water, energy, air quality, and waste management. Embracing the transition to a digital platform in an era of social distancing, GRIHA Council organized "The Product Catalogue Colloquium," where an opportunity was provided to the product manufacturers to disseminate information about their respective products to various stakeholders through webinars as well as a first-of-its-kind virtual exhibition.

The 2030 Sustainable Development Agenda highlights crucial linkages between sustainability, environment, human well-being, and a wide range of human rights, including the right to life, safety, food, water, and sanitation. Climate change is now recognized as a significant multiplier of health threats, with current effects projected to progressively affect human health, including through negative land, ocean, biodiversity and freshwater exposure, as well as the rising frequency and impact of natural disasters. In light of developments within the industry

and a deeper understanding of the issues facing us, GRIHA is also on the cusp of launching the upgraded version of its rating system – GRIHA Version 2019.

I acknowledge the unending support and trust of our valued partners and international collaborators, and the confidence they have placed in the GRIHA brand. It is without doubt that the progress made thus far has been possible owing to continued commitment from a motivated team and the unwavering support of extraordinary individuals and organizations.

As we move towards the year 2021, I am certain that GRIHA Council will remain a frontrunner in promoting sustainability and resilience, even beyond construction industry. Through its outreach programmes, GRIHA strives to spearhead the transition towards a more environment-friendly lifestyle and provide long-term solutions that are resilient even in these challenging times. I am certain that in the coming days, the organization will continue to grow from strength to strength.

I wish each one of you a safe and happy new year!

Ajay Mathur
*President, GRIHA Council &
Director General, TERI*



GRIHA TIMELINE

2012

- SVAGRIHA rating, GRIHA Product Catalogue
- SIDBI announces concessional rate of interest for GRIHA projects

2009

Committee of secretaries: 3-star GRIHA rating mandatory for all government buildings
CPWD embraces GRIHA
Acknowledged as an innovative region-specific green building assessment tool by the UN

2000-2008

TERI conducted over 100 building audits
TERI GRIHA released as an indigenous green building rating in India (2005)
MNRE adopts GRIHA as a National Rating System for Green Buildings (2007)
National Mission on Sustainable Habitat launched (2008)

2011

- CREDAI
PCMC announces discounts on premium charges to developers and property tax rebate for buyers for GRIHA-rated projects
EC linked to GRIHA precertification

2014

- GRIHA for Day Schools rating.
- * GRIHA projects in MoUD, Delhi Division, Government of India
Sikkim mandates GRIHA

2013

- GRIHA LD rating, GRIHA app, GRIHA new user-friendly metro design website
- * GRIHA projects in Noida, Greater Noida, and Punjab
PCMC announces premium discounts to developers and property tax rebate for buyers

2010

- Evaluators' and Trainers' Programme

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2015

- * GRIHA projects in Rajasthan, Pune, AUDA, and Uttar Pradesh
- * GRIHA projects in the Government of West Bengal, Department of Municipal Affairs
- o GRIHA v.2015 rating and GRIHA LD rating

A 25% subsidy on FSI for GRIHA-rated industrial projects in Andhra Pradesh

2016

- o GRIHA Help Centre, Institute membership programme ACE, students membership programme CATALYST
 - * GRIHA projects in Haryana.
 - MPPH & IDC, IICCI
- PMC announces discount in premium charges for GRIHA/SVAGRIHA projects

GRIHA recognized as India's own green building rating system in **INDIA's INDC** submitted to the **UNFCCC**

- o Launch
- Memorandum of Understanding (MoU)
- * Floor Area Ratio (FAR) incentive

2018

- PWD, Maharashtra and Orange County
 - Extended with NASA, India
 - o Paryawaran Rakshak Programme for RWA
- GRIHA Council felicitated with Green Excellence Award, 2018

2020

- o GRIHA Product Catalog Brochure
 - First Construction Council
 - Indian Institute of Architects (IIA), Northern Chapter
 - National Real Estate Development Corporation (NAREDCO)
 - * GRIHA projects in Himachal Pradesh
- Govt. of Gujarat (Industries Commissionerate) offers assistance of up to 50% of consulting charges or INR 2.5 lakh, whichever is less, for industrial buildings of more than 2,000 sq.m built up area which obtain green rating from GRIHA Council, GRIHA, and GRIHA AH-certified (4- and 5-star projects) would be provided financial incentives under SUNREF India program
- Additional 7.5% to 15% free of cost FAR for GRIHA projects in Rajasthan

2017

- o GRIHA EB rating, GRIHA for Affordable Housing rating
- o Revamped evaluators module and exam
- MPPH&IDC, PMC, BESTECH, Ireo, Vatika, CONSCIENT, ADANI Realty, Vilas Javdekar Developers and Godrej Properties
- EESL, NHB, ISHRAE
- Extended with NASA, India

Circular issued to all the State Police Housing Corporations for the incorporation of GRIHA in the ongoing and future projects by the BPRD

SPARSH installed at the UN office on UN Day 2017

2019

- o GRIHA for Existing Day Schools rating
- o GRIHA v 2019
- PWD, Maharashtra
- UNSW, Sydney
- Council of Architecture
- Indian Institute of Architects



GRIHA App on >



नितिन गडकरी
NITIN GADKARI



मंत्री
सड़क परिवहन एवं राजमार्ग;
सूक्ष्म, लघु एवं मध्यम उद्यम
भारत सरकार

Minister
Road Transport and Highways;
Micro, Small and Medium Enterprises
Government of India

MESSAGE

I am happy to learn that 7th addition of GRIHA Council's Annual Magazine "**Shashwat – Let Nature Be**" is being published with the theme '**Rejuvenating Resilient Habitats**', which talks about restoring and integrating resilience in new as well as existing structure.

I appreciate the GRIHA Council's mission of sensitizing people and educating them on the need to replenish our natural habitat and integrate it with components of resilience. I am confident that the magazine would attract a large readership across various sections of the society.

I wish GRIHA Council all the success and convey my best wishes for all their future endeavors.

(Nitin Gadkari)

Date: 1st December, 2020

Place: New Delhi

आर. के. सिंह
R. K. SINGH



विद्युत एवं नवीन और नवीकरणीय ऊर्जा
राज्य मंत्री (स्वतंत्र प्रभार) एवं
कौशल विकास और उद्यमशीलता राज्य मंत्री
भारत सरकार

Minister of State (Independent Charge)
for Power and New & Renewable Energy and
Minister of State in the Ministry of Skill Development
and Entrepreneurship
Government of India



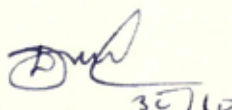
Message

I am pleased to know that GRIHA is releasing its annual magazine Shashwat aptly themed 'Rejuvenating Resilient Habitats'. This theme captures the need for systemic changes in wake of the COVID 19 pandemic and several other climate change disasters we have seen over the years. The global pandemic has brought forth the detrimental impact of unsustainable practices and the need for reform and adoption of a new normal in the way we live and work.

Protection of our environment has been central to the agenda of my Ministry. In addition to an increase in overall generation to 1390.467 BU during 2019-20 and a 9.12% increase in renewables, concerns relating to pollution and the disposal of ash from coal based power stations, are being addressed through environment friendly strategies. Both demand side and supply side initiatives are being implemented by the Ministry for optimizing the growth of energy requirement, to curb carbon emissions.

With the launch of the detailed manual for "GRIHA Version 2019", the effort of GRIHA Council for consistently striving to push the construction industry to adopt environment friendly practices is laudable.

I wish them success in all their future endeavors.


(R. K. Singh)



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हरदीप एस पुरी
HARDEEP S PURI



सत्यमेव जयते



आवासन और शहरी कार्य राज्य मंत्री (स्वतंत्र प्रभार)
नागर विमानन राज्य मंत्री (स्वतंत्र प्रभार)
वाणिज्य एवं उद्योग राज्य मंत्री
भारत सरकार

Minister of State (I/C), Housing & Urban Affairs
Minister of State (I/C), Civil Aviation
Minister of State, Commerce & Industry
Government of India

Message

It gives me immense pleasure to learn that GRIHA Council is launching their annual magazine, 'Shashwat - Let Nature Be' in December, 2020. The theme of this edition, "Rejuvenating Resilient Habitats" is apt, given the current pandemic that the world is facing. The theme also aligns with SDG 11 to make cities inclusive, safe, resilient and sustainable.

Sustainability and Resilience are the principles on which policies of the Ministry of Housing and Urban Affairs are framed to provide improved quality of life, while prioritizing green development through adoption of smart solutions.

The Swachh Bharat Mission was launched in 2014 to not only better sanitation practices but also deal with issues like pollution, waste management and plastic ban. Similarly, the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) mission of the Ministry of Housing and Urban Affairs aims for universal coverage of drinking water supply, improved coverage and capacities of sewerage systems and the development of non-motorized urban transport and green spaces and parks. Today, it spans across 500 cities, covering more than 65% of the urban population.

While these Missions are achieving the targets and objectives, what has been heartening is the people's wholehearted participation, particularly the youth of the country. The Swachh Survekshan results have seen a quantum jump in the number of cities participating thus injecting a healthy dose of competition. The flagship missions of the Ministry reflect, both the essence of cooperative federalism and a spirit of competitive ethos. In the end, the citizen will be the winner.

I congratulate GRIHA Council on the launch of GRIHA Version 2019 manual. It is heartening to see GRIHA Council's continued efforts towards betterment of the environment.

I convey my best wishes to GRIHA Council for all their future endeavors.


(Hardeep S Puri)

New Delhi
18 November 2020

संजीव एन. सहाय, भा.प्र.से.
सचिव
भारत सरकार

Sanjiv N. Sahai, I.A.S.
Secretary
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November 17, 2020



MESSAGE

I heartily welcome the launch of Volume 6 of GRIHA's annual magazine SHASHWAT centered on the theme of "Rejuvenating Resilient Habitats".

India is the world's third largest producer of consumer electricity and Government of India has undertaken a two-pronged approach to cater to the rising energy demand while also keeping carbon emissions in check. On the generation side, the Government is promoting renewable energy - solar and wind, while at the same time ensuring a shift toward greener technology in coal-based power plants. Simultaneously, efforts are being made to optimize consumption on the demand side through innovative policy measures under the ambit of the Energy Conservation Act.

The initiatives of the Ministry are in the interest of the country's efforts to meet the SDGs, but it is only through partnerships that systemic sustainability can be achieved. The efforts of GRIHA Council in promoting the use of BEE rated equipment while also ensuring compliance with mandatory requirements of the ECBC are giant steps toward India's global sustainability commitments.

It gives me great pleasure to learn that even in the face of adversity, GRIHA Council is taking strides to ensure a sustainable future for everyone. The magazine provides the ideal platform to share ideas and fuel discourse on the burning issues of the day and our collective goal of sustainable development.

My best wishes to the GRIHA team for a successful launch of this publication.


(Sanjiv Nandan Sahai)





HIGH COMMISSIONER

AUSTRALIAN HIGH COMMISSION
NEW DELHI



I am delighted to see that the GRIHA Council is soon to launch the latest edition of their eminent magazine "Shashwat- Let Nature Be".

The theme of the magazine - "Rejuvenating Resilient Habitats", is timely, given that 2020 has been an uncertain year with the bushfires, droughts, floods and pandemic; and climate adaptation and preparedness is a top priority. These events are evidence that climate change is upon us and we must act now to ensure the sustainability and resilience of our planet.

The creation of resilient systems, processes and infrastructure that are prepared for natural disasters and protect native habitats is of vital importance. It is therefore gratifying to note that GRIHA's upcoming magazine will not only continue to discuss, ideate and inform their readers about the furtherance of sustainable habitat development in India and the world, but will also encompass aspects of habitat resilience.

The theme also resonates deeply with Australia's climate change adaptation strategies, including the *National Climate Resilience and Adaptation Strategy* which identifies a set of principles to guide effective adaptation practice and resilience building, and outlines the Government's vision for a climate-resilient future. The Australian Government has an extensive agenda in climate resilience and adaptation, backed by billions of dollars of investment, including measures which address the impacts of and build resilience to drought and natural disasters and support and restore our iconic natural ecosystems, like the Great Barrier Reef.

Fostering partnerships is critical to secure a sustainable future. The Australian High Commission continues to provide support to small-scale, sustainable grassroots development projects across India. From the year 2018, represented by the UNSW, Sydney, Australia has strategically collaborated with the GRIHA Council enabling both parties to engage successfully for inclusive sustainable development.

I would like to commend the GRIHA Council for the successful implementation of their rating system in India and for headlining the country's efforts towards mitigating its carbon impacts. After all, only if we are sustainable today can we be resilient tomorrow.

I convey my best wishes to the GRIHA Council for their continued endeavours.

Yours sincerely

The Hon Barry O'Farrell AO



(Message for "Shashwat- Let Nature Be", GRIHA's Annual Magazine)

Ambassador of Royal Danish Embassy to India

It is a pleasure to introduce "Rejuvenating Resilient Habitats", the theme for this year's SHASHWAT magazine. With the world reeling under the impact of COVID-19, it is time to look towards balancing social development and resilient communities with the need for economic growth. The work of GRIHA Council is essential in ensuring that the Sustainable Development Goals are achieved.

Denmark is committed to pursuing the cause of sustainable development and fuel green ambitions and solutions the world over. The Royal Danish Embassy in New Delhi, a Climate Frontrunner, has been actively involved in spearheading innovative solutions and introducing Danish technology to India. Drawing on our learnings from greening cities such as Copenhagen, Aarhus, Vejle and Sonderborg through urban planning, the Danish Embassy is well positioned to work toward enhanced climate resilience.

On 28 of September, India and Denmark have launched the World's first Green Strategic Partnership aiming at combining scale, skills, scope and speed in the battle against climate changes. This unique partnership is a partnership of the "New Age" and inspired by the mantra: reform-perform-transform.

With the Royal Danish Embassy partnering in the activities of the GRIHA Council over the past year, I can definitely foresee great things in the future for sustainable development in India. I look forward to further evolving collaborations that strengthen ties between Denmark and India and congratulate GRIHA Council on the latest version of their rating system - GRIHA v2019. I am certain it will be a grand success.

Freddy Svane

दुर्गा शंकर मिश्र

सचिव

Durga Shanker Mishra

Secretary



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Nirman Bhawan, New Delhi-110011

MESSAGE

Changes in Climate and Environment have enormous impact on the natural systems that includes direct effects on organisms by altering physical habitat conditions, and indirect through changes in biotic interactions. COVID-19 pandemic has put unprecedented strains on our daily lives and habitat. Hence, there is a dire need to enhance habitat resilience to the uncertain and unpredictable effects of future changes.

Heartiest congratulation to GRIHA Council on releasing their annual magazine "Shashwat - Let Nature Be" that encompasses views of experts with diverse backgrounds who have contributed significantly in new areas of research on sustainability.

The theme of this year's magazine: 'Rejuvenating Resilient Habitats' is aligned with my Ministry's vision, which actively promotes holistic development of urban habitat and creation of sustainable, resilient and smarter cities, through policy interventions, urban planning, capacity building and knowledge creation.

I take this opportunity to appreciate GRIHA Council's mission in spreading awareness towards a resilient environment to empower the ecosystem for dealing with any future contingencies.

I further congratulate GRIHA Council on the launch of detailed manual for their **GRIHA Version 2019 Rating** and I wish them all the success in their endeavours.

(Durga Shanker Mishra)

New Delhi

October 08, 2020



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No.AAI/CHMN/2020

November, 2020



MESSAGE

It gives me great pleasure that GRIHA Council is publishing this year's version of their annual magazine SHASHWAT with the theme "Rejuvenating of Resilient Habitats". The topic is in line with the commitments of GRIHA Council toward furthering the cause of sustainability and creating awareness among the general populace. The theme assumes greater importance in light of the natural disasters and the pandemic that the world has faced in the recent past.

In order to cater to the rise in air traffic, the Government of India has steadily been working towards building new airports. As a nation, we are committed for achieving 200 operational airports across the country by 2024. In partnership with GRIHA, we at AAI are taking every measure necessary to ensure that we build green. Many Airports projects across India have been registered with GRIHA, with some having already received their final rating.

As the nation comes to grips with the pandemic and adapts to a new normal, AAI has also played its part by issuing specific guidelines for the operation of its airports. In this regard, the free-to-use Building Fitness Indicator (BFI) developed by GRIHA is a great tool in assessing preparedness against the COVID-19 pandemic and is a testament to the commitment of GRIHA Council toward building a better, more resilient tomorrow.

I would like to take this opportunity to congratulate the GRIHA team on the launch of the detailed manual for 'GRIHA Version 2019'.

I wish GRIHA Council success in all their future endeavors and look forward to our continued collaboration in future.


(ARVIND SINGH)



Vinit Kumar Jayaswal
Director General



भारत सरकार
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Message

I am delighted to know that GRIHA Council is bringing out its annual publication 'Shashwat-Let Nature Be' with the theme 'Rejuvenating Resilient Habitats'.

The ongoing year has witnessed a wide variety of appalling events both affecting man and infrastructure which depict how critical is to align our development agenda with environment friendly practices. Therefore the theme 'Rejuvenating Resilient Habitats' chosen for the publication is very apt and topical.

CPWD a principal engineering organization of Government of India constantly strives to be at the forefront in adopting sustainable construction practices. After the COVID-19 pandemic, there has been a strong push to strengthen our knowledge base and develop indigenous solutions for a self-reliant India. The future demands construction of habitats which are resilient both in terms of climate as well as living organisms, thus bringing back the culture and tradition of conventional buildings with a blend of modern facilities.

I would like to convey my deep appreciation to GRIHA Council and the strides it has taken towards mainstreaming sustainable construction practices with prime focus on indigenous materials and technologies. CPWD has a vision in line with GRIHA and we both are working towards making built environment more resilient and self-reliant.

I extend my best wishes to GRIHA Council for their continued success.


(Vinit Kumar Jayaswal)

Place: New Delhi
Date: 21.10.2020

अभय बाकरे, आईआरएसईई
महानिदेशक

ABHAY BAKRE, IRSEE
Director General



ऊर्जा दक्षता ब्यूरो

(भारत सरकार, विद्युत मंत्रालय)

BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)



It is with immense pleasure that I have followed GRIHA Council's efforts towards raising the bar for sustainable construction over the past decade and BEE is proud of its long-lasting association with an organization that is one of the front runners in the pursuit sustainability in India.

With our steady economic growth, the demand for energy has grown substantially and the efficient use of energy assumes tremendous significance – it is essential to curtail wasteful consumption and recognize the need for sustainable growth. To this end, the Government of India enacted the Energy Conservation Act in 2001 and established the Bureau of Energy Efficiency in March 2002. The Act provides for institutionalizing and strengthening the delivery mechanism for energy efficiency services in the country and provides much-needed coordination between various entities involved across the sector.

BEE and GRIHA Council share several joint missions from creating awareness and disseminating information about energy efficiency to promoting research and developing certification procedure. Together, we can be greater than the sum of our parts and we at BEE remain confident that our combined efforts will bring about tremendous impact in the sustainability space and lead us toward a more resilient future.

Adhering to the core tenets of the Energy Conservation Building Code, a performance standard developed by BEE for commercial construction, is already an integral aspect of the GRIHA Rating System. With over three billion square meters of residential development projected to be built by 2030, the BEE has also developed the Eco Niwas Samhita in order to establish a design template for energy efficient homes. The ENS aligns with the goals of the GRIHA Rating System in ensuring that our living spaces are envisioned from the design stage with the sustainability aspect in mind.

I congratulate GRIHA Council on the launch of the detailed manual for GRIHA Version 2019 and look forward to the publication of this year's Shashwat Magazine with the theme "Rejuvenating Resilient Habitats". As always, we look forward to strengthening our ties and continuing to work towards sustainable development in the times ahead.

अभय बाकरे
(Abhay Bakre)

स्वहित एवं राष्ट्रहित में ऊर्जा बचाएँ Save Energy for Benefit of Self and Nation

चौथा तल, सेवा भवन, आर.के.पुरम, नई दिल्ली-110 066 / 4th Floor, Sewa Bhawan, R.K. Puram, New Delhi-110 066

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Message from the President and Vice-Chancellor, UNSW Sydney, Australia

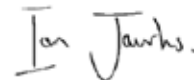


The theme for this year's Shashwat magazine – "Rejuvenating Resilient Habitats" resonates strongly with the mission of UNSW. Efforts in this direction have never been more greatly needed than they are today, as our world struggles to reverse decades of inaction on climate change and come to grips with the devastation caused by the COVID-19 pandemic.

UNSW sees its partnership with TERI and GRIHA as a vital part of our mission to create a positive global impact through education and commitment to long-term research. In the past year we witnessed, participated in and contributed to the success of the first ever GRIHA Virtual Fest and Exhibition Series, an event that we look at as a perfect example of resilience and adaptation during these times of social distancing and virtual collaboration. In the days to come, we look forward to embracing this "new normal" together as we work toward our collective goals.

I would like to take this opportunity to congratulate GRIHA Council once again on the monumental strides they have taken toward sustainable development in India – the latest version of their Rating System introduces new concepts, streamlines the approach toward building green and is sure to help many more new buildings to minimize their environmental footprints and optimize the consumption of dwindling resource stocks.

I look forward to the continuation of our collaboration and the emergence of more productive partnerships and innovative ideas in the times ahead.



Professor Ian Jacobs
President and Vice-Chancellor
UNSW Sydney



Dean, Faculty of Built Environment, UNSW, Sydney

UNSW, TERI and the GRIHA Council share a long-standing commitment toward promoting sustainable development, which inherently lays the foundation for the collaboration between our organizations.

As the first university in the world to have our entire campus powered by solar energy, UNSW places great emphasis on building toward a carbon neutral tomorrow. It is therefore with great pleasure that I endorse the launch of this year's edition of SHASHWAT, GRIHA Council's annual publication, with the theme "Rejuvenating Resilient Habitats". Featuring insightful articles and interviews, the magazine will undoubtedly provide a window to the way sustainability is addressed globally.

We are adjusting to a rapidly changing world that demands a paradigm shift in the way we approach planning, design and construction. India and Australia are simultaneously combating the onslaught of the COVID-19 pandemic and the need has never been greater for a transition toward a

more resilient, adaptable form of development. I foresee exciting times ahead for Australia and India as we strengthen our collaborations and we at UNSW look to strengthen our partnership with TERI and GRIHA.

I congratulate GRIHA Council on the development of GRIHA v2019 detailed manual, the latest version of India's very own green building rating system. I look forward to the enhanced impact that will result from the adoption of this updated and streamlined tool and am confident that it will empower the construction sector in India to make unprecedented strides toward sustainable and resilient development.

Professor Helen Lochhead

*Dean, Built Environment
UNSW Sydney*





Playponics

Hydroponic Playground Gardens for Schools in India

The Playponics project is being funded by Sheffield Hallam University's Global Challenge Research Funding (GCRF). It involves apparently unconnected topics; physical play, environmental sustainability and early years STEM education. We propose a joint venture with your organisation that will enable installation of Playponic playground equipment that facilitate hydroponically enabled crop growth, promote physical activity and sustainability education.

We welcome your interest.

 <http://playponics.in/>

 info@playponics.in





CHIEF EXECUTIVE OFFICER, GRIHA COUNCIL

Dear Friends & Colleagues,

In the face of ever-increasing environmental and climatic concerns, GRIHA Council continues its unwavering commitment toward sustainable practices. Over 1900 projects are currently registered with GRIHA, spanning the length and breadth of the country and exceeding 565 million square feet in built up area.

The first GRIHA Virtual Conference and Virtual Exhibition were conducted in July 2020 - in the present scenario, when people are not able to physically survey the market, the virtual exhibition was curated to provide a unique platform that allowed the exploration of sustainable materials and technology, while ensuring that both presenters and participants were safely out of harm's way. In the days ahead, the GRIHA Training Programmes will also make the transition online, allowing us greater outreach and ensuring that green building knowledge is accessible to anyone, anywhere.

Moving forward, it is my pleasure to announce the first ever GRIHA Virtual Summit. This year's theme, "Rejuvenating Resilient Habitats", centres on preparedness and the need to build infrastructure that is resilient in the event of disaster. Now more than ever it is imperative to strike a balance between social development and economic growth so that new a normal may be defined and unsustainable systems might be reinvented in the face of climate change and a global pandemic.

Embracing the new era of technological advancement and innovation, GRIHA Council is in the process of updating and improving its assessment tool to further incentivize enhanced building design and performance. The Virtual Summit will additionally provide a platform for the launch of GRIHA version 2019, a more sensitized approach towards accessing sustainability as it applies to buildings.

“

In a tumultuous year brought on by the COVID-19 pandemic, I am proud to announce that the team at GRIHA Council has risen to the challenge of embracing the new normal – project teams are now afforded the option to have site visits and orientation programmes conducted online and the processes developed for such activity are becoming more defined and streamlined with each passing day. In a time when remote presence is quickly becoming the norm, our efforts at disseminating knowledge and awareness on sustainability issues continues unabated - GRIHA Council has successfully conducted multiple online events and webinars and even hosted the GRIHA NASA trophy award ceremony on a virtual platform this past year.”

The multidisciplinary team at the GRIHA Council is driven and passionate towards our continual effort to meet sustainability goals. With dedicated effort and growing partnerships, I am certain that GRIHA Council will make strides towards realizing the collective agenda of environmental sustainability and attain new heights in the coming year.

I take this opportunity to acknowledge our esteemed clients and industry associates with whom we have built inclusive partnerships based upon shared principles, values, vision and goals. In these difficult times of economic slowdown, it is imperative also to ensure that the connections between the multitude of professionals who come together to establish the construction industry are not lost. GRIHA Council strives to provide a platform for interactions and deliberation that might culminate in the emergence of more robust mechanisms for sustainable development in the days to come.

On behalf of the GRIHA Council and our partners, I welcome you all to the GRIHA 12th Virtual Summit.

Wish you all Season's Greetings and a great year ahead !



(Sanjay Seth)
Chief Executive Officer, GRIHA Council

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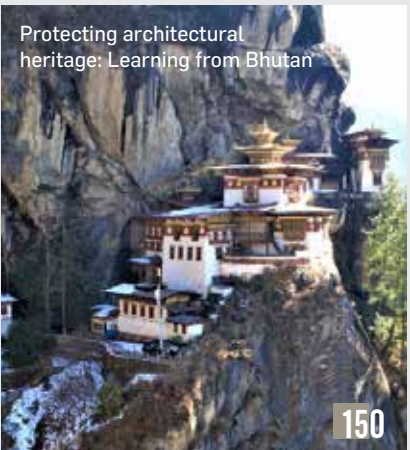
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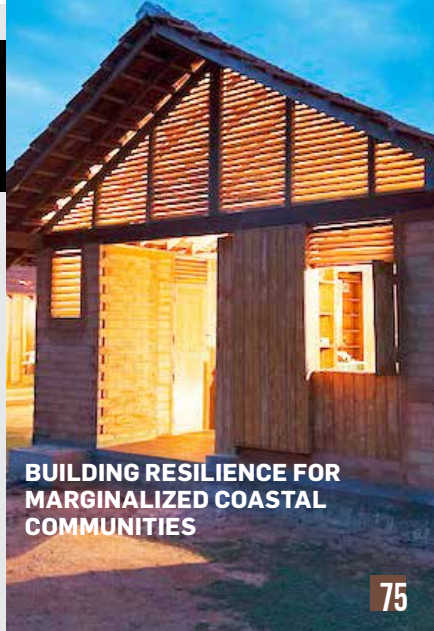
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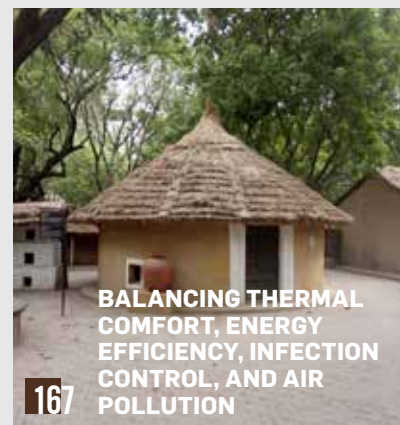
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Sanjay Seth
CEO, GRIHA Council

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SOLAR ENERGY AS A STRATEGIC TOOL FOR ASSISTING INDIAN DEFENCE SECTOR

India is now the third largest solar market in the world and fifth largest country in terms of installed solar capacity.

Subrahmanyam Pulipaka and **Gauri Menon** shed light on how solar energy applications can strengthen India's defence sector.

Subrahmanyam Pulipaka is the youngest CEO of the National Solar Energy Federation of India (NSEFI). He is an alumnus of BITS Pilani, BITSAA Global 30 Under 30 Award recipient, and is one of the youngest winners of BRICS Young Scientist Award (2018). He has several years of experience in the areas of solar power space, spanning technology, policy, skill development, and international collaborations. In his current role, he is responsible for handling the NSEFI Secretariat in Delhi. He can be reached at pulipaka.nsefi@gmail.com.



Gauri Menon is an intern at National Solar Energy Federation of India (NSEFI). She joined NSEFI after finishing her MTech in Renewable Energy Engineering and Management from TERI School of Advanced Studies, New Delhi. In her current role, she is undertaking various energy policy studies under the guidance of Mr Pulipaka. She can be reached at gaurimenon.nsefi@gmail.com.

INTRODUCTION

The 21st century is witnessing an unprecedented proliferation of renewable energy technologies in various day-to-day applications. In 2020 so far, wind and solar generated 10% of global electricity with India averaging at 10% of energy generation, as illustrated in Figure 1. India is now the third largest solar market in the world and fifth largest country in terms of installed solar capacity. Solar energy applications are finding their way into various applications, such as healthcare, industrial energy, manufacturing sector, including the defence sector.

Militaries of different countries across the world are slowly shifting to renewable energy to support their armed forces. The Department of Defence (DoD) in the US signed the Energy Policy, which mandated them

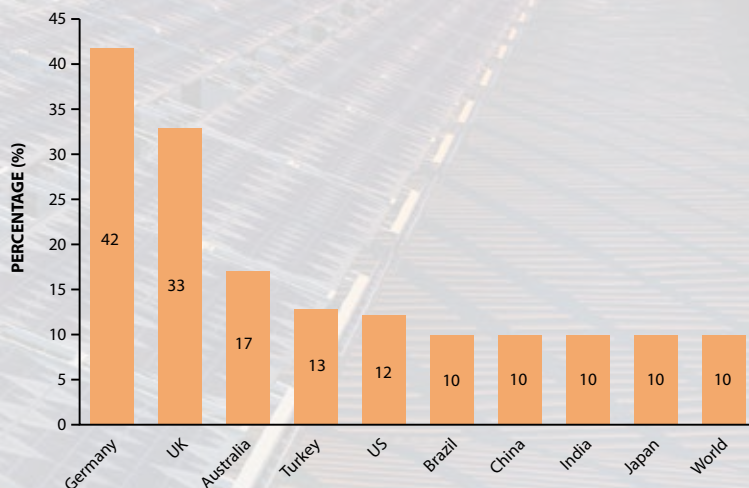
to procure or produce at least 25% of its electricity from renewable sources by 2025. By 2013, the Army, Navy, and Air Force had installed a combined capacity of 130 MW. Thus, the oil consumption in the military sector reduced by 20% between 2007 and 2015. (Solar Metric n.d.) This independence from grid is aimed at providing the military with low-cost and decentralized energy solutions with freedom from global supply chains.

Along similar lines, Australian Military is also adopting solar energy for various range of military applications. A specialized combat uniform was developed by the Australian National University that uses solar energy where the wearable solar cells will generate power in the field and reduce the use of batteries. It uses efficient, lightweight, flexible, and portable modules. The cells are bifacial so that light is absorbed from both sides (Off Grid Energy Independence

2011). Additionally, Australia's largest Naval Base, HMAS Stirling is powered by Garden Island Microgrid, and the Joint Headquarters of Australian Defence Force (ADF) is set to install 1.9 MW of solar array.

When it comes to India, it can be said without any doubt that our country is at prime stage of its solar energy proliferation with almost 37,000 MW of installed solar capacity. Apart from direct electricity generation applications, application of solar in agricultural pumps, agrivoltaics, solar driers are now witnessing widespread acceptance across the country. In the same manner, even Indian Defence Forces started embracing solar energy applications in military. The Indian defence sector houses the second largest army in the world with 1.4 million active personnel, the third largest Defence Budget, seventh largest Navy in the world, and fourth largest Air Force.

The Indian defence sector can harness solar energy to assist their electricity as well as heat requirements at difficult geographical terrains along with innovative applications like military microgrids with solar and storage that will strategically help the Forces. This article aims at understanding the current progress of solar energy applications in the Indian defence sector while suggesting key potential areas where solar energy can support and assist our troops.



» **Figure 1:** Energy generation from solar and wind until June 2020

Source: Jones, Graham, and Tunbridge (2020)

Army

- 350 kW solar power project at Gun and Shell Factory (GSF). This solar installation is expected to save 430 metric tonnes of carbon dioxide emissions (Electrical India 2018).
- Indian Army's 1 MW solar plant was established in Ambala Cantt (Sura 2018).
- 1.3 kW of battery house is built using indigenous materials in Ladakh for the troops (PARIKH 2019).

Navy

- 2 MW capacity solar power plant installed in Western Naval command.
- Indian Naval Academy, Ezhimala has commissioned 3 MW of solar power plant (Kaushik 2020).
- Indian Navy's Eastern Naval Command (ENC) has commissioned a 2 MW solar photovoltaic (PV) power plant at INS Kalinga in Visakhapatnam on May 28, 2020 (Tayal 2020).
- In the history of India, first time solar panels have been installed on an Indian Navy's survey vessel INS Sarvekshak. It is fitted with 18 panels and has an installed capacity of 5 kW.

Air Force

- Indian Air Force Maintenance Command in Nagpur set up rooftop solar PV on all major buildings.
- A solar power plant with a capacity of 1.0 MWp has been commissioned for MES at Air Force Station at Bhisiana, Bathinda.
- Agra Air Force Station had announced 1.5 MW of solar tender to meet 90% of its power demand.

» **Figure 2:** Glimpse of solar installations at Indian Defence establishment

Source: Jones, Graham, and Tunbridge (2020)

CURRENT PROGRESS

On 74th Independence Day, Honourable Prime Minister Shri Narendra Modi announced a solar park to fulfil the dream of green Ladakh. The plan is to set up a solar plant of 7500 MW capacity by 2023. Apart from serving the people, it will also help the stationed defence forces. This signifies the Government of India's resolve to popularize solar energy in the defence sector.

India has a target to achieve 100 GW of solar energy installed capacity by 2022. To achieve this, the defence forces have also joined hands and are doing their part to help the country realize its solar energy target. These projects are being implemented in the cantonment areas, air bases, and naval ships. Being areas of strategic importance, renewable energy can play a vital role in their functioning by providing off-grid energy solutions, which will also save transmission losses/charges while

lending strategic support in terms of uninterrupted power supply to defence establishments (Figure 2).

The first utility-scale project to be taken up by the Military Engineering Services (MES) was a solar power plant with a capacity of 1.0 MWp at the Air Force Station in Bhisiana, Bathinda. The MES has an overall plan of putting up 150 MWp projects at various stations of the Army, Navy, and Air Force. In addition to reducing the carbon footprints, such a plan will also yield good returns.

With an aim to contribute towards environmental goals, the Indian Navy has developed Indian Navy Environment Conservation Roadmap (INECR), which has a vision to reduce energy consumption and energy supply diversification. It has also pledged 1.5% of its 'Works' Budget to renewable energy generation. The 3 MW solar power plant at INA is the largest in the Indian Navy. The project was executed by Kerala State Electronic

Development Corporation Limited. This project will help the Naval station in reducing its carbon footprint. As mentioned in Figure 2, solar panels have been installed on Indian Navy's survey vessel – INS Sarvekshak. It is fitted with 18 panels and is used for battery charging, communication equipment, and a couple of air conditioners. The installed capacity is 5 kW, and the vessel will reduce 60,225 kg of carbon a year and 22,995 litres of diesel.

POTENTIAL

Strategic locations of military base camps are at tough geographical terrains and hence, deprived of basic amenities. In Ladakh, the mercury dips to minus 20°C or lower during winter nights and to minus 5°C during March and April. Thus, heating is extremely necessary. Sustainable habitats powered by solar energy can trap heat and keep the rooms warm while also contributing to reduction of carbon footprint. In this context, the following key potential areas can be explored to strengthen the strategic support to armed forces through solar energy.



Military microgrids

Through a combination of solar and energy storage, military microgrids can be built, which can be resilient to harsher weather conditions and earthquakes. As India has disputed boundaries not only in the North but also towards far East and West, microgrid installations in these areas would be of great help which would isolate them during cyber-attacks, grid failure, and power cut. Also, in the event of power failure in areas occupied by residents, these microgrids could serve as a backup, thus helping the surrounding localities too with power supply.

Portable solar-powered units

In many cases, the troops may have to be in motion and hence, it might be tricky to get reliable power supply. Portable solar-powered units, typically consisting of solar panels, storage device, solar heaters, solar lighting systems can be of great strategic help to our troops along with supporting their electricity requirements while being on the run.

Co-location of solar and agriculture

Very often, food requirements of the troops in high-altitude areas are fulfilled by several airlifts from the base camps. Solar energy can have a significant application here, where co-location of solar and agriculture can address both energy and food requirements of the troops. This concept, which is known as agrophotovoltaics (or AgroPV), helps in growing crops below the tilted solar modules, where the water requirement of crops is met through the water used for cleaning solar panels. AgroPV will help our defence sector to ensure the security of

food, water, and energy while contributing to climate change mitigation.

Conclusion

The Indian Defence sector is one of the best in the world and numerous attempts are already being made for the sector to switch to cleaner energy sources. This transition should be placed in such a way that while contributing to reduction in carbon footprint, the renewable technologies should also be in a stage to assist our soldiers both technologically and strategically.

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COVID-19: A STRATEGIC OPPORTUNITY FOR SUSTAINABLE DEVELOPMENT

Sustainability has assumed a newfound meaning in the wake of the COVID-19 pandemic.

Siddharth Jain, in this article, discusses the need to leverage the lockdown by working on strategic opportunities to execute the plan of sustainable development.



Siddharth Jain, Research Associate from Sustainable Buildings Division at TERI has more than six years of experience in green building consultancy, energy efficiency and ECBC implementation.

He has worked on more than 50 projects related to green building consultancy (LEED, IGBC, and GRIHA), energy modelling, energy audits, and GHG reporting, ECBC implementation, policy analysis, and advocacy. Recently, he authored a report, titled 'Study of sustainable space heating solution in the Himalayan Region', which was published by WWF and TERI. He can be contacted at siddharth.jain@teri.res.in.

The sector-specific allocations for health, education, and infrastructure in the Union Budget 2020–2021 collectively make up only a fraction of India's GDP, which poses potential challenges to our rapidly developing economy in the wake of a new global pandemic – COVID-19.



India's enthusiasm towards achieving the Sustainable Development Goals (SDGs) and adopting a proactive approach towards them seems to have taken a backseat in the present time of crisis. A critical question to ask ourselves at such a time is – how to prioritize our long-term goals in light of the current crisis? Should we be more concerned about the threat of climate change, instead? How do we ensure resource efficiency while ensuring healthy cities and adopt strategies from our past to conserve nature and its resources? These questions may not seem of utmost concern during the current situation but they are equally important and need to be discussed on a separate platform.

What Opportunities and Threats Does COVID-19 Pose?

COVID-19 marks the return of a very old – and familiar – threat. Throughout human history, nothing has been more devastating than viruses, bacteria, and parasites that are responsible for causing infectious diseases. Neither natural disasters like earthquakes and

volcanoes nor wars come close. There were billions of deaths recorded globally due to these pandemics (plague in the 14th century hit a population of '200 million', small pox in the 20th century affected '300 million', and the influenza pandemic affected '50 to 100 million' people – these numbers surpassed the death toll of World War One, which was being fought at the same time) (Walsh 2020). The 1918 flu virus infected one in every three people on the planet. As per the World Health Organization (WHO), HIV, a global epidemic that still lacks a cure, has killed an estimated 32 million people and infected 75 million with a greater number of cases being added every day. Over the millennia, epidemics, in particular, have been mass killers on a scale we can't begin to imagine today – even in the time of the coronavirus.

The impact of the pandemic around the world and the resulting mayhem in global markets are dominating global attention. The pandemic is turning into an unprecedented international crisis with serious repercussions on people's health and economic activities. Although

they may be severe, the effects are likely to be temporary. A January 2020 article by International Energy Agency (IEA), stated that the threat posed by climate change, which requires us to reduce global emissions significantly this decade, will remain. The ongoing crisis should not make us compromise on our efforts to tackle other inescapable challenges that face the world. Impetus plans and incentives are being put up by the governments to encounter the fiscal damage caused due to the coronavirus pandemic.

Lockdown and Sustainability

The lockdown provides a strategic opportunity to plan sustainable development in the following ways:

- India's manufacturing industry is highly diversified. A substantial majority of all industrial workers is employed in the millions of small-scale handicraft enterprises. About 30% of the total population of India depends on daily wages for survival. The current lockdown has disrupted the livelihoods of these people. We are even seeing a rapid de-urbanization with



people migrating out of larger cities to their respective home towns. This is the time where state governments can also focus on job creation in the same sectors, such as strengthening labour schemes, local start-ups, and small-medium enterprises to ensure employment for these migrants. Governments can address this by pursuing policies that have a successful proven record, such as measures to improve the energy efficiency of buildings, which created jobs, have reduced energy bills and helped the environment.

- Organizations working in research and implementation can adopt policies which support going digital, such as work from home and conducting conference calls over face-to-face meetings. Nevertheless, this could also be adopted by their private and public clients.
- The government needs to focus on core areas, which can help the most vulnerable of our population and strengthen healthy living for all.
- All the stakeholders could be more focused on webinars, online training programmes, seminars that could be beneficial commercially.

The most important sector i.e. green building ratings or sustainable buildings in India (GRIHA/IGBC/LEED/GEM, etc.) must be made mandatory. Green buildings reduce or eliminate negative implications on the environment and climate. They can be tied to carbon and energy objectives, such as net-zero emissions as well as considerations for occupants' health and comforts. Green and affordable health infrastructure could be adapted by the government. Investing in green

buildings allows market players to manage potential risks that stem from the global transition to low-carbon economies. Globally, the buildings sector consumes more than half of all electricity for heating, cooling, and lighting purposes, and accounts for 28% of energy-related greenhouse gas emissions, according to the International Finance Corporation (Ranjan 2019).

Real, sustained reductions in emissions will happen only if governments and companies fulfil the commitments that they have already announced – or that they will hopefully announce soon. Governments can use the current situation to step up their climate ambitions and launch sustainable stimulus packages focused on clean-energy technologies. The coronavirus crisis is already causing significant damage around the world. Rather than compounding the tragedy by allowing it to hinder clean energy transitions, we need to capitalize on the opportunity and help accelerate it.

Our focus going ahead should be to prepare for the next biggest challenge, the 'scarcity of water'. About 17% of the world's population lives in India and only 2% water is available for drinking. There is a need for more research to be conducted and policies to be framed and implemented by think tanks such as The Energy and Resources Institute (TERI), Council on Energy, Environment and Water (CEEW), Centre for Science and Environment (CSE) while detailed data analytics need to be showcased by energy agencies like the IEA.

A Healthy City

As India slowly heals from the pandemic, it is important to revisit our sustainable development

ambitions and provide for healthier cities. As per WHO, a healthy city is one that is continually creating and improving those physical and social environments and expanding those community resources which enable people to mutually support each other in performing all the functions of life and developing to their maximum potential. The definition of a healthy city not only encompasses the priority areas of the Indian government (such as SMART Cities Mission and AMRUT) but also integrates international demand for turning green and a focus on improving the resilience of communities. Such a wide overhaul of our lifestyle will require action and deliberation at all tiers of the government, industry, and academia. This change will also depend on individual action and responsibility. COVID-19 is not the last of viral infections that the world might see and with the right foresight and effective action, we can ensure that we are better prepared for the uncertain future. Hence, it is imperative that we not only make sure to prioritize our social, economic, and environmental concerns while fighting the pandemic but also ensure that sustainability in the aftermath of COVID-19 encompasses healthy living for all.

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TESTING AND COMMISSIONING PROCESS FOR BUILDING SYSTEMS

Is there a way to evaluate the efficiency and performance of buildings? In this stimulating article, **Shashi Ray** presents a detailed analysis of Testing and Commissioning – involving stringent protocols and sequential activities driven by well-documented processes – as an effective tool in the realm of building operations and management.



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Introduction

The concept of 'Environment Sustainability and Green Certification' has redefined the way efficiency and performance of buildings is perceived. Today, designers are focused to enhance efficiency through advanced systems and technologies. Over the years, there has been a remarkable progress in the field of mechanical, electrical, and plumbing (MEP) engineering systems, especially air-conditioning systems, lighting

systems, etc., wherein year-on-year, the efficiency parameters are improved. Parallely, the emergence of building automation system, IOT, smart building concept, etc., has introduced more sophisticated ways of managing building operations. Thus, with all the efforts in design, it is also important to test and commission these systems so that they can operate at their full potential and deliver according to their required capabilities. Efficient systems cannot necessarily guarantee efficient operation.

Systems, if not commissioned properly, are likely to face various problems, such as inefficient operation, non-operational BMS, systems in bypass mode, manual intervention, improper thermal comfort, unreliability of power backup and life safety systems, etc. All these challenges can be resolved by adopting a proper process-oriented 'Testing and Commissioning' (TNC) approach for the building systems.

What Is Testing and Commissioning?

Testing and Commissioning was previously undertaken at the end of the construction process by the contractor in-charge of a project. However, **‘Testing and Commissioning’** is not a one-time activity but a quality-oriented process for **achieving, verifying, and documenting** that the performance of facilities, systems, and assemblies **meets defined objectives and criteria**. TNC ideally should be carried out by a third-party agency (appointed directly by the owner) that is not a part of design and execution teams. This ensures a thorough and an unbiased review of the systems with prime focus on driving the quality, efficiency, and reliability of the systems. TNC also plays a role in integrating all the stakeholders, such as owners, designers, and execution teams and helps in completing the process.

Testing and Commissioning scope starts right from the design stage and extends till the handing over of the system to the facility team. The overall objective is to ensure design compliance, achieve operating efficiency and systems’ reliability. The scope of TNC covers all the MEP systems including Heating, ventilation, and air conditioning (HVAC) system, electrical distribution system, critical room (IT room and data centre systems), power back-up systems, firefighting, and life safety systems, plumbing systems, building automation systems, elevators, renewable energy, etc.

The rigour of TNC activity is usually defined in terms of different levels with Level 5 being the highest.

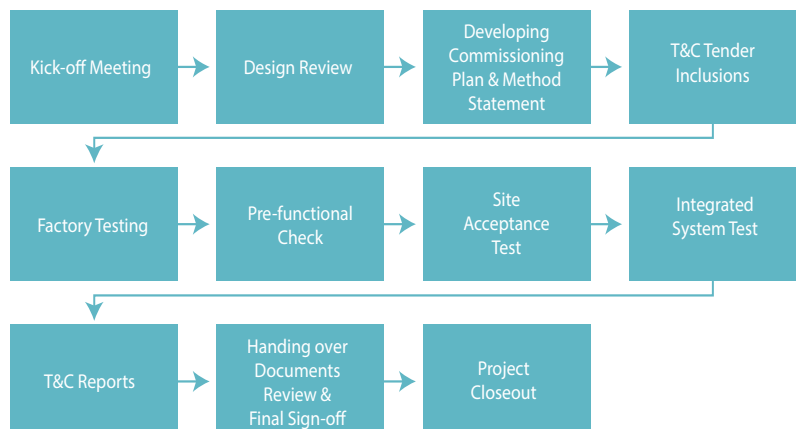
The 5 levels of commissioning are as follows:

- **Level 1 – Factory Test:** This will involve conducting pre-functional and functional test at the factory to ensure that equipment dispatched are without any inherent defect or deficiency. This saves time and cost during site execution.
- **Level 2 – Pre-functional and Component Start-up:** This includes preliminary/pre-functional checks involving review of system specification, quality of installation, safety aspects with startup checks for MEP systems. These are early-level diagnostic tests to make the system ready before functional testing, thereby reducing the probability of test failure.
- **Level 3 – Equipment-level Functional Test:** This is also called Site Acceptance Test. This involves all types of functional tests on individual equipment including load tests, current injections, and performance checks to ensure systems are operating and delivering the right parameters as per their design.
- **Level 4 – System Interface Test:** This is done to ensure that all individual systems are successfully

integrated and controlled by the automation system. This involves – integration test of individual system, along with control logics, Input-Output (IO) summary checks, graphical user interface test, alarms, and indications on the Building Automation System.

- **Level 5 – Integrated System Test:** This is the final level of testing, which is done to check reliability, availability, and functionality of all the systems together. Different MEP systems are subjected to simulated test conditions as per the cause and effect matrix. Responses of the systems are checked with respect to desired action. This will involve tests, such as Pull the Plug test (Total Blackout Test), Fire Condition Simulation, Individual Equipment Failure Test, and Availability of Redundancy, etc. This is the most important and final certifying test as it subjects the systems to critical and emergency conditions like fire or power failure, etc.

Testing and Commissioning involves stringent protocols and sequential activities driven by well-documented processes. Typically, Commissioning will have the following stages:



The tasks at each stage will be as follows:

- **Kick-off meeting:** This step will involve meeting with all the stakeholders and understanding owners' requirement and the basis of design. Basically, TNC team will understand and document all the critical parameters that are required to be considered in the design framework along with performance expectations.
- **Design review:** Depending upon scope, an early review of the design and schematic drawings will be carried out to ensure all the aspects of owners' requirement and design basis are captured in the design document. The review will focus on all the parameters that will make commissioning and future operations and maintenance easier. Here, compliance will also be checked for applicable regulatory and statutory requirements such as fire NOC, NBC, CEIG, etc.
- **Commissioning plan, method statement:** This stage will involve developing a well-written and



detailed step-by-step procedure of how commissioning activity will be carried out. It will include details such as lists of tests, duration, methodology, equipment set-up process, required instruments, success criteria, etc. Method statements are developed based on well-accepted standards such as ASHRAE, NEBB, CIBSE, NEC, IS, etc.

- **Tender inclusions:** This stage will involve providing be guidelines to vendors describing the commissioning activities to be followed at the factory and site. This will take into account all the

expectations and requirements which are covered in the commissioning plan and method statement.

- **Factory tests:** This stage will involve visiting the factory and carrying out all the tests as per the approved method statement. TNC team will participate in factory testing and will involve in the process of issuance of clearance for dispatch after required conditions are met.
- **Pre-functional and functional tests:** During this stage, TNC team will direct the entire pre-commissioning and commissioning activity at site and will conduct tests as per approved formats. Any deviations or defects would be recorded, reported, and followed up till the closure.
- **Integrated system test:** After individual tests are conducted, conditions will be defined for the integrated system test based on approved cause and effect matrix. A detailed process and method statement will be prepared and followed at site. This process involves detailed coordination amongst various stakeholders, which will be done by the TNC team.





▪ **Final report and handing over:**

After all testing activities are completed, detailed reports will be collated. The TNC team will review handing-over documents along with as-built single line diagrams, SOPs, testing reports, factory reports, guarantee documents, etc., to ensure that the completion happens on time. They will also ensure that requisite trainings are provided to the operation team and systems are successfully taken over without any defect.

Some of the recommended tests and methodology are as follows:

- Electrical Panels – Megger, Hipot, Millivolt Drop, Primary, Secondary Current Injection, Relay Tests, etc.
- Rising Main – Hipot, Load Tests, Megger, etc.
- Earth Pit – Resistance and Loop Impedance, etc.
- Transformer – Vector Group, Magnetic Balance, Ratio Test, Winding Resistance, OLTC, etc.
- Generator – Load Test, Fuel Consumption Test, Noise Vibration, Stack Related Tests
- UPS – Load Test, Block Load, Unbalance Load, Step Load, etc.
- Chillers – Pipe Pressure, Flushing, Water Balance, Power, COP
- Pumps – Flow, Power, Performance
- AHU – Air Flow, Air Balance, Duct Pressure, Power, Water Balance
- Firefighting System – Pressure Test, Pumps Operation, Sprinkler Operation, Flow Switch Operation, Detectors, MCP, Pressurization Fans

- Building Automation System – IO Summary and Control Logic

And many such tests are conducted to evaluate the operation and performance.

Overall, the TNC team is present on site during the entire construction stage, driving the entire process of commissioning. While other teams like PMC and vendors focus on project completion timelines, TNC add value by ensuring that installed systems meet the design specification, quality, operations, and performance expectations as per their intent. As far as time is concerned, TNC does not require additional time, it can work parallelly with the construction schedule. In fact, proper TNC can help in a faster handing over process, thereby reducing the time required for rectifying defects. On load performance and integrated operation checks help to tune the system closest to its best operating point. This helps projects to realize the anticipated energy savings right from day one as all controls and systems will be operational. Proper balancing of system helps to set operating thermal comfort conditions. The facility team gets systems with zero defects, thereby reducing maintenance and breakdown costs. Additionally, there is assurance and availability of all critical systems, such as, firefighting systems and life-safety systems during emergency conditions.

Thus, TNC is a value-added service and process, which can help the project to not only meet the operational goals but can also play an important role in enhancing the efficiency and performance of systems.

START-UP STORY

ABSOLUTE WATER



SMITA SINGHAL

As per the Central Pollution Control Board (CPCB), India will need 1.5 trillion litres of water by 2030. Using treated water is essential to meet the increasing demand for water. However, untreated sewage finds its way into the waterbodies, thereby leading to waterborne diseases, agricultural contamination, and environmental degradation. To address some of these concerns related to water availability, my father Sunil Singhal, a chemical engineer and myself, Smita Singhal, researched, designed, and installed a working model to convert sewage to drinking water in a sustainable manner. With this technology, we can hope to have safe, chemical-free, and clean water directly from the taps without worry.

At Absolute Water Private Limited (AWPL), our waste water treatment model ensures the availability of clean water by providing a 100% organic water recovery system that is simple, cost effective, and sustainable and can also be operated by unskilled labour. In developing this technology, the two main challenges encountered included making it a completely green process and keeping it commercially and physically viable.

We learnt through our research, spanning over one-and-a-half years, that the best available resource to tackle water scarcity is the untreated sewage itself, which is a non-perishable resource and it contains 90% water and only 10% solids.

Our aim was to treat sewage water and convert it to potable water, making it available at a nominal cost. We adhered to the WHO-BIS quality standards and drinking water norms. Our treatment model provides the same quality of water as an RO would but without the chemical dose and wasteful reject water issues.



Our treatment process is based on a mix of vermicast and microorganisms that naturally degrade all the pollutants in the raw sewage, converting some into nutrients, and ozone gas is used for natural disinfection. The filtration media comprises organic and inorganic components such as wood chips, pebbles, etc., to dispense good quality treated water for various uses in addition to it being used as an excellent soil conditioner. Further, this water can be organically treated to give clean drinking water.

The technology offers a number of distinct advantages in comparison to conventional technologies, which are listed as follows:

- 100% organic
- No sludge generation, therefore no sludge handling costs
- Minimal electricity

- 100% recovery rate for non-potable applications
- Highest recovery rate of 85% for drinking water
- Minimal operation and maintenance cost, as the entire design is based on gravity
- No odour, no noise
- High return on investments
- Reject from the system has been tackled by generating a form of liquid soil conditioners, which adhere to all CPCB norms
- Shortest stabilization time over all conventional technologies

Till now, we have installed 14 plants all around the country. The treated water is used in horticulture applications, construction work, toilet flush, floor wash, and river rejuvenation. The water is also used



for food manufacturing processes in addition to bathing and laundry purposes. This in itself replaces 60% of the freshwater usage, thereby resulting in decreased costs.



Presently, Absolute Water Private Limited (AWPL) is treating over four million litres of sewage daily, thereby supplying clean and safe water to a population of over six lakhs.



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TRAINING PROGRAMME

- 1 | 3 day Training Programme, Chandigarh, 19-21 June 2019
- 2 | 3-day Training Programme Noida, January 29-31, 2020
- 3 | 2-day Student Training Programme for second year students of SJB School of Architecture and Planning, Bangalore, February, 2020
- 4 | 3-day Training Programme, Kolkata, February 26-28, 2020
- 5 | 3-day intensive GRIHA V 2015 Training Programme in association with the Indian Institute of Architects (IIA), Northern Chapter for practicing architects TERI, New Delhi, February, 2020
- 6 | 3 Day Training Programme, Delhi, 27-29 Nov, 2019



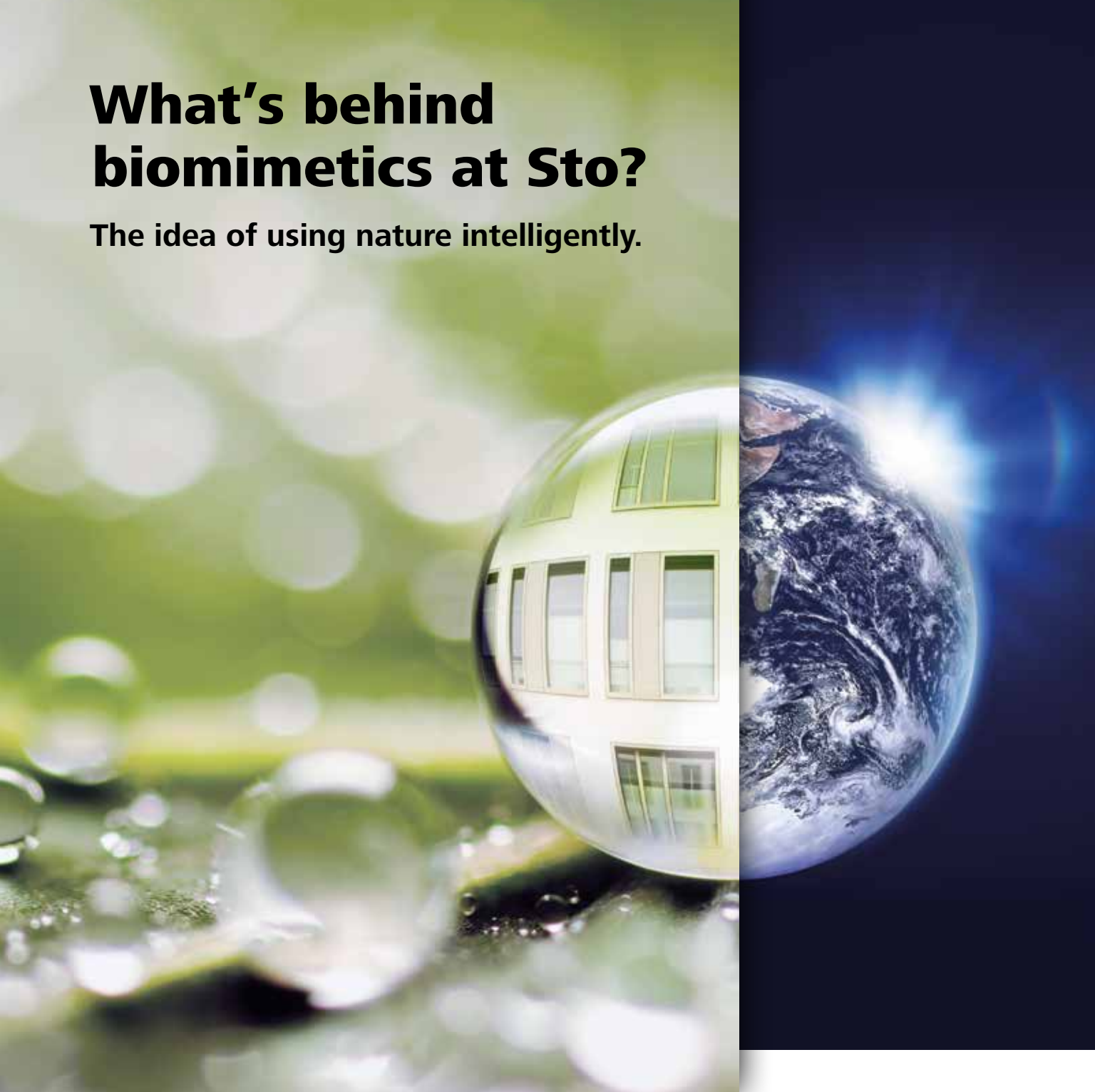
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What's behind biomimetics at Sto?

The idea of using nature intelligently.



Durability thanks to the experience of nature

For 20 years, we have been developing products based on the most efficient solutions from nature. Our inspiration: 3430 million years of evolution – constant optimisation through further development. The benefit to you: radiant colour intensity, UV protection, weather protection, surfaces that clean themselves, and a longer lifecycle for your facades. Cost-effectiveness and ecology combined. This is what we mean by Building with conscience.

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Building with conscience.

BUILDING WATER-RESILIENT COMMUNITIES

Every Drop Counts

In this article, **Geeta Kannupillai** foregrounds the success story of **Piramal Sarvajal**, a Gujarat-based mission-driven social enterprise, which is the frontrunner in India's water sector. It develops technologies and business practices for easy access of safe and clean drinking water to those rural and urban areas that are at the receiving end of acute water shortage and low-water quality. The community-level solutions, as proposed by Sarvajal, are locally operated and making the affected communities resilient to water crisis.



Geeta Kannupillai is a brand and marcom professional with more than 22 years of experience across diverse sectors spanning from media to electronics. She has a Master's in Business Administration and she did her Bachelor's in Economics. She leverages her marketing experience

to conceptualize and implement various activations to connect with the target audience, enhance the brand value, and create a positive image of the brand across markets.

Introduction

In most developing countries, more than half of the common ailments are linked to waterborne diseases. In addition to the health burden, such an alarming rise in diseases also leads to an economic loss of US\$600 million, annually. The most vulnerable are the low-income

communities, who either remain disconnected from the central water grid or are priced out of expensive domestic water purification alternatives.

According to a report on water supply and sanitation by WHO-UNICEF Joint Monitoring Programme (JMP), though India

has met the MDG 'drinking water' target, the data only measures the access to improved water sources rather than the quality of water, reliability, and sustainability of the water source. While a borewell is a dependable source of water for non-potable purposes, those relying extensively on these sources for meeting their drinking water requirements are vulnerable to a host of waterborne diseases. This is because groundwater sources, in large parts of India, are susceptible to contamination by not only biological pathogens but also ionic impurities (such as fluoride, nitrate, iron, and arsenic).

Among eight classified sources of water, tap water, water drawn from wells and handpumps constitute a major proportion, (approximately 88% for India), according to census 2011. Centralized treatment and distribution of drinking water for remote rural areas is capital intensive and tends to compromise on the water quality, which is the most vital parameter. 'Domestic point-of-use' purifiers are not affordable for three-fourth of India's population and these purifiers are inefficient to treat highly raw water. Moreover, packaged drinking water is way too expensive for nine-tenth of the country's population. This calls for the need to design holistic drinking water solutions for the creation of sustainable safe drinking water facility and easy access at the bottom of the pyramid – in both urban and rural locations.



» User of Pune under Andhra Pradesh Congress Committee HnS and water distribution in Kerala

Sarvajal: Water for All

Piramal Sarvajal is a mission-driven social enterprise, which designs and deploys innovative solutions for creating affordable access to safe drinking water in underserved areas. It deploys purification technology based on contamination profile, leverages cloud-based technology for greater operational oversight. So, these initiatives are low cost and aim for higher impact. The enterprise believes that providing safe drinking water is the most effective preventive healthcare measure.

Piramal Sarvajal leverages telecom technology to make 'Locally Operated Centrally Managed' public service delivery more accountable. This comes from operational supervision that provides proactive service support across a widely distributed network of local solutions. Although decentralized water solutions have witnessed a

wide adoption in India, a crucial flaw in their long-term success is the lack of any mechanism to monitor the purification plant, its volume, quality of water filtered or the number of families served. Those few monitoring systems available in the market are not designed to audit the requisite plant parameters on real-time basis and are dependent on the reports from the machine operator with limited functionality to control the plant components. At any given point, the stakeholders have limited or no information about the plant's functional status or the quality of water produced. These

blind spots often lead to operational dysfunctionality in the longer run with unsustainable solutions.

To address this problem and ensure sustainable solutions, Piramal Sarvajal developed a patented remote-monitoring device called Sookhak. This device is installed with the purification unit and enables real-time monitoring, process controlling, and data tracking, which are aggregated across multi-location operations. It tracks the plant's functional status to ensure the machine's overall health and its quality sensors assure product quality.



» Sookhak controller and community participation under Jal Shakti Abhiyaan



» Water distribution in Kerala and water ATM refilled with no-touch vehicle

Managing Disasters

The real-time monitoring and control of water systems by Piramal Sarvajal has helped with quick responses during disasters. It is because of devices like Soochak that the Sarvajal team could jump to action in just 1.5 hours during the jaundice outbreak in Shimla in 2016, owing to a sewage treatment plant failure. The then Shimla Chief Engineer, acting on the decision taken by the Hon'ble Chief Minister, Himachal Pradesh, asked Sarvajal to supply free water from three ATMs installed at Dari, Dharamshala, HRTC Bus Stand, Mandi and Mata Chintpurni Temple Campus, Chintpurni, Una for 20 days. Water was provided free of cost to all the said locations and the water offtake shot up by four times. Sarvajal was able to maintain two-fold increase post the government-sponsored period.



Since Piramal Sarvajal's inception in 2008, it has been learning and growing, perfecting the smart water implementation system. As a result of Piramal's innovative and technology-driven approach, today, the social enterprise serves safe drinking water to more than 600,000 beneficiaries daily across 19 Indian states with over 1800 water touch-points. The solutions have proven the enterprise's resilience to work across various difficult terrains and even in the most remote reaches of

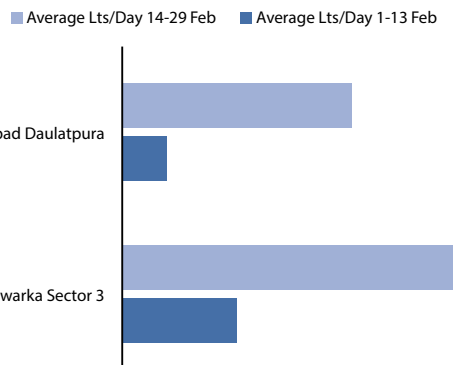
the subcontinent. It has also proved to be a boon to the local populace during natural calamities or man-made disruptions.

In September 2014, the Kashmir region suffered disastrous floods across many of its districts caused by torrential rainfall. More than 350 villages were submerged. Piramal Sarvajal responded by sending 10 purification machines and its team of engineers to Srinagar within 24 hours.

Overcoming Challenges

Having a proven record of accomplishment in both urban and rural locations, on 19 February 2016, Pro-Jat quota protesters blocked and breached the Munak Canal, restricting Delhi's water supply. About 60% taps in the capital went dry. Sarvajal's decentralized drinking water set-ups came to the rescue and proved to be a boon to the communities. The water offtake increased by three times in Shahbad Daulatpura and five times in Dwarka, Sector 3.

During Kerala floods in 2019, Piramal Sarvajal provided purification kits to one lakh families as part of 'immediate relief action'. When the situation stabilized, it reached out to support the Kerala government in its rehabilitation work by setting up 10 purification plants of 100,000 litres/day capacity



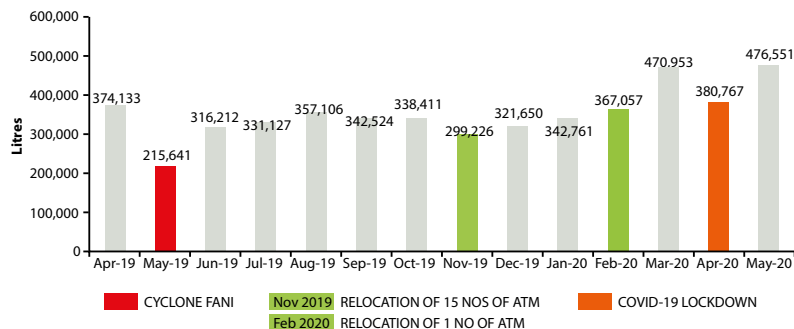
to fulfil drinking water needs of more than 20,000 affected families.

When Fani Cyclone hit Bhubaneswar in May 2019, the repercussions were extreme. The water and power supply got disrupted, even after the cyclonic storm had passed. Sarvajal continued to serve people through 13 water ATMs refilled from one plant and dispensed 66,100 litres of safe drinking water within 15 days. Water was supplied to all those who had no access to either power or water even when they were not Sarvajal consumers. In May 2020, when Cyclone Amphan hit parts of West Bengal, Sarvajal continued to operate all its 39 ATMs to ensure daily service to the affected communities.

Roughly, around 1.37 crore households, or 17.4% of urban Indian households lived in slums in 2011 (Census 2011). Close to half of these households are equipped with just one room and most of these dwellings are home to more than one married couple and children. These congested dwellings lack basic amenities, such as access to clean and



» People getting water for their houses soon after the installation and serving water to both the CRPF Jawans and residents near Dal Lake



» BMC monthly water dispense volume (litres) from 40 ATMS

safe water. To serve these affected dwellings within a cluster, Sarvajal innovated the 'Hub-and-Spoke' model. It comprised a single water treatment system in the community with decentralized dispensing units in a co-centric pattern. Such projects have been implemented even in urban slums of Delhi and are also spread across the city of Bhubaneswar to serve the urban poor and the commuting public.

COVID-19 and Sarvajal

During the nationwide lockdown, when only essential services were allowed, Piramal Sarvajal focused on continuing their service (supply) of safe drinking water at various locations without compromising on the safety of the field staff and community members. Some of the ATMs, especially the older versions (button-operated machines in urban areas [serve 40,000+litres/per day]) meant users would have to touch after scanning their smart water cards. This was an area of concern as possibilities of contamination were high, especially in cities such as Delhi and Bhubaneswar (high

risk zones). The R&D team designed a firmware for these ATMs and trained the drivers who refilled these ATMs to update the firmware. Within a week, the urban ATMs were modified to enable card scan dispensing, mitigating the risk to a considerably low level.

Piramal Sarvajal took immediate and stringent measures to maintain all precautions and educate the field teams and communities about prevention and how to contain the spread of the coronavirus at the community level. Stringent sanitation drives were carried out at all Sarvajal Kendras on a daily basis, especially at the button-and-scan areas. Social-distancing norms were adhered to by demarcation of boxes at a distance of one metre. Due permission was sought from government bodies to ensure uninterrupted services to the communities. Additionally, the water ATM operators also assisted the Gram Panchayats in sanitizing the villages, distributing rations, helping the needy families, and also maintaining lockdown norms in the villages.



The Way Forward

Over the years, the commitment and ability to provide communities with safe drinking water for a longer run have made Sarvajal's investment in community-level purification solutions worthwhile. With Soochak's efficient management of operating costs, the money has been invested in drinking water development initiatives with Piramal Sarvajal, and efficiency and effectiveness have been optimized.

In July 2019, Sarvajal partnered with the Ministry of Jal Shakti, under the Jal Shakti Abhiyan. Sarvajal supported the Abhiyan in 12 districts across nine states by organizing orientation workshops on campaign objectives, drafting and facilitating district action plans, mobilizing people participation by liaising with NGOs, CBOs, and SHGs, conducting exposure visits, and capturing success stories, and conceiving, planning, and executing IEC drives.

The Sarvajal team is hopeful that the Jal Jeevan Mission will be able to bridge the gap between easy access and quality of water for those who are in need. Considering the long-term nature of the plan and the diverse nature of the problem, small water networks like Sarvajal can create greater impact if there is government support and availability of adequate funds is ensured.



» Sanitation and social distancing at Gulf oil Attipattu plant

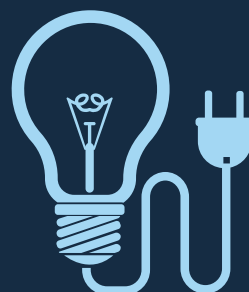
INFO-BYTES



Buildings use about **17%** of the annual available freshwater, compared to **5%** for direct human consumption



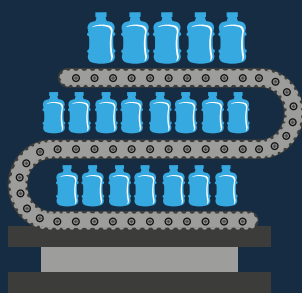
Producing one kilogram chicken requires over **4300** litres of water, compared to **322** litres for 1 kilogram vegetables



1 in 7 people still continue to live without regular electricity. On the other hand, **118** million people gain access to electricity each year



In 2019, Solar and Wind accounted for **7%** of global energy generation, up from **0.8%** in **2009**



Plastic production will double from **320** million tons in **2016** to over **640** tons by **2034**



Only **9%** of plastic ever produced has been recycled, while **79%** remains in landfills or the environment. **12%** is incinerated



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On the night of 2 December 1984, a toxic gas leak at the Union Carbide India Limited (UCIL) pesticide plant turned the city of Bhopal into a colossal gas chamber. It was, arguably, the first major industrial disaster in India. The plumes of toxic methyl isocyanate (MIC) killed a few thousand people in its immediate aftermath and submerged the city into a deluge of barren tress and bloating carcasses. In the days to come, the 'city of lakes' witnessed more than 200 per cent increase in its neonatal mortality rate. Subsequently, the *hibakusha*¹ of Bhopal developed long-term neurological and psychological disorders, as well as

¹ Hibakusha is a word of Japanese origin generally designating the people affected by the 1945 atomic bombings of Hiroshima and Nagasaki.



AVOIDING INDUSTRIAL DISASTERS: TOXIC GAS LEAKS AND BEYOND

“Death would have been a great relief. It’s worse to be a survivor.”

–*The Bhopal Saga: Causes and Consequences of the World’s Largest Industrial Disaster*, Ingrid Eckerman

India has been at the receiving end of a series of industrial disasters during the last 35 years in the aftermath of the Bhopal gas tragedy. In this incisive article, **Shreyans Jain** discusses the causes of industrial disasters, various levels for chemical disaster preparedness and response, the need for concerted efforts to minimize industrial accidents, and more.

deformation of bodies, and lung and corneal damage. More than three decades have passed since the disaster exacted a devastating toll on the state’s demography, but little seems to have changed.

The recent styrene gas leak from Visakhapatnam-based LG Polymers India Private Limited factory that killed several people and left hundreds sick is a grim reminder of lack of safety audits of hazardous manufacturing units. The disaster has reiterated the need to fix accountability of the company as well as the state administration. It has, once again, highlighted the need to strengthen the country’s public and occupational safety.

Industrial Disasters: A Background

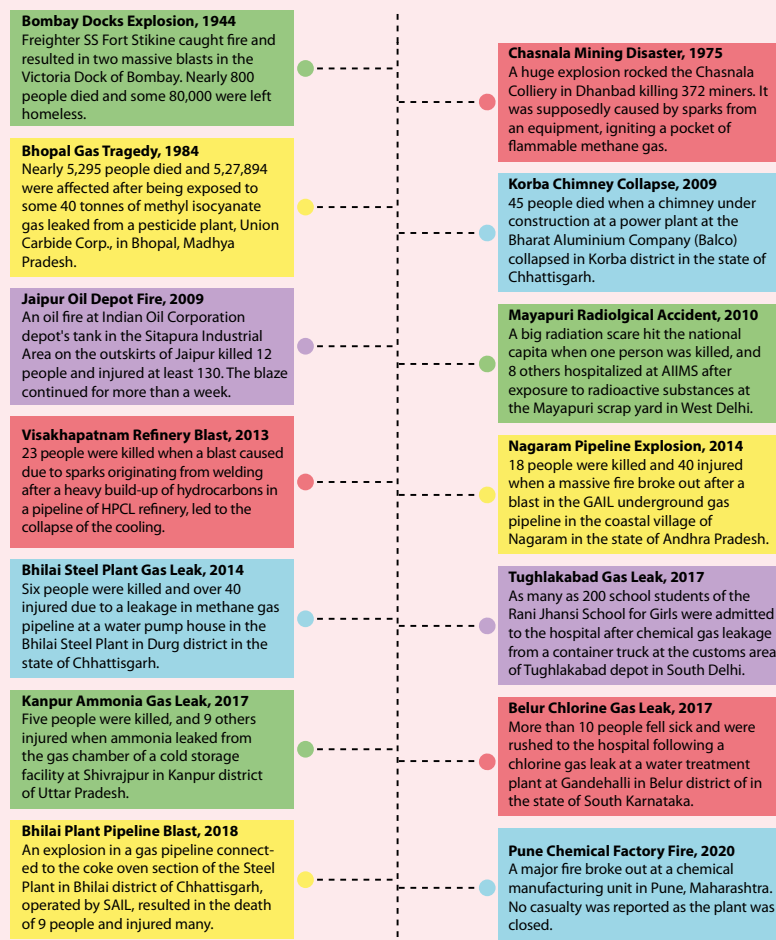
An industrial disaster may be defined as any threat emanating from industrial accidents, technological or infrastructure failures, environmental pollution or certain human activities, which has the potential to cause injury and subsequent loss of life, damage to property, social and economic disruption, and degradation of natural environment. Rapid industrialization has resulted in enhanced use of sophisticated machinery and hazardous materials and increased the complexity of industrial operations. This, coupled with blatant disregard for safety

procedures, inappropriate disposal of toxic wastes, lack of preparedness, and systemic apathy in enforcement of regulations has made the entire industrial activity vulnerable to accidents and caused tragic loss of precious lives. Figure 1 shows a list of major industrial disasters in India in the last few decades.

Causes of Industrial Disasters

Industrial disasters usually occur due to inadvertent process deviations resulting from human errors, sabotage, and other systemic causes. Some of them are listed as follows:

- Chemical manufacturing is a deregulated and decentralized



» **Figure 1:** Major industrial disasters in India

industry in India.² The ability to invest in occupational health and revamping or scrapping of ageing plants is constrained by the economic size of the small-scale enterprises operating in the sector.

- Reluctance to invest in long-term capacity building and skill development of workforce resulting in the employment of non-skilled casual workers in unsanitary conditions to undertake hazardous activities.

² National Informatics Centre (NIC). 2018. About Chemicals. Department of Chemicals and Petro-Chemical, Ministry of Chemicals and Fertilizers, Government of India. Details available at <https://chemicals.nic.in/chemical>.

Shoddy management practices, poor reporting systems, and lack of accountability³ in dealing with mishaps further exacerbate the problem.

- Casual workers are seldom equipped with adequate masks and personal protection equipment (PPE) and often succumb to poisonous gas leakages. Low awareness of safety standards related to material handling, storage and disposal, absence of emergency warning

³ *Economic and Political Weekly*. 2020. Gas Leaks, Industrial Disasters: Reflecting on India's Historical Lack of Systemic Accountability. Details available at <https://www.epw.in/engage/article/gas-leaks-industrial-disasters-reflecting-india>.

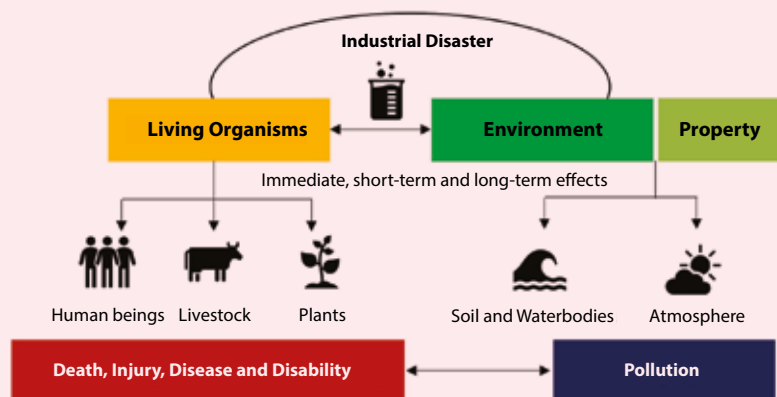
procedures, and non-disclosure of line of treatment add to the number of fatalities.⁴

- Labour and related issues fall in the Concurrent List under the Seventh Schedule of the Constitution of India.⁵ Both Central and State governments are empowered to make laws on this subject. As a result, the multiplicity of legislation and inter-state variation in regulations create a huge compliance burden for the employers and encourage rent-seeking behaviour.
- The temptation to score high in the Ease of Doing Business rankings⁶ has given rise to a paradoxical situation – industrial codes and regulations that were enacted to safeguard the rights of labour and ensure their safety at workplace are now being viewed as barriers to growth. State governments are indulging in an unhealthy competition to 'clean their factories' to attract investments.
- Growing demand for industrialization has led to mushrooming of unsafe factories in urban and semi-urban areas and encroachment on public spaces demarcated for industry. Due to this systemic callousness, the cities have become vulnerable to industrial disasters resulting in deaths and disabilities (Figure 2).

⁴ International Labour Organization (ILO). 2019. *Safety and health at the heart of the future of work*, 2019. Details available at <http://www.indiaenvironmentportal.org.in/files/file/work-safety-health.pdf>.

⁵ Government of India (GOI). 2019. *The Constitution of India*, Legislative Department, Ministry of Law and Justice, Government of India. Details available at <http://legislative.gov.in/sites/default/files/COI-updated.pdf>.

⁶ The Department for Promotion of Industry and Internal Trade (DPIIT) has developed Action Plan for State Reforms since 2015. It is engaging with States/UTs in envisioning, designing and implementing business reforms; Ministry of Commerce and Industry, Government of India. 2020. Details available at <https://eodbdipp.gov.in/>.



» **Figure 2:** Impact of an industrial disaster



Law and Industrial Disasters

The NDMA Guidelines on Chemical Disasters (Industrial), 2007 call for a proactive, participatory, multidisciplinary and multi-sectoral approach at various levels for chemical disaster preparedness and response.⁷ In *M.C. Mehta vs Union of India*,⁸ the Supreme Court laid down the principle of 'absolute liability' according to which the enterprise owes an 'absolute and non-delegable duty to the community to ensure that no harm results to anyone on account of hazardous or inherently dangerous nature of the activity which it has undertaken'. Further, the Constitution of India guarantees to its citizens the right to live in a clean and wholesome environment as a fundamental right. Table 1 lists some of the laws enacted by the government to reinforce the legal framework on the management of industrial accidents.

Table 1: Government laws regarding management of industrial accidents

Environment (Protection) Rules, 1986 ⁹	These rules lay down the procedures for setting standards of emission or discharge of environmental pollutants. The rules set discharge and product standards – source standards for restricting pollution; product standards for manufactured goods, and ambient air and water standards – for regulating the quality of life and environmental protection.
Hazardous Waste (Management Handling and Transboundary Movement) Rules, 1989 ¹⁰	Under these rules, industrial establishments are required to identify major accident hazards, take preventive measures, and submit a report to the designated authorities.
Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 ¹¹	These rules require the occupier to disclose necessary information to the public in the neighbourhood that is likely to be affected by a major accident at the site. An importer must furnish complete product safety information to the competent authority and must transport imported chemicals in accordance with the rules.

⁷ Government of India (GOI). 2007. *National Disaster Management Guidelines on Chemical Disasters (Industrial)*, 2007; National Disaster Management Authority, Government of India. Details available at <https://ndma.gov.in/images/guidelines/chemicaldisaster.pdf>.

⁸ *M.C. Mehta vs Union of India* on 13 January, 2002. The case originated in the aftermath of oleum gas leak from Shriram Food and Fertilisers Limited complex at Delhi. Details available at <https://indiankanoon.org/doc/16059052/>.

⁹ Government of India (GOI). 1986. The Environment (Protection) Rules, 1986; Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. Details available at http://moef.gov.in/wp-content/uploads/2018/03/THE_ENVIRONMENT.pdf.

¹⁰ Government of India (GOI). 2008. The Hazardous Waste (Management Handling and Transboundary Movement) Rules, 1989; Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. Details available at http://moef.gov.in/wp-content/uploads/2018/03/HAZMAT_2265_eng.pdf.

¹¹ Government of India (GOI). 1989. The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989; Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. Details available at <http://moef.gov.in/manufacture-storage-and-import-of-hazardous-chemical-rules-1989/>.

Chemical Accidents (Emergency, Planning, Preparedness and Response) Rules, 1996 ¹²	These rules envisage a four-tier crisis management system, requiring each state to set up a crisis group. The Central Government is required to compile chemical accident data received from the state authority, develop a web-based Chemical Accident Information Reporting System, and a GIS-based Emergency Planning and Response System.
Factories (Amendment) Act, 1987 ¹³	The Act extends the scope of risk from hazardous industries. As per the Amendment, the narrowly defined scope covering only workers and the premises of the factory was extended to the general public in the vicinity of the factory.
Public Liability Insurance Act, 1991 ¹⁴	The objective of this Act is to provide for damages to victims of an accident, which occurs as a result of handling any hazardous substance. It imposes a 'no-fault liability' on the owner of hazardous substance and requires the owner to compensate victim(s) of the accident irrespective of any neglect or default.

Tackling Industrial Disasters

Industrialization has brought with it an enormous economic upheaval. There is a need to pay adequate attention to understand the process of this disorder and make concerted efforts to minimize the destruction caused due to industrial disasters. Some of them are listed as follows:

- **Understanding the risk:** This involves strengthening information systems by mapping/

zoning of industrial zones on the basis of their hazard potential. There should be a comprehensive vulnerability and capacity assessment¹⁵ covering social, economic, and ecological aspects to help develop a deep understanding of the risks that lead to adverse consequences.

- **Warning, reporting, and data dissemination:** There should be seamless communication and coordination among central and state agencies to ensure timely intervention and effective dissemination of warnings and data. A prediction model that can spot problems prospectively as well as retrospectively should be synthesized.
- **Investing in disaster risk reduction:** Land-use norms should be suitably reviewed

¹² Government of India (GOI). 1996. The Chemical Accidents (Emergency, Planning, Preparedness and Response) Rules, 1996; Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. Details available at <https://parivesh.nic.in/writereaddata/ENV/HSM/rule3.pdf>.

¹³ Government of India (GOI). 1987. The Factories Amendment Act, 1987; Ministry of Labour and Employment, Government of India. Details available at <https://www.ilo.org/dyn/natlex/docs/WEBTEXT/32063/64873/E87IND01.htm>.

¹⁴ Government of India (GOI). 1991. The Public Liability Insurance Act, 1991; Legislative Department, Ministry of Law and Justice, Government of India. Details available at <http://legislative.gov.in/sites/default/files/A1991-06.pdf>.

¹⁵ Government of India (GOI). 2019. *National Disaster Management Plan, 2019*; National Disaster Management Authority, Government of India. Details available at <https://ndma.gov.in/images/policyplan/dmplan/ndmp-2019.pdf>.

and strictly enforced to prohibit setting up of hazardous industries in close proximity of human settlements. All industrial establishments should be provided with multiple routes for reliable access and escape for timely evacuation. The infrastructure should undergo renovation and modernization to build resilience and eliminate risks, as enshrined in the Sendai Framework for Disaster Risk Reduction.¹⁶ Rating tools like GRIHA can be used to certify the incorporation of sustainable practices in facility design.

- **Good engineering for safety:** All critical equipment/storage vessels should be regularly tested and statutory requirements complied with. This also includes provision, maintenance, and regular upgrading of safety gear including PPE.
- **Storage:** Safe storages of large inventories of hazardous chemicals should be accompanied with adoption of corresponding containment measures and best environmental practices. All enterprises must accord highest priority to the development of containment and neutralization systems.

The Way Forward

The government is undertaking a slew to economic reforms to position the country as a favourable destination to do business. The reforms are welcome. The pursuit of growth, however, should not overshadow the well-being of its subjects and the protection of environment. Transparent oversight and regulatory policies should not be a hurdle to economic growth.

¹⁶ United Nations Office for Disaster Risk Reduction. *The Sendai Framework for Disaster Risk Reduction*; United Nations. Details available at <https://www.undrr.org/implementing-sendai-framework/what-sendai-framework> (Reduction).

SYMBIOSIS BETWEEN EARTH, ENERGY, AND ENVIRONMENT

Need of the Hour

The synthesis between energy and environment is important for the survival of humankind. Unlimited use of energy resources can burden our ecology leading to irreparable damage to society. In this thought-provoking article, **Sachin Agrawal** explains why ecological footprints matter.



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of Management, Chennai. He is a professional with over 15 years of experience, which includes more than 7 years in the solar sector. He has worked with reputed companies in India including Jindal Stainless Limited, Thermax Limited, Larsen & Toubro Power Limited, and Reliance Power Limited. He can be reached at sachina@godrej.com.

Introduction

Our universe is a combination of living and non-living things and the humankind is blessed to exist on planet Earth, which till date is the only planet that supports life.

Hydrosphere, atmosphere, and geosphere are the components of the environment that surrounds us. Hydrosphere, the wet environment that consists of water, covers most

of the earth's surface. Sea, rivers, lakes, and under surface water are all part of the aquatic environment. Land or geosphere is composed of deserts, mountains, hills, and level lands. The earth's atmosphere is made up of gases, such as hydrogen, oxygen, nitrogen, and others. Every interaction shapes a living ecosystem with special properties that resonate with organisms.

What Is Earth Overshoot Day?

Currently, human beings are consuming the five elements, i.e. *bhūmi* (earth), *jala* (water), *agni* (fire in the form of fossil fuels), *vayu* (air or wind) and *akash* (space or aether or void), at a rate which cannot be replenished by Mother Earth. In this context, Earth Overshoot Day¹ is an important matrix to understand the replenishment rate of Mother Earth with reference to the consumption rate by humans in the world.

Earth Overshoot Day is like a report card, which marks the day when humans' demand for natural resources and services in a given year exceeds what the planet can regenerate that year. Not all countries have an overshoot day. A country will have an overshoot day only if its ecological footprint per person is greater than global biocapacity per person (1.63 gha).

Need of the Hour

There is a need to preserve the environment so that it remains clean and green. In earlier times, we used to lead a simple life by living in earthen or wooden houses, cooking on fire, and travelling with the help of animals. The idea of living in a joint family was prevalent in the past whereas our current lifestyle has led to enormous usage of fuel, cutting of trees, rampant usage of plastic, heavy consumption of electricity per household, water pollution, etc.

The prospect of rapid global temperature increase has created the need for immediate reduction in the use of fossil fuels and the associated emissions. India has committed to cutting its greenhouse gas (GHG) emissions intensity by 33% to 35% below 2005 levels by 2030.

¹ [Overshootday.org](https://www.overshootday.org). Details available at <https://www.overshootday.org/newsroom/country-overshoot-days/>

Country Overshoot Days 2020

When would Earth Overshoot Day land if the world's population lived like...



Source: Details available at <https://www.overshootday.org/newsroom/country-overshoot-days/>

One way of balancing the energy needs of humankind is to look for alternative sources of energy, such as wind, solar, and hybrid. Modification and practising moderation in our existing lifestyle could help in satisfying our insatiable need of energy.

Green buildings/net-zero buildings could be away to reduce energy consumption – both the embodied energy required to extract, process, transport, and install building materials, and operating energy to provide services such as solar heating. Green buildings preserve precious natural

resources and improve our quality of life by reducing negative effects on climate and the environment. Similarly, a net-zero energy building is one that is both water and energy neutral.

The latest technology trends, such as increasing penetration of clean and green energy like solar and wind, emergence of electric vehicles (EVs), energy-efficient equipment, green buildings/net-zero buildings, renewed focus and thrust on reduction in GHG emissions in the environment, among others are a few steps in the right direction.

Further, the government of each country should think of building ecosystems in rural areas to ensure that rural inhabitants do not migrate to the cities. This could lead to minimum movement of people, materials, and resources, and in turn, help in the conservation of natural resources.

It is everyone's responsibility to protect Mother Earth and her natural resources for future generations and all of us must work towards becoming a nature maven for a healthier living.

THE INDIAN INSTITUTE OF MANAGEMENT, KOZHIKODE (IIM-K)

The campus of the Indian Institute of Management, Kozhikode (IIM-K) is one of the most picturesque and oxy-rich properties in the country. It was designed by architect Gaurav Sanan of Urban Architecture Works, Delhi with a consortium of leading experts and design consultants in structural, electrical, HVAC, plumbing, landscape, and green building practices. Earlier this year, Phase-V of IIM-K, spread across 15 acres, was awarded the 5-star GRIHA rating. 'A harmonious blend of several eco-friendly designed technologies and energy-efficient measures has played a key role in achieving 66% reduction in energy consumption as compared to GRIHA's baseline benchmark,' says Neeraj Kapoor, a green building consultant, who works at Kalpakrit Sustainable Environments Pvt. Ltd. During the project, practices of sustainable site management, on-site water and waste management, procurement of sustainable materials, and energy efficiency optimization ensured minimum risks to the environment.

The project development consists of sustainable urban drainage strategies (SUDS) that include bioswales and rainwater harvesting for an astonishing 100% of yearly water requirement. The storm water overflow is managed scientifically and then directed to a bigger lake outside the campus without wasting the resources. The development of the site is covered with ample shaded breeze-ways that offer comfort to the users in the humid environs of Kozhikode. The embodied energy reduction of up to 15% has been achieved in structural infrastructure using PPC and Fe-500D steel.

Stone excavated from the land for storm water storage is used in creating efficient gabion retaining wall systems. A commendable 100% organic waste treatment has been accomplished via an electric organic waste composter. Low-flow fixtures help achieve 59% savings in water usage. The chiller plant on-site uses the environmentally benign brine-based refrigerant and thermal energy storage (TES) technology, tapping the State of Kerala's Time of Use utility tariff rates for electricity, thereby saving IIM-K not just energy but also energy demand and energy cost. Clerestory windows allow sufficient daylight to enter the interior spaces. A 140-KLD capacity STP, based on moving bed bioreactor (MBBR) technology, treats the sewage water to tertiary standards, which is re-used for flushing in toilets and irrigation of landscaped areas.



NEERAJ KAPOOR
Managing Director
Kalpakrit Sustainable
Environments Pvt. Ltd

The GRIHA Council has been consistently supportive, a highly responsive, client-focused organization in the entire rating-cum-certification process, extending educative assessments regularly. GRIHA fulfilled the needs of IIM-K in a professional manner. All the reports and responses were delivered as expected, which provided us with valuable insights from which IIM-K could benefit holistically.

A list of the consultant companies and their respective roles is shared as follows:

- Architects – Urban Architecture Works
- Project Manager – CPWD
- Sustainability Consultant – Kalpakrit Sustainable Environments Pvt. Ltd
- Landscape Consultant – Vinyas
- Structural Consultant – Vintech Consultants
- Electrical Consultant – Kanwar Krishen Associates
- Mechanical & Plumbing Consultants – M.J. Engineering Consultants

'SPIRITUALITY' AS FOURTH DIMENSION OF 'SUSTAINABILITY'

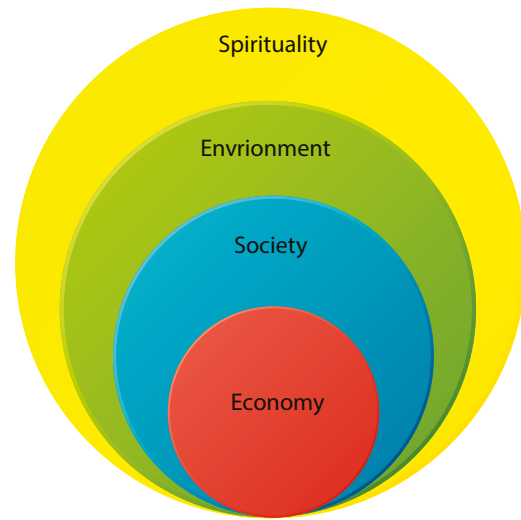
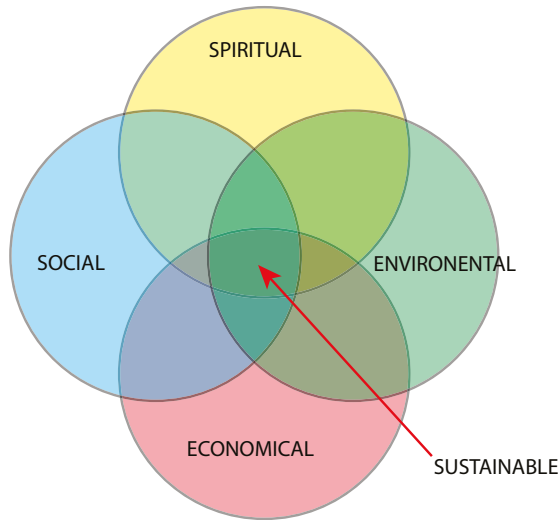
Are sustainability and spirituality interlinked? Has the pandemic compelled humankind to introspect and realize the disastrous implications of deforestation, unsustainable practices, and globalization? In this article, **Sudipta Singh** discusses sustainable and spiritual ways of building a pandemic-resilient society.

Introduction

The origin of the concept of 'sustainability' dates back more than 30 years. The terms 'sustainability' and 'sustainable' appeared for the first time in the Brundtland Report (1987), published by the United Nations World Commission on Environment and Development. The concept of sustainability is composed of three pillars: Economic, Environmental, and Social—also known informally as Profit, Planet, and People. However, in our 12-year journey towards the facilitation and execution of sustainable buildings and environmental planning, we realized that there is a need to introduce one more pillar to this concept in order to achieve sustainability at the ground level. That 'fourth dimension' of sustainability is – 'spirituality'. Hence, here we would like to propose that the Sustainable Development Goals (SDGs) should include – 1) Economic development, 2) Social development, 3) Environmental protection, and 4) Spiritual awareness. These four pillars of sustainability are not mutually exclusive and can be mutually reinforcing. In fact, the four pillars are interdependent, and in the longer run, none can exist without the other pillars. These pillars have served as a common ground in the formulation of several sustainability standards and certification systems in the building and planning industry.



Ar. Sudipta Singh is Founder, Sustainable Buildings Habitat (SBH), Bhubaneswar, who is instrumental in accelerating the 'green building movement' in Odisha. She did her Master's in Environmental Planning from School of Planning and Architecture, New Delhi. She has more than 12 years of experience in the field of Green Building and Sustainable Planning, including an 8-year tenure at GRIHA and Sustainable Habitat Division, TERI, New Delhi. She can be reached at sbhdesign2015@gmail.com.



Spirituality and Environmental Consciousness

Today, thanks to policy acceptance and public awareness, the budget required to achieve sustainability is no longer a constraint. People recognize the benefits of green building and sustainable planning. Starting from the government to an individual citizen, we all are aware of the concept of sustainability. The financial affordability has increased and the green material supply market is ready. However, we are still struggling to implement and execute the ideas of green building or sustainable planning. There is a huge gap between the commitment on paper and the actual execution. Hence, it proves that even when a society is equipped with adequate economy and skilled labour, it is incapable to ensure environmental protection. Till date, the implementation of

sustainability measures on field has not been significant. In their bid to be 'sustainable', people are either being forced to meet policy regulations or else, they are being driven by commercial gains. The attitude to achieve *true* sustainability is missing because the in-depth understanding of its need and the repercussions of continuing with unsustainable development work have not yet been realized. Therefore, stringent policies or government regulations or even technical capacity building are not the only solutions. Additionally, the most important aspect should be 'spiritual awareness', which will 'transform the soul/ attitude of society'. Our society must be enlightened with the true knowledge of spiritual existence of the self and our eternal relationship with the planet. Spirituality can bring about a paradigm shift in our consciousness to sustain and protect our planet.

In spirituality, there is a deep connection between human life and ecology. Nature has been our provider. It gives us our food, the air we breathe, and the body through which we express ourselves. Nature (*prakriti*) and life (*purusha*) are interconnected: without a healthy nature, there is no way to sustain human life. However, by living in cities built of iron and concrete and run by technologies, we have gradually distanced ourselves from Mother Nature. As a result of our urban lifestyle, we have buried the sense of interconnectedness with our environment. Today, we tend to perceive nature as a commodity to be traded and consumed, rather than respecting or acknowledging her maternal importance as a 'sustainer' of our lives.

Many experiments have proven that our mind and intention of the mind have an influence on our physical reality. The spiritual expression of this law of universe is called 'Manifestation of Thoughts' or Sankalp se Siddhi. This implies, **'Our inner climate creates our outer climate'**. It means, 'there

is a deep connection between our consciousness, thoughts, and actions and their impact on the planet.' It has been observed that any long-lasting change in our social or environmental system starts with a profound shift in the minds and hearts of people. The current pandemic crisis is a clarion call to transform our thoughts, lifestyle, and ways of development. Any shift in individual thought is reflected in society. Hence, to bring stability, resilience, and compassionate action on a global scale, we must adopt the aforementioned 'inside-out' approach. After all, a sustainable planet can be created by *sustainable beings*.

Once upon a time, our planet had an abundance of natural resources and the environment was pure. Slowly, it became unsustainable after repeated and unchecked anthropological activities. When we are unable to live by our values, our self-respect and self-trust are lost, and with that goes our peace of mind, happiness, and good relations with others. Consequently, we become an 'unsustainable' being'. To fill an ever-increasing void, we try to satisfy ourselves by consuming and acquiring more and more, thereby giving birth to competition, greed, dishonesty, and violence. We create divisions, barriers, and prejudices to safeguard what we believe is or should be 'ours'. In doing so however, we suppress our humanity and our ability to be humane—our natural instinct to connect, empathize, and share with others.



“Our *thoughts* define our *attitude*. Our *attitude* colours our *vision*. Our *vision* dictates our *actions*. Our *actions* create our *planet*. Everything starts with our *thoughts* – our state of consciousness.”

Spiritual Awareness and the Way Forward

The source of sustainable thought is 'spiritual awareness', which means to understand the self as a spiritual being, independent of our nationality, belief or status. This understanding brings us back to a deep feeling of brotherhood and belonging, a genuine caring for the common good. This will enable us to change ourselves willingly without reluctance or force. Self-respect, dignity, values, and love will be the prime reasons of the change within us. The current state of our planet is a consequence of the individual and collective consciousness of the human beings. We must realize that the solution to our current problems lies within us.

We have been ignoring the warning signs of climate change for decades. Once upon a time, we used to read

about the statistics and future projections regarding climate change and global warming. But now, we have arrived at a point where nature has already started retaliating. We are witnessing and experiencing the consequences of our '*past karma*'. Hence, the only time for action is **NOW** or **NEVER**...

Sustainability is not only a matter of some policies, summits or conferences, it's a much bigger agenda for every country. Within the paradigm of spirituality, the country's leading green political parties must recognize individual contribution and community participation at the grassroots level and work towards making the global sustainability movement a success story. Therefore, we must strive to integrate aspects of sustainability in all spheres of our life for a better tomorrow.

Source: Sustainability Wing of Prajapita
Brahma Kumaris Godly University

INHERITING SUSTAINABILITY FROM TRADITION AND CULTURE

57
FEATURE

In this article on sustainability and environmental protection, **Mohak Zanwar** discusses the urgent need to look back at our cultural heritage and traditional wisdom to understand the merit of leading a sustainable lifestyle in today's modern, machine-dependent, globalized world.



Mohak Zanwar is Senior Sustainability Consultant at Environmental Design Solutions Private Limited. He has more than eight years of experience in building design optimization. He has worked on projects towards acquiring LEED, IGBC, and GRIHA ratings. He believes that concepts of sustainability can be adopted in daily life and small steps taken by individuals can help reduce the ecological footprint of the country. He can be reached at mohak@edsglobal.com.

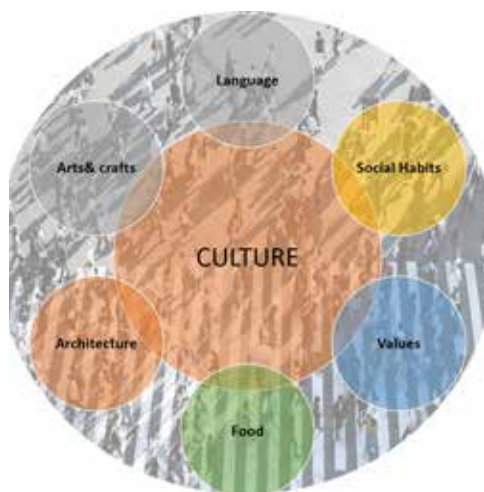
Defining Culture

What is culture? Culture means a way of living. It encompasses characteristic features or traits of everyday existence, shared by a group of people with the capacity for learning and passing on the acquired knowledge to successive generations.

Culture has an influence on language, religion, cuisine, social habits, music, arts and crafts, textile, and architecture. Behaviour, habits, and lifestyle patterns of a human or a community are derived from and informed by their culture. The impact of culture is so natural and imbedded that its influence on human behaviour is seamless.

Culture is the learned behaviour of a community within a social environment. For instance, children acquire and imbibe a set of beliefs, values, and customs from their social environment that defines their culture (Figure 1).

The geographical location and available natural resources also play a major role in shaping any culture and defining the consumption and production pattern of a community.



» **Figure 1:** Components of culture

India boasts of a 5000-year-old culture. Over time, many sustainable practices have been developed and even adopted in our day-to-day lives.

Conservation of nature is rooted in Indian culture. Rivers, mountains, trees, forests, flora, and fauna are considered holy and often worshipped. Therefore, it is considered sin to harm these natural elements. Through mythological stories and spiritual actions, the importance of natural resources is conveyed to humans. All of us are aware of the famous story of Lord Buddha and his way of recycling old cloth. In the story, Buddha's disciple reuses an old robe as a bedcover, the old bedcover is later converted to a curtain, old curtains turn kitchen napkins, old napkins are used as floor-cleaning dusters, and finally, the old floor-cleaning duster doubles up as twigs in oil lamps. This indicates how efficiently resources can be used. The concept of 3Rs – Reduce, Reuse, Recycle – is an integral part of Indian culture, exemplified through Lord Buddha's story.

Sustainable Practices and Indian Culture

There are numerous sustainable practices, which are still followed in our society related to food, clothing, water consumption, etc. This demonstrates our understanding and knowledge of conservation of nature and natural resources. Simple sustainable values, such as switching off lights when not in use, are engraved on our mind from a young age. Respecting food and saying



prayers before meals are taught to children for them to understand the need to avoid wastage of food. Serving drinking water through jugs ensures consumption of only required water. Using earthen pots for cooling water is an energy-efficient practice followed in many households even today.

Many people use cold water for bathing throughout the year, which reduces energy consumption. Fresh food is prepared every day to avoid storage and wastage. There are numerous examples of creative reuse of extra food to avoid wastage. Old clothes are passed on to siblings, clothes are even recycled to make new products, such as thin mattresses, bedcovers, etc. Using old clothes as dusters is common in many Indian households. Traditional Indian attire, such as, saris for women and dhotis for men do not require stitching, dying, and they also do not change with fashion trends. In fact, old saris are used for



sun-drying homemade food items. Commonly used food processing and cooking methods, such as grinding, churning, sun-drying, pickling, which do not use fossil fuels are energy efficient. Use of durable metal kitchen cutlery cut down on waste. Most people in Indian villages use old jute bags as doormats. These are some of the many examples that prove how sustainability and sustainable practices have been an inherent part of our culture and habit.

Understanding Biocapacity

Today, consumption of maximum goods and usage of all available equipment is believed to be an evidence of a successful life. This culture of consumerism has resulted in environmental degradation and over-exploitation of natural resources (Figure 2).

Studies show that India's ecological footprint has exceeded its

biocapacity. Biocapacity refers to the capacity of a given biologically productive area to generate an ongoing supply of renewable resources and to absorb its spillover wastes. Unsustainability occurs if the area's ecological footprint exceeds its biocapacity (Figure 3).

India has the third highest ecological footprint in the world and its resource use is double its biocapacity. The total ecological footprint of India is heavy because of its population of over 1.3 billion people, which is a seventh part of the global population.

Today, there is an urgent need to understand and redefine the meaning of development for our country. Development in the present era is restricted to economic development, per capita income,

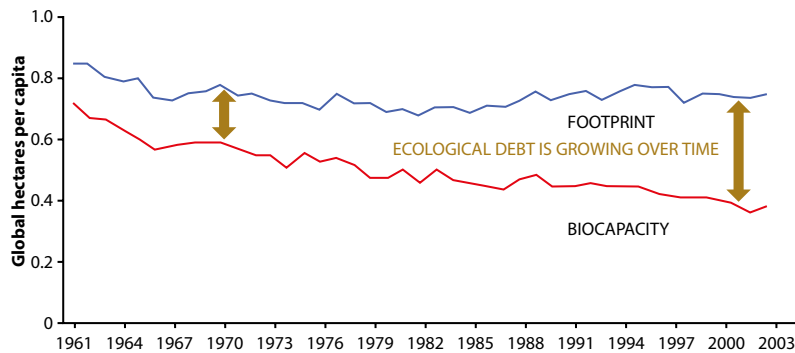
and excessive consumption of goods. However, the idea of development should not be only about materialistic growth, it must mean nurturing an environment where there is fresh air to breathe, clean water to consume, and a green planet to inhabit.

India needs to look back at its rich culture of sustainable lifestyle and efficient consumption practices that were once adopted by our forefathers. Let us have a lifestyle that can strike a balance between our growth and environmental health. Changes in behaviour and habits in terms of adopting sustainable and environment-friendly choices can reduce environmental degradation.

Some of the sustainable practices of our Indian culture are still



» **Figure 2:** Typical view of a supermarket



» **Figure 3:** India's ecological footprint

Source: Network (2008)

practical and can be easily adopted. Adoption of these practices can help reduce individuals' impact on our environment.

1. Food transportation is one of the biggest and fastest growing sources of GHG emissions, worldwide. Consuming locally grown and seasonal food items can reduce the pressure from transportation, minimize packaging storage, and avoid wastage of food.
2. Avoid use of disposable plastic items. Opt for disposable dishes and bowls made of leaves. Choose reusable cotton kitchen towels and handkerchiefs over use-and-throw tissue papers. This reduces waste generation. Use reusable water bottles.
3. Minimize use of showers and tub bath. Adopt a practice to have a bucket bath. It saves and reduces water use by almost 30%.
4. Hand-wash your clothes, this can save energy and water compared to machine cleaning.
5. Give preference to walking over automobile use for short distances. This helps reducing use of fossil fuels and prevents air pollution.
6. Avoid unnecessary printing and minimize the use of paper. This helps in avoiding emissions due to printing. This way, felling of trees for paper manufacturing and generation of subsequent paper waste can be drastically reduced.
7. Think wisely before discarding any reusable waste. This helps reducing landfill volumes.
8. Refuse plastic shopping bags, instead, carry a reusable bag of your own for shopping.
9. Set the higher cooling temperature of your air conditioner at 24°C instead of 22°C. This saves 6% to 8% of electrical energy.
10. Maximum use of daylight over electrical lighting is most beneficial and energy efficient.

Need of the Hour

Modern India has clearly understood the impact of our lifestyles on the environment. Many new start-ups are working towards making our planet a better space to live.

Once such example is a start-up in Hyderabad that manufactures edible cutlery. These cutlery items do not turn to waste as they are edible. This helps reduce waste generation and could be a sustainable alternative to single-use plastic items. Also, there are start-ups which have reintroduced leaf products in the market, such as dish bowls and spoons. For instance, Aarohana EcoSocial Developments is a social enterprise that has initiated the process of upcycling waste plastic into beautiful handcrafted fabric by using the traditional charkha and handloom. There are many examples of such sustainable products that are easily available and can be adopted in today's modern lifestyle.

A country like India, which has a rich culture of a sustainable lifestyle, has to adopt a different path of development than other developed countries. India needs a cultural shift and an overhaul in the mindset, which will take us back to a value system gifted to us by our ancestors. This value system will help us look at our environment as a source to nurture, not as an object to consume. Therefore, we must adopt a lifestyle that will encourage us taking from nature only that much as nature can regenerate.

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URBAN RESILIENCE, INSPIRED BY NATURE

The Value of Biomimicry

Is there a disconnect between humans and nature today? In this article, **Asha Singhal**, **Deborah Bidwell**, **Jamie Miller**, and **Johannes Fuchs** discuss the concept of biomimicry and how it can bridge the gap between humans and nature. The real success of biomimicry, they say, is when human designs learn to function like thriving ecosystems and create conditions that are conducive to life.



Asha Singhal is the Executive Design Lead at Biomimicry Frontiers. An architect specializing in Biomimetic designs, her mission is to bring the genius of nature to our built environment while experimenting with emergent technologies and their relationship with our habitats. She is also the Research Advisor at Biomimicry Academy. She can be reached at asha@biomimicryfrontiers.com.

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"I would feel more optimistic about a bright future for man if he spent less time proving that he can outwit Nature and more time tasting her sweetness and respecting her seniority."

–E.B. White

Let us reflect on the city. The urban lifestyle has framed our development and conceived new waves of creativity, culture, and community. It masquerades as a fortress from the harshness of the natural world while remaining exceptionally vulnerable to it. And while the best by-products of our

urban spaces result from their diversity and communal attributes, our city's greatest failures are derived by their lack of cooperative design.

From afar, we see the city as one operative place, and give it one name. This view could not be farther from reality. Our cities are

made up of assemblage of isolated components: systems, spaces, buildings, transportation elements, all working parallelly to provide a sense of limitlessness while competing for a variety of resources. Can we strive for something better?

Imagine a city that's self-sustaining, one that produces its own food while nourishing the ground it rises from, where waste becomes a resource. A city that manufactures its own materials at ambient temperatures and pressures, and runs on sunlight without the need of fossil fuels. This city is adaptive and responsive to information and resilient to systemic disruptions, thriving and pulsating with diversity.

The blueprint for our cooperative, regenerative, optimized city already exists. Replace each mention of the word 'city' above with 'forest' and the pieces of the puzzle start falling into place. The millions of species alive today, embody adaptations and deep patterns that result from research and development spanning 3.8 billion years. They represent time-tested, sustainable solutions to the same challenges we face today as humans. We only need to apply nature's blueprint.

As a civilization, we have spent tremendous energy in fighting entropy and building ourselves outside nature, creating separation between ourselves and the natural world that sustains us. That disconnect of humans from nature only perpetuates our energy demand as we input time, money, and resources into conserving an unnatural system.

The world's natural capital and ecological services already supply more than enough to sustain our needs, accounting for an estimated US\$33 trillion¹ and yet, our destruction of these services has led to more waste, chaos, disharmony, and despair.

Climate change is a generational challenge and threat multiplier having been voted the biggest problem by millennials for the past three years. Resilience literature refers to these as wicked problems, where facts are uncertain, stakes are high, decisions are urgent and multiple values are in dispute. What makes climate change so

difficult is that it requires new ideas, paradigms, and new ways of working together.

This is where biomimicry has value. Biomimicry is innovation inspired by nature. It invites us to look to nature as a model and mentor for how to thrive on this planet. It recognizes that nature's forms, processes, and systems are the evolution of four billion years, which can teach us about regenerative resilience.

Deeply rooted in biology and interwoven with both indigenous and emergent practices, biomimicry is an interdisciplinary field at the confluence of engineering, business, education, architecture, and social innovation. The biomimicry design process is guided by function; seeking nature's advice on 'how would nature do this function?' in context to identify natural mentors that have found solutions to those challenges. Biomimicry practitioners look at nature as a model, measure, and mentor, which means they learn from nature as much as they learn about it.

Practically, Biomimicry Frontiers has used biomimicry to disrupt traditional notions. In India, for example, we used our 'biodata' methodology to find more efficient methods of cooling a building. The key to these biodata sheets (Figures 1a, 1b) is knowing which function (passive cooling) should be solved. Inspired by elephant skin, barrel cactus ribbing, and termite mounds, processes became more self-reliant and less wasteful. The real success of biomimicry is when human designs learn to function like thriving ecosystems and create conditions that are conducive to life.

Unlike engineering resilience, which focuses on static state, nature works in dynamic non-equilibrium where

disturbances constantly push the system away from the static state. In order to thrive in such conditions, nature changes at multiple scales, and allows release (e.g. trees falling) for reorganization. It is a system of safe failure rather than fail-safe. The following represent key principles we can learn from the adaptive cycle of nature.

Create a culture of experimentation

Encourage small-scale, iterative release to promote creativity, innovation, and problem solving by deactivating fear of failure. In nature, regular cycles of disruption create opportunities for innovative rebounding as resources are freed up to re-enter the system in new ways. Summer leaves return to the soil during fall to fuel next season's cycle. What might this look like in a city?

Leverage existing assets and reconfigure them in completely new ways

Like all lifeforms, 96% of our bodies are composed of just five different elements (carbon, hydrogen, oxygen, nitrogen, and phosphorus); in contrast, a mobile phone is made of 75 different elements, all of which are hard to separate from one another, eventually ending up in a landfill. In which areas can we direct our cities to develop their own evolutionary innovation by reshuffling the possibilities?

Acknowledge biases and embrace creativity, heterogeneity, and uncertainty

Although organisms are frequently exceptionally well adapted, there is no such thing as being perfectly

¹ Costanza, R., d'Arge, R., Groot, R., Farber, S., Grasso, M., Hannon, G., Limburg, K.E., Naeem, S., O'Neill, R.V., & Paruelo, J., Raskin, R.G., Sutton, P., Belt, M., and Belt, H. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387(6630): 253–260. Details available at <http://dx.doi.org/10.1038/387253a0>



» **Figure 1a:** Biodata sheets by Biomimicry Frontiers

adapted because the only constant is change. Our planet is in perpetual, dynamic non-equilibrium and life runs on a tight energy budget. Thereby, there are fitness trade-offs when it comes to evolutionary change: the tallest trees in the forest capture the most sunlight through photosynthesis, but also risk falling over more easily in storms. We must optimize within our energy budget – choosing between an investment in growth or strength, as trees must, because the energy to do both is not available.

Embrace diversity: incorporate multiple layers and decentralization

Nature favours diversity within the specific ecological roles that species play through niche differentiation. In this way, cooperation is favoured as it is much less energy-expensive than competition. In natural systems, redundancy in the general roles that species play in the ecosystem (producer, consumer, decomposer) act as system back-

ups. This way, when one part of the network is down, another form can take over its functional role. There are no monocultures in nature, diversity and decentralization are requirements for healthy ecosystems.

Encourage self-organization: building from ground up

Slime molds self-organize without a brain. Trees grow at their tips adding strength where needed and thinning where not. Nature has a way of being ever-changing, self-renewing with constructive manufacturing, and zero waste. Phenotypic plasticity allows for flexibility in growth accommodating changes in the environment during the tree's lifetime. Self-organization of social superorganisms – insects, ants, bees, for example – helps make wise group decisions without a central leader or top down structure. Simply, this can be translated into local interactions at small scales to promote emergent patterns.

Avoid short-term thinking and move beyond conservation

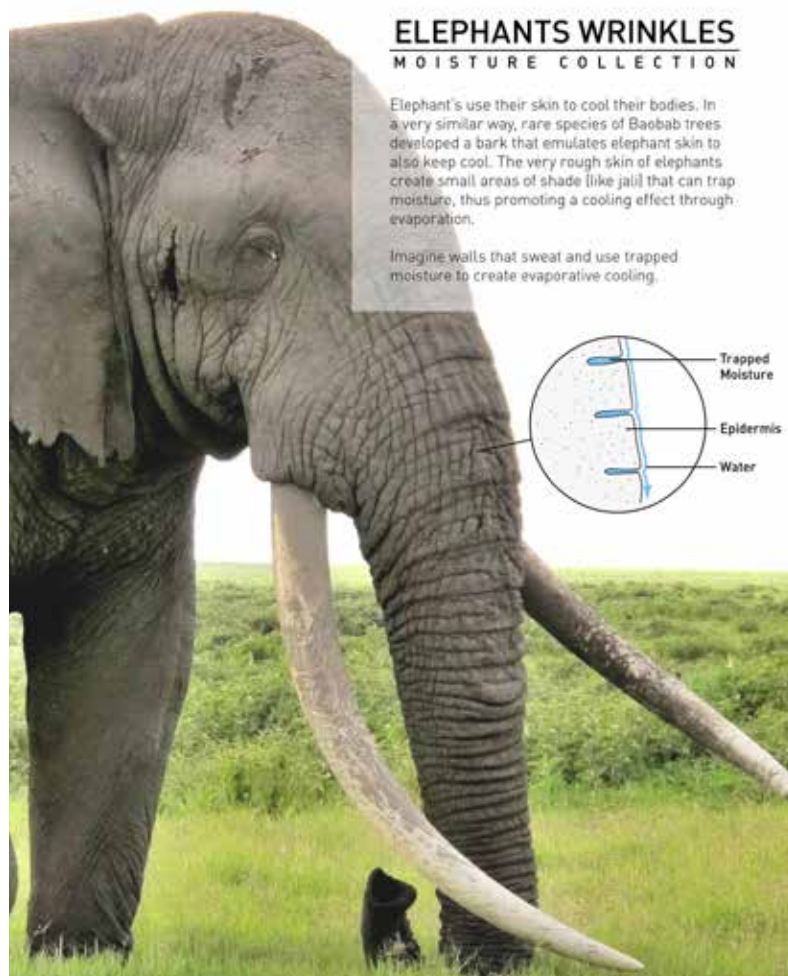
We can learn from both nature and indigenous teachings by adopting a '7-generation' mindset in which we start making decisions that support more life, over the long haul. A key element is to release ideas, behaviours, and technologies that are no longer relevant or serve the goal of creating more life. A defining factor for humans is our ability to harness stored energy (e.g. fire) to conserve systems past their life. The challenge, however, is that the longer something is held beyond its time, the larger and more extreme its potential failure.



Incorporate multiple layers and frequency of feedback

Nature is nested and interdependent, making it more resilient to environmental

pressures. Homogeneous systems, like monoculture agriculture are vulnerable because one pest or bad season can take out an entire crop. Through redundancy and diversity, nature can absorb more



» **Figure 1b:** Biodata sheets by Biomimicry Frontiers

environmental pressures and dissipate 'unforeseen' gradients.

The nested nature encourages constant feedback between layers. Our bodies are made up of genes embedded in cells, within tissues within organs culminating in organisms. Through feedback, these nested autonomous systems use information – rather than material – to ensure that the overall system is working.

Cities are ecosystems

Combining age-old indigenous wisdom with emerging technologies, embodied in the philosophy of living in harmony with nature gives us the opportunity to realize our vision of the future.

Urban ecosystems are a complex emergent web of dynamically interconnected systems spread over vast scales. Urban areas suffer from disrupted resource flows (hydrology, energy, biodiversity), and fragmented natural habitats, making them vulnerable to systemic disruptions.² In contrast to cities, elements within natural systems exist harmoniously while embodying greater complexity. If our cities begin behaving like these complex natural ecosystems, our planet can begin healing.

At Biomimicry Frontiers, we're working towards creating and sharing a synthesized compendium of principles of resilience from nature to the benefit of our cities and our forests.

² Alberti, M., and J.M. Marzluff. 2004. Ecological resilience in urban ecosystems: linking urban patterns to human and ecological functions. *Urban Ecosystems* 7(3): 241–265.

THE CARBONLITES STORY

In 2008, after a 34-year career with multinational companies such as Procter & Gamble (P&G), PricewaterhouseCoopers (PWC), and International Business Machines (IBM), Kevin Houston enrolled for a Master's programme in Carbon Management at the University of Edinburgh. In the University, he met the future co-founder of Carbonlites, Som Narayan, an environmental engineer, who had come to Edinburgh from Bengaluru, India. In 2009, on the graduation day, both the friends decided to form Carbon Masters UK with a mission to address the issue of climate crisis. They began by advising clients on how to measure their carbon footprint and then to reduce it by using energy efficiency measures and investments in renewable energy.



Their clients included Edinburgh University, the European Commission in Brussels, several local authorities, the Edinburgh Airport and other international clients in Europe and Latin America.

biogas, purify the gas, and bottle it into cylinders. At the outset, they wanted to sell the gas as a backup power source and as an alternative to diesel for telecom towers. In this regard, they designed specific cascades and cylinders in a unique 2-cylinder and 4-cylinder format that would be suitable for telecom towers. In 2014, the company was ready to begin testing these cylinders. However, the price of diesel back then was still available at a subsidised rate of INR 46 per litre, which posed a challenge to their business model. Meanwhile, LPG (used for commercial cooking) had reached an all-time high of INR 108 per kg. So, they decided to test the biogas in a few restaurants under the brand name Carbonlites.

In 2012, Som Narayan returned to Bengaluru and set up Carbon Masters India Private Limited with the hope to replicate Europe's success story. However, in 2012, there was little interest among clients in India to measure their carbon footprint. So, the company offered solutions that could mitigate GHG emissions. After several iterations, they came across a defunct biogas plant just outside Bengaluru where a chicken farmer had invested in a biogas plant with a bottling unit but had been unable to operate the plant let alone sell the products. So, Carbon Masters took over the plant and for the next 18 months, the team worked on learning how to operate a biogas plant, produce raw





The results were favourable. Chefs loved cooking with the fuel developed by Carbonlites as it helped them cook at a constant pressure unlike LPG where the pressure drops with the use of cylinders. With the use of biogas, these restaurants made savings between 10% and 15%; and being

carbon neutral, the use of biogas prevented carbon emissions. Additionally, a process for taking the digestate slurry from the anaerobic digestors and converting that into a nutrient-rich organic fertilizer was developed. This fertilizer was then sold to farmers under the brand name Carbonlites. Such a process yielded excellent results.

Beginning with the original pilot plant, Carbonlites has come a long way. Today, it operates five bio-CNG and organic fertilizer plants across two states. Two of these plants are in partnership with Mahindra & Mahindra Limited. Both Kevin Houston and Som Narayan are on a mission to expand Carbonlites across India. In 2018, WWF India felicitated the company with the prestigious Climate Solver Award and it was established that Carbonlites' technology has the potential to save about 28 million tonnes of GHG emissions globally by 2030. So, expanding Carbonlites would not only help India clean up the garbage in its cities, but also provide clean fuel with applications for transport, cooking, and backup energy sources. This in turn will help farmers improve soil health, crop yields, and their income.



DANIEL CHRISTIAN WAHL



Daniel Christian Wahl originally trained as a biologist, and holds degrees in Biology (BSc Hons, University of Edinburgh), Holistic Science (MSc, Schumacher College) and Natural Design (PhD, University of Dundee). He was the director of Findhorn College between 2007 and 2010, is a member of the International Futures Forum and H3Uni, an advocacy partner of r3.0, and on the advisory councils of Ecosystems Restoration Camps, Commonland, the Ojai Foundation, Future Planet Europe, the Centre for the Future and the Overview Institute of Australia. He is also a Findhorn Foundation Fellow.

In this conversation with GRIHA Council, Daniel Christian Wahl shares insights into regenerative cultures, traditional ecological knowledge, biomimicry and its connection with regenerative economy, eco-literacy, and more.

*For the complete interview, please visit:
<https://youtu.be/aH8o3sky4oI>*

GRIHA:

*In 2016, your critically acclaimed work **Designing Regenerative Cultures** was published. Could you describe for our readers in India what it is about and the future you envision for our species? What does one mean by regenerative cultures?*



The book is the result of 15 years of working in the space of sustainability, and doing a PhD in 2006 titled 'Design for Human and Planetary Health: A Holistic Integral Approach to Complexity and Sustainability'. And then between 2006 and 2016, when the book came out, trying to implement that systemic scale – linking the vision of how we can refit the human presence on earth into the planetary boundaries, with its social foundation. Kate Raworth's Donut Economic Model is a good way of visualizing that we need to not just work on ecological issues, but we also need to work on socio-political issues to enable a response to the ecological issues.



The book is basically focused on questions rather than answers and solutions, because I believe that in each place, in each cultural and ecological context, a regenerative culture will manifest differently. For me, a regenerative culture is a culture that is consciously building the capacity of everybody in a particular place to respond to change and accept transformation as something that life just 'does'. And we need to get away from this idea that we can plan a sustainable future on a drawing board, then implement it, and then everything will be fine forever after. It's a journey – we will never arrive. On that journey, we just have to keep asking the right questions and keep adapting our solutions and answers.

Our role is to be in service to that higher life process going on into the future. And that's also coincidentally the best way of working for one's own self-interest because the self and the world are not separate. Nature and culture are not as separate as the occidental worldview has made us believe. The Vedanta is full of this wisdom. In many ways, regenerative culture isn't something new – it is about remembering the inheritance of our species' long history. For 200,000 years, we have been bio-regionally adapted cultures that tried to manage or work with the ecosystems they inhabit. The relationship we have now with land – that we own the land, is not an indigenous relationship. The indigenous relationship is the other way around. We are expressions of the land. The land owns us, and I think humanity will not have a viable future if we don't come back to those insights.

GRIHA:

With regard to what you just said about Indian culture, I've noticed that you often mention TEK – Traditional Ecological Knowledge – in your talks and writings. In India, tribal and aboriginal communities regularly find themselves at the losing end of capitalism – they are displaced and have their traditional ways of life permanently taken away so that infrastructure can be built and coal can be mined. What do you think we could learn from these communities, and how could we begin to reconcile their ways of life with the larger global economy that we are all part of?



I think it's an important question, but it makes one assumption, which is that they need to be integrated into the larger capitalist economy that we exist in, as you just said. And maybe, the question is – what do we need to redesign about capitalism so that it is actually inclusive and serves all people and the planet? Some people will say there are basic assumptions in capitalism that will make it hard to actually be regenerative within a capitalist system as we understand it now. We cannot continue a system that is based on the necessity for continued economic growth. The current monetary and economic system is structurally dysfunctional and is driving us to exploit people and our planet. And it needs to change whether we call it capitalism or something else. COVID-19 has shown us how brittle large international supply lines are and climate change is now so urgent that we have increasing global alliances that understand the necessity to not only move towards zero carbon, but basically to not burn all the carbon that is still in the ground. We are moving towards a future that has less energy, more people, and we need to shift our entire material culture within the lifetime of people alive today – within the next two or three decades.

And in that transformation, the ancestral knowledge held by people who still have a connection to how this place has changed over millennia will be essential. It's not purely scientific data, it is much deeper than that. Scientific data has a bias towards only recording what is quantifiable, but narratives about place can

include the qualitative changes, the much more subtle relationship changes that people have tracked over generations. I think that's knowledge that is going to be vital if we try to build a global collaborative system that enables people everywhere to meet their needs within the bio-region they live in. I think if we want to preserve the biodiversity that still exists and create landscape scale initiatives that heal places, we need to also re-regionalize economic power and political governance. So, we need a shift towards subsidiarity where people in a place have more of a say on what is happening in their place. And not just the indigenous people, but everybody in a place needs to have the sense that their opinion and their voice and their contribution count, because otherwise, we won't get the kind of participation in this massive transformation that we now need to do.

GRIHA:

Where do you think the challenges could be in shifting towards a more regenerative society in a country such as India, where the aspirations of the government and the populace as a whole are often to 'catch up' to the living standards (and by extension, consumption patterns) of the developed world?



The whole vision of what is poor has been coming in as part of the insidious idea that there are developed and underdeveloped nations. Indian history and the Vedanta have much more development to give to the future of humanity than 200 years of Newtonian science, fancy technologies that ultimately have also created a lot of destruction on the planet. And of course, now our challenge as humanity is how do we marry the best of modern science and technology with the wisdom that is in the Vedanta that is in the old lineages of Sufism that is in the world's wisdom and traditions that hold a relationship between us and life? The notion of 'seva' (service) is central to the survival of humanity.

I think that India holds a key to a better future for humanity, but not if it thinks it needs to go the path of Western industrialized cultures. I think this image is also crumbling – everybody wanted to be like America. Look at America now – who wants to be like America, if you really understand what's going on there? I think you need to celebrate the wisdom of Swaraj and all the impulses that Gandhiji gave to the world. We can still learn so much. India is an amazing example of how to collaborate and build social cohesion, do healthier agriculture, and protect the land. The work of Vandana Shiva is a critical conversation that the whole world needs to learn from about saving our biological diversity and making it impossible for large corporate agribusiness to own the seeds that farmers need for their survival.

GRIHA:

I think that's a very thought-provoking message to send out to our readers. Could you share with us some more insight into how you got started on this path of designing regenerative communities, how you practise it, and how you've explored the idea through your book?



We need to really come back to community, come back to place, and into our local uniqueness. One theme that runs through my book are the questions that I ask in almost every chapter, instead of ending with a sort of summary of the conclusions of that chapter. Very often, when I speak about somebody else's work, who might've created a list of 10 bullet points of what you need to do, what I do is I turn these 10 bullet points into questions. And what happens then is rather than telling people what to do, I'm asking people in a place, in their context, to ask themselves the question, "Is this relevant to me? And if it's relevant to me, how is it relevant to me?" So, these are loaded questions. They've got guidelines in them, but they are asked as questions. Because if I ask you a question, I'm asking for your participation, your engagement, your contribution. If I tell you a principle of 'these-are-the-10-things-you-need-to-do' in order to be regenerative, I'm just asking you to jump onto some bandwagon. For me, the process of creating regenerative cultures is the process of living these questions together in community with focus. We need to always be aware of how our local project sits in our region within the wider national or subcontinental context. And then the global context.

Since my book came out, I've basically done a lot of work on social media, promoting this invitation for people in place to engage with this process of how we can transform our impact here in this place to be regenerative

rather than destructive. How can we take responsibility that this river system, this ecosystem that we have in front of us will be more bio-productive, healthier, and more diverse in the future than it was when we received it from our parents? And that I think is the journey we all need to go on.

GRIHA:

Could you tell us about the connection between bio-mimicry and the regenerative economy? What role could biomimetic design play in reshaping the idea of development in emerging economies such as India?



I'm originally a biologist. And as I said earlier, I believe that one of the core upstream organizing ideas that drives a lot of unsustainable patterns downstream is a conceptual belief that somehow nature and culture are separate, that somehow, we as human beings have become different from nature. That through our technologies, we are outside of that system and nature is just a resource base. If we really want to work regeneratively, we have to understand that we are expressions of life, and that life is a planetary process, as well as a process involving lots of different species and individuals. Learning from life's patterns by mimicry is a discipline that has been around for decades. Initially, it was called Bionics and then Janine Benyus in the late 1990s, wrote a book called Biomimicry and she has done wonderful work all around the world, promoting innovation inspired by life and other species. She always distinguishes that you can do this either at the product level, the process level, or at the systemic level. And so far, a lot of innovation has happened in that space – energy-efficient and faster trains based on the beak of a kingfisher, creating more efficient windmills inspired by the little bumps that are on the front of a humpback whales fin, etc. That's a biomimetic innovation that saved lots of fuel and with that, avoided lots of CO₂ emissions. But for me, the real amazing work of biomimicry is at the last level, which is the more complex level, where we understand how ecosystems function, how the complexity of ecosystems works, and then try to fit in our human patterns into this systemic biomimetic design, where we reframe the issue of climate change away from the current carbon myopia – that everything needed to solve the climate change problem is about reducing carbon emissions and getting to net zero carbon by 2050. It's a laudable and useful approach and we should continue to do so, but the danger with it is that we become myopic. All our decisions about climate change are about carbon, but there's a growing number of scientists around the world who say you could just as easily and probably more effectively and systemically start with water and heal the hydrological cycle place by place, which brings us back to a bio-regional approach which is what I'm advocating and believe would be the path towards a sustainable future.

GRIHA:

How would you say the building design and construction industry specifically might play a role in addressing the interconnected social and ecological crises that we're facing today?



The job that I think we have ahead of us is the retrofitting of existing infrastructure in a way that it's a lot less energy intensive and that it's still

functional in the future we're moving into. And of course, with the pandemic, the trend of increasing urbanization might well take a different turn – people might realize the danger of living in high density environments. Also, as part of reintegrating, some of these mega cities might be too big not to fail, they might have to shrink in the long term over the decades. But to reintegrate them back into their region, we need to make the cities the economic drivers and reconnect them with their surrounding bio-region, and also bring nature back into the cities to address heat island effects. We need to bring a lot more urban agriculture and trees back into the cities instead of putting more air conditioning units. We need biomimetic design at ecosystem level to redesign our cities so that they can naturally cool themselves rather than being dependent on energy for cooling. And, and of course, they're in the built environment space. There are lots of certification schemes, such as that administered by GRIHA, that are trying to minimize the impact. And that is a great first step to start on the journey for a conventional construction company, then pushing the envelope beyond that – planning with developers in a sensitive manner that unlocks the battles between local communities and large-scale developers successfully, making them realize that they're working together for the future of a place with a shared vision.

GRIHA:

What advice would you have for people working in the sustainability sector in India – especially young people who are just starting out and are looking to play a meaningful part in the transition to a more sustainable, regenerative, and circular economy?



If we want to build capacity for people in place to make a difference, collaborate in healing the place in a way that serves everybody in that place. Then we need to change education from this model that the first third of your life you do education, then you work and then you retire, which is only a privileged model. Many people can't afford to retire ever, it is an old model that has never reached all of humanity and it's unlikely to continue. The world is changing so fast that we need lifelong learning, continuous learning. American social anthropologist and intellectual Joseph Campbell once said this wonderful phrase that what happens when you do that, you end up getting to the top of the ladder and then you realize it's leaning against the wrong wall. And that's what I would advise young people not to do. Don't get onto that ladder because it's leaning against the wrong wall. There are wonderful projects all over. I work with an organization called Gaia Education that does a free introductory course on a whole systems approach to sustainability. And then do in-depth courses. These are face-to-face courses. Many of these have been taught in India – in Auroville and Odisha.

But I know that a lot of people don't have the privilege of being able to travel all over India to take courses. So, you can also learn from your local farmers and your local community. But educate yourself diversely rather than becoming a specialist. Because since we don't know what the future holds, if you have a lot of skills, you can always adapt. If you are a genetic scientist who only knows about the beta chain in the haemoglobin molecule and how it folds, and you know more about that than anybody else on the planet, you might still be out of a job in the future.

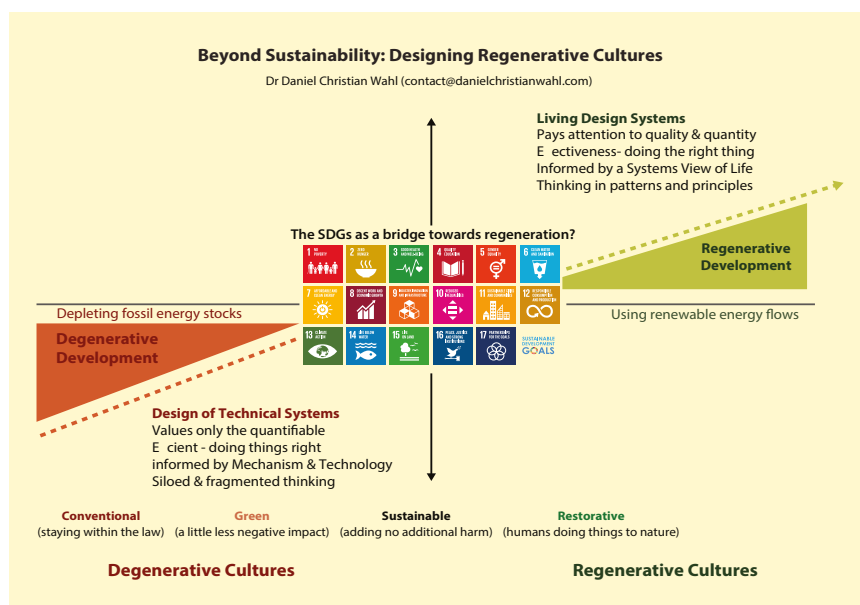
GRIHA:

What can be some of the strategies to build capacities and promote discourse around 'eco-literacy', especially in developing countries?



I do observe that there is a movement that I think could go two ways. If it's coming back to the wealth of ancestral knowledge held within the Vedanta and the Bhagavad Gita and within Hindu culture, (then we must) celebrate the times of India's culture, where religions lived peacefully together and co-created together. I think that the world is hungry and needs the wisdom that is held in the past of India. But if it leads to division, then it could be dangerous.

A friend of mine, the former CEO of Gaia Education, has this beautiful line that she says – "Creating your future without knowing your history is like planting cut flowers." In India, there's such wealth of revisiting the Bhagavad Gita and Vedantic texts, and with the knowledge of modern ecology and modern science, we are talking about the same knowledge we had two-and-a-half thousand years ago, but said in a different manner. We need to value this ancient knowledge and bring the old and the new together. There could be an inspiring movement happening in India that is uniquely giving India's gifts back to India and to the world.



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A Site-responsive Approach



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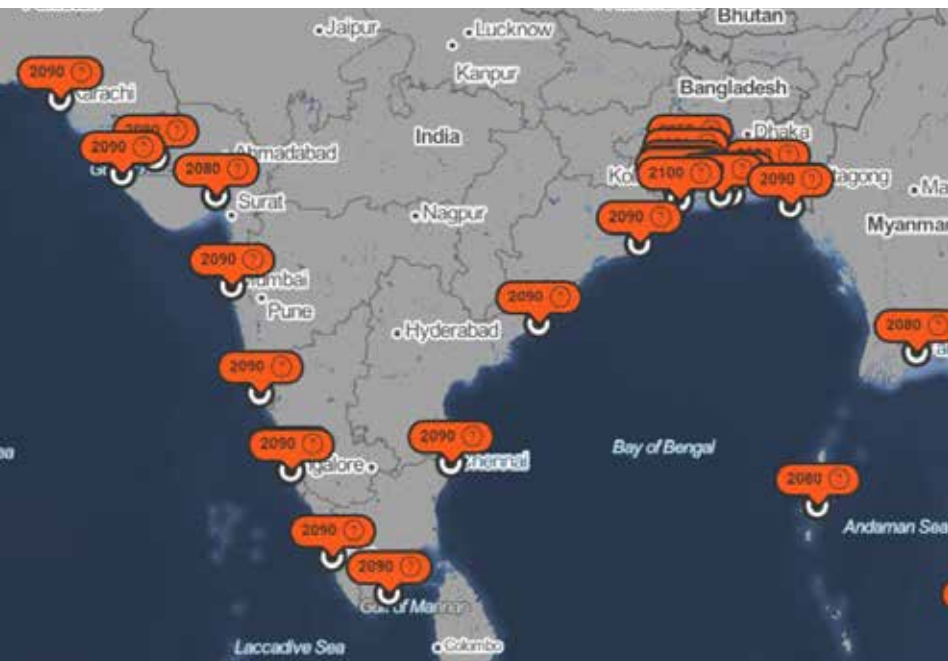
The frequency of natural disasters and calamities has increased over the last few years. What happens in the aftermath of cyclones and floods? In this article, **Gurleen Kaur** foregrounds the plight of marginalized fishing communities of coastal areas for whom 'relocation' in the guise of 'rehabilitation' often means displacement from their own soil.

Climate change and its associated risks have an unprecedented effect on oceans and ice-filled regions. As stated in the 2015 Paris Climate Agreement, if countries are unable to restrict their emissions 'well below' 2°C, sea levels are estimated to rise 1.1 metre globally by 2100. The current projections indicate that the rising sea levels will cause plausible damage by putting the coastal areas at risk. In Figure 1, the markers show where and when the sea level rise will reach 1.1 m if the current climatic conditions go unchecked.

CLIMATE CHANGE AND COASTAL HABITAT

Climate change and alterations in global temperatures have affected the recall period and the frequency of natural hazards. The storms, which were predicted to happen every 100 years, are now happening every five years. Hence, we cannot solely rely on our past to guide us to combat future risks. The solution lies in not just sustainable development but rather in building resilience especially to climate change and natural disasters. The true success of resilience lies in adapting to changing landscape and climatic conditions by transforming the habitat to overcome challenges posed by climate change and extreme weather events.

The coastal habitats lie on the interface of land and water. In March 2019, as per a study titled, 'On Lower Manhattan' conducted by New York City Economic Development Corporation (NYCEDC), there are two



» **Figure 1:** Sea-level rise risk zone map of coastal areas

types of climate hazards to which coastal settlements are exposed and they are listed as follows:

Chronic conditions: These include sea-level rise, rise of the groundwater table, tidal inundations and loss of local ecosystem.

Isolated events: These include isolated climatic disasters, such as storm surge, high precipitation, and heatwaves.

These conditions can create both immediate and long-lasting stress on the urban system.

THE INDIAN CONTEXT

When we put these in the context of Indian coastal settlements, we observe that India has been witnessing more intense and frequent climatic events and climate-induced natural disasters in recent times. Intense cyclones such as the Fani, Amphan, and Hudhud along with other severe floods have caused massive devastation to the coastal states of Odisha, Andhra Pradesh, Tamil Nadu, and Kerala.

But the most critical impact of coastal disasters has been on the urban poor and the marginalized fishing communities. Statistics show that almost 4814 villages were destroyed by Cyclone Hudhud; 16,000 villages were impacted by Cyclone Fani; and at least 9833 villages of Puri district were affected by Amphan. Consequently, the already struggling marginalized communities are being adversely affected by the additional stress of natural disasters and climate change caused by the urban sprawl and activities in the cities.

SOLUTIONS

Let us take a closer look at the solutions that the state and central authorities are providing to these affected areas. They broadly focus on structural measures with a standard solution that is supposed to 'work for all'. While some solutions such as construction of sea walls and relocation possibilities might work well for cities, these would not

be the best fit for marginalized or fishing communities, who are residing in these areas. These fishing communities have a way of life built around the sea. The villages are often formed out of hamlets. Different fishing and farming communities have cultural ties, annual festivities, and traditional lifestyle, which must be understood and respected. As per a research study conducted by the Indian Institute of Human Settlements on the fishing villages of Vizag, it was observed that the villagers were apprehensive to the solutions of relocation. Their unwillingness to move was due to their fear of displacement from their way of life and livelihood. They are often re-instated in apartments, which are almost 1.5 km away from the coast. These regimented pre-fab and RCC structures are in complete contrast to their homes (Figure 2). During my research-based on-site analysis, precedent and theoretical studies of these communities, three



» **Figure 2:** Conical house of fishing village

critical criteria emerged to create a more site-responsive approach for resilience building. These are listed as follows:

Understanding the context: 'One solution that fits all' approach is not always successful for traditional fishing communities. We must understand their cultures, livelihood needs, and the imminent threats through an in-depth assessment of the site and its social infrastructure.

- The use of technology in the form of GIS for future projections and on-site surveys can provide useful information to understand the context better.
- The vulnerabilities and impact of climate change vary for each site and hence they need custom solutions, e.g. constructing sea walls and broad walk could work for a coastal city like Vizag or Mumbai but the same could be disastrous for a village like Pudumadaka (Andhra Pradesh), which is surrounded by water on all three sides. In such a scenario, the diverted seawater from sea walls might cause flooding by getting inland from elsewhere (Figure 3).
- Other crucial aspects include the traditional settlement pattern and



» **Figure 3:** Google Earth showing location of Pudumadaka village



» **Figure 4:** Kirinda House prototype by Shigeru-Ban

basic housing unit for a residential community. The settlement in cyclone-prone areas should have clustered layouts nestled in tree cover.

- In terms of provisions for resilient homes to fishers, it is not advisable to completely disregard the traditional spatial planning by providing the affected community a regimented pucca house with no scope of customization. We need to look into solutions that would incorporate incremental planning, resilient construction methods, and locally available material, for instance, the housing by architect Shigeru Ban in Tsunami-hit Sri Lanka is a case in point. He used compact earth blocks, local rubber plant wood along with a layout, which was sensitive to the locals' way of life (Figure 4).

Green infrastructure: The built infrastructure can be part of a layered defence but the most effective and long-term solution lies in strengthening the green infrastructure. The local landscape, topography, drainage pattern, flora and fauna of the site can provide insights into managing flooding and tidal inundations.

- Trees are an integral part of the fishing community's culture. They not only provide shade in a tropical climate but also serve as the first line of defence against storm surge. They hold the soil together and prevent unnecessary erosion. The fishers use trees like palm and coconut for repair work, making thatch and boats. Thus, the local vegetation and landscape patterns must be understood, as villages and community are shaped around them.
- Mapping of the past green cover and contours of the site can give an insight into the infill development and the changing shoreline.
- The green cover lost due to development or past disasters can be rebuilt using mangrove engineering and tree plantations. Mangroves can strengthen the shoreline and buffer the impact of waves.
- The settlement should find ways to adapt to the seasonal conditions by making use of the changing shoreline and climatic conditions. A fine example of this is the village of Majuli, Assam where the locals have adapted

their livelihood and homes to accommodate the seasonal variation of river's floodplain. During monsoons, the locals use the rise in the water level of the river for fishing and in dry seasons, when the level dips, the floodplain is used for farming and growing paddy (Figure 5). This is how communities have created an adaptive relationship with their surrounding by engaging with the local landscape and climatic conditions.

Layered defence: This approach helps in creating multiple shields in the face of disaster and chronic stress. Resilience building is about emancipating the existing urban system while also preparing for the worst.

- Layers of defence like the primary defence of bio-shields and dunes along the coast followed by strengthening the inland infrastructure of roads, storm-water drains can help in making the urban system resilient.
- Civic amenities such as schools and community centres have the potential of being used as multipurpose shelters. Such amenities scattered over the village versus one designated shelter could prove more useful in mitigating disaster risks.
- Provision of retention ponds and constructed wetlands for



» **Figure 6:** Tanners park, urban wetland of Oregon

storm-water drainage can be vital 'blue infrastructure' in managing flooding due to high rainfall or tidal inundation (Figure 6). For instance, Tanner Springs Park in Portland, Oregon is a constructed wetland that manages the storm-water drain of the city.

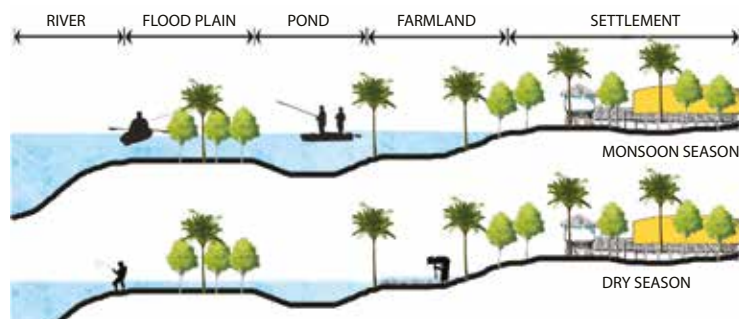
CONCLUSION

It is important that the social acceptance and needs of the fishing community are honoured. The need of the hour is to involve and engage local communities and authorities to understand the threats and vulnerabilities of the settlement and then build upon their plan of resilience. The focus of these efforts should primarily be on protection,

restoration, and sustainable management of natural resources while strengthening local capacity for climate adaptation with least amount of impact on ecology.

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» **Figure 5:** Section depicting seasonal activities of people of Majauli

THERMAL COMFORT FOR ALL AND BY ALL: PASSIVE COOLING AND PARTICIPATORY ACTION

In this article, **Neesha Noronha**, **Shruti Saraf**, **Vinita Rodrigues**, and **Vivek Gilani** discuss 'thermal discomfort' in tropical Indian cities and highlight the inequitable energy distribution propagated by air conditioners. They highlight how the climate chaos fuelled by ACs affects marginalized sections and draw attention to the need for 'intermediate technologies' to address thermal comfort requirements and reduce dependence on ACs.

'Informal settlements' is a term that obscures the systemic injustices engulfing low-income communities in urban areas. Instead, referring to them as 'marginalized' acknowledges our complicity in a system that favours the affluent at the cost of these communities who often serve our needs and wants, as they struggle for their own human rights, basics such as clean water and sanitation facilities.

In recent years, we can add 'thermal comfort' as a right that has been compromised in marginalized settlements. We diagnose thermal discomfort in tropical Indian cities and highlight the inequitable energy distribution propagated by air conditioners (ACs). The climate chaos fuelled by ACs affects marginalized sections disproportionately in addition to endangering other life forms



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Shruti Saraf works on the Fairconditioning Programme (fairconditioning.org) with cBalance. She is an architect and holds a Master's Degree in Urban (Habitat) Management from CEPT University. Her key areas of interest include passive building design, thermal comfort solutions for the built environment, and related research development. She can be reached at shruti@cbalance.in.





Vinita Rodrigues works with cBalance. She holds a Master's Degree in Natural Resources and Governance from Tata Institute of Social Sciences (TISS), Hyderabad. She explores the interconnectedness between socio-ecological systems, communicates the urgency to mitigate the climate crisis, and engages with participatory action techniques for a just world. She can be reached at vinita@cbalance.in.

Vivek Gilani is an Ashoka Fellow, an environmental engineer and a BEE-certified energy auditor. He is the Director of cBalance and co-creator of the Fairconditioning Programme (fairconditioning.org), which integrates building sustainability and efficiency into architectural and HVAC-engineering curricula, architecture firms, and real-estate enterprises through activities that seek to make responsible architecture a non-negotiable value. He can be reached at vivek@cbalance.in.



that have an equal stake on the planet and contribute to human well-being. We draw attention to the need for 'intermediate technologies' to address thermal comfort requirements and reduce dependence on ACs. We also challenge intervention approaches governed through centralized decision-making by a privileged 'few' for the 'betterment' of many. We share a potential pathway to address thermal discomfort in marginalized settlements through local collaborations with architecture academia, non-governmental organizations, marginalized communities, material suppliers, utility companies, and other stakeholders. We propose that only through an integration of ecologically sustainable and socially just perspectives into our

technological designs can we begin to create liveable conditions for all who inhabit our cities.

Inequity in Air Conditioning

Differential energy access is a direct contributor to socio-economic inequity in urban areas. India faces an energy shortage of 8.7%, as per-capita energy consumption increased from 1471 kWh/year in 1980–1981 to 4816 kWh/year in 2010–2014 (Central Electricity Authority 2019). Affluent inhabitants rely on ACs to meet their thermal comfort needs, whereas their non-affluent counterparts mostly depend on ceiling or floor fans. A typical one-tonne split-AC in India consumes as much power as 25 ceiling fans.¹ This is more

¹ Internal analysis. Details available at <http://fairconditioning.org/>.

unsettling considering that most affluent households have backup power sources to permit uninhibited energy use and ensure thermal comfort during power-cuts, whereas low-income households who cannot afford this luxury suffer inequitable thermal discomfort during peak summers. Literature on the effect of heat stress on health (Mastrucci 2019; WHO 2018) reveals a correlation between high temperature and physiological, and cognitive ailments and increased risk of mortality, thereby enunciating the injustices propagated by the use of ACs.

As ACs reduce indoor temperature, they contribute to rising outdoor temperatures causing exponential damage to marginalized communities who cannot afford this luxury. Additionally, ACs will continue

fuelling the perilous climate crisis by contributing to pollution of 338 MT CO₂e by 2030,² considering installed room ACs in India are expected to soar from 32 million to 225 million, while commercial ACs will grow from 9 million-TR to 104 million-TR, between 2015 and 2035 (Purohit, *et al.* 2016). Rising temperatures, expected construction boom, and decreasing AC prices supported by low-cost payment plans, such as equated monthly instalments (EMIs) are some factors that will accelerate the demand for ACs in the near future.

Developing a Sensitive Approach to Thermal Comfort

Exploratory data collected on thermal conditions (mainly dry bulb temperature) in marginalized structures in Mumbai and Pune indicated roof surface temperatures in excess of 50°C even when air temperatures were a moderate 30°C. The building structure often does not cool down adequately till about 11 pm or midnight (depending on the day's weather), thereby disrupting the sleep cycles of the residents. Additionally, conversations with women in these settlements revealed that they suffered sleepless nights and fatigue because of high indoor temperature during summer nights, often aggravated during power-cuts. The skewed distribution of household responsibilities compels women to wake up way before other household members. They fetch water, cook, and attend to other chores before they can head out to paying jobs that either supplement the household income or entirely rely on them. Women, therefore, bear the brunt of thermal discomfort's disproportionate impact on the well-being of marginalized communities.



Recognizing the need for socio-ecologically responsible cooling techniques, we experimented by installing radiant barrier³ retrofits in our Mumbai office and a Gits food-processing plant in Pune whose roof structures resemble those of marginalized settlements. The retrofits are also installed in the five marginalized structures (the women's homes), as previously discussed. Readings at the former two revealed an average temperature drop of 8.5–10°C with radiant barrier installation. Our next step will be a formal pilot intervention using passive cooling techniques in the marginalized settlements.

The proposed intervention will diverge from centralized top-down approaches that disregard indispensable local knowledge and skills, resulting in the implementation of inefficient and/or unsustainable programmes. Secondary research studies (Nassar 2018; Venter 2019) endorse the

adequately or not and where interventions are welcome, will be sought. Rapport building challenges will be addressed by connecting with community members through local partners (NGOs, etc.), who have established relationships of trust and engagement. Participatory dialogues will form the basis of co-creating and finalizing on roof prototypes after integrating inputs, desires, and ideas articulated by housing occupants during these workshops. Moreover, the architecture academia will support the process of refining prototype solutions, based on techniques co-created with community members.

Once designed, installed, and tested for effectiveness in the pilot phase, a locally sustained market for these assemblies will be encouraged. Construction, installation, and maintenance practices of successful retrofit measures will be shared within the communities. The programme material that relies on the problem-posing concept of education, rather than knowledge-imposing, will be devised to facilitate such a learning process. The post-installation

³ Radiant barriers are materials that restrict the transfer of far-infrared radiation across an airspace. They do this by reflecting the radiation that strikes them and—at the same time—by not radiating energy (Fairey 1986).

² *Ibid*, see Footnote 1.



view that meaningful and efficient housing upgrades call for an approach that is sensitive to the local socio-ecological context, where local communities are participants and contributors, rather than being recipients of supposed benefits. Participatory approaches facilitate inclusive problem-solving methods by creating a sense of ownership. This paves the path to capacity building within local communities (Chambers 1994; Marschall 1998). Local cooperatives characterized by democratic management and collective ownership are known to facilitate socio-economically resilient systems for sustenance of welfare initiatives (Ganapati 2014).

For our programme, while we recognize that the government's intervention during some strategic levels is important for legal recognition and financial aid, we are also aware that it is a potential source for corruption and further concentration of power away from the rights holders, thus reproducing the same injustices it sought to replace. The overall intervention approach will, therefore, primarily focus on localizing the process of problem-solving in collaboration with local community members, architecture academia, local utilities, suppliers, NGOs, and other stakeholders.

Piloting Passive Cooling Techniques and Participatory Local Action

We are currently engaging with local architecture academia to perform rigorous simulations of less-energy and carbon-intensive retrofit prototypes that can be installed as roof assemblies in marginalized settlements.

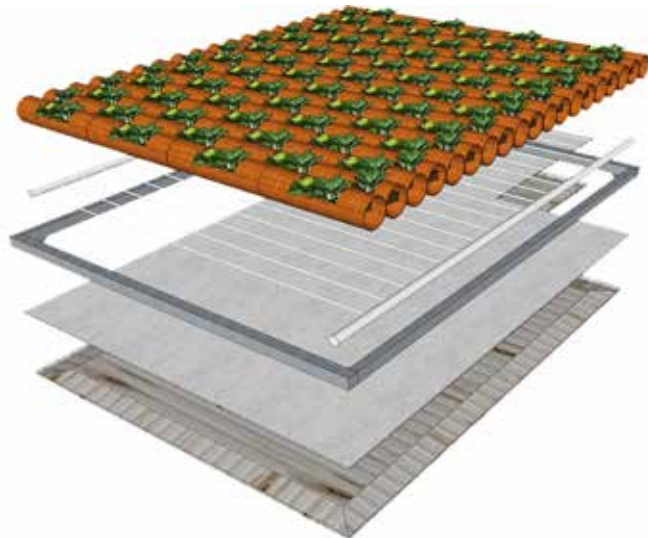
Potential retrofits being simulated include the following:

1. Crosslinked polyethylene aluminium-foil foam (alufoil) used as a mobile daytime radiation barrier and night-sky radiation enabler.

2. Recycled inorganic waste films, which comprise recomposed aluminized plastic packaging used for food packaging.
3. Durable rooftop vegetation structures and exoskeletal structures above the roof layer to support urban gardening.
4. Barite-based plasters applied directly (as used in traditional construction in Rajasthan) or installed as external panels.
5. Thermal mass enhancement of roofs using discarded plastic bottles filled with water and placed on the roof for multiple diurnal cycles for delaying and dampening solar heat gain.

Creating simulations for such projects not only builds skills for intermediate cooling techniques among budding architects but also cultivates socio-ecological sensitivity and the capacity to initiate a dialogue with diverse stakeholders.

Through a series of 'listening workshops' with women from local communities, an understanding of the complex interconnected issues of thermal comfort, space use, and other competing requirements that their dwellings either meet



progress towards enhanced thermal comfort will be verified, and avoided AC energy consumption will be estimated through a real-time performance-sensing network and digital mapping platform for demonstrating performance metrics to future stakeholders (e.g. utilities) and policymakers. Local women's cooperatives, supported by start-up capital from a revolving-capital fund, established through levying an 'Energy or Thermal Comfort Equity Cess' on high-energy consumers in collaboration with local utility companies, will be encouraged to ensure the socio-economic sustenance of this thermal comfort endeavour.

Conclusion

A society that functions within the realms of a system, which skews resource distribution, thereby depriving less-affluent humans besides other life forms from what is rightfully theirs, demands new pathways to break away from toxic shackles towards a compassionate world. Addressing thermal discomfort in marginalized settlements through integrating passive cooling techniques, while simultaneously requiring air conditioner users to underwrite these costs or also switch to passive solutions, is a promising step towards social and ecological justice and a cooler environment for us all. Participatory approaches to problem-solving supported by inclusive governance mechanisms and nourished by locally available knowledge and skills can create a pathway that will invite all to walk away from the heat by keeping the material/technical progress firmly anchored to ecological sustainability and social justice.

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WHAT IS SUSTAINABLE ARCHITECTURE?

Architecture is a creative field and the concept of sustainability makes it more versatile. This poem by **Sakshi Singhal** is about the role of sustainability in the construction sector. It talks about how the development of a country is dependent on environmental and socio-economic aspects. It also reflects on the role of green-rating manuals in the creation of a clean and green environment.



Ar. Sakshi Singhal is a gold medalist and has a Master's Degree in sustainable architecture from Deenbandhu Chotturam University, Murthal. As an intern with GRIHA Council, she has been passionate about the field of sustainable materials. A GRIHA and GEM-certified professional, she can be reached at architectsakshi6@gmail.com.

Our Sustainable Architecture

*Our lovely and persisting architecture in itself is a poetry
An amalgamation of creativity, versatility, and geometry.
An iconic field with a blend of various trends and styles
From ancient Greek, Roman to modern and green profiles.*

*Designing green is about lowering the carbon emissions
And it becomes possible with sustainable building solutions.
By a thought process and the three tiers of sustainability
Architecture is emerging with the concept of adaptability.*

*Extending limits from design to climate-responsive design
Architecture focuses on the aspects of comfort zone align.
With the intent of using spaces and thus resources wisely
It has the ability to act as per five cardinal elements sensibly.*

*Compilation of green manuals for a perfect design sense
Elaborates the various sections and needs of their existence.
Through management of site, energy, waste, water, and innovation
This field is leading society towards enthusiastic destinations.*

*An art of designing spaces as per culture, terrain, and locale
Architecture is an extending field of creation, beyond the scale.
Buildings with respect to wind pattern and sun orientation
For the construction sector, it's not less than a transformation.*

*By obstructing excess heat and thus welcoming diffused light
Window design strategies make spaces ambient and bright.
By various sources, assemblies, techniques, and great synergy
Sustainability inspires to use materials with low embodied energy.*

*Management of energy by using more renewable energy sources
Green is lowering the emissions from thermal production process.
By promoting use of low flow fixtures and rainwater harvesting
Sustainability is also introducing to the new ways of landscaping.*

*Guiding society towards usage of various waste treatment means
It's creating awareness regarding various colour-coded dustbins.
By using the concept of universal design, it creates a realm of divinity
An era of designing green has showed an amazing ingenuity.*

*Our lovely and persisting architecture in itself is a poetry
And being blessed as an architect,
I love to recite it for my whole country.*



TRAINING PROGRAMME WEBINARS

PROGRAM/WEBINAR	DATE
5-Day Online GRIHA V 2015 Training Programme	Sep 21 - Sep 25, 2020
One day online training programme on SVAGRIHA	Aug 28, 2020
5-Day Online GRIHA V 2015 Training Programme	Jul 27 - Jul 31, 2020
Release of the Policy Brief on Sustain the Sustainable Change	Jul 23, 2020
5-Day Online GRIHA V 2015 Training Programme	Jun 22 - Jun 26, 2020
GRIHA Council celebrates World Environment Day - Healthier Environment	Jun 5, 2020
GRIHA Case Studies Webinar	May 28 - May 29, 2020
Way forward for Schools Post Lockdown	May 15, 2020



Mr Ankit Bhalla

Webinar on:
**INTRODUCTION
TO GRIHA V.2019**

17th April, 2020 (Friday)

11 am to 12:30 pm

(Includes live chat and Q & A session)
Open to all, registration is free.



GRIHA

Council is celebrating



WORLD
ENVIRONMENT
DAY

Date: 5th June, 2020

Time: 2:00PM - 3:00PM

Free registration for all

WAY FORWARD FOR SCHOOLS POST LOCKDOWN

(A webinar for students and teachers)

May 15, 2020

11:00 AM - 12:30 PM

(includes live chat and Q&A session)

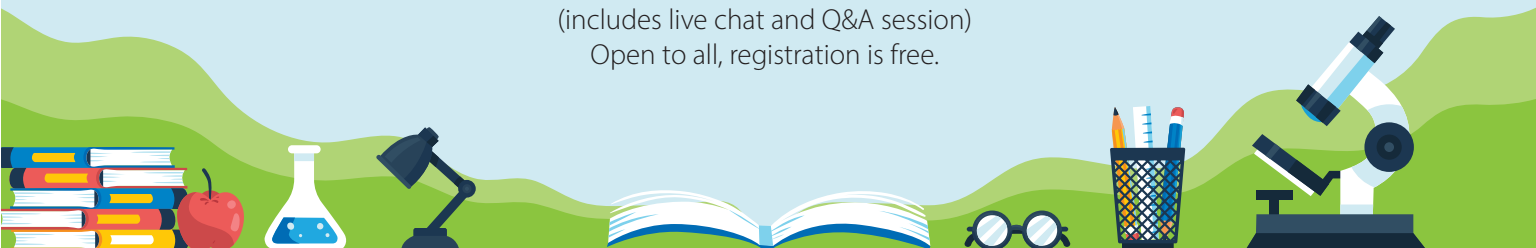
Open to all, registration is free.



Ms. Shabnam Bassi



Ms. Gaura Saxena



CAN 'GREEN HOUSE' BE 'DREAM HOUSE'?

What are the challenges of building green and sustainable houses? Architect **Saurabh Mundra** delves into the merits and demerits of opting for glass houses in tropical countries like India.



Ar. Saurabh Mundra holds an MArch, specializing in Energy Efficient and Sustainable Architecture from NIT Trichy and is a GRIHA Certified Professional. He is currently working with Environmental Design Solutions, Delhi as a Green Building Analyst, and is involved in different projects opting for green building ratings. He has

a keen interest in researching optimization of building geometry for indoor and outdoor thermal comfort.

Is making a 'Green' house, a sustainable house, truly a challenge? Is it a feat only achievable after a stringent and time- and money-consuming designing and planning process?

The art of designing a house evolved over centuries and even though the current prominent style of constructing a house, in many regions around the world, might not seem sustainable, it is actually over-weighted at times by

other important parameters such as, innovation, art, trend, politics, durability and most importantly, necessity. When stronger and durable materials are made available at cheaper costs, people tend to get attracted towards them and use them at the cost of making buildings unsustainable. What one needs to realize is that what might be sustainable for one could actually be unsustainable and harmful for the other.

This also does not mean that to be sustainable, we need to go back to older, vernacular architectural styles. Sustainability can be achieved by putting together older design ideas and construction techniques in new ways, rather than conjuring up truly new ideas. In various realms of human endeavour other than architecture, such as semantics, law and even arts, so-called 'new' or 'original' ideas are rarely developed. The



» **Figure 1:** Use of glass at the Crystal Palace for the Great Industrial exhibition in London



notion that 'sustainable' or 'green' architecture is actually a variation or synthesis of existing ideas finds its greatest support in the aforementioned fields. Regarding the former, despite many words and new terms to define sustainability in the modern architectural world that are unique to western culture, modern buildings are derived from and built upon a variety of traditional vernacular practices put together, ultimately forming a new trend in architecture. Had we insisted on rejecting traditional and vernacular style of architecture all together in favour of purely modern architectural and construction practices, we would have essentially nothing to hold on to and rest upon.

Let us go back in time, not much, just a few centuries. The 19th century was essentially a transition period in architecture, especially in the field of structures. This could be linked to a greater exposure to different cultures and civilizations through the means of trade, exploration, industrialization, and of course, colonization. Some people believed that the new industrial civilization would give birth to new architectural forms and consequently, had high hopes. The great innovation observed then is the application of glass in architecture (Figure 1). There is a special relationship between glass and buildings. As a construction material, glass proved to be a

reliable product, which was weather resistant, could be moulded into different shapes and sizes, and made available in different opacity and colours. Increased use of glass in building, specially facades (and thus, increased window-to-wall ratio), made buildings more interesting and open to environment with respect to daylighting and outdoor views while at the same time protecting the building occupants from harsher outdoor elements. Use of complex geometric shapes

in building design became possible and use of steel along with glass in building started dominating the architectural style.

By revisiting the history and the importance of current trends, it becomes clear how interdependent these parallel disciplines that often converge, obliquely so, are with architecture. The early 20th century saw the architectural response to a changing, new society, but now, high-tech architecture is symbolized by towering structures and dramatic steel and glass facades, made possible by the use of flexible steel and lightweight tinted glass.

Within the paradigm of today's international 'superstar architecture', the most familiar feature of contemporary modern houses or buildings is glass. Of course, being transparent, glass gives a sense of open and bigger spaces. By letting

in natural light, it reduces the need for artificial lighting. But there is a cost to it. Everyone learns in their early-school years that 'glass traps heat', and the principles of greenhouse effect. This effect is beneficial in European countries, but is it suitable for the tropical climate of India?

Unlike cold countries, we need to design and build our houses in a tropical, and more specifically complementing to the Indian context. These apparent disadvantages of glass houses do not seem to deter future house-owners or architects from creating their 'dream homes' – a vision of a modern glass house (Figure 2). In Indian metropolitan cities, this wave of building glass houses has hit late compared to other developed nations but it is strongly affecting our cityscape. By making our



» **Figure 2:** Residential building with extensive use of glass



houses' front facades completely glazed, even in smaller houses, just from the aesthetic point of view, we are disturbing the balance of thermal comfort indoors as well as outdoors. Having larger windows without considering the orientation and shading increases the amount of trapped heat and at the same time causes issues like glare.

The solution we opt is installation of air conditioners. What we are actually doing is creating a problem for ourselves and then finding a solution for it, which is just 'for ourselves'. Use of air conditioners definitely will help achieve balanced indoor thermal comfort but what we are forgetting is that the heat we are reducing inside is going somewhere and as is the case, it is increasing the outdoor temperature.

Some of the most basic parameters of building design that we should

always consider at the design stage of any building as experts of this industry in a tropical climate like India include the following:

1. Orientation of the Building

Though most of the time orienting a building is not in our hands in urban societies, we should always pay heed to design guidelines already established for the context. What we can control in such a situation is the type of exposure of our building.

2. Lighting Design

If the need is only for daylighting, top lighting concepts (skylights, solar tubes, etc.) provide longer daylight hours while also keeping the exposure minimum.

3. Ventilation Devices

Designs with more ventilation are always preferred over

closed-off boxes in tropical environments. Cross ventilation design helps in most situations.

4. Shading Devices

Glass houses can be justified if they have proper shading devices designed. External direct solar radiations need to be cut off.

Glass is only one such example! In today's time, the most important aspect of consideration is designing vis-à-vis natural local resources, keeping in mind facts and figures for judicious and effective usage. Criticism is not mainly about finding faults but a detailed examination of the undertaken case should be priority. Take a step back, revisit the vernacular materials, designs, and principals. Modify them to your taste and style and then build. The building thus made would be a combination of centuries' worth of trial and error to make the best possible and sustainable design with modern techniques while reflecting an independent style. Rejuvenation of tradition to which India is the first signatory is what Contextual, Sustainable-Green Architecture demands, and in this process, creativity would constantly evolve between tradition and modernity.

As a tree drops dead wood on its own, we as the load-bearers of future architecture, should evolve the flexibility to bring about the required change with respect to time, space, context, and people. Change is desirable and at times unavoidable; further, it can be either beneficial or disastrous. The era is changing, the technology is at its brilliance, yet we are craving a new safer world, which is sustainable and energy-efficient to regain the balance between man and nature as it should be.

GRIHA PROJECTS' UPDA

10% Additional FAR for GRIHA 4/5 rated projects

Himachal Pradesh

MoHUA gives **1% to 5%** extra ground coverage and FAR for projects of more than 3,000 m² plot size on the basis of GRIHA evaluation

Delhi

5% Additional FAR for 4/5 star GRIHA rated projects

Punjab

Upto **15%** extra FAR for all building uses (except plotted residence) for all GRIHA variants

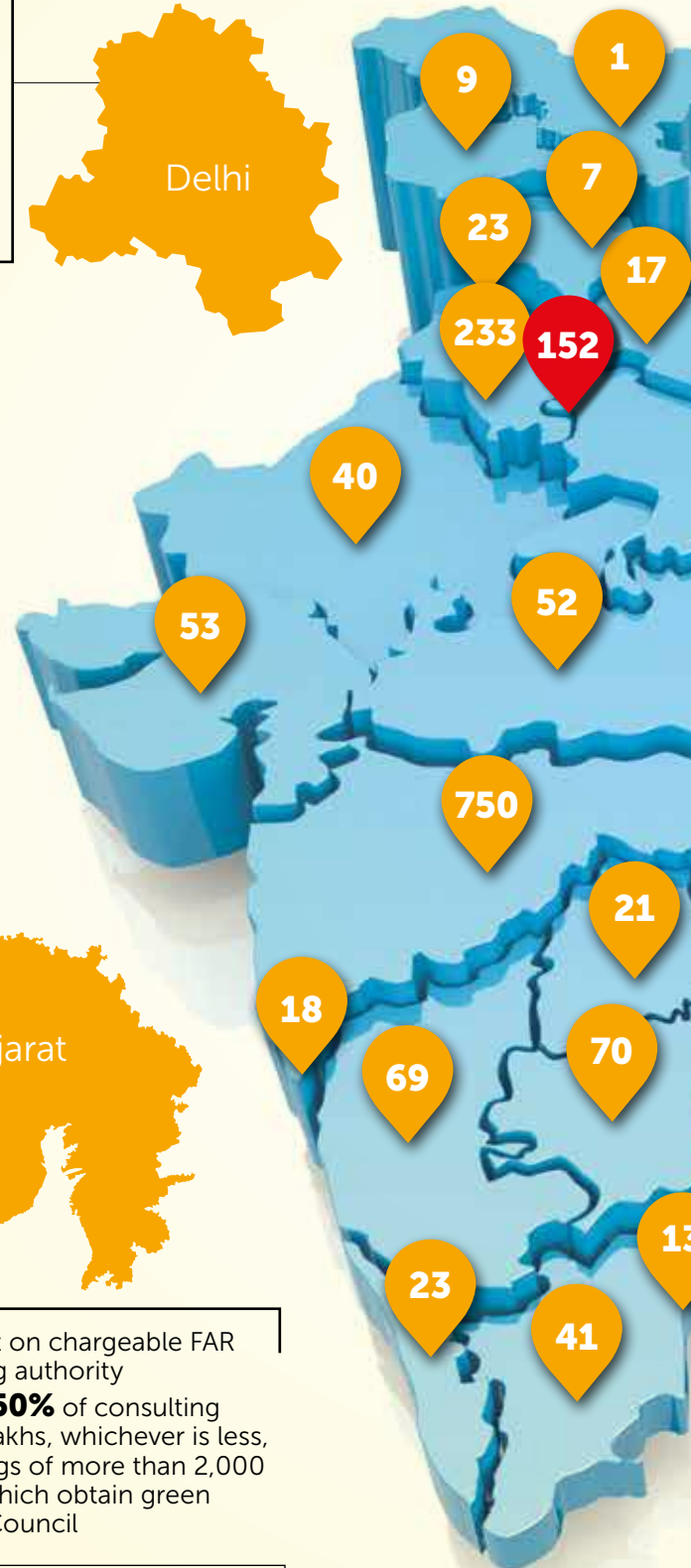
Haryana

Rajasthan

Gujarat

- Buildings having GRIHA rating certificate will be eligible for an additional **7.5% to 15%** Floor Area Ratio (FAR) free of charge

- AUDA: 5%** Discount on chargeable FAR payable to approving authority
- Assistance of up to **50%** of consulting charges or INR 2.5 lakhs, whichever is less, for industrial buildings of more than 2,000 sq.m built up area which obtain green rating from GRIHA Council



FAR: Floor Area Ratio | MoHUA: Ministry of Housing and Urban Affairs | MoEFCC: Ministry of Environment, Forest and Climate Change

*The numbers indicated in the map represent registered projects for rating with the GRIHA Council.

TE & LINKED INCENTIVES

GRIHA REGISTERED PROJECTS = 1,881
GRIHA FOOTPRINT = 614 MN/FT² (APP)

Jharkhand

Uttar Pradesh

Urban Development & Housing Department, Government of **JHARKHAND - 3%, 5%, & 7%** additional FAR shall be awarded to all building uses (except plotted residential) for achieving a 3-star, 4-star, or 5-star GRIHA rating, respectively

- **NOIDA & G.NOIDA: 5%**
Additional FAR for projects of plot area > 5,000 m²
- **UTTAR PRADESH: 5%**
Additional FAR for 4/5 star GRIHA rated projects.

Sikkim

Mandate for all government and semi-government projects to go for a minimum 3-Star GRIHA rating

- **10%**
Additional FAR
- Fast track sanction of plans

West Bengal

Andhra Pradesh

- GoAP to provide **25%** subsidy of the total fixed capital investment of the project

Maharashtra

- **PMC & PCMC:** Discount in premium charges (payable to Municipal Corporation, for both GRIHA & SVAGRIHA projects)
- **PMC & PCMC:** Up to **10%** discount on Property Tax for home owners for the GRIHA projects. Up to **15%** discount on Property Tax for home owners for SVAGRIHA projects
- PWD, GoM, mandates GRIHA rating for all new and existing government buildings

OTHERS

1. Fast Track Environmental Clearance by the MoEFCC for GRIHA pre-certified projects.
2. GRIHA and GRIHA AH certified (4 and 5 star projects) would be provided financial incentives under SUNREF India program
3. Ministry of Urban Development, GoI announces free of cost 1% to 5% extra ground coverage and FAR for GRIHA projects: MoUD issues a notification for local authorities to incentivize and provide 1% to 5% extra ground coverage and FAR for projects of more than 3000 sqm plot size on basis of GRIHA evaluation.



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भा.वि.प्रा. का सुरक्षित हाथ

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International benchmarks
You are in safe hands of AAI

126 स्थान जहाँ भरे
भा.वि.प्रा. के
संग उड़ान
Destinations
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in its respective category



23

अंतरराष्ट्रीय हवाई अड्डे
(3 सिविल एन्क्लेव तथा
3 संयुक्त उद्यम हवाई अड्डे)
International Airports
(3 Civil Enclaves &
3 Joint Venture Airports)

+

08

कस्टम हवाई अड्डे
(4 सिविल एन्क्लेव)
Custom Airports
(4 Civil Enclaves)

+

76

अन्तर्देशीय हवाई अड्डे
Domestic Airports

+

19

अन्य सिविल एन्क्लेव
Other Civil Enclaves

=

126

हवाई अड्डे
Airports

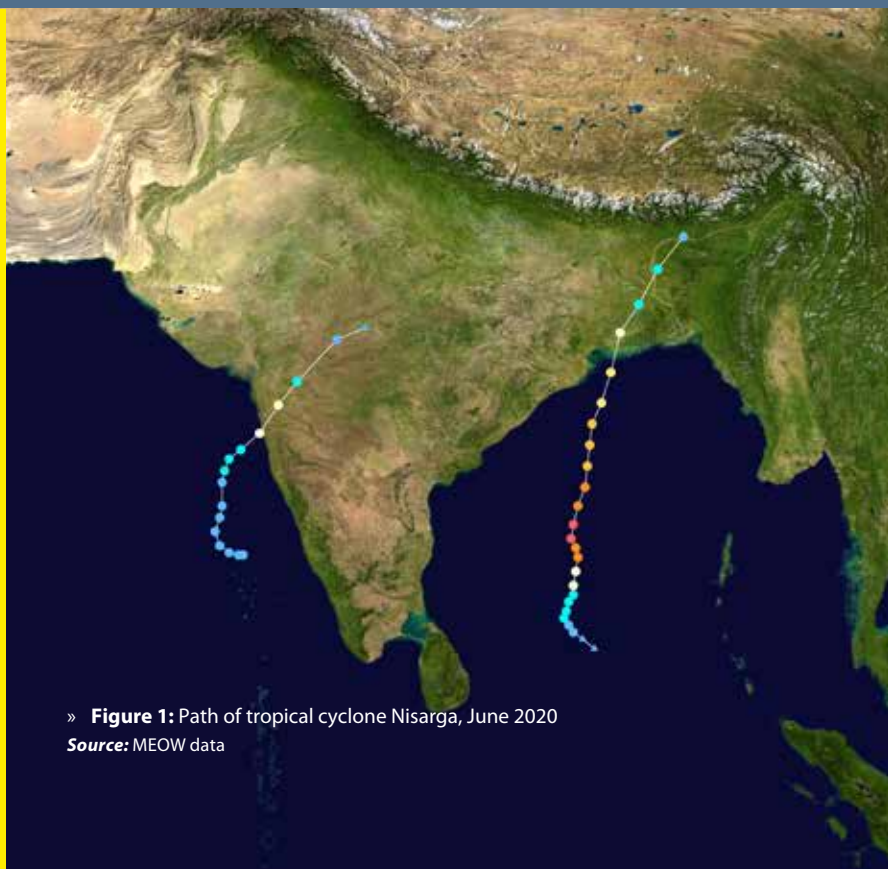
DISASTER PREPAREDNESS OF VERNACULAR BUILT FORMS

While the country was reeling under the impact of the novel coronavirus outbreak, Cyclone Nisarga's fury ravaged the coastal towns of Maharashtra. In this article, **Sarang G. Karmarkar** foregrounds the difference between vernacular and modern buildings in their response to the disaster.



Ar. Sarang G. Karmarkar completed his graduation in Architecture from Bharati Vidyapeeth College of Architecture, Navi Mumbai (University of Mumbai) and is currently Principal Architect with Karmarkar Associates. He is engaged in a wide spectrum of residential and industrial projects. A GRIHA-certified professional, he is also an energy modeler and visiting faculty at Bharati Vidyapeeth, Navi Mumbai.

On 3 June 2020, a severe tropical cyclonic storm 'Nisarga' made landfall in the Western Ghats of Maharashtra with wind speed of more than 110 km/h. The last known storm of such intensity was observed in 1891. Until Nisarga hit, the area had been considered safe and had undergone a surge in development. The cyclonic storm made landfall (estimated) near creek of Veshwi (Ratnagiri district) and travelled northward ravaging the coastal towns of Hari Hareshwar, Shriwardhan, Murud, and Alibaug before dissipating north easterly. It caused extensive damage to infrastructure, countless trees were uprooted, the power grid was destroyed and almost every house was left roofless.



» **Figure 1:** Path of tropical cyclone Nisarga, June 2020
Source: MEOW data



» **Figure 2:** A day after the storm: Shriwardhan main road
Photo courtesy: Sarang Karmarkar

From our office in Shriwardhan (Raigad, Maharashtra), where the storm was at its peak, we could only helplessly watch the disaster unfold in front of us. Raigad was hit by two waves of winds – one from the east and the second from the west. The evening after the storm was equally intense and gloomy. However, the road to recovery was a classic example of disaster preparedness of vernacular built forms in the affected area.

As a practising architect in the town, our team looked at this disaster as an opportunity to observe and examine the resilience of vernacular buildings to high winds and recovery methods. Vernacular (also called 'kaccha') houses are often considered weak and less protected during such disasters where there are high water and winds. We usually perceive these areas as more vulnerable to elemental changes. But as the recovery in the area began, it unravelled a completely different narrative. It was a story that had the potential to change 'our' mindset as far as disaster preparedness for all our modern and vernacular buildings was concerned.



» **Figure 3:** Shriwardhan ST depot
Photo courtesy: Sarang Karmarkar

The town of Shriwardhan has a mix of modern RCC and vernacular buildings, which are built with timber, bricks, and constructed with Manglori roofing tiles over wooden framework. Being a semi-urban area, it mostly has individual houses with large backyards. Usually, every old vernacular house is equipped with a well to provide water to the garden and meet household needs. These vernacular buildings have a composite framework of timber (teek, sheesham) and have sloping roofs to safeguard against peak monsoons every year. The roofing is usually clad with Manglori tiles interlocked with each other and has intricate truss, purlins, and batten work. On the other hand, modern structures are usually load-bearing with RCC slabs and fibrocement sheets on top for faster construction and cost savings. RCC buildings have larger windows with typical rail sliding glass panels. This difference in the component level makes both the building types significantly different in their respective response to disasters.



» **Figure 4:** Manglori tile internal battens
Photo courtesy: Sarang Karmarkar

Most of the Manglori tiles were blown off by the winds and fell in nearby areas. The tiles that landed on soil survived the impact and were quickly collected by the people and used for installation. Every vernacular house has a basic provision to access the roof from inside through a mezzanine (usually used as storage for grains). The evening after

the storm had passed, people inhabiting the old houses self-repaired the roofing tiles and could sleep inside their homes safely whereas people living in the buildings, which had cement sheets or GI sheets as roofing, had no way to secure the roof by themselves. Therefore, the self-repair modular capability of the old houses came as a blessing. The shape and slope of the roof also played a crucial role in determining the degree of damage suffered by the roof. The vernacular Manglori-tiled houses usually have higher slope angles with hipped roof running down from all four sides of the structure. It was also observed that a few old houses had suffered no core damage to the roofing tiles due to the angle of the roofs. Contrarily, the modern structures suffered massive damage that required heavy tools and manpower to install the roofing. About 90% of the modern RCC buildings have either cement or GI sheet roofing on the terrace to prevent leakage.



» **Figure 5:** An uprooted cement roofing sheet
Photo courtesy: Sarang Karmarkar



» **Figure 6:** Damaged rooftop of a building
Photo courtesy: Sarang Karmarkar

Windows play a crucial role in protecting the buildings from strong gusts of wind. The old vernacular infrastructure has smaller windows with heavy wooden shutters. These windows block most of the rain and debris flying along with gusts, thereby protecting the residents. The damage to the windows was observed to be minimum and repairable, whereas modern RCC buildings suffered a higher degree of window damage. The winds with speed of 140 km/h had shattered the glass in most of the windward façades causing winds and rain to enter the building. The damage was beyond repair in these buildings and people had to wait several days to get the windows fixed. Continuous downpour in the affected area a few days after the storm made the situation worse for help to arrive in time. Moreover, the heavy glass shrapnel proved to be risky for the people living inside and in nearby areas.



» **Figure 7:** Vernacular house after minor roof repairs
Photo courtesy: Sarang Karmarkar

Almost all old vernacular houses have an open well either in front or the backyard. After the storm, people could draw water from these open wells for their needs. Modern buildings, on the other hand, have tap wells with submersible pumps. Without electricity, water from these taps cannot be pumped. Such buildings had to rely on neighbouring wells for their water supply. Due to heavy modularity, the vernacular buildings also proved to be cheaper to repair as compared to the modern buildings. The small components were locally available and cheaper than their modern counterparts. It took considerable time for new GI, cement roofing sheets, glass windows to arrive from nearby cities and these materials were very expensive due to COVID-19 transportation restrictions.

There are several components in the vernacular buildings which suffered damage but were easily repaired by the residents themselves without the help from any professionals, skilled labour, or power. The storm had destroyed the power grid in the area and it took almost one-and-half months to have the electricity in the town. Most of these old houses were repaired within a month's time without power and could function normally once power was restored. The RCC buildings with heavy roof damage and broken windows had to wait till the power was resumed for the repair work to begin. Old school buildings in the area proved to be great shelters for NDRF teams and other rescue workers from various NGOs. This experience was an eye-opener and made us think about the choices we make as an architect. It also proved the comprehensive thought which went into creating these vernacular buildings. The inherent modular repairability, otherwise considered weak, proved to be a great tool in disaster response. The vernacular buildings not only accommodated the residents and neighbours but also gave shelter to the rescue workers and supplied them with essentials like water during the recovery process. These vernacular buildings performed much better as far as disaster recovery was concerned and are still standing tall as a testament to rooted thoughts, humility, and a strong will of survival.



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NEIGHBOURHOOD GARDENS: AN APPROACH FOR SUSTAINABLE LANDSCAPE

In this article, **Dr Prajakta Baste** foregrounds the need for neighbourhood gardens in cities to combat climate change risks. She explains how urban green spaces or parks/gardens can contribute immensely to an improved quality of life.



Dr Prajakta Baste, a PhD from the Centre for Environmental Planning and Technology (CEPT), Ahmedabad University, has over 24 years of experience in Environmental Landscape Designing. She has been appointed as an Environmental Expert on the Godavari Pollution Abatement Committee by the Mumbai High Court. Within the framework of environmental protection, her focus areas include temperature reduction, biodiversity conservation, and increase in groundwater levels among others. She can be reached at psbaste@gmail.com.



Currently, cities represent about 3% of the world's land usage, but its effects on climate, natural resources, environment, and biodiversity extend far beyond the municipal borders. Large local environmental changes are greater than those that filter down from global environmental change (Grimm, *et al.* 2008). Rapid urbanization, economic growth, and increasing population are some of the stumbling blocks that India must overcome to realize its goal of sustainability. Hence, sustainable cities and ecosystem services are the need of the hour. The percentage of million-plus cities with reference to India's total urban population increased drastically from 6% in 1901 to 19% in 1951 and further to 33% in 1991 (Maiti and Agrawal 2005). According to the findings of McKinsey Global Institute in India, by 2030, there will be 68 cities with a population of over 10 lakh.

Sustainable development calls for a convergence of economic development, social equity, and environmental protection (Drexhage and Murphy 2013). The term 'urban sustainability' implies that 'urban green spaces' provide social, ecological and economic benefits, which contribute to the increase in the levels of liveability, equity, and sustainability in the cities.

Urban green spaces or parks/gardens contribute to an improved quality of urban life in many ways, even though these functions are often taken for granted by the public and city authorities, mostly in developing countries (Chaudhry, Bagra, and Singh 2011).

The study investigates the critical engagement of trees in the neighbourhood gardens (NGs) as a predominant form of vegetation. An NG is an open or a green space, which is located within a residential area and used for leisure and relief by the residents and people living in the vicinity. Due to lack of data collection exercises (MOEFCC 2014), there is a dearth of information on the status of tree cover in urban areas, especially for two- and three-tier cities and urban agglomerations.

Study Context

A study on NGs was conducted in Nashik, a city that has grown and expanded in terms of geographical area and population in the last two decades. The current population is more than two million (Census 2001) and according to the 2011 census, the city ranks 29th amongst the urban agglomerations of India.

Nashik Municipal Corporation (NMC), the city's local governing authority, has demarcated six divisions in the city, namely 1) Nashik Panchavati, 2) Nashik West, 3) Nashik Satpur, 4) New Nashik, 5) Nashik East, and 6) Nashik Road. There is a noticeable difference in the socio-economic and the demographic character of these areas (Nashik Regional Planning Board 2009; Nashik Municipal Corporation 2015).

Neighbourhood Gardens

NGs are common land use in the city. An NG is an open space or a green space, which is located within a residential area. As previously mentioned, such a space is used by the people living in the vicinity within a radius of 2.5–3 km. However, not much attention is paid to these natural spaces close to where people live and work; the small-scale green areas in cities and their benefits (Chiesura 2004) are neglected too. The NGs in all the previously discussed six areas have been developed in the last 15–20 years by the NMC. Four gardens each from four sub-divisions and three from two sub-divisions were selected for the present study.

Survey and Methods

The study was conducted using two methods—empirical (field research) and structured interview (with visitors and residents of the selected neighbourhood).

- A. Field research was majorly conducted for mapping the trees. Trees were classified as indigenous and non-indigenous species. A variety of species and the number of trees in each category for

every garden were enlisted through field visits. The diversity index, density index, and the evenness of trees were calculated using the Shannon and the Simon index formulae. A comparative analysis is presented in the following paragraphs.

- B. Interviews were conducted to understand the level of environmental awareness of planting trees. A total of 20 persons were interviewed in each garden. The questions posed are given as follows:
1. Could they identify the tree varieties in the garden by their local names?
 2. Could they classify the trees as indigenous and non-indigenous?
 3. Were they aware of the environmental values of trees in the garden, such as a) reduction in air pollution, b) temperature reduction, c) water retention, and d) support avifauna and other fauna?

Results and Discussion

The aforementioned survey revealed that the number of species of the indigenous trees was more than the non-indigenous species. But the total number of non-indigenous trees was more than the indigenous variety (Table 1).

The diversity and the dominance of the indigenous species were marginally elevated than the non-indigenous species. In 14 out of 22 NGs, the most commonly observed indigenous tree was *Azaderchta Indica*. In 16 gardens, the non-indigenous tree observed was *Delonix regia*. Other indigenous varieties observed in other gardens were – *Ficus bengalensis*, *Ficus glomerata*, *Ficus religiosa*,

Table 1: Diversity, Dominance and Evenness of trees in NGs

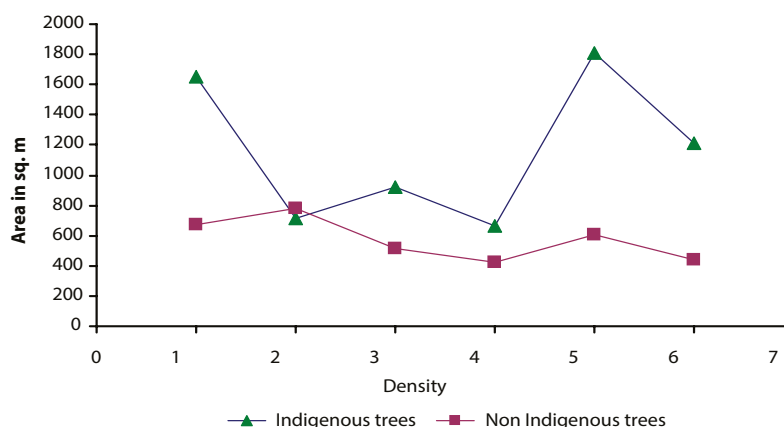
Type of Trees	No of Species	Total no of Trees	Diversity	Evenness	Dominance
	n	N	H		D
			$\frac{\sum P_i \times \ln P_i}{P_i = n/N}$	H/H_{\max} $H_{\max} = \ln(N)$	$\frac{1}{\sum P_i^2}$
Indigenous Trees	16	107	2.22	0.80	6.93
Non Indigenous Trees	13	194	2.15	0.83	5.29

Millingtonia hortensis, *Zizyphus jujuba*, *Cocos nucifera*, *Anthocephalus kadamba*, *Terminala cattappa*, *Alstonia scholaris*, *Lagerstromia indica*, and *Bauhinia*. On an average, these varieties occasionally occurred in four or five gardens. The non-indigenous species of *Tecoma gauduchaudi*, *Callistemon lanceolatus*, *Spathodea campanulata*, *Jacaranda mimosifolia*, *Roystonea regia*, *Grevillea robusta*, *Eucalyptus* were found in three or four NGs. *Saracca indica* and *Caryota urens* were found in 12 gardens. The trees were full grown in all the studied gardens and underwent the natural cycle of flowering, fruiting, and leaf fall. The density of trees in the NGs did not show any relation to either the area or the size of the NGs. As observed in Figure 1, the density of indigenous plantation was sparse in comparison to the density of the

non-indigenous trees in six sub-divisions.

One NG in Nashik west has six *M hortensis* along with *A Scholaris*, which ensures a dense coverage within the garden. In Panchavati, two NGs have *F Religiosa* and *A. indica*, which are 50 years and 30 years old, respectively. In Nashik Road, two gardens occupying an area of more than 4000 m² have *A. indica* and *A. scholaris* planted at an appropriate distance (Figure 2).

As previously mentioned, about 20 NGs have roads, at least on two sides, and the trees provide adequate shade to the footpaths. A major activity that limits the growth of the trees is the annual pruning of the branches of these trees before monsoon. This exercise is done to ensure safety from the overhead electrical wires.



» **Figure 1:** Density of trees in the total area of NGs of the 6 sub-divisions. Density is calculated by dividing the total area of NGs of a particular sub-division by total number of indigenous and non-indigenous trees in the respective sub-division



» **Figure 2:** Image of trees in neighbourhood gardens

Environmental Awareness

People appreciate that urban green spaces serve important social, psychological health, aesthetical, ecological, and economic functions. However, these functions are frequently taken for granted (Sinha and Kant 2015).

In the selected six sub-divisions, the interviewed visitors were aware of two facts – 1) trees provide shade and help in reducing the temperature of the surroundings and 2) trees support a variety of birds. In Nashik (west area), the residents were aware of the terrestrial fauna, such as reptiles, insects, and snakes that are supported by vegetation. In Nashik's Panchavati, people revered trees as sacred but were unaware of the environmental effects of a neighbourhood with trees. Only 20% of the interviewed people could answer the question on the definition of indigenous and non-indigenous species. About 67% of the people could identify the trees by their local names. And, 3% people knew about the medicinal properties of some species. At least 50% of the respondents were familiar with the concept of biodiversity.

Conclusion

Adequate information on the abundance and spatial distribution of urban vegetation can immensely

aid in the development of sustainable urban policies, and could be a key indicator to determine the quality of urban life (Van de Voorde, Vlaeminck, and Canters 2008). It is evident that municipal authorities have determined the richness and density of plants and trees while developing the NGs and the motivation to develop indigenous plantation could be attributed to the ethical responsibility rooted in religious beliefs (Dearborn and Kark 2010). The NGs have 55% non-indigenous trees. Indigenous trees should be planted in at least seven gardens (as per research) with an area of more than 6000 m² where there are fewer trees as compared to the density in other gardens with limited area. It is now possible to select the appropriate species of trees for proposed plantation from the detailed inventories that were prepared for Nashik.

It is sometimes difficult for the general public to understand what lies behind 'the intrinsic value of biotic diversity' (Soulé 1985). The knowledge gap in urban greening, with particular reference to the environmental importance of native species of trees for plantation in the NGs and the concept of sustainability must be bridged by popular and easy-to-understand innovative techniques. Today, the citizens are already utilizing NGs for various purposes, thereby

generating participation and ensuring sensitization in envisioning an environmentally secure world.

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BIHAR MUSEUM, PATNA BCD, BIHAR



M. S. YAHYA
Executive Engineer



At the outset of the project, the design brief for the construction of Bihar Museum clearly specified that it should be a green building as per the GRIHA guidelines. The team of architects had integrated a climate-responsive and environmentally sensitive approach in their proposed design that made it the winning entry in the prestigious design competition for the new Bihar Museum. Later, the GRIHA rating system helped the entire team align their objectives with the system's requirements and sustainable goals.

Aiming for a 5-star rating meant that every aspect of design had to be thought out early in the design stage, which would eventually shape the final outcome of the building. Passive design strategies including correct orientation, limited window-to-wall ratio, adequate shading, good insulated wall and roof, high-performance glazing, and good daylight ensured that the building contributed towards a sharp reduction in energy demand. Thereafter, energy-efficient air-conditioning systems, lighting, and controls were selected as per the GRIHA requirements that helped

the project achieve 52% energy savings over the GRIHA benchmark. Further, water conservation measures, rainwater management, limited paved areas, sensitive landscape design, and on-site waste segregation areas addressed other aspects of sustainability. The construction practices adhered to the GRIHA guidelines that not only helped the project, but also ensured the health and safety of the construction workers.

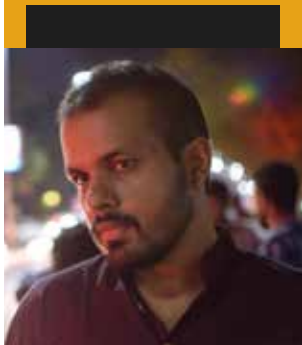
Since a museum is a public building, it gave us an opportunity to showcase the benefits of

sustainability to the visitors, thereby creating awareness on environmental protection and climate sensitivity. While learning about the rich history of Bihar, the visitors also get a chance to understand contemporary architecture that is sustainable in nature.

The GRIHA Council has been supportive throughout the process. With able assistance from our sustainability consultants, the entire journey has been a beneficial experience for us. We are proud to have the 5-star plaque on our building.

REIMAGINING MASS HOUSING DEVELOPMENT FOR LIG USER GROUPS

In this article, **Sunny Agarwal** and **Anurita Bhatnagar** discuss the necessity for sustainable housing solutions and explain why the concept of adequate shelter must be redefined in the present era of globalization.



Sunny Agarwal is Assistant Professor at Amity School of Architecture and Planning, Noida. With over 7 years of experience, he has worked on various projects ranging from retail interiors, residential, group housing, mixed-use and river front development. He is also an academican with an MArch in Urban Design from CEPT University.



Anurita Bhatnagar, a faculty member at Amity School of Architecture and Planning, Amity University, Noida is a built environment professional. For the past 13 years, she has been active in the field of urban planning and development, and has worked on several transaction advisory assignments related to improvement in urban planning, urban infrastructure, real estate advisory, and construction services. She has also been a housing sector consultant for Terwilliger Centre for Innovation in Shelter, India.

*“Human life swings
between two poles:
Movement and
Settlement”*

–Lewis Mumford

Housing, in essence, encompasses a human's desire to fulfil their primal need for shelter. While being a utilitarian unit, a house represents safety for its dwellers, introduces a sense of integration with the social fabric of the settlement, provides status, and equity while ensuring the creation of a saleable commodity in times of need. Irrespective of financial standing, a house – big or small – caters to the social, financial, and emotional well-being of its inhabitants. Housing, the place of abode, and its adjoining physical environment constitute what is known as a 'habitation' (Chandoke 1980).

What is adequate shelter?

Adequate shelter may be defined as one 'which was more than a roof over one's head, it also meant adequate privacy, adequate space, physical accessibility, adequate security, adequate lighting, heating and ventilation, adequate basic infrastructure – all of which should be available at an affordable cost.'

(Task Force on Affordable Housing 2008)

The Present Approach for LIG Housing

With the focus on realizing the goal of 'Housing for All' by 2022, urban local bodies, State and Central Government agencies have been working tirelessly in providing housing solutions for the Low-income Group (LIG) and Economically Weaker Section (EWS) group, which represent more than 90% of the current housing demand. In India, a typical LIG housing dwelling unit varies in the range of 30–60 m² (Pradhan Mantri Awas

Importance of House for Economically Weaker Section

Recognizing the importance of housing in human life, one can fathom the importance of a house in the life of Economically Weaker Section.

A house is a financial asset, a medium to assert social status, a means to recuperate, rejuvenate, and in most cases, a space to generate economic activity.

“Housing is recognized as one of the priorities in the development agenda, which is a fundamental building block of economic activity.”

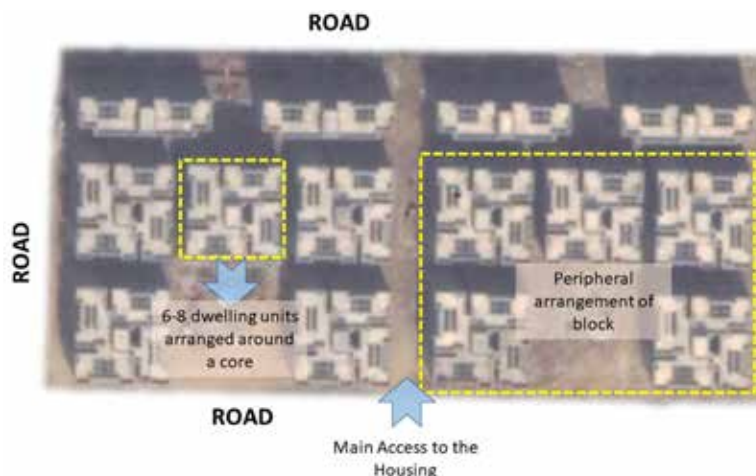
–Task Force on Affordable Housing 2008

Yojana [PMAY] 2015). The most common approach to meeting the housing demands of any urban area is the development of housing societies for low-income user groups without any consideration for quality of spaces to ensure the living standards of the user group.

To understand the housing solution provision at the local level, the present study focuses on the government/janta housing of Noida, Uttar Pradesh. A typical janta housing in Noida is developed as a gated colony, which limits interactions between user groups in surrounding areas, both physically and visually, by high compound walls. The housing scheme is a low-rise structure (G+3) built along the site periphery after making requisite provisions for setbacks as per the zoning plan.

The common elements of such a housing scheme are low-rise structures of up to 15 m in height to save additional costs of installation of lifts, a single core shared by six to eight dwelling units per floor with shared passage size as the only common area connected to the core (Figures 1 and 2), doubling up as a possible social space for interactions for the residents.

A private balcony (1–1.2 m in width) serves as the only private open space for the family of the homeowner. The required recreational spaces are created in the centre as the only space for interaction between the user groups, which is usually inadequate to provide segregation of spaces for different age groups.



» **Figure 1:** Typical housing scheme layout in Noida

Source: Google Earth Imagery with overlay by authors



» **Figure 2:** Housing scheme, Noida

A basic convenience store is provided to accommodate commercial needs, which somehow never serve the purpose and people are mostly dependent on local markets for cheap buying options that are available only at nearby street markets.

Emergent Gaps

While the current approach works well when considered from the perspective of affordability, land cost, and associated subsidies, it compromises on the quality and the associated usability of spaces thus produced.

The present approach of housing development is inward focused, thereby eliminating the concept of eyes on street, making the streets and cul-de-sacs unsafe for passing commuters, especially during late

hours. Compound walls, though beneficial in limiting the entry of non-residents, have often led to the encroachment of spaces adjacent to the plot line by facilitating illegal parking space, including littering and dumping practices. Most of the LIG housing solutions developed by urban local bodies and other government organizations show poor considerations for social factors at play in day-to-day life, providing impersonal urban environments. Such housing solutions, produced keeping in mind economies of scale rather than quality of space being created, often ignore the basic functionality of housing for an EWS dweller.

Besides the site features, the housing unit itself is a typical apartment with no or limited incremental spaces. The solution being offered though functional on an urban scale doesn't inculcate the idea of ownership to most users and falls short of meeting the living standards of majority of Indian population that thrives on outdoor interaction with neighbours. Interactions and conversations form a necessary component for creating social networks that in turn help build a safer and sustainable living condition for all user groups. Such interactions are extremely necessary for lower-income groups as their dwelling areas also serve

as spaces for economic activities, which are often informal in nature and are fostered in an environment that encourages the idea of community living. In such a setup, neighbourhood co-dependencies are necessary for mutual benefits.

Possible Solutions

The possible solution for Indian LIG housing lies in treating the house – the basic habitation unit – as a small but liveable module that provides the dwellers ample flexible spaces to live and work peacefully. The need of the hour is to provide socially and culturally appropriate solutions that are suited to the lifestyle of the intended users.

One such prominent housing development, which has set the tone for incremental housing in India, is Aranya Community Housing (Figures 3 and 4). The community was designed by B.V. Doshi and the services are provided around a central spine that consists of six sectors.

One of the key elements of Doshi's design was a hierarchy of open spaces that included small courtyards, larger green spaces for each of the settlement's six sectors, and a central playing field to serve the entire development (MIT n.d.).

Designed along the principles of vitality, equity, efficiency, feasibility,



» **Figure 3:** Layout plan, Aranya Community Housing (MIT n.d.)



» **Figure 4:** Development of incremental and flexible housing unit, Aranya Community Housing (MIT n.d.)

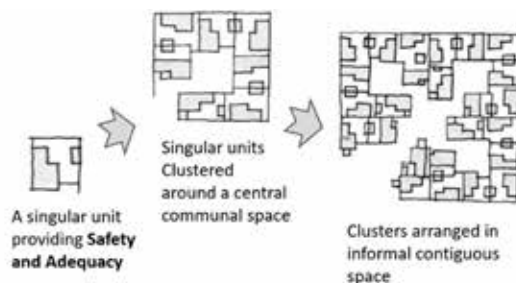
and flexibility, the township puts the user at its centre and evolves spaces necessary for ensuring 'liveability' for the individual and 'sustainability' for the community.

Another approach to ensure social and cultural sensitivity in housing has been demonstrated by Charles Correa while designing the CBD Belapur Housing (Mimar Books 1984) (Figure 5).

In this approach, the house as a unit is treated in terms of modules, which are defined private spaces interspersed with semi-public interaction avenues and public congregational spaces, thus introducing a lifeline in the community's day-to-day activities.

Not just a shelter, it is important to understand that a house and its associated habitat is a space where individuals live both as a family and a community. Clusters of singular units arranged around shared communal spaces provide the much-needed interaction essential to break the monotony of a typical day.

Well integrated formal and informal open areas provide respite from the rambling pace of everyday humdrum (Figure 6).



» **Figure 5:** CBD Belapur: An attempt to connect individual and shared communal spaces in a harmonious manner (Mimar Books 1984)



» **Figure 6:** Space as a means of recuperation, rejuvenation, social interaction, and economic survival (Mimar Books 1984)



» **Figure 8:** Tara Group Housing (illustrative section) (Mimar Books 1984)

This understanding has been further demonstrated by Tara Group Housing (Mimar Books 1984), a social housing project in New Delhi, where the resident is prioritized over vehicular movement; the built form is separated from the outside world through strategically located landscape elements and parking spaces (Figure 7).

The user comfort is thus given precedence over the need for



» **Figure 7:** Layout plan, Tara Group Housing (Mimar Books 1984)

densification and generic solution provision. The unit design respects the needs of the potential user with thoughtful considerations for basic amenities, such as space, lighting, and ventilation (Figure 8).

The Way Forward

The present times require a paradigm shift in design thinking,

which ought to be mindful of the economic pressures exerted due to paucity of land and the consequent need to achieve densities without compromising on the considerations for liveability, cultural appropriateness, and adequacy of spatial solutions.

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EMERGING TRENDS IN SANITATION WORK – JALODBUST

On 8 October 2019, the JALODBUST team gathered at Weaver's Colony, a suburban location in South Bengaluru. Having braved many a summer, Kadirappa, a manual scavenger could not believe that a small battery-operated machine – JALODBUST – could remove semi-solid faecal sludge from the leach-pit without dirtying a human hand. Dr Obalesha, Director of Thamate – an NGO overseeing the implementation of JALODBUST – had convinced Kadirappa for a trial. Gayitri Handanahal, Trustee, Reimagine Waste Trust, was leading the team.

Rakesh Kasba, founder of JALODBUST was deliberating an extension of his stay to make the mechanization equipped enough to end the menace of manual scavenging. Eventually, Kadirappa helped the JALODBUST team to set up a demonstration of the machine and he was satisfied with the results. The location of this demonstration was important because of the narrow and steep lanes, which meant that no vacuum truck could reach it.



Erika Kasba
Founder, Jalodbust

The story kept repeating at different locations across Bengaluru, from Thannisandra and Saraipalya in the north to Yeshwantpur in the west. The results were promising and every lesson from each demonstration influenced the next design iteration of the JALODBUST.

The Problem

Manual scavenging – the biggest scourge of civilization today – stems from the gaps in the proper disposal of faecal waste. Pained by the social ostracization meted out to sanitation workers in our country, Mahatma Gandhi had worked tirelessly to bring inclusivity by extolling the virtues of cleaning one's own toilets.¹

¹ Desai, P. 2014. Collective sanitation as practised by Mahatma Gandhi. Details available at <https://sanitation.indiawaterportal.org/english/node/2911>



The law defines a manual scavenger as a person who manually cleans, carries, disposes or handles human excreta in any manner in a latrine, open drain or a pit before it fully decomposes. Any person engaged in the task of manual scavenging has been denied the fundamental right to live with dignity. Therefore, a manual scavenger not only faces social ignominy, but is also prone to several health hazards. As a corollary, any sanitation worker handling sewage containing undigested faecal waste, which might take up to six months of isolation before becoming safe for handling, would still be called a manual scavenger. Thanks to organizations such as Safai Karmachari Andolan (SKA) and Thamate, sanitation workers are now aware of their rights and they refuse to be relegated to the bottom of the social pyramid.



RAKESH KASBA
Founder, Jalodbust



According to Swachh Bharat Mission (SBM),² 36 states and 706 districts have been declared open defecation free (ODF) under ODF Plan 2014–2019. The task of constructing a phenomenal 10.28 crore new toilets under SBM is the first step towards creating a sustainable sanitation system. Safe removal and transport taken up under ODF++ (2019–2029) project is the next step. About 45% of the pour-and-flush toilets discharge faecal sludge on-site in a containment area. At regular intervals, the collected faecal sludge must be processed to ensure that no harm is done to the environment and people. The processing of the faecal sludge through a sewage treatment plant is necessary to extract the nutrients.

Emerging Technologies

The first sanitation facility was founded in ancient Babylon around 4000 BC,³ yet the landmark in sewerage system occurred in 1858. Emptying human excreta into Thames and along its banks eventually led to ‘the Great Stink’ in the hot summer of 1858. Such was the urgency that in a matter of 18 days, the construction of a new sewer system began. Even after 150 years, we are using the same sewer network systems to dispose faecal waste. Since it is based on dilution and gravity flow, it depends on consistent water flow and a network of underground, sloping pipes. However, this is now understood to be impossible to take to every household.

Decentralized sanitation solutions such as the non-sewered sanitation (NSS) and the faecal sludge and septage management (FSSM) are gaining currency. Dasra’s comparative study on sewer system versus FSSM showed a capital cost saving of more than 90% and operating cost saving of greater than 85% (NFSSM Alliance, Dasra n.d.).

In 2021, the International Water Association will organize the first international conference on non-sewered sanitation (NSS) with the aim to provide stimulus for research and innovation for NSS and off-grid sanitation solutions including faecal sludge management. It is evident that the world does not have enough water to flush every toilet. The cost and inconvenience of laying of sewer lines and building

² Department of Drinking Water and Sanitation, Ministry of Jal Shakti. Swachh Bharat Mission – Gramin (All India). <https://sbm.gov.in/sbmReport/home.aspx>

³ [wearewater.org. 2017. Sewage, the trace of our history. https://www.wearewater.org/en-IN/sewage-the-trace-of-our-history_281141](https://www.wearewater.org/en-IN/sewage-the-trace-of-our-history_281141)

large STPs away from habitations are some of the factors that push in favour of NSS and decentralized sanitation solutions.

SFD and Manual Scavenging

During 2012–2013, the Water and Sanitation Programme (WSP) of the World Bank carried out an analysis of excreta management in 12 cities and developed new tools for assessing the context and outcomes related to the flow of excreta through the city. The study aimed to provide a more comprehensive understanding of excreta management along the sanitation service chain.

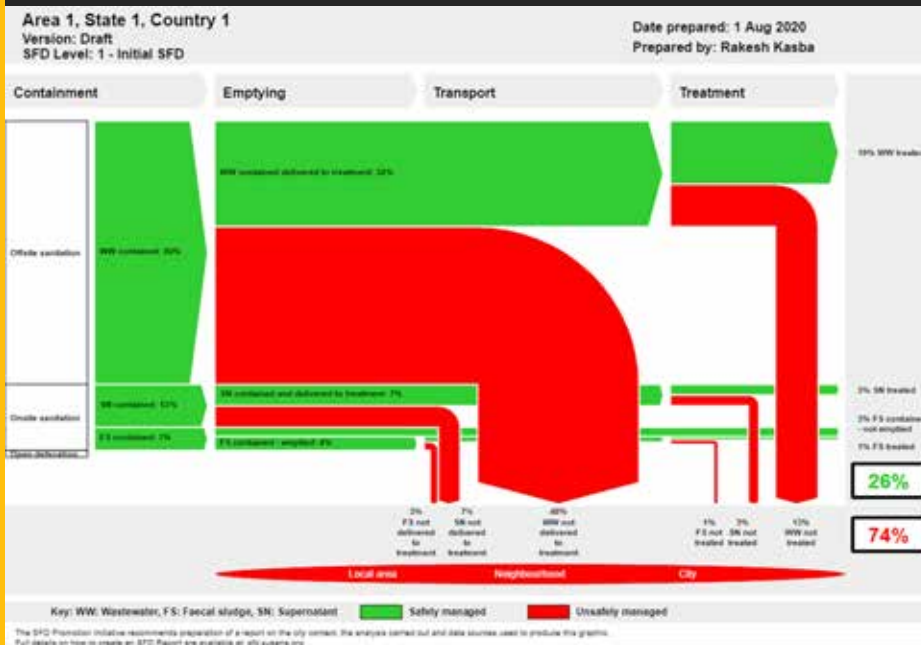
From the perspective of manual scavenging, the method of removal of faecal sludge from the containment structure has a bearing on its transportation and disposal. Today, an SFD (shit flow diagram) does not indicate statistics regarding the occurrence of manual scavenging but it must do so to make the authorities take cognizance of

the situation. As per the theoretical illustration of the SFD for 2020 (Figure 1), 48% of the faecal sludge has not been delivered to the STP, thereby raising concerns on its mode of disposal inter alia the method of removal and the occurrence of manual scavenging thereof.

JALODBUST Technology

JALODBUST–Pride, the portable model, is born out of respect to those involved in sanitation tasks. JALODBUST is aspirational and respectful. It is designed in a way that it takes into account the plight of the community of sanitation workers. Its function makes handling of faecal sludge odourless and splash free. Empathy rather than sympathy has been the driving force during the design of JALODBUST. Its technological innovation infuses a sense of respect and dignity to an otherwise risky, deprived, and ignominious task. This has potential to address the menace of manual scavenging.

JALODBUST, a novel method of sludge handling, is based on water hammer technology. It is a portable, self-sufficient, and affordable machine designed for the task of managing faecal waste. Its agitator is introduced into the septic tank or the leach pit through a 100-mm hole and operated from a simple control panel. The biodegradation of faecal matter reduces it to almost 2% solids, which collect in the septic tank, waiting to be emptied. Vacuum trucks or dewatering pumps, designed to pull out the liquid by suction, leave the settled and densified faecal sludge behind, thereby adding to the misery of sanitation workers. Moreover, inadequate mechanization to cater to the narrow spaces and remote locations leads to manual scavenging.



» Figure 1: Shit flow diagram



Credibility

JALODBUST has received acclaim from several worthy quarters for its innovation and intent as a hardware-led social start-up. In February 2019, helloScience.io, a Denmark-based incubator working towards accelerating Sustainable Development Goals (SDGs), collaborated with JALODBUST to promote the cause of faecal sludge management. In March 2019, SOCIAL ALPHA (supported by TATA Trusts) offered the author of this article a 12-month seat as entrepreneur-in-residence. On 19 August 2019, JALODBUST was invited by the Ministry of Housing and Urban Affairs (MoHUA) for a live demonstration at the Swachh Bharat Mission Exhibition at Vigyan Bhawan, New Delhi. It was subsequently included to the Directory for Sewage, Faecal Sludge and Drain Cleaning Equipment. In March 2020, JALODBUST was featured in *TimesNext Super30*. JALODBUST was also invited for exhibiting at the Swachh Sarvekshan Awards in Delhi in April 2020 (deferred indefinitely). The highest acclaim came to JALODBUST when it was declared the top hardware-led social innovation by the American Society of Mechanical Engineers at the ASMEISHOW 2020 in New York in April 2020. In July 2020, ISC-FICCI declared JALODBUST the best in the category of 'Excellence on work for upliftment of sanitation workers'.

Conclusion

The outlook of the entire sanitation industry is set to change from the archaic sewer system to the more accommodating systems of NSS and FSSM. It is imperative to elevate the position of sanitation workers by introducing more respectable, hygienic, and machine-operated tasks. Innovations in technology and decentralization will ensure that sanitation entrepreneurs lead a life of safety, dignity, and empowerment. There is a lot of space for innovation and more urgency for breaking age-old silos of class and community to retain the function of sanitation.

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NEELKANTH CHHAYA

Neelkanth Chhaya is an architect and academician. Presently, he is Adjunct Faculty at Srishti Manipal Institute of Art Design and Technology, Bengaluru. He has previously been Dean of Faculty of Architecture, CEPT University, Ahmedabad, where he taught for 26 years. As an academic, he has been interested in forms of traditional settlement and dwelling in India, and has led many documentation projects. His own research has concentrated on the relationships between environments, cultures, and architecture. As a practising architect, his work spanning over 40 years in Kenya and India has won many awards.



In this conversation with GRIHA Council, Neelkanth Chhaya highlights the importance of traditional knowledge and its application in artisanal practices and architectural design to develop low-cost sustainable homes. Within the context of ecological conservation, he talks about his organization Hunnarshala Foundation that did tremendous work in relief, rehabilitation, and reconstruction after the Bhuj Earthquake of 2001.

GRIHA:

The global pandemic has affected every individual and more so, the lives of the thousands of migrant workers, who were forced to move back to their villages under appalling conditions. What sort of capacities do you think could be developed for this marginalized section to help them recover from the present socio-economic crisis?

Neelkanth Chhaya (NC): This is a very broad question. Our economy brings about conditions such that work is concentrated in cities, forcing people from rural areas to seasonally migrate to find work. There can be several ways to address this. The care and upkeep of the land, the forests, waterbodies, etc., could be a category of work that would provide livelihoods in lean seasons. Money and resources as well as institutional mechanisms for carrying out such work need to be thought about. It is important that such works pay well. Many kinds of work that happen in cities could very well be done at home in the places from where migration happens. Well-evolved links between the needs of the cities and the skills available in rural areas, especially with the use of good communication, would decentralize the availability of livelihoods. This would also require locally owned (perhaps cooperatively, Amul being an example) forms of production units. All this requires both the strengthening of local economies, infrastructure, education and financial support on the one hand, and the larger scale networks of communication being used more effectively on the other.

Equally important is the recognition and true evaluation of the contribution of workers to the urban work scene. A change of attitude is necessary, one in which the migrant worker is considered an indispensable part of society, and accordingly given better terms and effective legal protection.

Every city needs to create provisions for temporary housing as well as provision of water, sanitation, and other services.

There is no representation of such migrant workers in any governance system. This puts them at the mercy of major urban forces. This needs to be remedied and systems of local, state, and national governance should be modified to include the voices of migrant workers.



GRIHA:

What are some of the fundamental changes that designers and the construction industry at large can make to 'localize' and 'humanize' architecture and build greater capacities for disenfranchised communities?

NC

Use of local materials, tools, techniques, and forms of work organization is one aspect that designers should take into consideration. Designers and the construction industry should explore ways in which these can be effectively and efficiently integrated into building programmes. Within the paradigm of construction activities, some loss of speed may be needed, but when weighed against the human costs of adopting newer technologies, such slight slowing down in the longer run could be beneficial for the overall well-being of the workers.

GRIHA:

Your work emphasizes on the use of local knowledge and materials. How do you think this can be incorporated into the large-scale and fast-paced construction activity we are seeing across the country with rapid urbanization?

NC

Large-scale is not necessarily fast-paced. The overall time could still remain comparatively similar whether done at a large scale or at small scales. Were Jaipur or Fatehpur Sikri or Hampi built slowly? All of them were built by workers organized in small-scale teams, and it is therefore instructive to see how small-scale does not necessarily mean slow-paced, nor does local material hinder exceptional living environments.

So, if we recognize and support the immense energy and initiative of people, we might be able to deal with rapid urbanization in a wiser way. Minimal controls over occupation and development of land, clear and effective provision of land and services at an affordable cost, diffusion of knowledge and techniques across society – all these could bring about unexpected yet excellent solutions to (address the effects of) urbanization.

GRIHA:

The importance of ecological preservation and contextual response is more evident than ever. How does this translate in your architectural practice?

NC

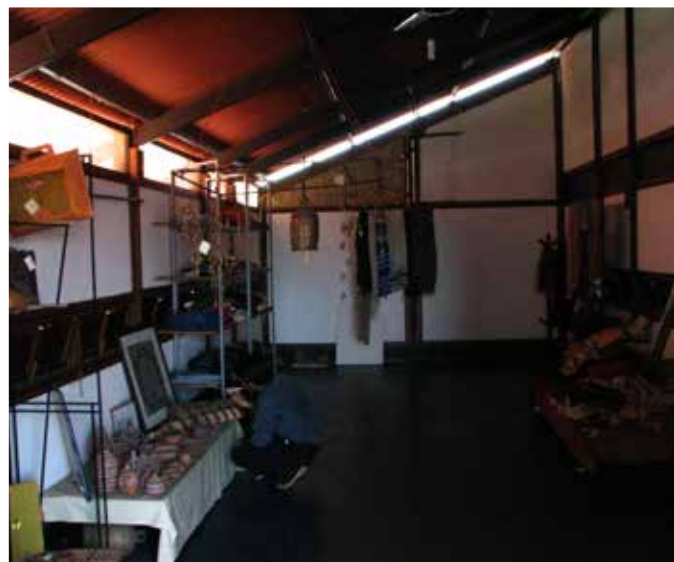
Respect what exists. Do not reshape the land unless absolutely unavoidable. Keep the trees that exist. Do not block water courses and run-offs. Bring back health to degraded lands, study the older practices to find vegetation, and practice waste management. Do not waste materials or space, do not overbuild. Study sun-paths, wind patterns, rainfall, and other climatic aspects so as to orient correctly and allow (efficient) use of natural ventilation and lighting.

GRIHA:

Do you think the nuanced values and richness of local handicraft have lost their importance? What could be some ways to revive these?

NC

Use the crafts in your designs and pay the craftspeople their rightful due. It is important to take into account not only the time and effort they put in while producing unique, individual work, but also acknowledge their role as educators of future craftspeople.





GRIHA:

Could you introduce our readers to the organization you are associated with – the Hunnarshala Foundation?

NC

Hunnarshala Foundation was set up by a few friends in Kutch after they had done a lot of important work in relief, rehabilitation, and reconstruction in the aftermath of the Bhuj Earthquake. I got associated with it from the initial stages of its formation. Hunnarshala's objectives include empowerment of local communities to shape their own habitats. It helps develop ways of making these habitats environment-friendly, disaster-safe, and sustainable. This will help artisanal knowledge take centre stage in making habitats and further future research in unconventional and artisanal construction methods.

GRIHA:

What were some of the key learnings for the Hunnarshala Foundation and yourself from rehabilitating and capacitating people affected by the Bhuj Earthquake? What were the biggest challenges you faced during this time?

NC

One of our key learnings has been that there exists a vast storehouse of traditional knowledge in artisanal practices that would still be applicable today. Also, communities are capable of steering their own fate provided suitable forms of communication are used. The best results come about when communities are part of the whole decision-making process and thus own the results. The challenges have generally been the lack of appreciation and understanding of these powerful resources amongst top-level decision-makers and votaries of impatient development models.

GRIHA:

Self-supporting communities and associations emerged as a consequence of the Hunnarshala Foundation. Can such communities be the answer to the need for sustainable, resilient, and regenerative habitats in a developing nation like India?

NC

No community can be completely self-sufficient. All individuals, communities, and resources are interdependent and interconnected. Communities built on this understanding may be more resilient and regenerative not only in India but elsewhere too.

GRIHA:

Given the interconnected nature of challenges today, do you think architectural discourse needs to evolve and incorporate concepts such as complexity theory and 'systems' thinking? How do you envision the future of architectural education in India?

NC

Both complexity theory and systems thinking allow us to see our reality as consisting of deeply enmeshed and interconnected components. They allow us to understand design actions as phenomena happening in a dynamic ongoing process, where the objects that come about are part of an interactive whole. Thus, architectural practice starts including not only the effort to perfect architectural objects but significantly giving careful consideration to origins and effects of processes. This would lead to a kind of non-invasive, non-violent, and permeable kind of architecture. Education in architecture needs to develop ways of reawakening the students to think about interconnected processes.

GRIHA:

How does cultural responsiveness manifest in an evolving and complex society such as ours that aspires to 'Western' ideals of modernity and development?

NC

Both 'western' societies and Indian society are beginning to doubt the wisdom of the 'progress-control-and-dominance' model of development. The problems of the world around us make it clear that this model has been destructive and divisive. At the same time, enhanced communication between people of different lands and languages leads to cross-cultural learnings and adoptions. In India, we need to become aware of the problems of adoption of models that are based on the ideas of dominance over the world, control over whatever reality we work within, and the notion that more is always better. We also need to see more clearly problems, divisions, and injustices that are part of the Indian culture, so that we change and evolve in a direction that is our own and yet connected to the world.

GRIHA:

Do you think the frugality of cultural responses has been lost in our way of life and replaced with patterns of over-consumption and indulgence? What are the behavioural changes that individuals must make?

NC

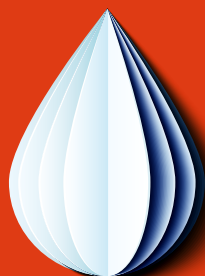
When we say that we have lost the ability to be frugal and have become addicted to patterns of over-consumption, we should remember that we are voicing the concerns of our class of well-off Indians. The minority which is trying to lead the majority (who have frugal access to resources) i.e. most of us, afflicted by this problematic behaviour, needs to reflect upon the direction of 'development' that we support. We will need to think of 'the last person', as Gandhi said, and constant awareness of the consequences of our actions on the world at large could lead to behavioural changes.



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Ar. Taru Rawat, LEED AP ID+C is an interior architect with knowledge in green building designs. She has 7 years of work experience with global architecture companies. She is enthusiastic about sustainable building solutions and holds various green credentials, such as GRIHA CP, RESET AP, and IGBC AP. She can be reached at tarurawat@outlook.com.

Introduction

What is Ozaki 8? It is an adventure sport that revolves around eight ordeals to achieve one goal: 'To be one in body, mind, and spirit', through tributes to nature. This sport honours the forces and wonders of nature. Not everyone is a sports enthusiast but to achieve the same goal, one can start small and gradually become an eco-warrior. The eight ordeals are listed as follows:

1. The Emerging Force
2. Birth of Sky
3. Awakening Earth
4. Life of Water
5. Life of Wind

6. Life of Ice
7. Master of 6 Lives
8. Act of Ultimate Trust

Ozaki 8 is about giving back to earth and its inhabitants (Figure 1). We are on the verge of exhausting earth's resources and it's about time we follow these eight ordeals to compensate for the losses and rejuvenate our only habitat.

The Emerging Forces

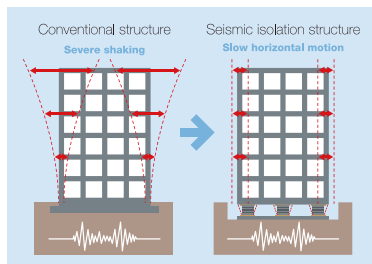
The very first ordeal talks about the forces of nature that bring disaster and death. From massive earthquakes, hurricanes, floods, and droughts, this emerging force is the harbinger of destruction and devastation. Be it the

European Commission, the financial sector or private companies, they need to adopt water stewardship by assessing strategies and mitigating associated risks. So, how can an architect or an average person be considerate towards our planet? Some of the ways are summarized as follows:

- Design disaster-resilient structures, for example, well-built dams (Figure 2).
- Focus on water-related systems, such as rainwater management (Figure 3), drainage control, recharging of groundwater.
- Follow laws on construction in wetlands, green lands, etc.



» **Figure 1:** Responsibility towards our environment



» **Figure 2:** Conventionally designed building vs a resilient structure

Birth of Sky

We always complain about the sky not being blue, the smog covering most of the country, and the diminishing biodiversity. Air quality has been compromised with the increase of human population. Lack of construction-and-demolition waste management plans, incineration facilities, ETS (Environment Tobacco Smoke)



» **Figure 3:** Example of rainwater run-off stored for future use

control, and general emissions have polluted the air. This cycle of harmful gases continues to affect our environment.

The best practice is to always ask ourself how relevant or important it is to conserve before we decide to either burn a thing or throw it away. Following green strategies can help add quality to not only our own lifestyle but also our environment. Some of these strategies are listed as follows:

- Use green cleaning chemicals (Figure 4) or prepare your own homemade cleansers like bio enzymes. No chemicals will automatically mean no harmful elements.



» **Figure 4:** Use green cleaning products or DIY to eliminate harmful fumes

- Use materials (paint, adhesives, sealants, etc.) which have low VOCs (volatile organic compounds).
- As a designer/contractor, follow air quality management guidelines.

Awakening Earth

While this ordeal talks about the natural caves and shafts found on the planet, let us focus on how we can take care of Mother Nature and heal earth.

- The first and foremost thing is to put a stop to the exhaustion of non-renewable resources.
- When we take a trip to rejuvenate ourselves, we must ensure that we clean up too. One simple habit to inculcate is: DO NOT LITTER (Figure 5).
- Make it a give-and-take relationship, if you are taking something from Mother Earth, give her love and care in return by being considerate. Plant more trees, reduce your carbon footprint. Explore new places but don't spoil the natural habitat.



» **Figure 5:** Do not litter and learn to segregate waste

Life of Water

This ordeal talks about the waves and the extreme sport that involves surfing these rapids which happen once a decade. We can derive life from water by considering aspects that produce renewable energy, for example, tidal energy. Many countries like ours receive enough rain, which cause devastation. This water can be used to recharge groundwater, and the tidal waves can help us generate energy. If we are using the source for our benefit, we are also making sure that we are providing ways to give it back by practising small habits.

- Reuse wastewater
- Install water-efficient fixtures (Figure 6)



» **Figure 6:** Using low-flow fixtures

- Incorporate native landscapes to eliminate special irrigation

Life of Wind

Wondering how wind can give us life? Well, what is wind? Wind is air in motion. And this air is the most essential thing for our survival. Keep the air clean, be considerate, contribute towards maintaining the quality of air. Plant more trees, keep your surroundings clean, control air pollution levels.

- Using natural ventilation can cut the need for mechanical ventilation (Figure 7).
- The government needs to target those areas with high pressure winds from where wind energy can be derived (Figure 8).
- Designers should design spaces where temperature, humidity, air movement, and natural lighting are given priority. This will automatically improve the air quality.

Life of Ice

The only term that comes to a building professional's mind at the mention of 'Ice' is 'refrigerants'. These refrigerants are as destructive to the environment as the



» **Figure 7:** Incorporating operable windows in design to enable natural ventilation and less reliance on mechanical ventilation



» **Figure 8:** Investment in renewable sources of energy will benefit in the longer run

formidable ice trail is to the Ozaki. For this reason, green building strategists condemn the use of CFC-based refrigerants in any new construction.

- Investing in a new electronic appliance, focus on the refrigerants as well.
- Select refrigerants used in HVAC, etc., that eliminate the compounds, which add to ozone depletion and climate change.
- Hospitality and retail projects have a list of equipment and appliances that come under the class of certified products (e.g. EPA Green Chill)
- Design spaces for no refrigerants or low-impact refrigerant use by focusing on glazing properties, shading devices, insulation materials, and lighting power density (Figure 9).

Master of 6 Lives

The seventh ordeal signifies the art mastered in the last 6 ordeals,



» **Figure 9:** Opt for no or low-CFC refrigerants

eventually reaching the top of these practices. This stage is of pure enlightenment and awareness. Once you are aware of your surroundings and the importance nature has in your life, there's a realization that one can do only so much. One person cannot change the world but if that person masters their habits, they can definitely influence other people to change as well. Start at home, start small. The considerations, contributions will grow gradually.

The Act of Ultimate Trust

The last ordeal is simply an understatement: 'Put your life in Earth's hands' (Figure 10). The simplest path to complete these ordeals is to *commit* yourself to nature and earth, which have given us our lifelines in the form of water, food, and oxygen. Value these gifts, protect, and preserve these natural resources. Live a life of sustainability and work towards balancing it. Do not forget that Earth is the only habitable planet in this universe.



» **Figure 10:** Have trust in your environment

ITC KOHENUR, HYDERABAD

The GRIHA certification is based on a life cycle approach rather than a first-cost one, which helps the project achieve its target easily. The GRIHA guidelines evaluate the environmental performance of a building holistically over its entire life cycle, thereby providing a definitive standard for what constitutes a 'green building'.

The assessors were accessible, which allowed us to engage in an effective dialogue. Some of the pertinent features in any GRIHA rating, such as being able to assign 'non-applicability' to certain appraisal and receiving partial points in criterion, added value to the dynamic certification programme.

Further, GRIHA helped develop an understanding of the effects of the previously discussed features on the overall energy efficiency of the project. Periodic site audits by the GRIHA team kept the project on track. Also, during these site audits, it was beneficial to have a sit-down with our assessor, the contractor, building owner, and client to address specific points and engage in a productive dialogue. The final report gave the client key things to consider in terms of maintaining the project.



VANDANA
Sr. Project Manager
Environmental Design
Solutions Pvt. Ltd

Environmental Design Solutions (Global) has been closely associated with GRIHA for over a decade through several projects and it has been a rewarding experience in terms of knowledge enhancement in green buildings. The ITC Kohenur in Hyderabad – the hotel project – has been awarded a 5-star rating by the GRIHA Council, exemplifying excellence in sustainability parameters at various stages. To ensure an environment-friendly building, the development of ITC Kohenur adhered to sustainable principles in architectural and engineering design, construction, and operations.

The design process of ITC Kohenur was based on an analytical approach, which started with a series of consultations regarding the project's design parameters. These parameters included site location, site topography, site landscape, environment, project brief, culture, and end users' experience. The analysis led to an informed decision in design. Studying the design parameters and balancing these decisions were the tools that helped to carve the building.

Some of the highlights of the project included achieving an efficient Energy Performance Index (EPI) through various energy efficiency measures, use of solar water heating systems, motors and pumps, energy and water metering, efficient lighting systems, and investment in off-site renewable energy.

As a green building consultant, it often seems an uphill task to maintain the true intent of sustainability in the process of constructing a building. But with the GRIHA certification team and ITC Limited as our client, it was a pleasure to see the true meaning of sustainability being maintained throughout the tenure of the project.



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INTEGRATING LIFE CYCLE ASSESSMENT WITH GREEN BUILDING ASSESSMENT

For a Cleaner and Greener Planet

With rapid urbanization and industrialization, there is habitat destruction, resource depletion, watershed degradation, and waste generation. In this article, **Chित्रarekha Kabre** and **Sakshi Singhal** highlight the importance of using life cycle assessment tools and sustainable building techniques and designs in India's construction sector.



Dr Chित्रarekha Kabre earned her PhD from the University of Queensland, Australia and has 30 years of academic and professional experience in sustainable architecture. Presently, she is Professor of Architecture at DCR University of Science and Technology, Murthal (NAAC 'A' grade State University of Haryana). She is Fulbright Visiting Professor, North Dakota State University, Fargo, USA (2012). She is GRIHA-certified professional and evaluator (Architect & CM). Her books include Sustainable Building Design: Applications Using Climatic Data in India and Synergistic Design of Sustainable Built Environment. She can be reached at drchित्रarekhaKabre.arch@dcrustm.org.

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Introduction

Nature is organized according to the principles of nutrients and metabolisms, evidently circumventing all concepts of waste. A fruit tree gives flowers and fruits. After pollination, the flowers

that fall to the ground enhance the quality of soil with the help of organisms and microbes. Waste, if it occurs, becomes nutrients in return. This biological life cycle has been sustained for millions of years on Earth with an abundance of magnificent species. Humans

in contrast, are the only species in this system that extract large quantities of nutrients but rarely return them to the cycle in a usable form. Waste from our current consumption patterns are breaching the capacity of our planet to absorb. Consequently, there is habitat

destruction, resource depletion, watershed degradation, and waste generation.

Over the past two decades, the design of sustainable built environment has been emphatically shaped by green building assessment methods and associated building regulations (standards and codes). This argues for integration of life cycle assessment (LCA) and life cycle costing (LCC) (together known as 'life cycle thinking' [LCT]) with the green building assessment methods as a premise of sustainability. The objectives of the study are as follows:

- Analyse sustainability metrics and LCT
- Identify parameters of LCA and LCC from various green building assessment methods
- Study of LCA in built environment
- Recommend guidelines for integration of LCA in green building assessment method

Sustainability Metrics and Life Cycle Thinking

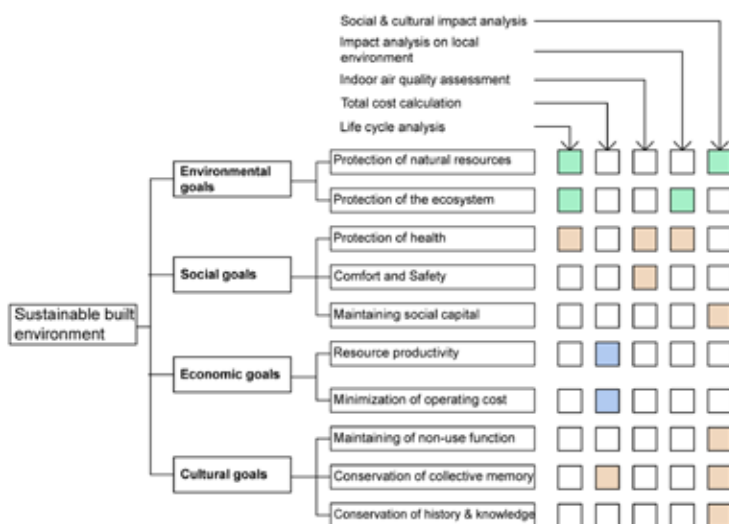
Sustainability has two intrinsic requirements. First, it entails inter-

and intra-generational equity within the constituent domains of sustainability – environmental, social, cultural, and economic, as described by the notion of the 'triple bottom line' (Figure 1). Second, sustainable development requires long-term planning and responsibility.

A sustainable built environment is assessed by the way various systems (decisions) fulfil multiple functions.

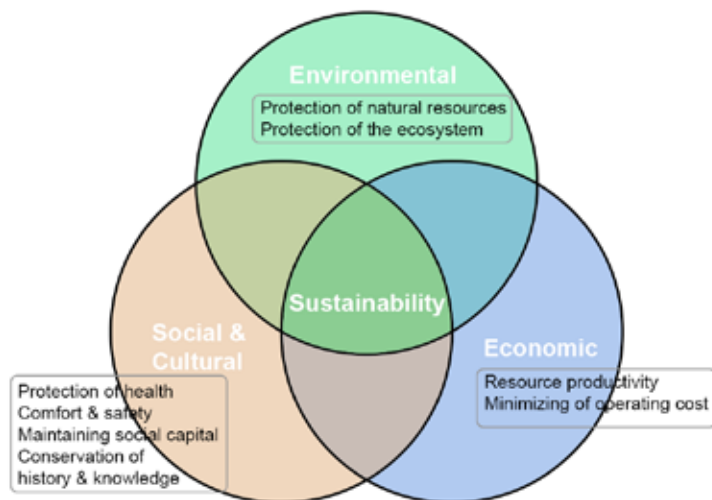
High environmental performance within demanding cost and time constraints is guaranteed through a creative synergy of systems and goals (Figure 2).

In terms of LCT, both LCA and LCC are important factors that work simultaneously. If we initiate the LCA of any building to reduce emissions, the first point we think of is its costing. The additional cost incurred by a project to adopt



» **Figure 2:** Test of sustainability can be achieved with a combination of various assessment methods

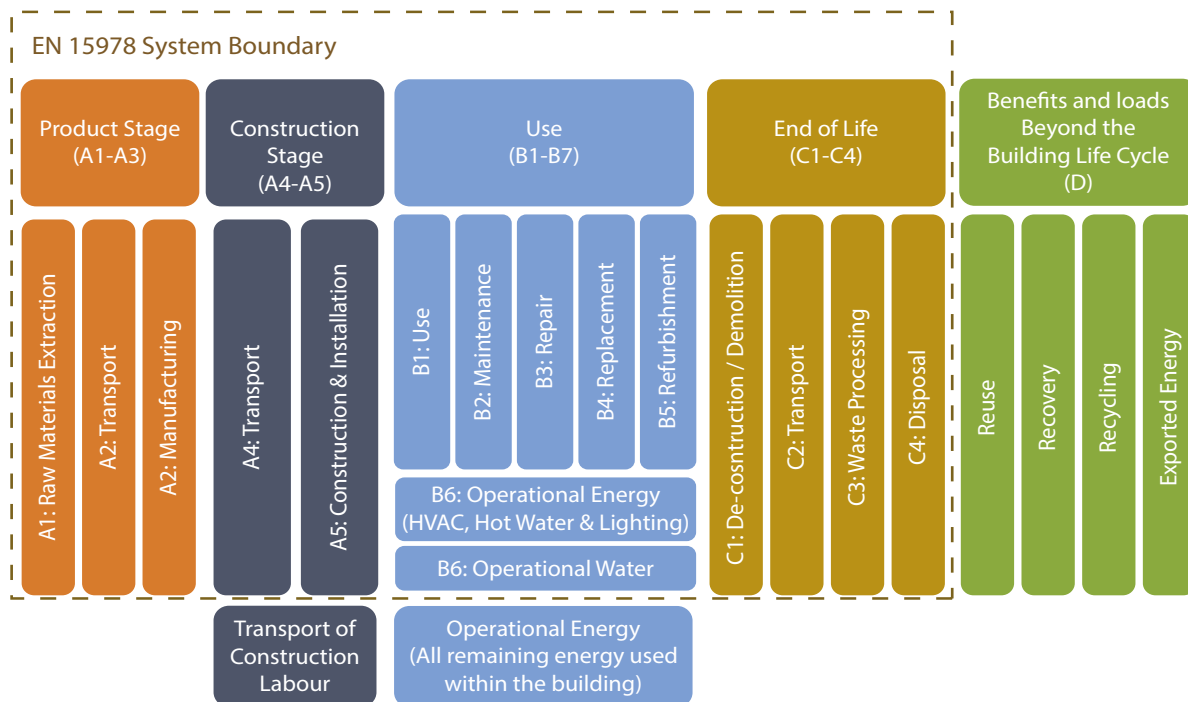
Source: (Kohler, et al. 2012)



» **Figure 1:** Triple-bottom line approach to sustainability

sustainable design strategies as opposed to conventional building design strategies can be justified using an LCC analysis since the cost benefits of these strategies are realized during the operational phase of a building.

LCA can be performed at various stages of a building construction, which include Product, Construction, Use, and End of Life followed by the principle of 3Rs: Reduce, Reuse, and Recycle. The different sub-stages of every construction stage are represented in Figure 3. The building materials have varying tendencies from raw phase to end-of-life phase, and their LCA can be carried out on the basis of LCA variants as shown in Figure 4.



» **Figure 3:** System Boundary of LCA

Source: Details available at <https://etoolglobal.com/>

LCA Software Study

Various software and databases were studied that work on the principle of LCA (Table 1). Only one software named 'One Click LCA' was identified that could work in the Indian context. This software primarily

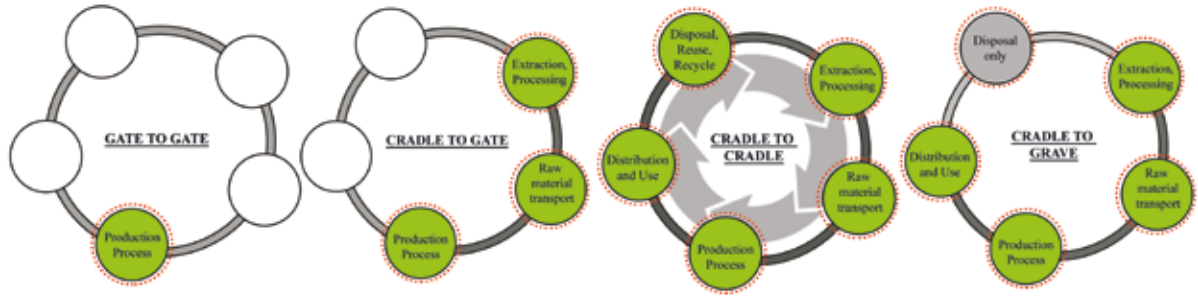
works for LEED and BREEAM, but it also has embodied energy data for some materials pertaining to India. Some of the other propriety software that can be used for an LCA study are Open LCA, Sima-pro, Gabi, etc., as listed in Table 1.

LCA and LCC: Barriers

LCA and LCC computations are based on the databases related to embodied energy, transportation distances, service life of any material and its global warming potential, operational energy required, durability, and costing among others.

Table 1: Software for LCA calculations

Software	Link	Availability
Open LCA	http://www.openlca.org/	Open source and free software
EDGE	https://app.edgebuildings.com/#/	App is available for direct calculation
Sima-pro	https://simapro.com/	Software to be purchased (30 days demo version)
E-Tool	https://etoolglobal.com/	Software to be purchased (trial for only one project)
Gabi	http://www.gabi-software.com/international/software/gabi-envision/free-trial-gabi-envision/	Software to be purchased (30 days trial)
Athena (Canada)	https://calculatelca.com/software/impact-estimator/	Software to be purchased (no trial)
BEES (USA)	https://www.nist.gov/services-resources/software/bees	
One Click LCA (Indian context)	https://www.oneclicklca.com	Software to be purchased (14 days trial and student license for 1 year)



» **Figure 4:** Variants of LCA

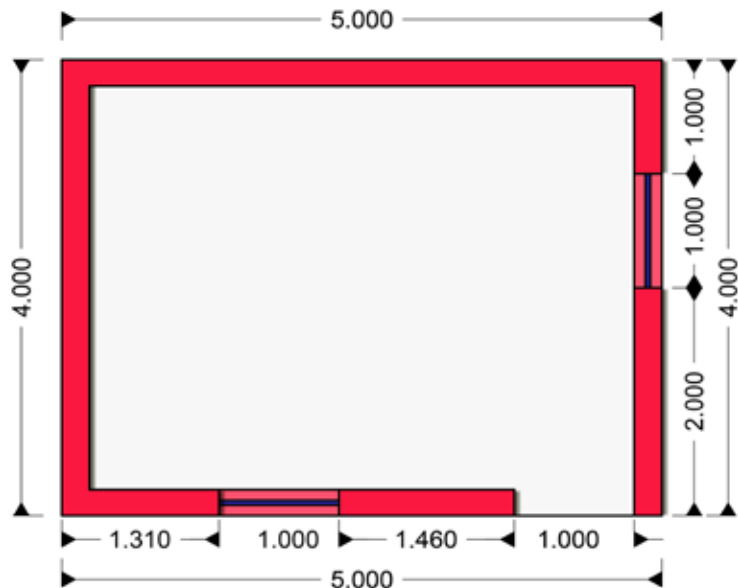
India must refrain from adopting the databases of other countries owing to significant differences in climatic conditions, transportation distances, and manufacturing processes. An LCT system needs to be framed for the Indian context and this article attempts to identify the sources for data collection and the corresponding technicalities.

Application of LCA

With LCA, one can interpret the results of carbon reduction in the context of transportation distances, choice of materials, durability, and maintenance. Carbon values for different materials give clarity on carbon reduction in both design and base case. The LCA of an apartment room (4 m x 5 m x 3 m) is derived as a study (Figure 5). Different materials with different transportation distances are taken as cases to

observe the results between carbon emissions of green materials and conventional materials (Table 2).

The global warming potential (GWP) is presented in Figure 6 for conventional and green building

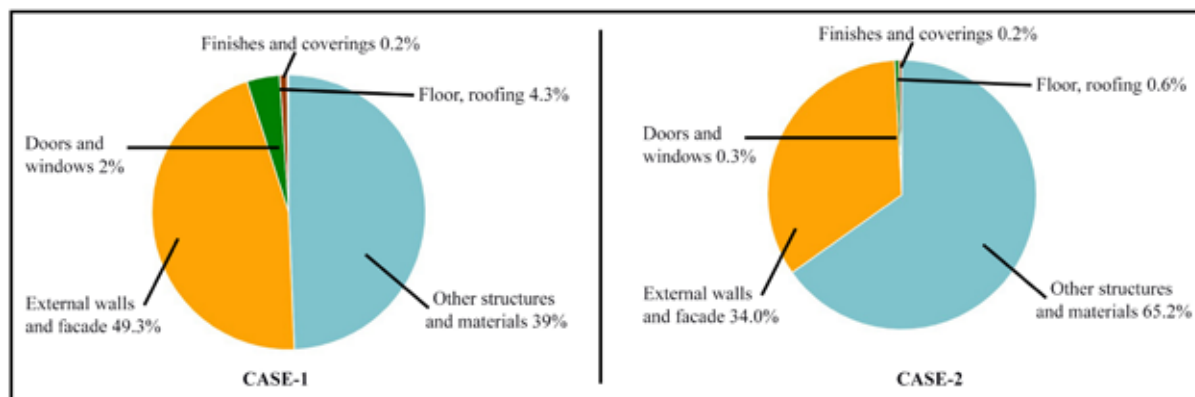


» **Figure 5:** Plan of a sample room for LCA calculation

Table 2: Parameters for sample LCA calculation

CASE-1		CASE-2	
Transportation distance: less than 10 km		Transportation distance: within 60 km	
Materials	Quantity	Materials	Quantity
Red bricks	25 m ³	AAC blocks	25 m ³
R C C slab	13 m ²	Coffered slab with green concrete	13 m ²
Glass for openings	3 m ²	Recycled glass for openings (ASAHI)	3 m ²
Vitrified tiles	13 m ²	Mosaic tiles	13 m ²
Plaster	10 mm	Plaster with 30% fly-ash	10 mm
Result: Carbon emissions are high because of virgin materials whereas their transportation distances are less (as shown in Figure 6) 75,211 kgCO ₂ e		Result: Carbon emissions are less because of recyclability content of materials despite greater transportation distances (as shown in Figure 6) 17,888 kgCO ₂ e	

Source: Details available at <https://www.360optimi.com/app/?&channelToken=oneclicklca>



» **Figure 6:** Global warming (kg Co₂e) classification by building elements

materials. The difference in carbon emissions is presented in Figure 7 for four stages of building, along with the variation in environmental indicators.

Conclusion

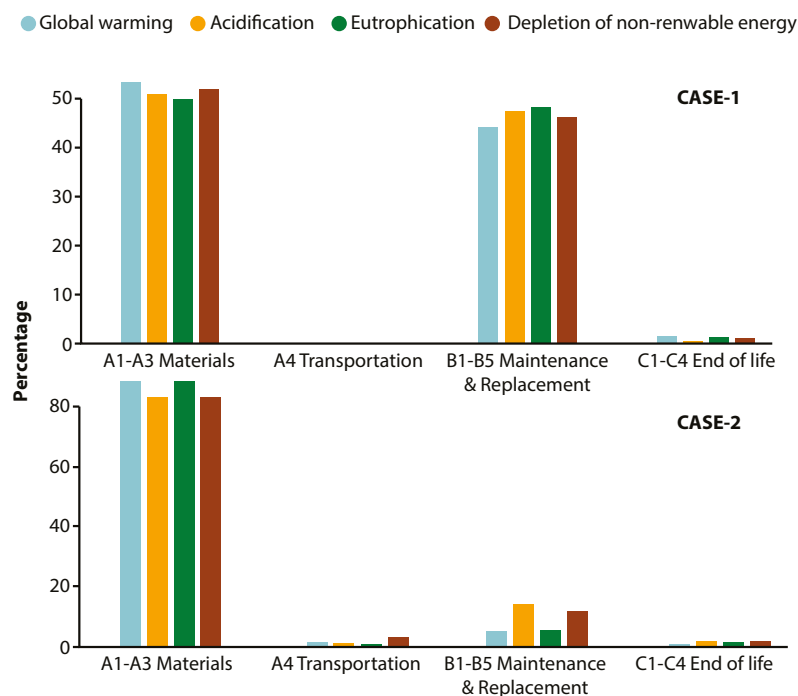
The sustainability of buildings is mainly determined by factors of durability and adaptability. Therefore, the LCA tool can be used

in the decision-making process of renovation of the existing building stocks and construction of new buildings. If demolition of an unfit existing building and its construction from scratch is the chosen solution at first, consideration of the environmental and social consequences might lead to the renovation of existing building stock for preservation and

adaptive reuse. The Renaissance Hall, a century-old building, was to be demolished at first, but it was renovated and reconstructed to the standard of LEED gold certification for adaptive reuse by the Department of Architecture and Landscape Architecture, North Dakota State University, Fargo, as shown in Figure 8 (a). On the other hand, a new building stock could be designed and constructed considering the life cycle approach. According to German engineer Prof. Werner Sobek, future buildings should be characterized as follows:

- Zero energy: in total, they will not require energy for their annual operation
- Zero emissions: they will not emit any harmful substances
- Zero waste: all materials will be completely recyclable

This 'Triple-zero Concept' was epitomized in his design for the Energy Plus (experimental) House in Berlin, as shown in Figure 8 (b). According to Prof. Sobek, the ecologically conscious building could be extremely attractive and exciting, especially because it compels the designer to face new challenges.



» **Figure 7:** Carbon emissions at each life cycle stage



(a) Renaissance Hall, North Dakota State University, Fargo, USA



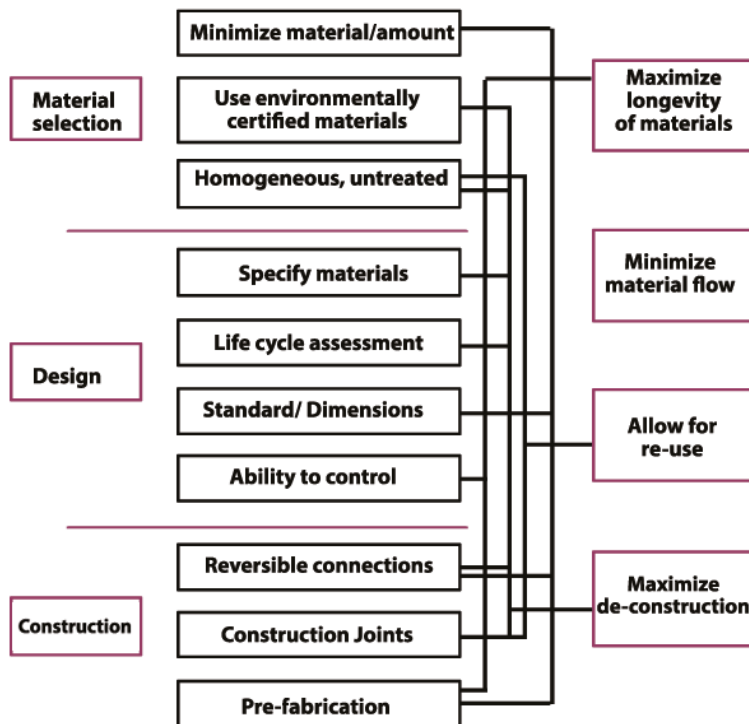
(b) Energy Plus House, Berlin, Germany

» **Figure 8:** LCT: existing building vs new building

Photo courtesy: C. Kabre

If new construction is considered, it should include, as a matter of principle, strategic evaluation of the future of the new buildings (Klaus and Hammann 2008). The question is: which measures implemented today will increase the value of the

facility in the longer run? The art of design lies in the capability to establish or enhance the usability of a structure with many small corrections and interventions to secure its use without destroying its basic substance (Figure 9).



» **Figure 9:** Principles of increased life span design and construction: reverse engineering is incorporated into initial design phase

Source: (Kohler, et al. 2012)

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PRELUDE EVENT

"PRAYAAS" - AN EFFORT TOWARDS CLEANLINESS

A clean-up drive was organised by GRIHA Council in association with Green Dream Foundation at Hauz Khas on 16th November, 2019 as an effort towards cleanliness and to generate awareness and drive action among the people of New Delhi about ill- impacts of littering and inefficient waste management



MUD AND BAMBOO ARCHITECTURE WORKSHOP

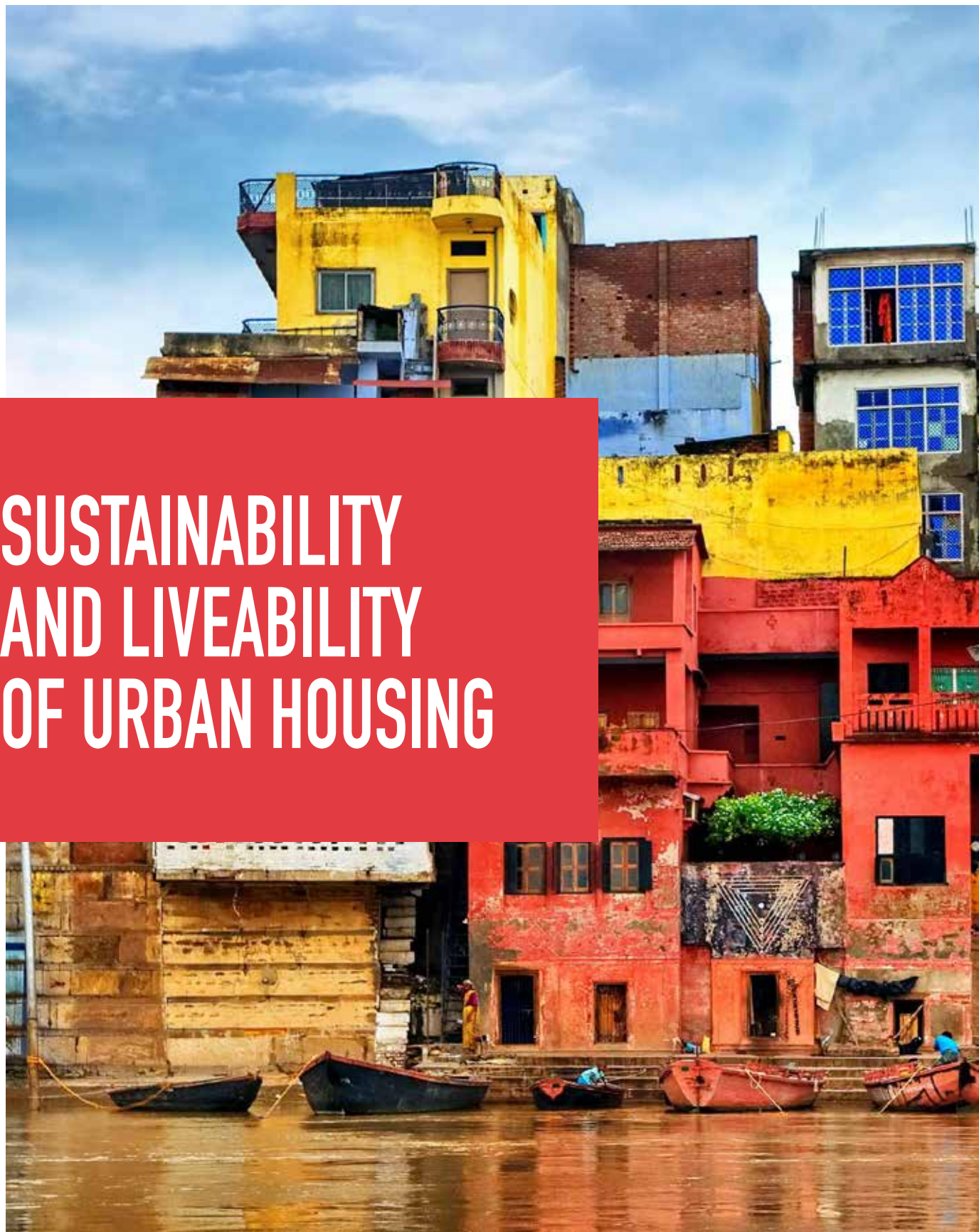
A two days' workshop was conducted on "Mud and Bamboo Architecture" by Ar. Revathi Kamath, aimed at providing participants with the knowledge needed to evoke their sensibility towards benefits of using these materials in architecture and techniques for sustainable integrated development.

SITE VISIT AT HEADQUARTERS BUILDING FOR UNIQUE IDENTIFICATION AUTHORITY OF INDIA (UIDAI), NEW DELHI

GRIHA Council organized a 'Green Building Tour' to a GRIHA rated building in New Delhi on 14th December 2019. The tour demonstrated the green materials incorporated in building design, construction material and systems.



SUSTAINABILITY AND LIVEABILITY OF URBAN HOUSING





Shagun Agarwal is Assistant Professor with Amity School of Architecture and Planning, and PhD scholar with RICS, Amity University, Noida. She is currently pursuing her research in Sustainable Practices in Affordable Housing. She can be reached at ar.shagunagarwal@gmail.com.

Affordable housing and liveable habitable conditions are the basic needs of a human being. In this thought-provoking article, **Shagun Agarwal** highlights the concerns of India's rural population that is compelled to migrate to cities in search of better employment opportunities. The author also discusses the importance of making urban housing solutions sustainable, liveable, and affordable.

Introduction

Over the last few years, India has been undergoing major and rapid transformations and the pace of development is predicted to keep increasing in the coming years too. Urbanization and modernization have compelled workers in the villages to move to cities. As per a survey conducted by the UN, it is estimated that by 2030, almost 40.76% of India's population will be living in urban areas. But the big question is: Are our cities equipped to handle this transition and accommodate people migrating from rural areas to urban areas in huge numbers? On the one hand, we are progressing towards the 'Smart City' revolution and on the other hand, the country is still struggling with providing liveable habitable conditions to a major percentage of its citizens.

Housing – The Basic Human Need

Shelter is and has always been one of the basic yet most essential needs of humankind. Good living conditions define the health of city dwellers, thereby affecting the growth and prosperity of the city itself. The desire for a more comfortable life has encouraged the rural population to move to urban areas in search of better employment opportunities. These migrants are neither used to nor exposed to the harsh urban living conditions. The most dramatic shift can be noticed in the lower income group. People in this group are either willing to or are forced to leave their native place and move to urban sectors in search of better paying jobs. They look for higher economic growth and prosperity for themselves and their families. Their needs are simple and basic. They do not demand luxury but they want habitable, liveable spaces. They are not interested in owning a home; all they want is a roof above their head to spend the night. However, the skyrocketing prices of any type of basic accommodation in cities make the hope of buying formal housing a distant dream for the migrants. Ultimately, they are forced to make do with temporary informal sheds, which in turn makes their living conditions far worse than what they came from. The prime focus of this group of people is to minimize their daily expenditures and maximize the savings for their family back home. And since they are already used to

surviving in minimalistic conditions in their native places, they willingly accept the unhygienic and almost inhumane living conditions that they are exposed to in the cities.

The main expenses incurred by these households include – accommodation, transportation, food, and healthcare. Accommodation costs are minimized by living in small, densely populated clusters where there is poor ventilation. Transportation, however, continues to be a deterrent for most of them. Since they can only do so much about the food and medicine expenses, their priority is to minimize or totally do away with the transportation expense. The best possible alternative to achieve that is to find accommodation or build accommodation at a walking distance from the workplace. Most of the companies and offices are, obviously, located in the business districts of the city. These districts have their own story. They are the face of the city and its financial centre. Hence, the infrastructural costs in these business districts are quite high. Acquiring a dwelling unit in these prime locations of the city is a challenge in itself even for the financially affluent groups. Under such conditions, finding a formal housing solution is one of the biggest challenges faced by rural migrants. With no feasible option, they resort to finding shelter in illegal temporary makeshift structures close to their workplaces, which at least cancel out the transportation cost with poor living conditions as the trade-off. And that marks the beginning of a new slum development. Inadequate and inappropriate housing options are factors responsible for the rise of slums in India.

Quite a few studies in the past have indicated that housing shortage is

one of the major causes for squatter settlements and an increase in slum development. Over the last several years, the government has undertaken numerous steps and floated various schemes to address the issue of housing availability for all the citizens at reasonable costs. But at some level, the policies and schemes offered by the government to address the housing deficit has failed miserably. Not only does the availability of housing at affordable prices continue to be an issue but the sustainability and living conditions in housing that are available for consumption remain to be addressed.

Only a handful studies have been done to understand the qualitative aspects of the housing facilities available in the city. The noteworthy fact is, despite the huge gap in the supply of housing units, there are quite a few projects that have not been implemented even though they fall within the affordable range. This can be attributed to the factors that affect the quality of life offered to the inhabitants by such projects, rather than the financial dynamics of the dwelling itself. A few research studies have focused on identifying the criteria, which are essential to make housing sustainable and hence, desirable for the people.

Sustainability

Sustainable affordable housing is defined as 'housing that meets the needs and demands of the present generation without compromising on the ability of the future generation to meet their housing needs and demands.' Sustainability in housing can be categorized under three main heads – economic, social, and environmental.

Economic sustainability refers to ensuring that housing is available to



the consumers at affordable prices. In India, housing that costs 30% of the household income is considered affordable. This ratio might hold good for the higher income groups, but it might be a challenge to find housing available in this price range (based on 30% household income criteria) for the lower income groups. Also, this generalized definition of affordability doesn't take into account the household expenditure incurred besides the cost of the dwelling. Hence, what is understood as affordable by the government agencies and developers might, in reality, be over the budget for a large percentage of the consumers. Or, the money left after investing in the housing unit to fulfil the daily expenses might be insufficient for the consumer. This is one of the prime factors contributing to housing units lying vacant despite the huge deficit in supply. The government could explore the possibility of making more housing units available on rent rather than concentrating on ownership to promote economic sustainability. Modifying the existing policies to support the private developers and bring down the cost of the housing units could be a way to address the issue.

Social sustainability aims at achieving inclusive design by integrating all income groups together in the same housing fabric. The provision of basic amenities within the housing complex and at the neighbourhood level affects the desirability and the saleability of the housing project. Some of the critical factors that directly affect the success or failure of a project include accessibility to work, accessibility to alternative means of public transport, availability of basic infrastructure such as shops, quality education facilities, recreational

activities, health services, fire station, open green public spaces in the vicinity, safe neighbourhood area, security associated with the location, crime rate, etc. Besides these, the per-square-foot area of each dwelling unit and the design of the unit along with the quality of construction also have an impact on the psychological well-being of the inhabitants. The presence of these facilities promotes sustainability at the community level.

Environmental sustainability focuses on ensuring a balanced ecosystem by devising energy-efficient solutions for housing with little or no impact on the dwelling cost. Building orientation, use of solar panels, mud bricks, sun control and shading building devices, improved insulation of the housing envelop are some of the features that can be used to reduce the energy consumption within the housing units, thereby cutting down on the energy costs. These solutions help lower the running expense of the household while being eco-friendly for all.

Conclusion

The government has been actively promoting 'affordable housing' schemes over the past few years to maximize their outreach to all the income groups. Pradhan Mantri Awas Yojana (PMAY), Rajiv Awas Yojana (RAY), and Housing for All 2022 are a few such initiatives in the endeavour. While it is important for the government and private developers to work in tandem to bridge the gap between the housing demand and supply, it is also essential to understand the various factors, merits, and demerits of housing solutions in India. Sustainability needs to be integrated with affordability to achieve long-term housing goals. An in-depth



study of the economic, social, and environmental sustainability factors must be conducted, detailed out, and integrated with various government policies.

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START-UP STORY

Journey of Bhuyantra

‘Bhuyantra’ translates to ‘Earth-Machine’. We believe, only NATURAL can be SUSTAINABLE.

It all started in 2016. News about landfill fires, cases of rising water pollution in nearby places, new health challenges, and space limitation for waste recycling were all pervasive. Considering the complex structure of our country, it cannot be denied that the Central government, State government, and numerous NGOs were doing a commendable job in order to keep such environmental issues in control but were unable to do so. After rounds of surveys and research studies on ground reality, it was concluded that having a centralized waste management was not an optimum solution. To avoid landfill problems, we needed to eliminate them. Also, it had to be sustainable with negative carbon footprint.

The next step was the execution of the aforementioned idea. We needed to empower people so that everyone could contribute towards this mission. For that, we needed customizable and decentralized solutions. At first, we started with wet waste. A typical household of four people generates 500–600 grams of wet waste daily. Our society can be categorized into individual homes, small to medium apartments, large housing societies, and industrial canteens. After a close study of the waste generation pattern of these places, five solutions were designed and invented to manage waste at source while consuming the least energy. These solutions were – ChaCha Bins™ (up to 350 g per day), Home Bin™ (up to 2 kg waste per day, no electricity), Compost Hut™ Mini (handles up to 25 kg waste per day), Compost Hut™ (can handle 100 kg to 5 tonnes of waste per day), and finally Bhuyantra Organics™. All solutions were based on aerobic decomposition, these did not release harmful gases or smell and did not require any skilled manpower. By this, we were doing two things – stopping the generation of wet waste that was being dumped in landfills and creating new jobs opportunities at apartments/societies/canteens, which never existed before. But our job was still far from being done.

After tackling wet waste, we designed and manufactured various shredding machines with brand Katran™, which cuts dry waste (packaging material, plastic waste, biomedical waste, and electronic waste) into small pieces for easy transportation, effective recycling at source or to suit every recycling centre’s requirements. In the next phase, we also developed agriculture and garden waste processing machines to help farmers.

By this time, we had good market acceptance and our machine installations were available across the country. We had also supplied to the Indian Navy and the Indian Army along with other prestigious organizations. Still, we felt something was missing. We were able to reduce and recycle the wastes but we were still not able to reuse them. So, we launched the last part of the cycle with Bhuyantra Organics™.

Under Bhuyantra Organics™ vertical, we empowered every household to achieve organic, healthy, and self-sufficient vegetable and fruit produce. This particular solution was soil-less and was capable of growing 60 plants within a space of 4 ft² and enabled everyone to grow fruits and vegetables at a larger scale.





How will Bhuyantra Organics™ impact sustainable change in the future?

There will be four challenges in the long run, which must be solved. These are related to – awareness, segregation of waste, making solutions ultra cost-effective, and changing the way we treat our waste. We are going to solve some of these challenges in the upcoming days. First, we intend to make the solutions affordable and available to everyone so that they could start recycling. Second, we wish to make hyper-local recycling centres. We have several ongoing R&D projects, which aim to solve bio-hazardous waste management issues in the era of the COVID-19 pandemic.

Till date, we have stopped over 5,000,000 kg waste from ending up in landfills, produced over 1500 tonnes of organic manure, helped grow more than 13,000 completely organic plants, and created hundreds of jobs while keeping everything natural, sustainable, and eco-friendly. We plan to make these figures ten-fold by the end of 2023.

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INTERFACE BETWEEN CRITICAL INFRASTRUCTURE AND EXTREME WEATHER EVENTS

Within the paradigm of national economic security, public health, safety, and overall welfare, critical infrastructure (CI) is a term that defines assets necessary for the efficient functioning of an economy and the larger society. In this article, **Dr P.S.N. Rao**, **Dr Virendra Kumar Paul**, **Dr Chaitali Basu**, **Abhijit Rastogi**, and **Dr Anil Kashyap** discuss the importance of resilient, secure CIs, which in today's globalized world – grappling with climate-related events – are crucial than ever before.



***Dr P.S.N. Rao** is Professor, Department of Housing, School of Planning and Architecture; **Dr Virendra Kumar Paul** is Professor, Department of Building Engineering and Management, School of Planning and Architecture; **Dr Chaitali Basu** is Assistant Professor, Department of Building Engineering and Management, School of Planning and Architecture; **Abhijit Rastogi** is Assistant Professor, Department of Building Engineering and Management, School of Planning and Architecture; and **Dr Anil Kashyap** is Head of Department of Geography and Environmental Management, University of West of The England, Bristol, UK.*



Dr Virendra Kumar Paul



Dr Chaitali Basu



Abhijit Rastogi



Dr Anil Kashyap

Introduction

The main purpose of this article is to establish the cascading impact of extreme weather event(s) (EWEs) on critical infrastructures (CIs). The EWE is defined by those weather phenomena that are at the extremes of the historical distribution, and are rare for a particular place and/or time, especially severe or

unseasonal weather. Such extremes include but are not limited to severe thunderstorms; severe snowstorms, ice storms, blizzards, flooding, hurricanes, high winds, and heatwaves. The definition of CI differs amongst countries as those infrastructure assets (physical or electronic) that are vital to the continued delivery and integrity of the essential services, the loss

or compromise of which would lead to severe economic or social consequences or to loss of life. This article evaluates and identifies 13 CIs in the Indian context that are essential for societal functions, health, safety, security, and economic or social well-being. Their interdependencies are categorized based on their driving power and dependence on other sectors



through application of cross-impact matrix multiplication applied to classification (MICMAC). Then, based on the dependency number, weighted ranking is established.

Extreme Weather Events

In recent years, a variety of EWEs, including droughts, rain-induced landslides, floods, winter storms, wildfires, and hurricanes have threatened and damaged different regions across Europe and beyond. These events, in some cases, had a devastating impact on CI systems (CORDIS 2018). According to UK Weather Projections (2014), extreme weather indicates those weather phenomena that are at the extremes of the historical distribution, and are rare for a particular place and/or time, especially severe or unseasonal weather. Such extremes include but are not limited to severe thunderstorms, snowstorms, ice storms, blizzards,

flooding, hurricanes, high winds, and heatwaves. In 2018, World Meteorological Organization (WMO) stated that while 2016 was the hottest year with global temperatures recording 1.1°C above pre-industrial era, 2017 was a particularly affected year in terms of disasters with high economic implications. The total disaster losses from weather and climate-related events were estimated at US\$ 320 billion, the largest annual total on record (after adjustment for inflation).

Identifying Critical Infrastructure

Critical infrastructure

In the past, civilizations like the Romans protected their CI, such as aqueducts and the military roads (Setola, *et al.* 2016). The definitions of CI differ amongst countries; however, their importance for the functioning of societies is widely recognized. In situations when services provided by

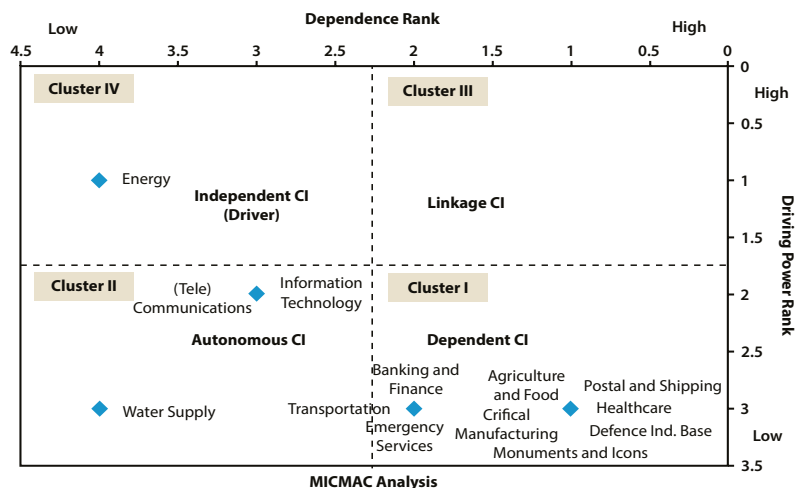
such infrastructures fail due to certain EWEs such as landslides, flash floods, snowstorms, then only do societies become cognizant of their dependence on these infrastructures, and of the vulnerabilities that arise from such dependence. The UK Government defines Critical National Infrastructure (CNI) as: 'Those infrastructure assets (physical or electronic) that are vital to the continued delivery and integrity of the essential services upon which the UK relies, the loss or compromise of which would lead to severe economic or social consequences or to loss of life' (Strategic Framework and Policy Statement 2010).

Critical infrastructures in India

In a study by Singh, *et al.* (2014), they identified 13 CIs in the Indian context, and also established their interdependencies through Interpretive Structural Modelling (ISM) methodology and then categorized the CI sectors into four sub-groups based on their driving power and dependence on other sectors through the application of cross-impact MICMAC. The results are presented in Figure 1. These CIs and their interdependencies shall be explored further in the course of this piece within the Indian context.

Methodology

The assessment of CIs and EWEs has been conducted in two phases. The first phase is based on the literature review for ranking CIs based on interdependability. In the second phase, a survey is conducted for ranking CIs and EWEs.



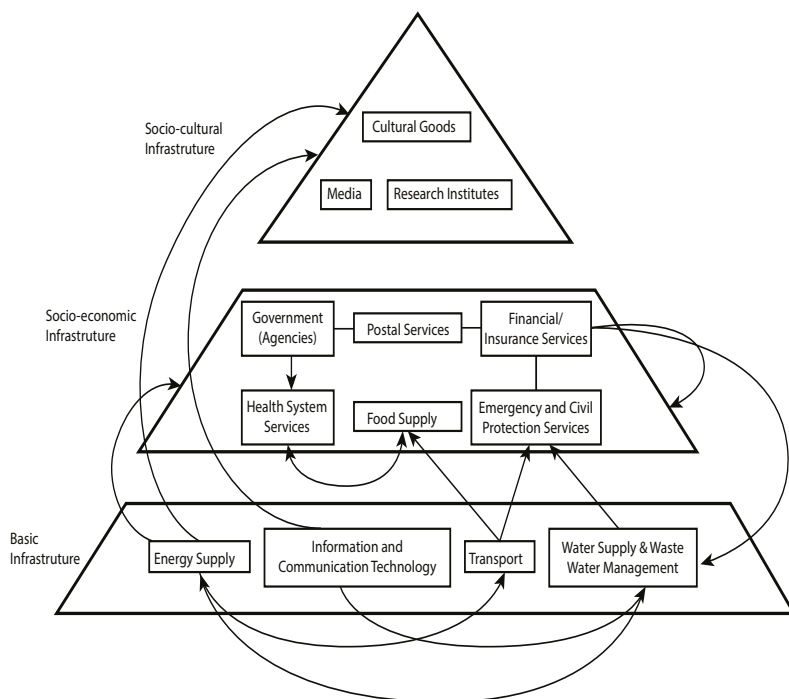
» **Figure 1:** Critical infrastructure of India and the dependencies

Assessing the 'Critical Network' of Infrastructures

Complexity of critical infrastructures and interdependencies

CIs are of essential importance for the functioning of societies and their

interruption or destruction could have major effects on societies due to the growing dependency of the population on the infrastructural services, and an increasing complexity of infrastructures due to their interdependencies. Lauwe and Riegel (2008) proposed an interdependency model for the



» **Figure 2:** Interdependency model for the infrastructures considered 'critical' in the UK

Source: Lauwe and Riegel (2008)

infrastructures considered 'critical' in the UK. It is presented in Figure 2. The same model has been adopted to explain the interdependency hierarchy of the Indian CIs based on the dependency model by Singh, et al. (2014), which is presented in Figure 1.

Mapping interdependability for critical infrastructures in India

From the study by Singh, et al. (2014), 13 CIs have been identified. From the interdependability matrix, the relative ranking of CIs may be established, as presented in Table 1. Using the hierarchical model, the interdependability matrix has been developed and presented in Table 2.

Table 1: Ranking of CIs based on interdependability

Critical Infrastructure	Weightage	Ranking
Energy	1.00	1
Telecommunication	0.85	2
Information Technology	0.85	2
Water Supply	0.54	3
Banking & Finance	0.23	4
Transportation	0.15	5
Emergency Services	0.15	5
Agriculture & Food	0.15	5
Critical Manufacturing	0.15	5
Postal & Shipping	0.08	6
Healthcare	0.08	6
Monuments & Icons	0.08	6
Defence Ind. & Base	0.08	6

Table 2: Interdependability of CIs based on referred case studies

	Socio-cultural Infrastructure										Monuments & Icons			Points			
	Socio-economic Infrastructure					Water Supply	Banking & Finance	Transportation	Emergency Services	Agriculture & Food					Critical Manufacturing	Postal & Shipping	Healthcare
	Energy	Tele Communication	Information Technology														
Basic Infrastructure																	
Energy	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13
Telecommunication	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	11
Information Technology	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	11
Water Supply										1							3
Banking & Finance							1										1
Transportation						1		1	1	1	1	1	1	1	1	1	7
Emergency Services									1	1				1			2
Agriculture & Food											1				1		2
Critical Manufacturing												1					2
Postal & Shipping													1				2
Healthcare															1		1
Monuments & Icons																1	1
Defence Ind. & Base																	1

Findings and Discussion

Thus, it can be established that Energy is considered the most CI, followed by Telecommunication, and Information Technology. However, the study presented through this article establishes the interdependability based on the cascading impact of CIs and does not take into account the EWEs. Therefore, in the future, this study could be extended to develop interdependability based on both EWEs and their corresponding cascading impact.

Acknowledgements

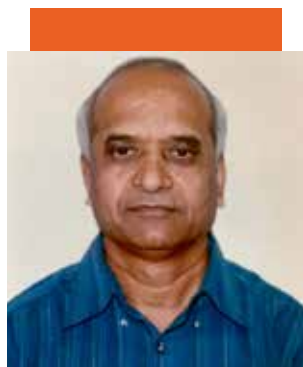
The funding for this research was received under the UKIERI-UGC Project 'Decision-Support Framework for Resilient Critical Infrastructure against Extreme Weather Events and Climate Change', between School of Planning and Architecture, New Delhi and University of West of The England, Bristol, UK. The opinions and findings expressed here, however, are those of the authors alone, and are not necessarily the views or positions of the UKIERI and UGC.

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PHOTOCATALYTIC NANO TITANIA COATING FOR AIR PURIFICATION AND BUILDING PROTECTION

Air pollution is one of the serious threats to humankind. In this article, **Mohan K. Dongare** discusses the use of photocatalysts in building materials to improve the living conditions of urban environments. The author points out how TiO_2 nanocoatings are now being engineered to offer significant benefits for applications in aerospace, defence, medical, marine, and oil industries.



Dr Mohan K. Dongare, a scientist, (rtd) from National Chemical Laboratory, Pune has been involved in R&D activities for the last 44 years and has published his research work in reputed national and international journals (about 100 publications) and patents (about 30 national and international patents) in the field of catalysis/chemicals.

Recipient of two national awards for 'Innovations' by FICCI, DST, Lockheed Martin, and Texas Institute, USA, he is associated with chemical/sugar industries for developmental work. He can be reached at dongare.mohan@gmail.com.

Introduction

The increased public concern around environmental pollution has led to the development of effective pollution control technologies. Volatile organic compounds (VOCs), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), and particulate matter ($\text{PM}_{2.5}$ and PM_{10}) are the main pollutants that affect both the indoor/outdoor environment and human health. At present, particularly in India, the concentration of these pollutants

in various places has reached critical levels. However, there are no technologies available for removal of these pollutants from all the sources in the environment to protect our society from health hazards. Indirect measures such as tree plantation and reduction of pollutants at sources are some of the efforts being taken to curb pollution levels. Some examples of direct technologies such as catalytic converters for automobile to convert harmful exhaust gasses (CO, HC, and NO_x) to harmless gasses, in-house air purifiers/air filters are being utilized for environmental remediation, albeit with limited success. Hence, to ensure a safe, healthy, productive, and conducive environment, it is necessary to develop comparatively simpler and cost-effective technologies and/or effective strategies to improve indoor/outdoor air quality and protect our environment.

Photocatalytic Oxidation of Air Pollutants

Advanced oxidation processes (AOPs) using photocatalytic oxidation (PCO) are being considered an efficient process for environmental remediation owing to their potential to degrade a wide range of organic pollutants in the air or in the aqueous media under ambient condition without significant energy demands (Spasiano, *et al.* 2015).

Indoor Air Quality

Over hundreds of VOCs contributing to indoor pollution have been qualitatively identified as alkanes, aromatics, esters, alkenes, carboxylic acids, and alcohols. Additionally, an analysis of the available data on VOCs

contributing to indoor pollution, demonstrates a statistical association between indoor air quality and occupants' health and performance.

Pure or modified titanium dioxide (TiO_2) with a nanoparticle size has been proven to be an efficient photocatalytic material for degrading organic and inorganic air pollutants. PCO technology utilizes nano TiO_2 as photocatalyst, which on illumination by UV light forms highly reactive hydroxyl radicals ($\text{OH}\cdot$) in the presence of oxygen and water vapour. These free radicals undergo a series of reactions with pollutants, such as bond cleavage, substitution, and electron transfer, to finally mineralize them into CO_2 and water. PCO represents the newest generation of proactive air purification technology. The basic working principle of PCO process is shown in Figure 1.

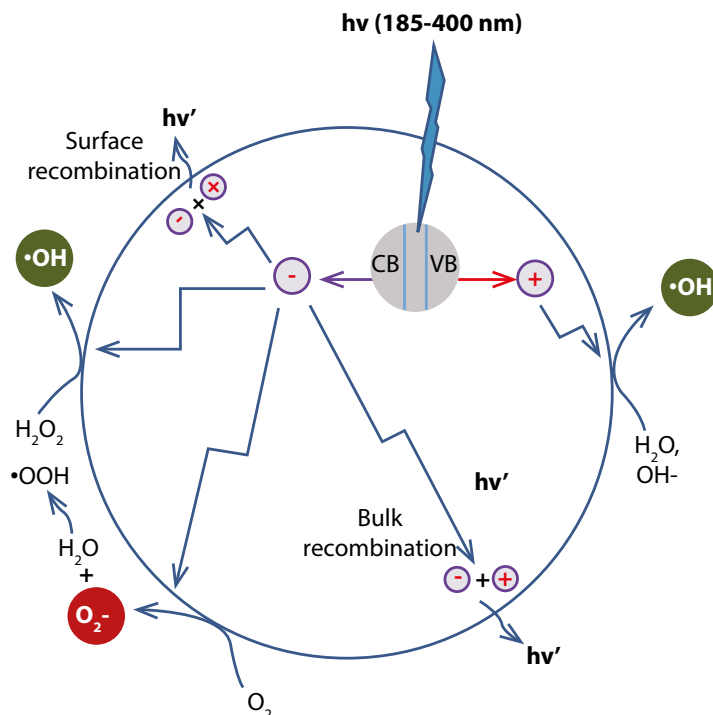
Extensive work on PCO has been performed on bench, pilot, and commercial scales for indoor air pollutants' abatement. The physical properties of nano TiO_2 , crucial for determining efficiency of PCO include – surface area, pore size, pore structure, chemical elements, morphology, and crystal structure of the photocatalyst (Zhong and Haghighat 2015). For the performance and operating costs of the air purifiers, adherence to nano TiO_2 coating, the gas flow pattern of the air (to be purified), and the wavelength of UV light are crucial factors. Photocatalytic coatings are known to remove pathogen from the surrounding air. Silver/copper nanoparticles modified nano TiO_2 are reported to have a very high efficiency for antimicrobial activity (Muranyi, Schraml, and Wunderlich 2010). Internationally, such PCO-based air purifiers are commercially manufactured and are being

used for indoor air purification in hospitals, airports, theatres, especially in Japan, Europe, and USA.

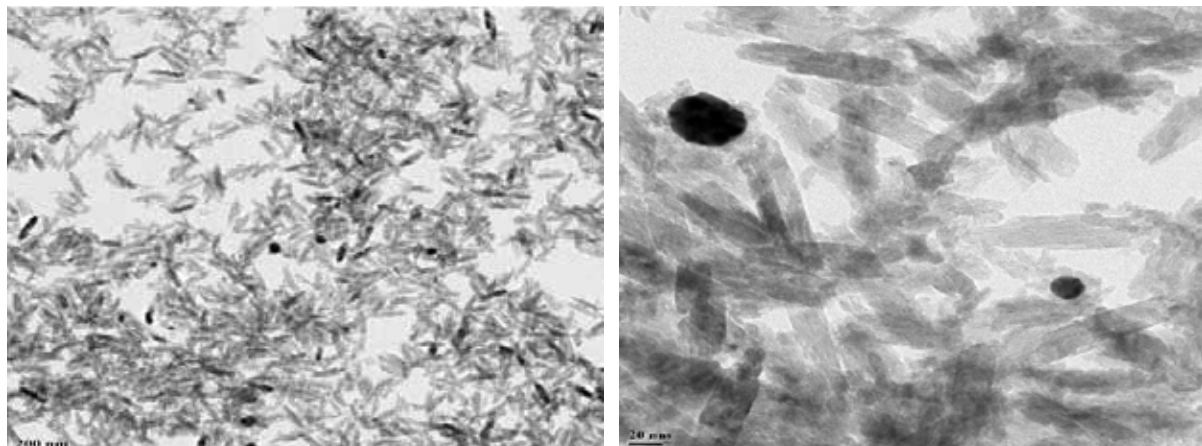
Our Technology

The team at National Chemical Laboratory, Pune has developed polymeric TiO_2 nanostrands of 1–2 nm diameter and 30–40 nm length clusters, which have shown very high photocatalytic activity under solar radiation for the degradation of air pollutants (patent filed). This material showed very high zeta potential (the potential difference existing between the surface of a solid particle immersed in a conducting liquid, e.g. water, and the bulk of the liquid) of –35 to –80 Mev. This indicates high stability of the material and negative charge on the surface due to which it adsorbs cationic species from the aqueous solution instantaneously and oxidizes in sunlight. This reduces toxic elements from the air. It is also effective in the removal of pollutants from air by PCO under sunlight. Being an aqueous-based product, TiO_2 nanostrands can be easily coated on either cement or metallic support and can be used as photocatalytic paint. The TEM (transmission electron microscopy) images of the nano TiO_2 are shown in Figure 2.

Using this nano titania, a photocatalytic air purifier was developed (Figure 3) and tested for its efficiency in pollution abatement at CSIR–National Chemical Laboratory, Pune. The VOCs, such as toluene, propylene, carbon monoxide, and NO_x (over 1000 ppm) were decomposed to 99% when passed through an air purifier. Typically, the pollutants in the atmosphere are in ppb level. However, this technology showed pollution abatement even in ppm



» **Figure 1:** Production of active oxygen and hydroxyl radicals by photocatalysis and further reactions for pollution control



» **Figure 2:** TEM images of TiO₂ nanostrands

level, which indicates the high efficiency (1000 times more than required) of the photocatalytic air purifier.

Air Flow Capacity: 100 CFM

Light Source: UV Lamp

VOC Reduction: 80–90% reduction in a single pass

The PCO-based photocatalytic air purifier has been tested under dynamic conditions at the Environmental Laboratory, MITCON Pune, using a deodorant spray as a VOC source. The VOC level was reduced from about 80–119 ppm to 5–8 ppm in one pass and <1 ppm with multiple passes when contaminated air was passed through the air purifier. This showed

a very high efficiency of prototype PCO air purifier for removal of VOCs from the atmosphere. Similar air purification units have been installed in HVAC systems for air purification (to remove bacteria and VOCs) in Pune's IT industry.

Outdoor Air Purification

The de-pollution performance of photocatalytic cement-based materials containing TiO₂ has been assessed in numerous studies over the past decade, illustrating their potential in urban pollution control (Angelo, *et al.* 2013). Within the framework of the project, PhotoPAQ demonstrated the effectiveness of coatings of photocatalytic materials on a realistic scale in photocatalytic

depolluting fields set up in Leopold II tunnel in Brussels, Belgium. For that purpose, photocatalytic cementitious material was applied on the side walls and ceiling of selected test sections inside a one-way tunnel and the results were obtained for the viability of using PCO coating for such applications (Boonen, *et al.* 2015).

In recent years, self-cleaning coatings using photocatalytic TiO₂ have gained considerable industry attention. With assistance of UV light from fluorescence source or sunlight, TiO₂ offers unique advantages such as, strong oxidation power and super-hydrophilicity. Strong oxidation power helps kill bacteria attached



» **Figure 3:** Photocatalytic air purifier developed by EnviPure using TiO₂ nanostrands coating specifications

on the wall, or oxidize/remove foul smells from stains in toilets (e.g. TiO_2 -coated tiles and glasses are commercially available). Super-hydrophilic properties allow dirt and stains to be easily washed away with water or by rainfall when such a coating is applied on exterior surfaces. Nano TiO_2 self-cleaning coatings greatly benefit building maintenance, especially skyscrapers, as the need for costly surface cleaning is reduced. Photocatalytic coatings are also useful for improving indoor air quality by reducing VOCs and other toxic chemicals present in hotels, restaurants, commercial business facilities, university laboratories, hospitals, and residences. Anti-stick properties of nanocoatings ensure less staining and easy-cleaning-effect on exterior and interior surfaces. Anti-graffiti properties also help remove the stubborn stains simply with a high-pressure hose. Water-based, VOC-free, clear impregnating nanoparticle wood coatings containing nano UV absorbers have been commercialized, and are designed for use on masonry and concrete surfaces. Such coatings provide superior water repellency, reduce efflorescence, and guarantee significantly improved abrasion resistance. NYC luxury building coated with nano TiO_2 is claimed

to have the air-purifying power equivalent to 500 trees.

TiO_2 Nanostrand Coating on Outdoor Surfaces

As part of an experiment, polymeric titania nanostrands were coated on cement terrace in 2017 and the coating has been exposed for last three rainy seasons. From the photographs given in Figure 4, it is evident that areas coated with nano titania remain very clean whereas the surrounding area (without coating) showed mould formation. The nanocoating has also been applied on ceramic tiles.

The results of the tests performed in the laboratories and on-site showed that photocatalytic materials, when irradiated by appropriate light, increase the effectiveness of abating noxious organic and inorganic substances responsible for air pollution. Additionally, experimental evidences show that photocatalytic-based products are able to maintain their aesthetic appearance unaltered for a long time too. Therefore, the use of photocatalysts applied to building materials could improve the living conditions of urban environments.

Surpassing the limited performance standards of traditional coating

materials, TiO_2 nanocoatings are now being engineered to offer significant benefits for applications in aerospace, defence, medical, marine, and oil industries – and have driven manufacturers to seek products that offer innovative properties and advanced functionalities including UV resistance, indoor air purification, self-cleaning surfaces, odour control, environmental remediation, conductive materials, anti-microbial and anti-viral properties, anti-mildew applications, anti-corrosion applications, and more.

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» **Figure 4:** Pictures of nano TiO_2 coated on terrace and tile exposed to three rainy seasons

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Dr. Ajay Mathur and Shri. Nitin Jairam Gadkari at the Green exhibition and Lighting the lamp ceremony at the inaugural of the 11th GRIHA summit



Launch of GRIHA v2019 Rating at the Inaugural session to the 11th GRIHA Summit. L-R - **Prof. Ian Jacobs**; H. E. **Mr. Freddy Svane**; **Dr. Ajay Mathur**; **Shri. Nitin Jairam Gadkari**; H. E. **Ms. Harinder Sidhu**; **Mr. Sanjay Seth**



11TH GRIHA SUMMIT



Plenary session was held on the theme of the summit – 'Approach to Integrated Sustainability (Grand Challenge on Rapid Urbanization)

Helen Lochhead

David Sanders



"Venu Kutir" a 240 sq. ft. cottage inspired by the form of a bird's nest was inaugurated by **Shri Suresh Prabhu**, Hon'ble Member of Parliament, Rajya Sabha on 16th December, 2019 at the India Habitat Centre. The structure was designed to create a comfortable living space using one of the most sustainable materials on earth, 'Bamboo'..



The GRIHA Green exhibition was centered not only at spreading awareness about upcoming technologies among visitors, but also in helping them understand the detailed functionality and benefits of such products so that they can take an informed decision in the future.



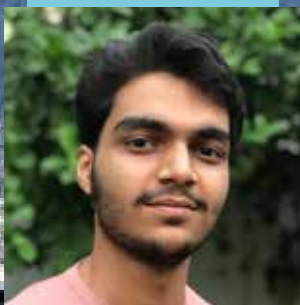
H. E. **Mr. Freddy Svane**, Ambassador of Denmark to India, Embassy of Denmark and **Shri Sanjay Seth**, CEO, GRIHA Council addressing the audience.



The signing of memorandum of understanding between the GRIHA Council and National Real Estate Development Council (NAREDCO) at the curtain raiser to the 11th GRIHA Summit on 16th December, 2019 at Hotel Claridges, New Delhi

PROTECTING ARCHITECTURAL HERITAGE: LEARNING FROM BHUTAN

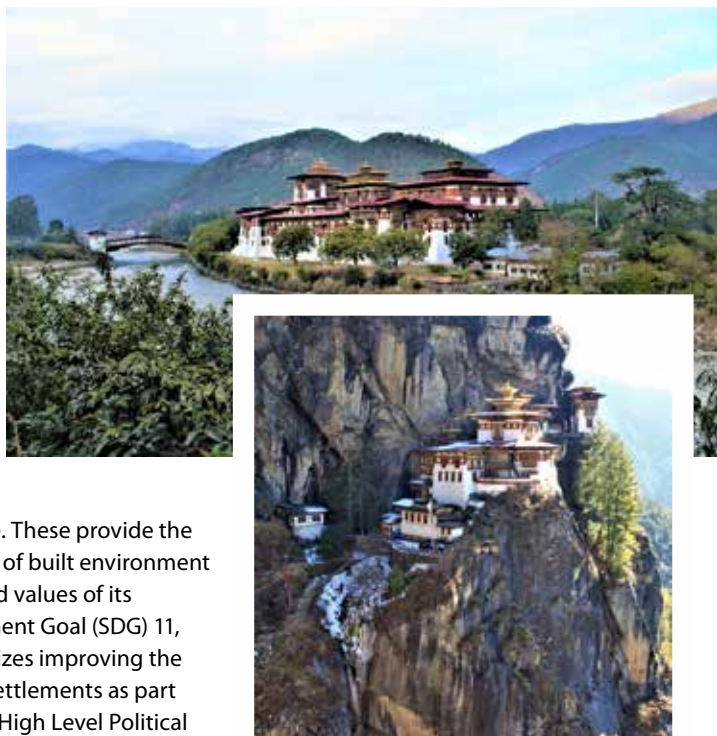
Why is it important to preserve and protect a country's architectural heritage, culture, and traditional wisdom? In this article, **Paurush Singhal** foregrounds how Bhutan strives to create and strengthen resilient, sustainable architecture without disturbing the country's environmental and cultural landscape.



Paurush Singhal, a student from Sushant School of Art and Architecture has passion for photography. He contributed (photo documentation) to the 'Design and Technical Guide for Implementing Innovative Municipal Scale Coastal Resilience in Southern Connecticut', led by Dr A. J. Felson of Yale School of Architecture, US. He presented a paper on 'Coastal Resilience' at the International Conference on Future Cities (2019), organized by IIT Roorkee. He can be reached at paurushsinghal00@gmail.com.

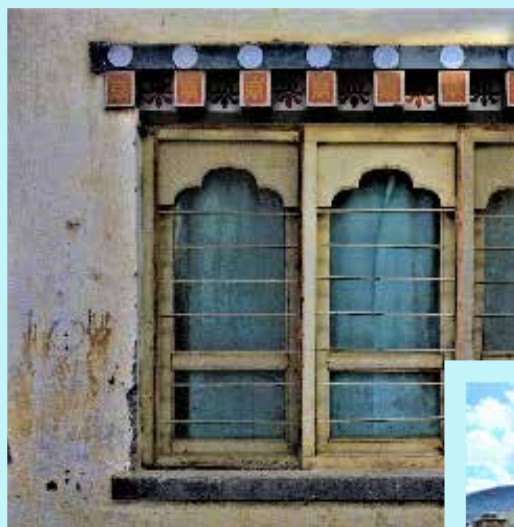
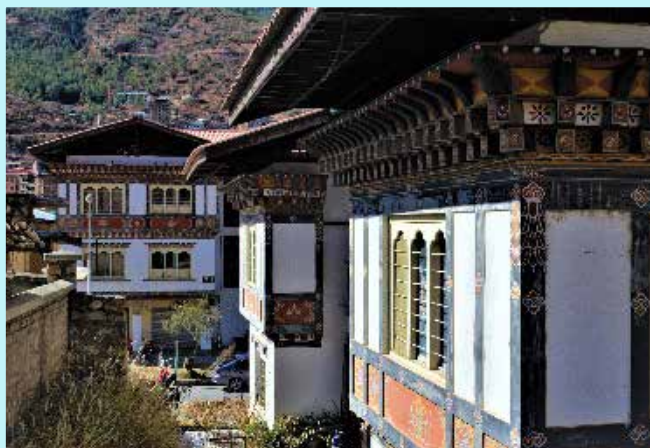
This article highlights the significance of Bhutan's multi-level resilience approach towards protecting its architectural heritage from the increasing demands and pressures of growth and modernization. The methodological approach focuses on the review of relevant literature, settlement study visits and photographic documentation, and unstructured interactions with the local community. The analysis indicates that despite exposure to modern construction techniques and materials in a globalized world, settlements in Bhutan are making sustained efforts to protect and promote traditional architecture and heritage.

A top-down framework: At the national level, the Royal Government of Bhutan in collaboration with the Ministry of Works and Human Settlement, published the Bhutanese Architecture Guidelines (MoWHS 2014) with the objective to support the restoration of traditional structures and construction of modern buildings that are in harmony with traditional architectural design practices. Moreover, the National Human Settlement Strategy, 2017, the Spatial Planning Standards, 2017, and the Bhutan Building Regulation, 2018 (MoWHS 2018), aim to promote resilient, functional, and accessible settlements for inhabitants without either compromising on their living standards or disturbing the country's environmental and cultural landscape. These provide the regulatory framework to facilitate sustainability of built environment in Bhutan, aligned with the cultural heritage and values of its people. In context to the Sustainable Development Goal (SDG) 11, Bhutan's 12th Five-year Plan (2018–2023) prioritizes improving the liveability, safety, and sustainability of human settlements as part of its National Key Result Areas (United Nations High Level Political Forum 2018).



Protecting built environment heritage in Thimphu: At the urban level, the capital city had made sustained efforts towards preserving the cultural heritage (Basnet 2020). The Thimphu Thromde Development Control Regulations, 2016 have played a significant role in maintaining planned development and in implementing the Thimphu Structural Plan, related Local Area Plans and Urban Design Plans, 2002–2027. Due to these measures, it is mandatory to maintain the visual appearance through architectural features (such as balcony, building height, etc.) by adhering to the Bhutanese Architecture Guidelines, 2014.

The Dzongs and monasteries of Bhutan have traditional architectural features, such as roof style, windows, columns, and paintings (of dragons, snow lions, and tigers) on their walls. Over decades, such architectural characteristics have been integrated into the contemporary built environment of Thimphu (and other cities). Bhutanese architecture is an expression of



the country's unique character. There is a synthesis between modern buildings and traditional architectural design and proportions (MoWHS 2014). The country's vernacular architectural practices follow sustainability principles through passive design, low-energy construction material and techniques while also creating livelihood opportunities for the local communities.

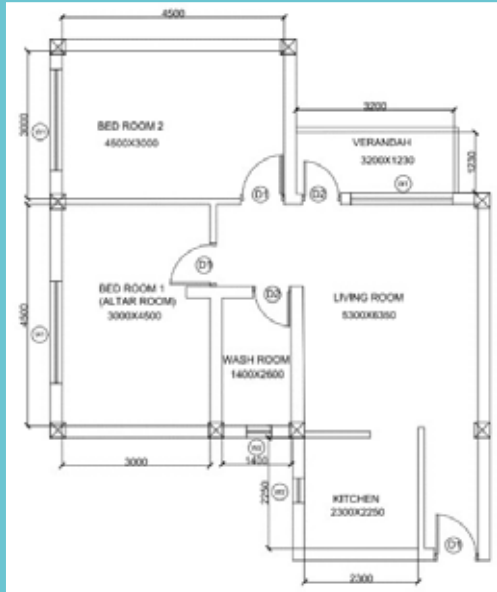
Architectural heritage, people's pride and happiness in Changjiji:

At the settlement level, the Changjiji community located near the Thimphu Chu River has been examined. The residential areas, such as Changjiji in Thimphu are self-contained with the presence of amenities, such as parks, shops, schools, banks, temples, and bus stops in and around the neighbourhood. The shops are mostly owned by the community residents. The neighbourhood park is extensively used by people for various purposes, such as festivities, prayers, and community



gatherings. A set of prayer wheels is a common design feature of such parks. With the advent of tourism, hospitality-related facilities, such as hotels, market, police stations have been constructed in the close vicinity of the neighbourhood.





Detailing at household level: In the Changjiji area, government housing has been examined to understand the measures undertaken for the protection of architectural heritage at the household level. A typical residential block in a housing setup is of two floors with a small attic area on top (used for storage) and consists of eight residential units. Each unit/ household has two bedrooms out of which one is mostly

reserved for an altar (prayer room). In most cases, just below the roof, an elaborate wooden cornice is built along the top of the wall. Artworks of beautiful floral patterns (representing the lotus), eight auspicious symbols (Tashi Tagye), and cloud whirls are commonly found on the façade of residential buildings. According to locals, the unique design of cornices, window-frames, artwork, rabsels, and other features are adopted from and inspired by the country's prominent religious buildings.

Inferences: The built heritage is a valuable asset for Bhutan's identity and national happiness. A multi-level strategy is facilitating the country's resilience in protecting its architectural heritage despite interventions from external forces, such as regional and international tourism, globalization, and trade. Some of the key factors in building such resilience include the foresight of the royal leadership and the government in their strict enforcement of regulations along with the positive attitude of people towards their architectural inheritance. Given Bhutan's ecological richness and sensitivity, the environmental preservation of the country is the need of the hour. As Bhutan demonstrates continual enhancement of resilience towards preservation of its architecture and built environment, the country also exhibits immense potential for learning by other countries in the Himalayan Region.

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OLGA CHEPELIANSKAIA

***Olga Chepelianskaia** is an international sustainability expert and founder of UNICITI. She specializes in sustainable urban development in Asian cities with a focus on climate resilience, natural ecosystems, and heritage revival. She also advises on climate finance and clean energy. In her career of over 15 years, she has managed seven prominent international programmes, covered over 20 cities and 40 countries, and worked with leading international institutions such as ADB, CDIA, ISOCARP, Rockefeller Foundation, UNDP, UNECE, UNEP, and UNESCAP.*

In this conversation with GRIHA Council, **Olga Chepelianskaia** discusses the role of UNICITI in reviving and expanding Asian cities to make them sustainable and climate-resilient.

GRIHA:

Can you tell us a bit about your work at UNICITI and its programmes across Asian cities?

Olga Chepelianskaia (OC): UNICITI is an international consultancy and think tank, founded a couple of years ago. As its name hints, it stands for uniqueness in cities. Why? Because my 15 years' experience of working with developing countries and cities across the global south made me realize that cities can prosper and thrive only when they activate the potential of their unique local natural and cultural assets. A 'one-size-fits-all' approach to urban development and development in general is very dangerous, especially in Asia, because Asia is most prone to climate change challenges. When we don't take into consideration the local context, we strongly exacerbate these challenges. Take the example of Jakarta, the capital of Indonesia. The capital will be relocated as it is literally sinking (Figure 1). The reason is that very dense and high-rise (building) construction happened in low lying areas. Additionally, the city's density wasn't matched by corresponding water supply, which put high pressure on the groundwater and further fragilized the soil. Add to this that 97% of the city's surface is covered by non-percolating pavement: the monsoon rains can only become floods since they can't get absorbed. So, by not adapting to the local context, a massive challenge was created.

For this reason, we at UNICITI have developed effective processes and tools that can help Asian cities screen their challenges and assets, and then come up with unique solutions tailored to the local context that activate the city's unique assets to address the city's unique challenges. To give an example of our work, we have developed a unique method to generate downscaled climate change projections that minimize climate models' biases. Municipal decision-makers need to know as accurately as possible where a city stands in terms of future climate-related challenges. Using this data, we help leaders visualize different future scenarios. These scenarios tell how exactly the city's urban fabric is going to react to future climate change parameters based on the decisions made today. The city can then easily identify most effective and cost-competitive solutions.

We also help cities access climate finance in which there are great opportunities for both low and low-middle income cities and countries. They can tap into funds such as the Green Climate Fund. Climate analysis helps build the case for climate finance. Once you know what climate vulnerabilities are, what needs to be done to address them, and what will work best for your local context, you will need to fund the actions. Hence the climate finance step.

To make our approach more systematic, we have launched two programmes that are complementary to each other. One is called Sustainable Cities through Heritage Revival, or SEHER Asia, which we launched in partnership with INTACH in 2017. Later, we also received support from the Cities



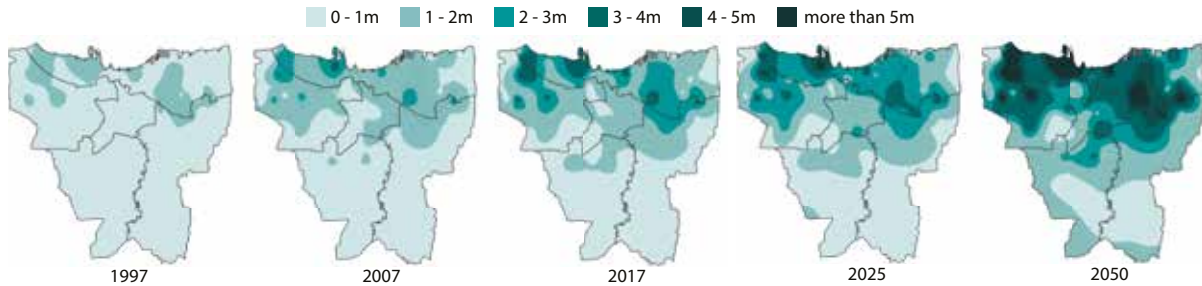
Alliance and the Future Institute in India. Through this programme, we help cities design Integrated Staged Action Plans, which show the city how existing local natural and cultural assets can be revived to solve the city's challenges so that it becomes both resilient and competitive. The second programme is called Third Way of Building Asian Cities. It works on identifying innovative ways to build cities today and is supported by renowned practitioners and researchers across the world. It aims to reconcile two important needs: to build fast and affordable (cities) to cater

to the rising housing needs in Asia, and the need to build sustainable and liveable (cities) without meeting which cities expose themselves to great vulnerabilities. A city that does not use natural resources in an efficient manner and fails to build resilience to climate change (risks) exposes itself to major social unrest and huge economic losses. A city that doesn't offer quality of life loses competitiveness and economic opportunities in the long run. So, it is very important to build in a way that appeals, that is sustainable, but at the same time that is affordable and fast-paced.

GRIHA:

How does urban morphology affect the way we live in and perceive cities? What role would you say the preservation of heritage and contextual design play in this regard?

OC: It affects us tremendously: our lifestyle, our feelings. It affects us both physically and mentally. And we do not yet give it full importance. For example, when we talk about affordable housing, we essentially mean some kind of roof above one's head. But a person cannot thrive in an environment where uniform concrete buildings are built one after another (Figure 2) without any green or public space. It's a real question on social justice because it is globally accepted that one has the right to housing, but housing where one can have a decent human life. It's not only about the roof over your head but also about whether you can breathe properly in that place, whether you feel thermally comfortable in it, whether it inspires you and unleashes your creative side.



» **Figure 1:** Jakarta's gradual land subsidence through the years
Source: Hidayat (2018)

One must think of the kind of life patterns, both physical and psychological, that built infrastructure is locking people into. You have probably heard about the Canadian researcher Colin Ellard. He has conducted an experiment in which people first walked along historical façades, and then the same people walked along monotonous inactive concrete façades. He noticed a difference in how people felt. In the first case, they felt uplifted and relaxed, in the second case however, they felt oppressed and stressed out. So, it essentially comes down to how we want our citizens to feel in their cities. For this reason, we at UNICITI always position this question of physical and mental health as one of human rights and social justice. So, to answer your question, urban morphology is in fact very important.

Taking this idea a little further, every city wants to be competitive today: it wants to thrive and generate economic opportunities. Now, today's conventional urban population growth projections are misleading. The UN forecasts that urban population will grow drastically in the coming years. Asian cities, for example, hosted 2.1 billion people in 2015 and are projected to host 3.3 billion by 2050 (UN 2018). Surely, some growth will happen, but we expect the same accelerated urban growth patterns that we've been observing in the past and these patterns don't reflect the disruptions of the 3rd and the 4th industrial revolution (IR). After the 2nd IR, people were moving to cities for jobs in factories. Their jobs were directly related to their physical presence. That's essentially how cities grew exponentially from the end of the 19th century. Today, it is rather the opposite, and the current pandemic situation has showed it well. Qualified workforce can work from anywhere with an Internet connection and a laptop. Cities need to understand that people are now choosing the context in which they want to live.



» **Figure 2:** Housing cooperatives are building a workers' city in Solapur, India
Source: Dennis (2018)

When a city doesn't invest in a quality urban fabric, one should not apply the usual UN urban population growth projections to that city. Because, in 20–30 years from now, people may not actually want to go and settle (down) in such cities but choose to live closer to nature instead or choose those cities that would actually offer a vibrant quality of life and stimulate creativity. So, in other words, if cities don't invest in a quality urban fabric today, they might as well be signing up for their death in the coming decades.

Coming to heritage, there is one concern that I'd like to clear immediately. There seems to be this tension between new development and built heritage preservation. This is a false tension. We at UNICITI did research and found that the percentage of the historical urban fabric is in general hardly 1–5% of the overall city's surface in Asian cities. So, the argument that you need to get rid of built heritage because you need new development doesn't hold any ground. Because the value of those centuries' old buildings simply can't be reproduced today. Interestingly, countries such as Singapore or China have understood this well. Singapore went through a phase of demolishing heritage areas to make way for new



» **Figure 3:** Kampong Glam

Photo courtesy: Olga Chepelianskaia

construction right after the independence. But when in the 1980s, it realized that its tourism statistics were dropping dramatically, it shifted its strategy to a unique visual identity and to a coexistence of the old with the new (Figure 3).

Similarly, China went through a phase of massive heritage demolition. However, lately, I had the chance of working on a few projects in China and was amazed to see the shift. The country now consciously revives its heritage areas to unlock their value. Take for example, the national programme that aims to revive heritage cities along the Grand Canal (Figure 4). This is a message to other Asian countries – which are still in the process of fast urbanization and rapid infrastructure development – to learn and leapfrog rather than make the same mistakes. For this reason, at UNICITI, we work at the regional level because there are important messages across countries that can enrich other countries' experience and developmental paths.



» **Figure 4:** Grand Canal, China

Another critical question that arises is, how do we build the rest of the urban fabric while preserving our heritage areas? As I said, heritage is just a small percentage of the urban surface, so unless we address the question of how do we build today to have a valuable, sustainable, and liveable urban fabric, we can't have thriving cities. Sergio Porta, an inspiring architect and urban designer we've been collaborating with, said, "We have stopped building the heritage of the future."



» **Figure 5:** Monotonous urban skylines of Hong Kong and São Paulo, Brazil

Source: (Lancaster n.d.) (Open Government Partnership n.d.)

When you think of it, it is quite striking. Until the mid-20th century, every construction epoch would have something that we would learn from and want to preserve. Somehow, after the Second World War and hence forward, we are easily bringing buildings down and putting up new ones. Needless to say, it is highly unsustainable too (Figure 5). We need to learn how to build today in a way that is tailored to the unique local context and one that we want to transmit to the future generations. This is why our programmes – Sustainable Cities through Heritage Revival and Third Way of Building Asian Cities – go hand-in-hand.

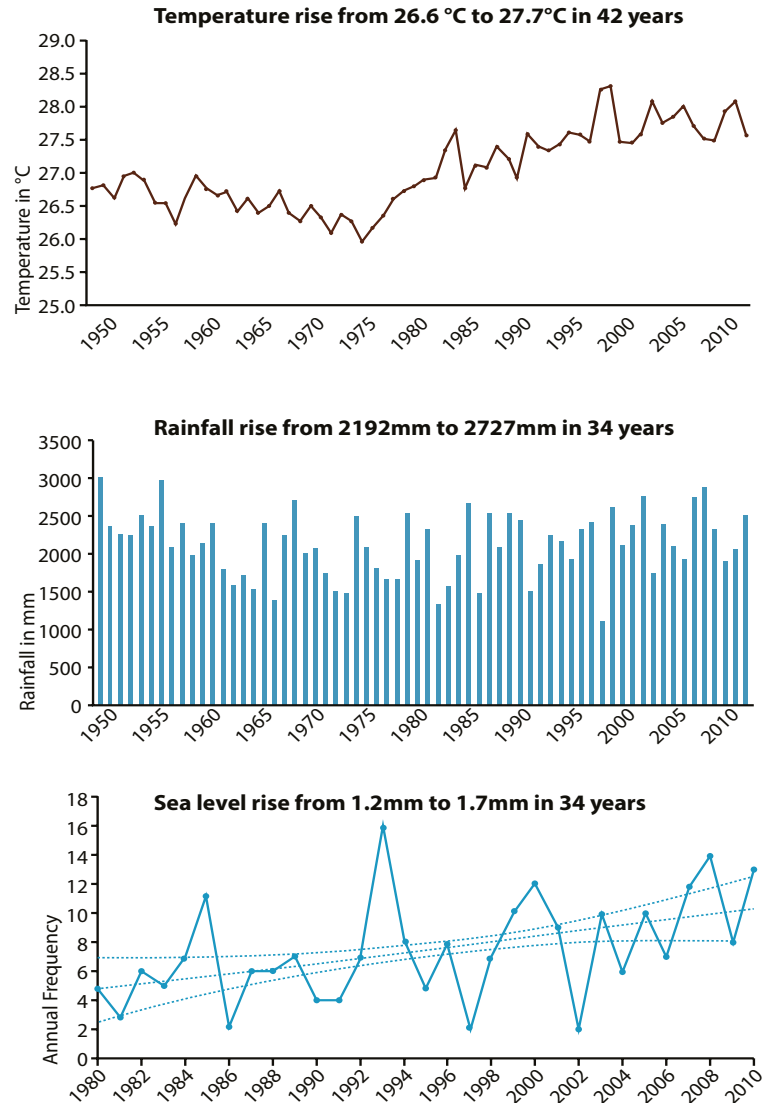
GRIHA:

What are some of the major issues that you foresee Indian cities facing due to climate change in the coming years? How might we, as citizens, work towards adapting to these changes?

OC: Coming to climate change in India, it is clearly one of the most vulnerable countries in the world. The Global Climate Risk Index 2020 ranks India as the world's 5th most vulnerable country to climate change. India reported the world's highest number of fatalities and second highest monetary losses due to climate change in 2018 (Bandyopadhyay 2019). But the key question is whether this is a natural or a man-made vulnerability. It is in most cities' hands to be either climate-vulnerable or climate-resilient.

Singapore, for instance, recorded a mean average temperature rise of 1.1°C in 42 years, an annual rainfall rise of 535 mm in 34 years, and a sea level rise of 0.5 mm in 34 years (Figure 6). However, despite accelerated climate change patterns, the city's flood-prone areas reduced from 3178 ha in the 1970s to only 34 ha in 2013 (Figures 7, 8). How did this happen? The city focused on reactivating its blue and green ecosystems: the green cover of Singapore increased from 36% of the total surface in the 1980s to 47% today, that too while the city's density continued increasing (Senthilingam 2016).

So, clearly, appropriate climate adaptation can drastically reduce climate change-related losses and damages. I'll reiterate this idea: there is no choice but to build with respect to the local context. It is not viable, for example, to bring water from 300 km upstream. In doing so, we incur not only high energy costs but also create water stresses. For instance, the Tamil Nadu government proposed to bring water by train to Chennai from Jolarpettai, Vellore district, located 220 km west of Chennai. This is after Chennai lost 80% of its waterbodies in the last four decades (Figure 9).



» **Figure 6:** Climatic projections

Source: Chang (2014)



» **Figure 7:** Flood-prone areas of Singapore in the 1970s (3178 ha)

Source: Hill (2013)



» **Figure 8:** Flood-prone areas of Singapore recorded in 2013 (34 ha)

Source: Hill (2013)

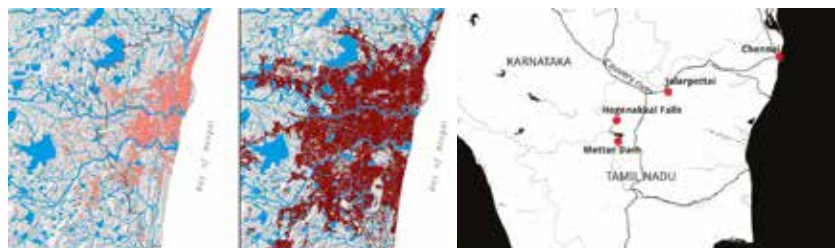
In other words, this 'one-size-fits-all' approach is detrimental to both Indian and Asian cities. Typically, when we work with cities, many still want quick engineering fixes, for example, pumping stations to pump the water out of a flood-prone city area, or building a wall along a river stream to deviate the water from an area. Now, the capital and maintenance costs of such measures are high and those very measures often fail to address the matter. Additionally, funds used for such measures do not unlock any other benefits. In the context of financial constraints, while needs are numerous – a typical situation for developing Asian cities – this is a very inefficient use of financial resources.

Instead of such solutions, we suggest looking into what we call ecosystem-based adaptation or nature-based solutions, which by definition are tailored according to the local context. For example, reactivating a damaged or neglected green or blue area of the city will not only help absorb water during heavy rains, but also replenish the groundwater level, cool down the neighbourhood during peak heat, and provide a healthy recreational area to the citizens. Therefore, by reactivating the potential of our natural assets, we can build climate resilience along with unlocking numerous co-benefits while optimizing cities' value for money.

This brings us to the question of how do we motivate leaders to see value in such investments, which might not necessarily pay off during their political term? This is a critical topic if we want to see change. We screened dozens of successful local leaders who stood for climate resilience through nature-based solutions and identified common patterns of their motivation and success. Outcomes of this work were presented at the UNDP event on Fostering Local Leadership for Urban Climate Resilience at the World Urban Forum 9 in Kuala Lumpur. We want to generate more attention for this topic from our international development partners and jointly make our dialogue with political leaders more impactful.

Finally, how can we bring change as citizens? Each one of us can contribute to an extent. One of the reasons leaders don't act is because we do not demand long-term sustainable action from them. We demand shelter, opportunity to work, but we as citizens in many developing Indian cities do not feel entitled to a certain quality of life. There are a number of valid reasons for that – for example, one has simply never experienced a better quality of life and cannot ask for what one doesn't know about. Until we get this sense of entitlement to a quality of life versus an entitlement to survival only, most of our leaders will not step up. So, let us start with cultivating this sense of entitlement in ourselves: as a human being, I'm entitled to a healthy lifestyle, to have greenery around me, to have buildings that don't alienate me.

While this is happening, which is a long-term process, small actions count a lot. For example, the simple act of putting a plant on my balcony changes the way my street looks. Another example is, in most Indian cities, waste segregation at source is not yet in place, but if I take a decision to segregate waste in my house, I'm already making a small difference, be it as little as helping the waste-picker segregate at the dump field. Here is an example of Bengaluru's lakes' revival (Figures 10, 11). A 23-acre lake next to Amruth Nagar Main Road was serving as a sewage and storm water drain. Residents and commercial establishments in the vicinity would throw their garbage into this lake bed. A citizen group urged the Bruhat Bengaluru Mahanagara Palike (BBMP) to revive the lake and initiated the lake's cleaning process. Their activism got the city to disburse US\$ 1.23 million to revive the lake (Rakshitha 2019).



» **Figure 9:** Chennai grew over its lakes
Source: Malladi and Kumar (2019)

This story is pretty known, but what we've discovered when we looked into this case is that behind each success story, there were just a couple of dedicated individuals who believed in the importance of what they were doing and motivated others to take action. This shows that it is within the outreach of each of us to make change happen.



» **Figure 10:** Alhalli lake (before)
Source: City Life (2019)



» **Figure 11:** Alhalli lake (after)

Source: City Life (2019)

GRIHA:

With a large percentage of the infrastructure yet to be constructed, what are the ways in which we can ensure that the uniqueness and liveability of cities are maintained and our natural environment is protected, while also addressing the needs of a growing urban population?

OC: An extremely important question. We at UNICITI often refer to the World Bank's estimate: 60% of the infrastructure we'll see by 2030 is yet to be built. For us, it means that we have now entered a critical decade that will determine our quality of life for many decades to come. This is because when we make a building, we cannot simply discard it like a painting or a sculpture if we don't like it. We'll have to live with it, in it, and that too for decades. Our collective consciousness on the consequences of any infrastructure choice is very weak.

What do we want to do? First and foremost, build in line with the local context. Our programme Third Way of Building Asian Cities started with the realization that essentially, there are two ways in which we build today. One is mainstream, where we build uniform concrete

boxes irrespective of the local geographical, climatic, social, and cultural context. In my article 'Why Should Asia Build Unique Cities' published by ISOCARP, I detail all the disastrous consequences of this approach. Here, I'll only refer to the International Energy Agency highlighting that the manufacturing of today's conventional building materials such as cement, steel, glass, and aluminium represents 20% of global CO₂ emissions and 25% of global energy demand. If we don't revolutionize our building materials right now, we will simply be missing on the targets of the Paris Agreement. The second way of building today is very niche and meticulously takes into consideration the local context. It is mostly led by remarkable sustainability architects and urban practitioners as well as conscious individuals who are their clients or, sometimes, city decision-makers too. This work is exemplary, but faces the major challenge of scalability. Some of the barriers to scalability are higher costs, lack of supportive policies and regulations, and scarce technical knowledge and skills. Consequently, the second way of building represents less than 1% of the urban fabric today.



» **Figure 12:** Building sustainable blocks

Source: ArchDaily

In Third Way of Building Asian Cities, we aim to reconcile the need of building fast and affordable (cities) with the need of building sustainable and liveable (cities). With valuable support from renowned international experts, we are working on identifying breakthroughs in terms of alternative building materials, alternative design techniques, alternative urban development models as well as alternative policies, regulations, economic and financial models. Indeed, new technology combined with local knowledge opens up great new opportunities. This combination will allow us to bridge the gap between the second way and the third way. To give you an example, in a case study we published with IGES, we demonstrated that compressed stabilized earth blocks (CSEBs) allow us to build up to five storeys high. Non-stabilized earth blocks limit the structure to two storeys high, which doesn't work for a relatively dense urban fabric. But if you put 2–10% of cement to stabilize the block, you can actually go higher (Figure 12). That too, in some cases, we can use the very earth we dig for foundations to make these blocks. What could be more sustainable?

To conclude, I think we are at a stage where we don't have all the answers, but we know what we need to do and we know which avenues to explore. It is important we put all our possible resources together and focus on finding alternative solutions with absolute urgency. We are doing our bit with Third Way of Building Asian Cities and we welcome all collaborations that go in the same direction.



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FINANCING INDIA'S GREEN BUILDINGS

Green buildings are the future of sustainable India. In this article, **Jolly Sinha** and **Shreyans Jain** focus on the need for certified high-performing green buildings that can contribute to 20–30% of energy savings and 30–50% of water savings.



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Today, India is characterized by a burgeoning population, expanding cities, and unprecedented rates of urbanization. Concomitant with this growing trend is a rise in energy consumption and expansion of concrete jungles. According to United Nations Environment Programme (UNEP), the residential and commercial sectors in the country consume upwards of 30% of the total energy, which is expected to rise further to 48% by 2040.¹ Is this consumption pattern sustainable and energy efficient?

According to a survey conducted by Johnson Controls, an Ireland-based multinational, only 4% of the buildings in India could be classified as 'green' in 2019. With the global average of more than 14%, India is struggling to catch up with the rest of the world in pursuit of transitioning to a low-carbon economy.² To move away from these grim statistics and contribute to a 2°C pathway, India must achieve at least 50% reduction in building energy demand and related greenhouse gas (GHG) emissions by 2050.³

¹ United Nations Environment Programme (UNEP). 2017. Towards a zero-emission, efficient, and resilient buildings and construction sector: Global Status Report 2017. Details available at https://www.worldgbc.org/sites/default/files/UNEP%20188_GABC_en%20%28web%29.pdf.

² Kabeer, N. 2019. With Only 4% Green Buildings, India Suffers from Tech and Funding Barriers: Survey. In Mercom India. Details available at <https://mercomindia.com/with-4-percent-green-buildings-india-barriers/>.

³ Graham, P. and Rawal, R. 2019. Achieving the 2°C goal: the potential of India's building sector. Building Research & Information 47(1): 108–122; doi: 10.1080/09613218.2018.1495803.

Given that certified green buildings have the potential to contribute to 20–30% of energy savings and 30–50% of water savings,⁴ India needs unprecedented focus on high-performing green buildings to reduce its GHG emissions by 33–35%. Lack of funding for energy-efficient projects has been cited as the primary barrier towards realizing this aspiration.

But let's take a step back. Although significant finances have been directed to climate change mitigation-related economic activities over the past few years in India, understanding the quantum of such flows still remains a challenge. Measuring finance flows is a prerequisite to acknowledge a funding gap. Do we have the mechanisms in place to track investments, measure progress, and optimize the deployment of resources in a way that can effectively unlock investments at the transformational scale needed? Since there is an absence of reasonable and comprehensive data, envisioning progress in the sustainable infrastructure sector could be difficult.

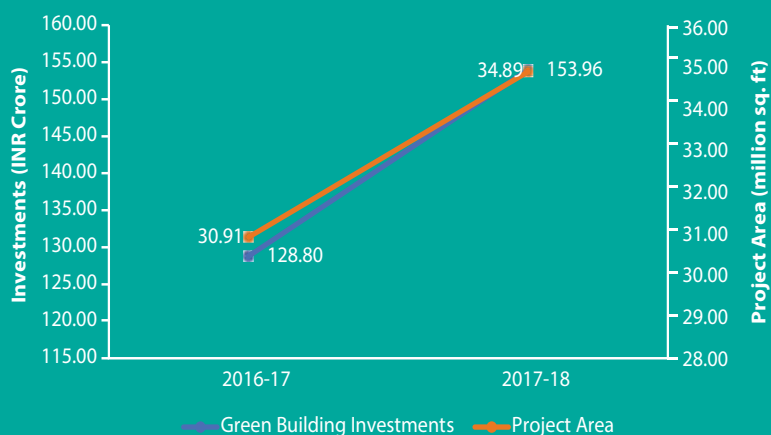
'Landscape of Green Finance in India 2018' is one-of-a-kind study undertaken by Climate Policy Initiative that presented the most comprehensive information on green investment flows in the country during FY 2017/18. The study tracked both public and private sources of capital and built a framework to monitor the flow of finance from source to end beneficiaries. This case study helped in understanding the

nature and volume of green financial flows in the country and identified the methodological challenges and data gaps in conducting a robust tracking exercise.

According to the report, between 2016 and 2018, about 65.8 million square feet of green building footprint was established amounting to INR 283 crore in domestic investments (Figure 1). In 2017, the share of international public finance in tracked green finance flowing to the built infrastructure sector amounted to ~INR 143 crore. A majority of these investments were driven by bilateral development financial institutions (90%) in the form of concessional debt, followed by grants. These investments were divided between various typologies including residential, commercial, office, and institutional establishments.

The Ministry of Power (MoP), along with the Bureau of Energy Efficiency (BEE), works toward the implementation of energy efficiency

initiatives in the areas of household lighting, commercial buildings, and standards and labelling of appliances. Its work also includes demand-side management in agriculture/ municipalities, small and medium enterprises, and large industries including the initiation of the process for the development of energy consumption norms. Energy Efficiency Services Limited (EESL) undertook energy efficiency programmes such as the Unnat Jyoti by Affordable LEDs for All (UJALA) for LED bulb distribution, and the Street Lighting National Programme (SLNP) to replace conventional streetlights with LEDs, which has shifted the market to make LED technologies affordable and accessible for the masses. While increased awareness among homebuyers and real estate developers has enabled the green building sector to emerge as a promising investment option, the total tracked investments in the sector fall far short of the requirements.



Year	Green Building Investments	Project Area
2016-17	128.80	30.91
2017-18	153.96	34.89

» **Figure 1:** Total green building investments (in INR crore) and project area (in million sq. ft)

⁴ Jain, S. 2020. Financing architecture for green buildings in India. In Observer Research Foundation (ORF). Details available at <https://www.orfonline.org/expert-speak/financing-architecture-for-green-buildings-in-india-63650/>

“Of the total tracked investments, 3.2% corresponds to an energy efficient end use of which only 5.3% went into new green establishments, renovation, and upgrade and modernization of existing building stock.”

Opportunities to Align Investments with Green Targets

The real estate sector in India is projected to reach US\$ 1 trillion by 2030 and contribute to 13% of the country's GDP by 2025.⁵ Presently, the sector is at an inflection point wherein it presents a compelling opportunity to align future investments with the country's NDC targets.

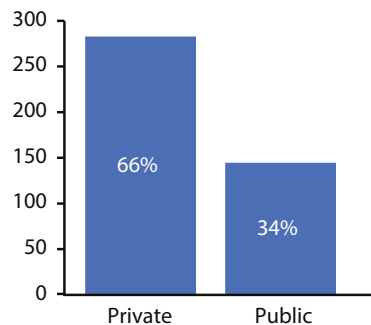
A recent report by International Finance Corporation (IFC) estimates a US\$ 1.4 trillion opportunity for the green buildings sector in India by 2030 (residential sector: US\$1.25 trillion, commercial: US\$228 billion) owing to the rapid urbanization, and policy incentives at the state and central levels.⁶ Rating and certification agencies such as GRIHA, LEED, IGBC, and IFC-EDGE also play a proactive role in bridging the performance gap (mismatch between design and operation of a green building) by incorporating requirements to verify that buildings are used in a way that maximizes the effectiveness of the measures.

Although the initial investment required to make a building green

may be higher than a conventional building, the long-term benefits of green buildings more than compensate for the additional costs incurred. According to the World Green Building Council, the increase in operational costs of the built infrastructure is compensated by higher sales premiums (up to 31%), faster sales time, higher occupancy rates (23%), and a rise in rental proceeds (8%). There are multiple other fiscal and ecological benefits that are driving the uptake. But a lot more needs to be done.

Barriers and Recommendations

- High upfront cost and lack of financial products and instruments present a significant hurdle in realizing the full investment potential of green buildings sector. Innovative products such as home improvement loans, mortgages, and REITS targeting the untapped markets can help circumvent this challenge.
- Fiscal incentives and government enablement are essential to catalyse the segment. We have already progressed on this path with the updating of ECBC in 2017 and ECBC-R in 2018. Raising the building code baseline, coupled with mandatory third-party verifications, can help encourage developers to sufficiently reduce emissions from their new constructions. Further, significant public demand has the potential to shift the market, lower the



» **Figure 2:** Public and private investments: built infrastructure (in INR crore)

procurement costs and drive private investments (Figure 2) by aggregating the public sector's buying power through bulk procurement of materials for construction and renovation of government and institutional buildings.

- Awareness of the benefits of green buildings among the populace is still sparse. In 2019, a survey conducted by Johnson Controls pointed that only 38% of buildings in India want to get the 'green building certification' as compared to the global percentage of 44. On the other hand, though 46% are willing to pay a premium to lease space in a certified green building in India, the figure stands at 51% globally.⁷

Cooling/heating technologies are expected to drive consumer demand in the future owing to a rise in the living standards. Mandatory enforcement of energy performance standards in conjunction with higher awareness, and decreased costs of energy efficient technology can enable greening of the energy demand in the country.

⁵ India Brand Equity Foundation (IBEF). 2020. Indian Real Estate Industry. Details available at <https://www.ibef.org/industry/real-estate-india.aspx>.

⁶ International Finance Corporation (IFC). 2017. Climate Investment Opportunities in South Asia: India. Details available at <https://www.ifc.org/wps/wcm/connect/44d9ebf1-8a80-4c29-bf7e-8ac612dbdf88/17663-IFC-India-Factsheet-v3.pdf?MOD=AJPERES&CVID=m0ymJCY>.

⁷ International Finance Corporation (IFC). 2017. Climate Investment Opportunities in South Asia: India. Details available at <https://www.ifc.org/wps/wcm/connect/44d9ebf1-8a80-4c29-bf7e-8ac612dbdf88/17663-IFC-India-Factsheet-v3.pdf?MOD=AJPERES&CVID=m0ymJCY>.

IREO HOSPITALITY COMPANY PRIVATE LIMITED, GURUGRAM

At IREO Hospitality Company Private Limited, the conceptualization of a sustainable project/building is not limited to minimizing consumption of energy, materials, and water; rather, it follows a holistic approach. It strives to conserve and transform the fundamental components of a building into vibrant spaces with the aim of enriching the lives of the occupants. Through innovative ideas and measures at the early stages of design, the projects undertaken by IREO adopt differential and sustainable designs, features, and elements. Thereafter, the ideas are implemented with utmost competence and commitment. While several design elements are mandated by specific codes and regulations, IREO walks the extra mile to incorporate some unique features by collaborating with leading architects, consultants, and designers of international repute.

The 'Grand View Complex' – a mixed-use project conceptualized with Grand Hyatt, Gurugram, Grand View Tower, and High Street Retail – is one such collaboration that brings together the creativity of some of the best minds in the fields of architecture, design, and hospitality. The key partners in realizing this vision include Foster+Partners UK – a Lord Norman Foster-led architectural firm, Design Guru – Tony Chi & Associates NY, and the Hyatt Group. The IREO group is honoured to take up this project, which has been awarded a '5-star' rating by GRIHA.

In addition to fulfilling the parameters on water and energy use, some of the unique design features include the following:

- The vehicular-free central spine/boulevard connecting the hotel, office, and retail spaces provides a pleasant experience. The boulevard's ambience boasts of an array of trees, enhanced natural airflow, water features, misting, and music.
- Impeccable landscaping promises a feeling that the entire development is being planned in a garden.
- Imposing towering lobbies and all the floor plates across 29 storeys of the Grand View Tower is column free with a span of 30 metres. These act as mood enhancers and ensure natural light from all four directions, thereby redefining the living experience for the occupants.

GRIHA's rating system is drafted as per the Indian climate zone requirements, that makes our design more sustainable and efficient. We extend our sincere gratitude and appreciation to the GRIHA Council for showcasing the 'green building' footprint of IREO Grand Hyatt, Gurugram on the cover page of 'GRIHA v. 2019'. Without the support of the GRIHA Council members, it would not have been possible to succeed in bringing to life one of the first largest mixed-use developments – awarded GRIHA's '5-Star' rating – in the NCR. Moreover, GRIHA's online platform helped us to effectively navigate our project right from the pre-certification stage to the final certification. We would like to congratulate the entire team of GRIHA for making this rating system efficient and useful for achieving sustainable development in India.



At IREO, we introduced passive features during the initial design stages to comply with all the 'green building' requirements. These requisites not only helped us to conceptualize a sustainable design, but they also reduced the running cost of the building by approximately 10–15% in comparison to conventional building expenses. Further, acquiring the GRIHA certification made it possible for us to convince potential clients to lease out retail and office spaces. We are certain that this would encourage more projects to adopt sustainable features and follow GRIHA's vision of increasing the 'green building' footprint across the country.





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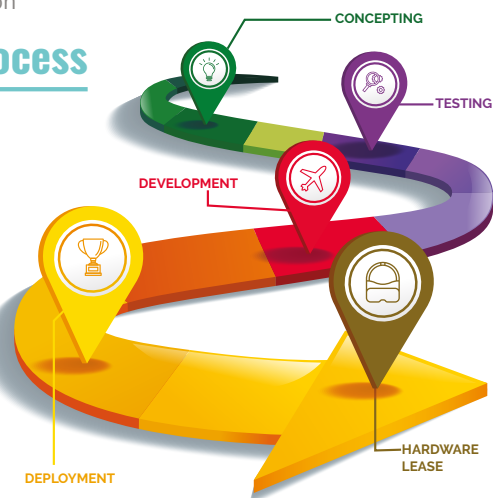
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BALANCING THERMAL COMFORT, ENERGY EFFICIENCY, INFECTION CONTROL, AND AIR POLLUTION

In this article, **Raja Singh** and **Anil Dewan** discuss the need for monitoring air pollution levels in Indian cities. The authors explain why in a pandemic-stricken world, the importance of maintaining indoor air quality, thermal comfort, and energy conservation has assumed a new meaning.



Ar. Raja Singh is a Research Scholar at the Department of Architecture, School of Planning and Architecture, New Delhi. He is currently researching in the area of natural ventilation and its role in airborne infection control. During his Master's at NIT Trichy, he did his research on the relation between fire spread and natural ventilation. He has been a speaker for CPWD and an invited reviewer for the journal *Indoor and Built Environment*. He can be reached at rajaphd@spa.ac.in.

Dr Anil Dewan is Professor (Architecture), School of Planning and Architecture, New Delhi. He has decades of experience teaching architecture design and healthcare planning to students, hospital administrators, and bureaucrats. Working on hospital standards in his doctoral research, he has played an active part in code development for the Bureau of Indian Standards and has played a key role in WHO and World Bank committees on related issues.



The 1973 oil crisis prompted the energy conservation movement in the world (Hobday and Dancer 2013). This was the time when the West started to think of saving energy due to supply-related issues from the Middle East. The outcome of this movement was most beneficial for developing countries as they could give their growth stories a new spin. These countries had the option of developing without repeating what the West had done, i.e., indiscriminate use of fossil fuel for industrial growth. For India too, energy conservation gradually became part of common parlance.

With energy conservation as a goal in the built environment, multiple green building consultants brought in the best computer simulation experts who optimized built spaces, treating them as mechanical zones which had to be engineered. This created excellent results in providing just the right thermal comfort with maximum savings. But, often overlooked was the indoor air quality, as a decreased energy use meant recycling cool air and decreasing the air changes per hour. Often discussed is the Sick Building Syndrome, which was an outcome of such an energy-optimized building. Recirculation of air became a norm leading to an

increase in the gas concentrations in the indoor environments. The rise in air pollution in Indian cities further strengthened the practice of recirculation as the outside air was 'foul' and the air inside was kept isolated with rounds of filtration and refiltration. GRIHA addressed this issue with an increased stress on the monitoring of the indoor air quality with a recommendation for using carbon dioxide meters in the indoor spaces to ensure effective ventilation and fresh air supply.

But as evolution goes, this was soon challenged by the COVID-19 crisis where fresh air was to be brought in not only for gas exchange, but also for the dilution effect caused by ventilation on the microbial concentrations in the indoor spaces. In dilution ventilation, the fresh air flushes out the microbial concentration from the indoor space with the outdoor space making the chance of transmission in congested spaces lesser (Escombe, *et al.* 2007; Richardson, *et al.* 2014). This is the most cost effective way as it sometimes requires only a simple intervention of opening the windows (Cox, *et al.* 2012). This effect has been widely studied during research on tuberculosis (TB) and its spread. TB is an airborne infection that spreads from one person to another through the small droplets,

which a person emits while talking (Issarow, Mulder, and Wood 2015). These droplets infect another person in the proximity who inhales them. These droplets increase in number when a person coughs or sneezes. TB has remained in humans for thousands of years and we have become a very reliable reservoir for this disease (Lougheed 2017). In the latent state, TB can infect a person without any symptom and that person can get the symptoms later in life due to ageing or immunosuppression. The infected person then becomes a spreader, albeit unknowingly. With COVID-19, there is a large body of researchers that is continuously researching on the airborne transmission of the disease. The research done on TB for decades is constantly becoming relevant to decrease the spread of diseases like COVID-19.

India has multiple climate zones. In the composite climate, for instance, there are spells of extreme heat and extreme cold. Our lives, which are increasingly being spent indoors, are getting permanently influenced by the thermal comfort provided by the air conditioner. There have been many successful attempts for a lucky few to get buildings, which are passively designed and have thermal comfort within the adaptive range. But not all buildings today are

being designed with the assumption that there will be a provision for air conditioning systems in it. In some new design and most retrofit designs where the air conditioner is introduced, the designer remains clueless in providing for optimal air changes per hour into the spaces. The problem of fresh air supply is solved to an extent in the centralized air conditioning systems through air handling units where air changes are possible. This is almost impossible to be done when a split AC is prescribed that has no mechanism for fresh air supply into the room. This situation is made worse by the use of hermetically sealed window and door frames, which reduce any air 'leakage' which would have otherwise provided some fresh air as a blessing in disguise. Increasingly, HVAC engineers are prescribing Ultraviolet Germicidal Irradiation (UVGI)



technology which kills the microbes in the air handling unit (Escombe, *et al.* 2009). This may be appropriate for sterile settings but the cost of this technology for all domestic buildings could be prohibitive. On another front, current research in total sterilization discourages the use of a complete 'slash and burn' as done in UVGI as we may need certain sets of microbes to keep us healthy (Kembel, *et al.* 2012,

2014). This is further supported by the Hygiene Hypothesis, which is built around the fact that over sanitization may make us vulnerable when we are moving to spaces with higher microbe concentrations. These spaces could just be outside the door of our ultra clean and private air bubbles (Gardiner 2020). There is further research being done on creating standards for optimum levels of permissible microbial flora in the indoor environment.

These private bubbles could serve well in another area where Indian cities have topped the charts. This is the problem which we constantly dismiss by stating the excuse of developmental aspirations (Spears 2019). On the back of developmental work, the problem of air pollution gets pushed to the background by the growth numbers in terms of electrified villages and multinational factories being set up in the city. The electricity production in India is largely through coal-powered plants and we have a long way to go to make a switch to renewable energy. Even if all the cities in the country, as often pushed, switch to electric vehicles (EVs), we would still be using fossil fuels to produce the electricity to run them (Smedley 2020). We might solve urban pollution levels in Delhi, but that will be offset by a rising pollution





level in a small town where the coal-powered electricity project will be located. A switch to renewable energy is a must to make sure our windows in the cities can open for the good reason of 'fresh' air supply and infection control due to dilution.

Studies done in isolation on thermal comfort may neglect fresh air supply. Studies done on fresh air supply and infection control due to ventilation could miss delving into air pollution in detail. Studies on air pollution alone could put a dent on the energy performance of a building.

The Holy Grail for Indian cities lies in creating indoor environments which can optimize energy performance with thermal comfort, infection control with air pollution, and so on. The problems can be identified and solved once they are acknowledged. They are acknowledged once they are measured and they can be measured only when our society reaches a tipping point where the only way to go is through the problem, which sometimes takes us back to where we all started.



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BHAMASHAH STATE DATA CENTRE, RAJASTHAN

On 8 March 2016, the honourable chief minister of Rajasthan, Vasundhara Raje Scindia announced the setting up of a new state data centre in the Budget Speech (para 223). The data centre would support the government's new IT initiatives and provide uninterrupted services to the people.



AMIT KAKKAR

Department of Information Technology & Communication, Government of Rajasthan

The project to construct the data centre was steered by Akhil Arora (Principal Secretary, IT&C, Government of Rajasthan) and was completed within 18 months. For such a state-of-the-art building, a team of experts was set up to conceptualize sustainable and energy-efficient designs to reduce carbon emissions, thereby contributing to national energy efficiency goals.

This is the only tier-4 data centre, which is Uptime-certified and considered the most secure in India. Within its ambit are two buildings including Bhamashah State Data Centre (BSDC) – for process and office floors – and Bhamashah Techno Hub (BTH) that is specifically meant for offices. Equipped with common energy-efficient features, the entire project – both buildings and adjoining parking area (with solar PV) – was given a 4-star rating by the GRIHA Council. Additionally, the building also achieved an Energy Performance Index (EPI) of 82.55.



Project Features

During the construction stage, effective erosion-and-sedimentation control measures, and proper implementation of staging and spill prevention were adopted. The project team planted more than 180 native plants on-site. The buildings were designed in such a way that their shadows would not obstruct nearby buildings. By implementing certain passive strategies as per the region's climatic conditions, the energy consumption was reduced and adequate daylight in the regularly occupied space of buildings was ensured.

Fly ash bricks and AAC blocks were used, which reduced embodied energy of the building. The PPC with 34.4% fly ash content (by weight) was used in plaster and masonry. The building has installed low-flow water fixtures, which reduce 50% of water consumption. Further, an efficient system of drip irrigation for landscaping helps reduce water consumption by 50%; STP of 90 KLD treats the water, and 70% of it is reused.

The building is equipped with efficient air-cooled chillers, VRV systems, and double-glazed windows, which reduce 20% of EPI from the GRIHA benchmark. A system of highly efficient LED lighting, integrated with daylight and occupancy sensors, reduces energy consumption. The data centre also uses free cooling for process load (data centre racks). Moreover, the building generates its own energy through a solar PV system of 208 kWp capacity. The building operations are monitored by high-performing building management systems (BMS).

OUTGROWING EFFICIENCY

Understanding Jevons' Paradox

In this article, **Shubham Chowdhury** focuses on acknowledging Jevons' Paradox by exploring the role of complexity in the emergence of a regenerative, sustainable future.

“We tried to make our buildings more energy efficient which is a good thing to do, but we find that in the end, they're still fossil fuel powered and nuclear powered, and so on. We tried to reduce our toxic releases but we're still releasing toxins. We tried to mitigate this problem or that problem but what we're doing is mitigating problems that we're perpetuating, perhaps more efficiently, but it's not necessarily good. It's just less bad.”

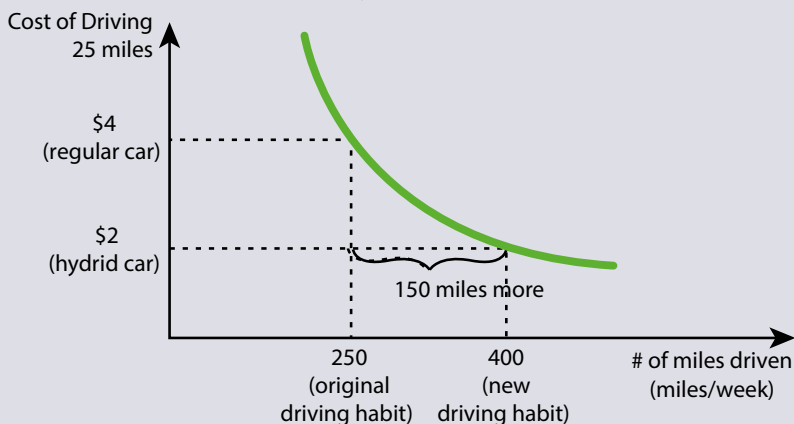
– William McDonough



Shubham Chowdhury is an architect, who is currently working as a Project Officer with GRIHA Council. Perpetually enthralled by the natural world, Shubham is a bio-mimetic, cradle-to-cradle and environment-responsive design enthusiast and an amateur naturalist. He may be reached at shubham.chowdhury@grihaindia.org.

The process of heating and cooling buildings is energy-intensive, especially when it involves factoring in electricity consumption for lights and appliances, along with transportation, which leads to greenhouse gas emissions. Increased efficiency has become the go-to solution – energy efficiency has been called ‘the fifth fuel’ after coal, petroleum, nuclear power, and renewables (Owen 2010), and is seen as a no-cost tool for accelerating the transition to a ‘greener’ economy. In 2007, the United Nations Foundation stated that efficiency improvements constituted ‘the largest, the most evenly geographically distributed, and least expensive energy resource.’ As one paper describes it, ‘The goal of green building is to increase the efficiency of resource use (including energy, water, and materials) and reduce the building’s negative impact on the environment during the building’s life cycle’ (Zhang and Cooke 2010). In the recent past, technological advancements have steadily increased our ability to do more with less, but still, not much has changed. With global carbon emissions on the rise, how efficient would we need to be before we start making a difference?

Jevons’ Paradox:
Hybrid Car Example



Logic behind Jevons’ Argument

In 1865, a 29-year-old Englishman named William Stanley Jevons published a book titled, *The Coal Question*, in which he argued that Britain’s affluence depended entirely on its endowment of coal, a finite resource that was on the verge of rapid depletion. He postulated that an eventual collapse could not be averted through increased ‘economy’ in the use of coal – what we, today, refer to as energy efficiency – and concluded that ‘it is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The

very contrary is the truth.’ Jevons offered the example of the iron industry – whenever technological advancements made it possible for blast furnaces to produce iron with less coal, profits would rise and attract new investment in iron production. The price of iron would drop, stimulating additional demand. Eventually, he concluded, ‘the greater number of furnaces will more than make up for the diminished consumption of each.’

The logic behind Jevons’ argument is simple – when we talk about increasing energy efficiency, what we are actually talking about is increasing the productivity of energy. And, should you succeed in increasing the productivity of anything, you have the effect of reducing its implicit price because you get more return for the same money, which means that demand inevitably goes up. Called the ‘rebound effect’ today, there are multiple examples to demonstrate that in the longer term, this phenomenon can dramatically exceed any gains from energy efficiency. Efficiency improvements push down costs at every level and reduced costs stimulate

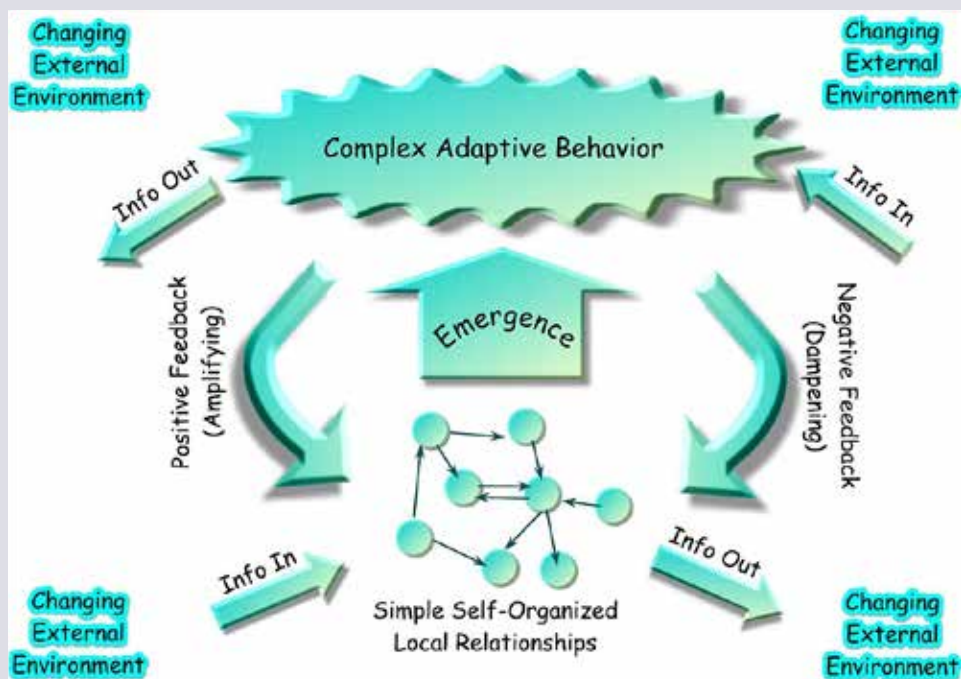


increased consumption (Sorrell 2015). This is precisely why efficiency cannot be, by itself, the solution to the problem of climate change and its associated risks.

Human Behaviour and Energy Consumption

Our planet is finite. If we continue on our current trajectory of mindless consumption, it makes little difference to our long-term survival whether we can achieve more for less today. Since the 1970s, we have all been accumulating debt. Every year, Earth Overshoot Day marks the date on which humanity exceeds the ability of the planet to naturally regenerate what we consume. For the remaining days in the year, we maintain our ecological deficit by drawing upon resource stocks and pumping carbon into the atmosphere. For decades, this date has steadily been moving to earlier points in the year. One side-effect of the COVID-19 pandemic is that this year, the date for Earth Overshoot Day has moved back in the right direction by more than three weeks – to 22 August. What will it take to ensure that we continue to roll back Earth Overshoot Day and allow the rejuvenation of ecosystems everywhere?

When it comes to consumption, it would appear that we have but two options – we either give up the pursuit of efficiency as a lost cause or ignore Jevons' Paradox entirely. If we conclude that energy efficiency is the right direction for sustainability, then we must also address the elephant in the room – consumption behaviour. Jon Bird, a senior research associate at University College London, who divides his time between the computer science and psychology



departments, works on 'nudge' theory – which involves ways to use behavioural psychology to encourage citizens to make smart choices. He says that while it is obvious that "the most efficient light bulb is one that is switched off", human behaviour and motivations are messy. "There's a difference between awareness and behaviour," says Bird. "We've got the awareness, but haven't quite got the motivation... Why is it that gyms have more membership than capacity? Most people don't go. That's human beings," adds Bird (Hanscom 2011).

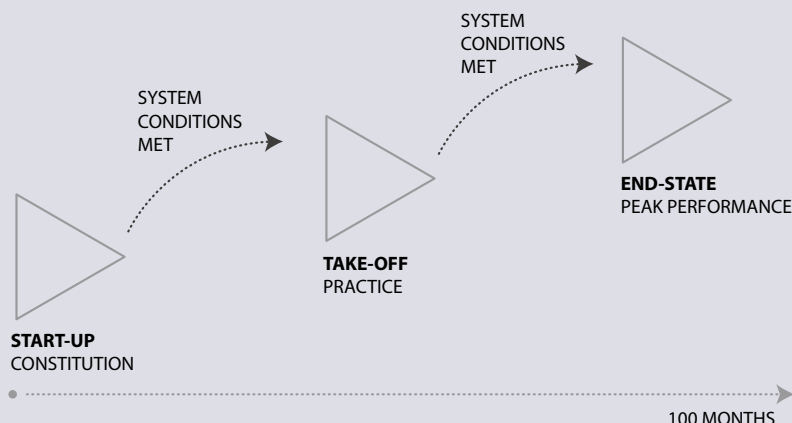
Strategies aimed at modifying human behaviour have traditionally tended toward 'command and control', focusing on short-sighted gains at the cost of long-term sustainability. Such strategies provide no incentive for going beyond the limits they set, offer

limited flexibility on where and how to reduce negative effects, and often have politically motivated loopholes. This has repeatedly resulted in unexpected side-effects that range from cheating on fishing quotas to the uncontrolled loss of biodiversity (Kompas and Gooday 2007).

Long-term solutions require a different approach – favourable conditions must be created for self-organized sustainability to emerge. Interconnectedness, unpredictability, and uncontrollability are key underlying factors that simply cannot be ignored. A worldview of the environment and society as static and predictable systems must be replaced by the acceptance of continual change and uncertainty. Understanding and adjusting for complexity is becoming increasingly important. We do realize that much of the unpredictable behaviour

observed in everything – from financial markets to the global climate – is a function of the adaptive systems we are living and operating in. In dealing with complexity rather than mechanisms, the aim shifts from improving our ability to predict and control to better understanding the dynamics and relationships of the systems we participate in so that our participation can evolve.

Examples of complex adaptive systems include ant colonies, flocks of birds that create swirling patterns in the sky and the human brain, as well as our financial markets, the global economy and interactions among groups of people within communities. Accepted wisdom



from the 'complexity theory' suggests that emergent phenomena — a hallmark characteristic of complex systems – can be observed across these systems. This observation signals the contributory value of a complex system's

perspective towards sustainability science (Fawehinmi 2015). Societies are complex adaptive systems in which individuals are driven by decisions they have the privilege to make and are constantly engaged in pursuits without being directly aware of how their actions can cumulatively affect society as a whole. Similarly, ecosystems and the biosphere are complex adaptive systems exhibiting micro-level interactions, which influence the emergent whole-system behaviour.

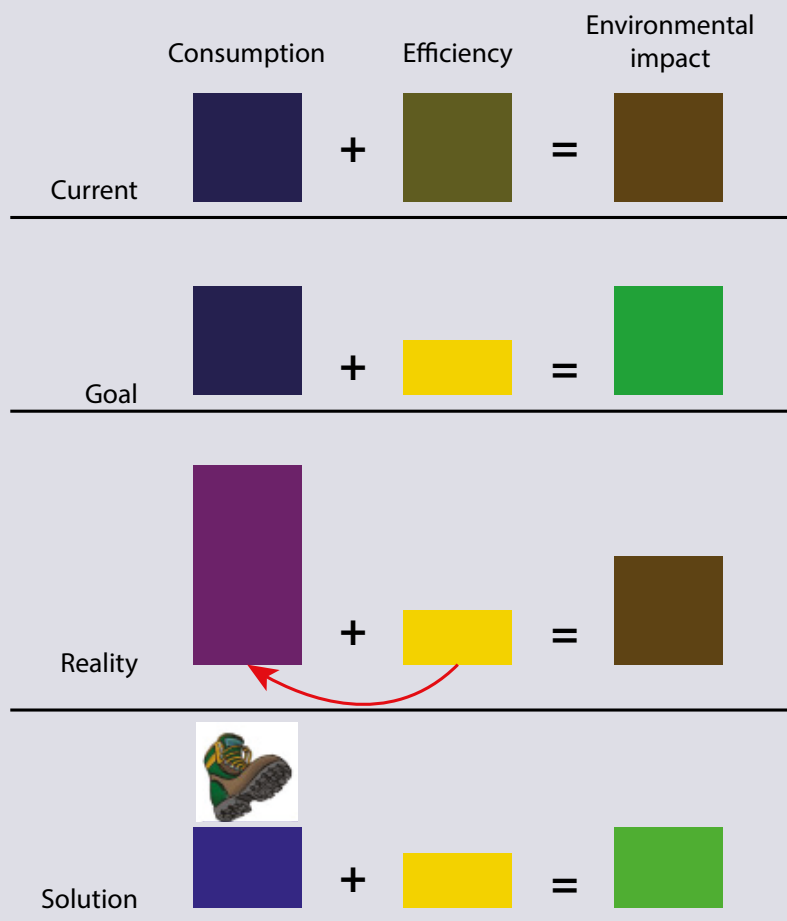


“Complexity theory is becoming a science that recognizes and celebrates the creativity of nature. Now that’s pretty extraordinary, because it opens the door to a new way of seeing the world, recognizing that these complex dynamic systems are sensitive to initial conditions and have emergent properties. We have to learn to walk carefully in relation to these complex systems on which the quality of our lives depends, from microbial ecosystems to the biosphere, because we influence them although we cannot control them. This knowledge is new to our western scientific mentality.”

– Brian Goodwin

The Gigatonne Strategy

For an insight into how the complexity theory might help us transition towards a more sustainable future, we can take a look at the Gigatonne Strategy, the proponents of which claim it could successfully mitigate the climate crisis if operational for a hundred months. According to them, ‘Tactically, we set the goal of demonstrating in practice how to reduce global emissions by one gigatonne of CO₂e per year. However, the underlying strategic challenge is redesigning society from one in which the natural systems are simply fuel for our machines to one in which we protect those ecosystems on which we depend and of which we are part.’ Their aim is to build



“There is plenty to do, of a different sort of ‘doing’. The future can’t be predicted, but it can be envisioned and brought lovingly into being. Systems can’t be controlled, but they can be designed and redesigned. We can’t surge forward with certainty into a world of no surprises, but we can expect surprises and learn from them and even profit from them. We can’t impose our will upon a system. We can listen to what the system tells us, and discover how its properties and our values can work together to bring forth something much better than could ever be produced by our will alone. We can’t control systems or figure them out. But we can dance with them!”

– Donella Meadows



the social, operational, and market infrastructure required to help achieve gigatonne-scale reductions every year by financially and technically supporting multidisciplinary teams across the world that will implement practical responses for reducing greenhouse gases at speed and scale. The teams, based in cities with populations of over a million people, are expected to work in six-month operational cycles and develop five energy-efficiency prototypes per cycle (The Gigatonne Strategy 2019).

With increasing interest in leveraging systems-based solutions to tackle climate change, our species is slowly coming to terms with the need to reverse the damage we have done thus far. When we become ‘sustainable’, we would have arrived at a neutral point – it means, not adding any more damage, but after two-and-a-half centuries of industrialization and five thousand years of deforestation and agriculture, that will no longer be enough. According to William McDonough, architect, and author of *Cradle to Cradle*, being efficient – ‘less bad’ – is not the same as being ‘good’. Effectiveness, not just efficiency, is the key to long-term success. Our continued survival as a species depends entirely on our ability to understand and appreciate the complex nature of the interactions that provide us with a habitable home on this pale blue dot we call Earth.

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