WHITE PAPER: HEALTHY AFFORDABLE HOUSING IN INDIA

PRIORITISING THE WELL-BEING OF OCCUPANTS IN THE DESIGN AND CONSTRUCTION OF LOW-INCOME HOUSING

Prepared for GBPN by

Primary Authors

- Ashok B. Lall, Ashok B. Lall Architects
- Girisha Sethi, Ashok B. Lall Architects
- Niroopa Subrahmanyam, Ashok B. Lall Architects
- Smiti Agarwal, Ashok B. Lall Architects

Other Contributors

- Kriti Agarwal, Center for Empathic Development
- Urvashi Yadav, Ashok B. Lall Architects

Supporting Team

- Dr. Mahaveer Golechha, Indian Institute of Public Health - Gandhinagar (IIPH - G)
- Prof. Peter Graham, Monash University - MADA - E.D., Global Buildings Performance Network (GBPN)
- Kate McFarlane, Monash University - MADA Asia Pacific Office, Global Buildings Performance Network (GBPN)
- Gautam Nagar, Global Buildings Performance Network (GBPN)
- Maaz Dixit, Global Buildings Performance Network (GBPN)

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PREFACE

This White Paper is based on the research findings of the project titled 'Healthy Affordable Housing in India'. The research has been promoted by the Global Buildings Performance Network (GBPN) and is carried out by Ashok B Lall Architects (ABLA), New Delhi, in collaboration with the Indian Institute of Public Health, Gandhinagar (IIPH-G) and Monash University, Australia. The research proposes standards for health, well-being, and climate resilience in the design and construction of low-income housing in urban areas in India.

GBPN was first established as a think tank in Paris in 2011. It has since transitioned into a system-wide network organisation implementing projects for policy reform, technical assistance, insight development, and education, while supporting impact philanthropy. Working in India since 2018, GBPN has taken a bottom-up approach by facilitating local coalitions for collective and local solutions, developing evidence-based data for the building sector, and supporting governments and industry with resources to enable them to transform policy and deliver best practice solutions. GBPN also engages with local experts and partners to work on policy change and implementation for climate resilience, and health and well-being.

In the context of the growing impacts of climate change, particularly for the poorer and more vulnerable urban populations seeking secure affordable housing in cities, it will be necessary to enhance existing policies and regulatory frameworks to safeguard the health and well-being of these vulnerable groups. This becomes urgent with the rapid pace of urbanisation and the sizable remaining shortfall of affordable housing in urban areas in India. The research considers various dimensions of health for low-income housing – physical, social, and psychological – with a focus on the felt needs of women, children, and the elderly, coupled with the need to reduce risk and stress in the face of accelerating climate change.

The white paper puts forward recommendations for the coordinated enhancement of policies, codes, and regulations. It lay out a framework for guidance for the Ministry of Housing and Urban Affairs (MoHUA), the Ministry of Health and Family Welfare (MoHFW), and the Review Committees of the Bureau of Indian Standards (BIS) for the National Building Code (NBC), to harmonise their actions for healthy affordable housing in urban areas. The larger goal is to create an institutional and regulatory framework for mandating provisions for healthy and climate-resilient homes for low-income groups in India, that can be executed by Urban Local Bodies (ULBs) and public and private developers.

SUMMARY FOR DECISION-MAKERS

	CONCERNED MINISTRIES	RELEVANT POLICIES, PROGRAMS AND OTHER ENABLING INSTRUMENTS
1.	Ministry of Housing and Urban Affairs (MoHUA)	National Urban Habitat and Housing Policy (NUHHP), Model Building Bye-Laws, State-level Development Control Regulations (DCRs), Local Building Bye-Laws
2.	Ministry of Health and Family Welfare (MoHFW)	National Health Policy (NHP), Heat Action Plans (HAP) in coordination with the National Disaster Management Authority (NDMA)
3.	Ministry of Consumer Affairs, Food and Public Distribution (DCA)	National Building Code (NBC) by the Bureau of Indian Standards (BIS)

Three factors – rapid urbanisation, growing need for affordable shelter for the urban poor, and climate change – have converged critically for India. As the Indian urban population is expected to rise to 50% by 2050[1], there is a huge demand for affordable housing by low-income groups. Additionally, the palpable effects of climate change – heat waves, droughts, storms, and floods – also affect most the health and well-being of low-income groups. Women, the elderly, the sick, and children end up being the most vulnerable. These effects get exacerbated in towns and cities as they expand and densify.

In the context of affordable housing for urban poor, so far the governmental policy focus has been on enabling rapid delivery of dwelling units to meet the outstanding and growing demand. The qualitative attributes of housing such as climate appropriateness for comfort and overall health and well-being of occupants are not prioritised. Moreover, the need to curtail the carbon footprint of construction and promote resilience to climate change impacts is yet to be addressed. Observations on the ground show that the current practices in affordable group housing for low-income groups tend towards high-rise and high-density construction, lacking provisions for climate comfort and resilience to climate change threats. For small homes (30 - 50 sq m) with large household sizes and the lack of effective community resources, this also adds to social and psychological stress.

An enormous amount of affordable housing, almost doubling the current housing stock, will be required to shelter the increasing urban population over the next two decades. This poses both an unprecedented challenge and a critical opportunity, as houses thus built will last at

[1] United Nations, Department of Economic and Social Affairs, Population Division (2019). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER. A/420).

least 50-60 years and have the potential to impact resource usage and well-being of inhabitants during their lifecycle. This calls for a prospective enhancement of policies and standards for the design and construction of affordable housing – to protect and enhance the security, health, and well-being of poor urban households, build resilience against extreme events, and contribute to climate change mitigation through resource and energy efficiency. Not acting now would put at risk the well-being of a large section of urban residents, and will carry the burden of investment made in suboptimal residential environments.

This paper proposes a framework for a holistic definition of health and well-being for low-income housing in urban areas – encompassing physical, social, and psychological dimensions of health, and resilience against disruptions caused by climate change and other extreme events. The felt needs of women, the elderly, the disabled and the sick, and children are given due consideration, especially their need for safe and secure social interaction. A review of existing policies, programmes, codes, and regulations that guide the design and construction of low-income housing highlights the need for enhancement and amendment against a holistic definition of health. This enhancement in policies and programmes holds the potential to positively contribute to India's adherence to the United Nations' New Urban Agenda and the Sustainable Development Goals (SDGs), and support its commitment to reduce the emissions intensity of its GDP as pledged in its Nationally Determined Contribution (NDC) in 2022 as a part of the Paris Agreement.

The recommendations of this white paper result from a structured research and stakeholders consultation process. A holistic understanding of healthy buildings was arrived at through a review of global literature. Then existing policies, programmes, codes and regulations were reviewed, along with the prevalent trends in design and construction practices for low-income housing. These were analysed against the proposed holistic framework for defining healthy buildings in the context of climate change. Additionally, four existing affordable housing projects were analysed through the model of a living lab. This involved evaluation of the building performance during heatwaves, along with in-depth interviews and focus group discussions with occupants to collect data on key health and well-being-related issues experienced by occupants. The policy review and assessment of the issues faced by occupants on the ground prompted the recommendations put forward in this white paper for different instruments of planning – including policies, programmes, codes and regulations – that have a bearing on the design and construction of low-income affordable housing in urban areas.

Policies by the Central Government that impact the health and well-being of residents in urban areas include the National Urban Habitat and Housing Policy (NUHHP) formulated by the Ministry of Housing and Urban Affairs (MoHUA), and the National Health Policy (NHP) by the Ministry of Health and Family Welfare (MoHFW). These policies were framed before the

severe threats and impacts of climate change gained urgency. The white paper recommends an alignment of the objectives of the two policies so they are mutually supportive, and a coordinated extension to incorporate aspects of health and resilience to climate change for low-income urban residents.

The National Building Code (NBC) of India, formulated by the Bureau of Indian Standards (BIS), provides the basis for the Development Control Regulations (DCR) and local building bye-laws that are implemented by State Governments and Urban Local Bodies (ULBs). Various sections of the Code are identified where extensions and amendments can be made to include minimum and mandatory standards for the health, well-being, and climate resilience of occupants in low-income housing. These will inform the review and revision of the Code which is due in 2024-25. Once the recommendations are incorporated into the NBC, they could then be integrated into the Development Control Regulations (DCR) and local building bye-laws of the states. The Ministry of Housing and Urban Affairs (MoHUA) also formulates guidelines for Urban and Regional Development Plans Formulation and Implementation (URDPFI) and the Model Building Bye-laws (MBBL). These, too, can be aligned with the amended Code with a focus on low-income housing in urban areas.

Additionally, the Pradhan Mantri Awas Yojana - Urban (PMAY-U) – a flagship programme of the Central Government – acts as the primary engine for promoting affordable housing in India. It is supported by the promotion of housing finance regulated by the National Housing Bank (NHB). The National Housing Bank, which received 'green' finance for affordable housing, is also developing procedures for the disbursement of funds tied to the assurance of green and environmentally sustainable performance for climate change mitigation in the built environment. This implies that green design and construction – including passive design strategies for climate comfort and reducing energy demand, design for health and well-being, resource efficiency, and resilience – would soon be a prerequisite for financing low-income affordable housing in urban areas. It is thus opportune to align the provisions of PMAY-U concerning the definitions of the minimum requirement for eligibility with the progressive measures for health, well-being and climate resilience. A shortcut to implementation would be the formulation of Model Building Bye-laws (MBBL) for PMAY (U) that supersede DCR and other existing bye-laws which are at variance.

Finally, it is recognised that Green Building Rating Systems also have a bearing on the outcomes of residential developments for low-income groups in urban areas, as the certifications are recognised for financial support, subsidies, and incentives in the affordable housing sector. The white paper, therefore, recommends extensions and improvements in the parameters of the rating systems to include objectives of healthy buildings and climate resilience. Listed below are the recommendations that the white paper proposes for upgrading the policies, codes, regulations, and the rating systems in focus.

Physical Health and Resilience to Climate Change

The trends of increase in the intensity and duration of heat waves, compounded by the Urban Heat Island (UHI) effect, call for protective and adaptive measures in the design and planning of residential neighbourhoods. Additionally, preventive measures are needed to curtail vector-borne diseases and resilience facilities to care for vulnerable and affected persons during heat waves and epidemics at the neighbourhood level. Rising air pollution in cities also requires protective measures for residential areas. The white paper puts forward the following recommendations for physical health and resilience to climate change in low-income housing –

- Adherence to Eco Niwas Samhita (ENS) Energy Conservation Building Code (ECBC) (R) for thermal comfort – this could be made prescriptive, giving standard solutions for walling, windows, external shading, and roofing for ease of implementation.
- Provision for mechanically-aided ventilation.
- Mandating roof construction with reflective coating and high insulation.
- Protection of homes from mosquitoes and vermin.
- Design of on-site drainage for no stagnant water.
- Minimum buffer between land for affordable housing and major transportation arteries to minimise air pollution.
- Provision for roof-mounted Solar PV as a resilience measure for assuring minimum electricity supply for essential services.
- Provision of sheltered resilience centres.
- Provision of emergency water storage at the community level.

Social Health and Psychological Health

It is seen that high densities combined with high-rise buildings resulting from increasing FSI tend to create socially and psychologically adverse conditions, in addition to the stress of increase in carbon footprint and operational and maintenance costs for low-income households. Small homes with large households also need to be adaptable in utilising their limited floor area. Women and children, especially girls, need secure, habitable, shaded outdoors adjacent to their homes. The white paper puts forward the following recommendations for the social and psychological health of occupants of low-income housing –

- Recommendation for design to permit flexibility in the partitioning of internal spaces.
- Prohibit FAR incentives that contradict social and cultural appropriateness and environmental sustainability.
- Limit building heights to stilts plus four stories as a fundamental requirement.
- Limit to densities of housing (DUs/hectare of land) to avoid overcrowding.
- The minimum standard for accessible shared space, sheltered or open, adjacent to homes as compensation for small dwelling units with high occupancy.

- Inclusion of women in post-occupancy management of community assets as changemakers for sustainable lifestyles.
- Limit to hard paving and vehicular access, minimum standards for green and soft ground.
- Review of on-site provision of vehicular parking to maximise green open spaces.
- Review of fire tender access rules to optimise green open space.

The rapidly growing challenges of urbanisation and climate change can adversely impact low-income residents and the quality of life of their homes. Reform in policies, programmes, standards, and regulations is thus urgently needed. The National Building Code (NBC) and Model Building Bye-Laws (MBBL) need to be revised immediately. The alignment in PMAY(U) provisions and Green Building Rating Systems would follow suit.

1. HEALTHY LOW-INCOME HOUSING IN THE CONTEXT OF CLIMATE CHANGE

In India, with the twin conditions of rapid urbanisation and increasing numbers of urban poor with inadequate housing, and the onset of the effects of climate change, a critical situation is fast emerging. The global impacts of climate change continue to threaten the health and safety of ecosystems as well as human systems. United Nations' Intergovernmental Panel on Climate Change (IPCC) recognises that the poor populations of the Global South, due to their paucity of resources, are the most affected by the stress and disruption caused by climate change[2]. This white paper and the research that it is an output of, thus, focus on the health and well-being of low-income urban residents that constitute approximately 30% of the present urban population in India and seek a secure and affordable shelter in cities.

1.1. Context

1.1.1. Critical Situation in India: Urbanisation and Shelter for the Urban Poor

India's urbanisation is considered to be the 'largest national urban transformation of the 21st century'[3]. By 2050, it is estimated that over 50% of India's population will be living in urban areas, as Indian cities undergo a progressive rise in population as well as geographic expansion. From 2018 to 2050, India is projected to add 416 million urban dwellers[4]. This ongoing urbanisation, particularly rural-urban migration, intensifies the demand for affordable housing especially at the low end of the market. In 2015, the Ministry of Housing and Urban Affairs (MoHUA) identified migrants in urban areas as the largest population needing housing in cities, given an inadequate supply of low-income ownership and rental housing options in cities[5].

As per estimates, the urban housing shortage was 29 million in 2018, compared to 18.78 million in 2012[6]. Over 96 per cent of this urban housing shortage is confined to Economically Weaker Sections (EWS) and Low-income Groups (LIG). This includes households residing in

[2] IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
[3] Worldbank. (2011). Urbanisation in India. www.worldbank.org/en/news/feature/2011/09/22/india-urbanization.
[4] United Nations, Department of Economic and Social Affairs, Population Division (2019). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER. A/420).
[5] Ministry of Housing and Urban Poverty Alleviation. (2017). Report of Working Group on Migration. Government of India.
[6] Roy, D., & Meera, M. L. (2020). Housing for India's low-income urban households: A demand perspective (No. 402). Working Paper. Indian Council for Research on International Economic Relations (ICRIER), New Delhi.

inadequate shelters with severely congested conditions and existing slum populations in urban areas. In this context, Government programmes for planned affordable housing will need to accelerate to meet the burgeoning demand and provide low-income housing that is secure, healthy, and adapted for climate change resilience.

Hitherto, the Government's policies and programmes have focused on a minimum '*pucca*' (meaning solid, permanent, made up of materials like brick, stone and concrete) house as a unit of provision, and on a quantitative approach of rapid delivery of affordable housing units to meet the outstanding and growing demand. The qualitative attributes of housing such as climate appropriateness for comfort, overall health and well-being of occupants, shared community assets, and resilience to climate change impacts are not prioritised. Additionally, aspects related to embodied and operational carbon, energy efficiency, and the environmental impact of large-scale construction are yet to be addressed.

The current practice in affordable housing is toward more high-rise, high-density developments prompted by the high FAR permitted by the Development Control Regulations. Increased FARs and taller buildings are promoted with the rationale of maximising the capacity of built space for efficient land use, principally addressing growing housing demands and attracting more investment from real estate developers. However, this blanket increase in FAR overlooks the lifecycle carbon footprint of high-rise development, its vulnerability to disruptions, the increased construction, operation and maintenance costs, and the strain on infrastructure capacities. The increased costs of tall buildings tend to strain affordability, and are not conducive to social and psychological well-being for small homes with many children. It, therefore, becomes important to review policies and trends that lead to higher GHG emissions and reduced affordability for the EWS and LIG sections of the urban population.

The Government's flagship programme Pradhan Mantri Awas Yojana (PMAY) aims to provide affordable housing to urban and rural poor. Under the PMAY -U (urban) mission, 12 million houses have been sanctioned by 2022, with half of them yet to be constructed. With each dwelling unit size varying from 30 - 60 sq m, the additional building footprint in urban areas will be at least 360 million sq m once all sanctioned houses are constructed[7]. Houses built under the mission will last fifty to sixty years. Not taking proactive measures to safeguard the qualitative aspects of affordable housing for the poor may result in a long-term liability of large, sub-optimal building stock and adversely affect the health, well-being, and security of the inhabitants.

[7] Kumar, S., Singh, M., Chandiwala, S., Sneha, S., & George, G. (2018). Mainstreaming Thermal Comfort for All and Resource Efficiency in Affordable Housing: Status Review of PMAY-U Mission to Understand Barriers and Drivers. New Delhi: Alliance for an Energy Efficient Economy.

1.1.2. Carbon Emissions and Climate Change

The consequences of climate change are being experienced globally. As per the World Health Organisation (WHO), climate change is the biggest health threat to humanity. Extreme weather events like heat waves, floods, and droughts are increasing in frequency and causing disruption and destruction of homes and infrastructure, and severe physical and mental health impacts. The IPCC states that the occurrence of extreme heat events and climate-related water-borne and vector-borne diseases has increased, resulting in human mortality and morbidity. Climate impacts also include mental health challenges associated with increasing temperatures, trauma from weather events, and loss of livelihoods and culture[8].

India is currently facing a collision of multiple cumulative and co-occurring climate hazards that are accentuated by rapid urbanisation. Over 75% of Indian districts are hotspots of extreme climate events[9]. Research shows that the country's average temperature is expected to rise by 4.4 degree Celsius by the end of the year 2100[10]. The rise in temperatures is coupled with the increase in the duration and intensity of heat waves over large parts of the country. This gets accentuated further in urban areas, compounded by the Urban Heat Island (UHI) effect, with temperatures rising up to 50 deg. C.

The IPCC recognises that lower-income groups – given their limited resources, socio-economic marginalisation, and living in more vulnerable locations – will be the most affected by climate change impacts. Consequently, economic progress will likely be adversely impacted, and more marginal communities may fall into poverty. Proactive action is, therefore, necessary to protect the most vulnerable populations and build resilience strategies to mitigate these impacts.

To mitigate climate change impacts, it is also important to reduce carbon emissions by promoting resource and energy efficiency. In relation to low-income groups and their housing, it is essential to follow a combined approach of reducing their risk and vulnerability to climate change impacts and promoting energy efficiency to curtail energy demand. This makes the need for passive design and energy-efficient strategies vitally necessary in the design and construction of the large anticipated footprint of affordable housing.

[8] IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

[9] Mohanty, Abinash. (2020.) Preparing India for Extreme Climate Events: Mapping Hotspots and Response Mechanisms. New Delhi: Council on Energy, Environment and Water.

[10] Krishnan, R., Sanjay, J., Gnanaseelan, C., Mujumdar, M., Kulkarni, A., & Chakraborty, S. (2020). Assessment of Climate Change over the Indian Region: A Report of the Ministry of Earth Sciences (MOES), Government of India. Springer Nature.

1.1.3. Health and Well-being of Low-Income Urban Residents

The palpable effects of climate change – heat waves, drought, storms and floods – affect most the health and well-being of those who are poor. The impact of climate change on their physical and mental health is accompanied by socioeconomic costs. Additionally, the distressing experience of the COVID-19 pandemic has highlighted the increased vulnerability of low-income residents in the face of disruptions. It also brought attention to the correlation between risk and high density of residential environments, inadequate natural ventilation, and access to open space. As urban economies came to a halt during the outburst of the pandemic, poor citizens without secure housing were the most vulnerable. The reverse mass migration from urban to rural areas, following the nationwide lockdown in India in March 2020, manifested their vulnerability.

To ensure and protect the security, health, and well-being of poor urban households, it is essential that low-income housing in urban areas include measures for resilience against climate change impacts and other disruptions like the pandemic. Certain groups have a higher susceptibility to climate-sensitive health impacts owing to their social marginalisation (poverty, migration or tenure status), age (children and elderly), and gender (particularly pregnant women). Additionally, India is estimated to have around 42 million home-based workers, most of them women. For them, climate change impacts like heat waves bring a cruel double blow, affecting both their health and productivity. In this context, the specific needs of women, children, the elderly and the sick, for secure and healthy environments seek prioritisation.

Observations on the ground show that the current practices in affordable group housing for low-income groups tend towards high-rise and high-density construction. For small homes (30 - 50 sq m) with large household sizes, this also adds to social and psychological stress, with the paucity of effective community resources. The current practice in group housing projects for low-income groups also lacks provisions for protection from and resilience to climate change threats. Additionally, designers and builders often do not adapt passive design strategies for climate comfort, leading to greater discomfort. This offers scope to optimise the passive design of the buildings to be climate responsive and secure environmental conditions – such as adequate light, ventilation, and green open space – for improved health and well-being. The need for shared community assets to build-in resilience to overcome disruptive events also becomes important to uphold the health and security of occupants.

1.2. Opportunities: Current Government Initiatives

1.2.1. Initiatives for Climate Change

The National Action Plan for Climate Change (NAPCC) was launched in 2008 by the Prime Minister's Council on Climate Change (PMCCC). It put forward multi-frontal, long-term strategies to address climate change and its impacts. One of the eight missions of the NAPCC is the National Mission on Sustainable Habitat (NMSH) which aims to promote low-carbon urban growth to reduce GHG emissions and to build resilience to climate change-related risks and extreme events.

Some strategies outlines in the NMSH for promoting green buildings and for mitigating climate change include - integrating green building guidelines into Development Control Regulations (DCRs) and Building Bye-laws and mandating them for all new constructions of more than 20,000 sq. m. area; promoting roof cooling techniques in new developments of more than 20,000 sq. m in peri-urban areas; and mandating Green Rating Systems notified in Development Control Regulations (DCRs) and Building Bye-laws, for all new constructions of more than 20,000 sq. m. area.

The Bureau of Energy Efficiency (BEE) has taken several steps to address the rapid increase in demand for air conditioners in the residential sector and the consequent steep increase in cooling energy requirements. It has published its Design Guidelines for Energy-Efficient Multi-Storey Residential Buildings, and the recommendatory Energy Conservation Building Code for Residential Buildings (ECBC-R) known as Eco Niwas Samhita (ENS) to be adopted by states for implementation. Furthermore, the Ministry of Housing and Urban Affairs (MoHUA) is taking steps to promote 'Climate Smart Buildings' as climate-responsive designs for affordable housing for low-income groups (EWS and LIG). A project has been commissioned to develop replicable type designs suitable for all climatic zones, available as open-source.

Over the past years, the Indian Meteorological Department (IMD) has mapped the increasing frequency and intensity of heat waves, especially in and around cities where populations are concentrated. Prompted by a perceptible rise in death rates and casualties reported by hospitals during heat waves, the National Disaster Management Authority (NDMA) has taken up the preparation of Heat Action Plans (HAPs) for implementation in various cities. HAPs outline preparatory, adaptive and responsive measures for government departments to tackle the heat and its impacts on health and mortality. Vadodara, Ahmedabad, and Nagpur are front runners in adopting HAPs to be implemented by the health department of their respective municipalities. HAPs also present the opportunity to bring necessary focus on vulnerable populations, including residents of low-income groups.

1.2.2. Affordable Housing - Programme and Practice

The Pradhan Mantri Awas Yojana-Urban (PMAY-U), is the central government's flagship programme under the Ministry of Housing and Urban Affairs (MoHUA) to catalyse and support affordable housing for low and medium-income groups of the urban population. The programme is being implemented through four verticals: Beneficiary Led Construction (BLC), Affordable Housing in Partnership (AHP), In-situ Slum Redevelopment (ISSR) and Credit Linked Subsidy Scheme (CLSS).

Under the PMAY-U, approximately 70% of the beneficiaries have been individual home builders from small towns and their suburbs. Only 30% of the homes have been built as group housing by developers or state agencies. This trend toward group housing is expected to accelerate as planned urban development seeks compact urban growth. Group housing schemes with common services, shared community facilities, and open spaces will become the norm. As we move forward, it is expected that almost 70% of the housing requirements will be provided by small and medium-sized local or regional developers and state agencies.

IN SITU SLUM REDEVELOPMENT	AFFORDABLE HOUSING THROUGH CREDIT LINKED SUBSIDY (CLS)	AFFORDABLE HOUSING IN PARTNERSHIP (AHP)	BENEFICIARY-LED CONSTRUCTION (BLC)
- Using land as a resource - With private participation - Extra FSI / TDR / FAR if required, to make projects financially viable	- Interest subvention subsidy for EWS and LIG for new house or incremental housing - EWS - Annual household income up to Rs 3 lakhs and house size up to 30 sq.m. - LIG - Annual household income between Rs 3 - 6 lakhs and house size up to 60 sq.m.	- With private sector or public sector, including Parastatal agencies - Central assistance per EWS house in affordable housing projects where 35% of constructed houses are for EWs category.	- For individuals of EWS category for new house or enhancement - State to prepare a separate project for such beneficiaries - No isolated / splintered beneficiary to be covered

Figure 01: Four verticals of Pradhan Mantri Awas Yojana
(Source: Ministry of Housing and Urban Affairs, Govt. of India, Drawn by Author)

The survey conducted by GIZ for the project on replicable type designs suitable for all climatic zones, commissioned by MoHUA, brings out gaps in present design and construction practices. Designers and builders often do not follow key principles of climate-responsive

passive design. The orientation of buildings with respect to the sun and suitable shading of windows is often sacrificed to the convenience of rubber-stamping identical blocks. There is a growing trend toward monolithic reinforced concrete construction without adequate insulation for tall buildings.

1.2.3. Supporting Actions for Housing Finance

In response to the global recognition of the urgent need to contain climate change and the search for a paradigm of development that is environmentally and socially sustainable, global investors and financing institutions are offering financial support at concessional interest rates for Affordable Housing tied to verifiable 'green' outcomes. The National Housing Bank in India also recognises energy-efficient residential housing as a segment that needs to be addressed.

Under its Go-Green Initiative, the National Housing Bank has launched the SUNREF (Sustainable Use of Natural Resources and Energy Finance) Affordable Green Housing India programme in partnership with the French Development Agency (AFD) and with support from the European Union (EU). The programme aims at supporting the development of green and affordable housing to reduce the negative environmental impact of the rapid growth of the housing industry in India. It also aims at encouraging the adoption of rules favourable to green housing in public policies.

As a part of the programme, the National Housing Bank has received green finance for affordable housing and is developing procedures for the disbursement of funds tied to the assurance of green performance. 'Green' is an umbrella term that brings together environmental sustainability, health and well-being, and climate change mitigation in the built environment. Given these trends and practices, green design and construction – including passive design strategies for climate comfort and reducing energy demand, design for health and well-being, resource efficiency, and resilience – would soon be a prerequisite for financing low-income affordable housing in urban areas. It is thus opportune to align the provisions for affordable housing with progressive measures for health, well-being and climate resilience.

1.3. Affordable Housing for Health and Well-Being

1.3.1. Project Scope

This White Paper is based on the research findings of the project titled 'Healthy Affordable Housing in India'. The white paper lies at the intersection of climate change - adaptation and

mitigation, affordable housing for EWS and LIG sections of the urban population, and the health and well-being of occupants. It thus proposes a comprehensive approach to address the imperatives of climate change with a special concern for the long-term health and well-being of occupants in the provision of affordable housing for the EWS and LIG sections. It builds on the initiatives already taken by the Government of India, as cited in 1.2, and highlights the need to extend their provisions to make essential amendments and extensions to policies, programmes, and other implementation instruments.

This paper proposes a framework for a holistic definition of health and well-being appropriate for low-income housing in urban areas – encompassing physical, social, and psychological dimensions of health, and resilience against disruptions caused by climate change and other extreme events. The felt needs of women, the elderly, the disabled and the sick, and children are given due consideration, including their need for safe and secure social interaction. It outlines actions for the design and construction of healthy affordable homes and neighbourhoods that co-benefit climate change adaptation and mitigation - provide resilience against climate change impacts, curtail cooling energy demand, and minimise embodied carbon of construction. It then puts forward recommendations for upgrading associated codes and regulations, to institutionalise the proposed actions for healthy affordable housing. It also outlines a road map for action for institutional coordination and implementation of the recommendations across different instruments of planning.

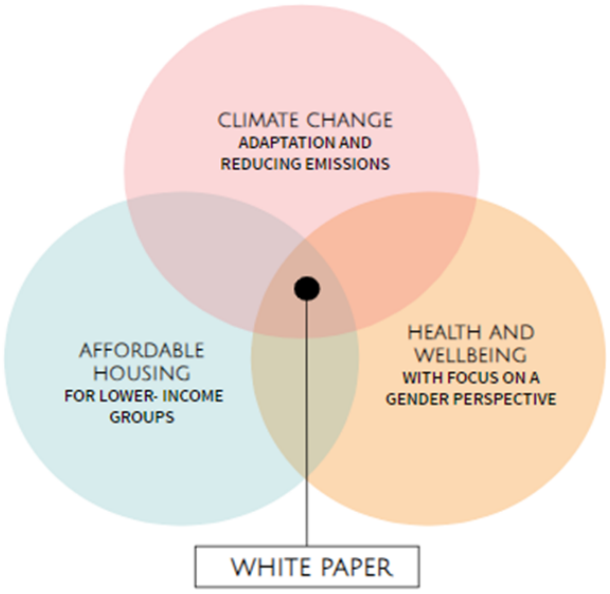

Figure 02: Scope of the white paper. (Source: Author)

1.3.2. Research Methodology

The recommendations of this white paper result from a structured research and stakeholders consultation process. A holistic definition of healthy buildings, suitable for affordable housing in India in the context of climate change, was arrived at through a review of global literature. The trends in the intensity and duration of heat waves and their correlation with health risks

and morbidity in Indian cities were identified. Then existing policies, codes, regulations, and green building rating systems were reviewed, along with the prevalent trends in design and construction practices for low-income housing. These were analysed against the proposed holistic framework for defining healthy buildings to identify opportunities for encouraging healthy Affordable Housing.

Additionally, four existing affordable housing projects were studied and analysed through the model of a living lab. This involved evaluation of the building performance during heat waves, and in-depth interviews and focus group discussions with occupants to collect data on key health and well-being-related issues experienced by occupants. The living lab then involved two pilot projects in the form of design charrettes for two upcoming Affordable Housing projects, providing practical guidance and solutions to the agencies to enable the incorporation of design measures and functional provisions that meet the definition of healthy buildings. This helped test the applicability of the recommendations and highlighted the constraints and limitations faced on ground. It is worthwhile to note that while the recommendations helped the projects create a healthier built environment, they also reduced their cooling load by 30 to 35%.

The review of existing policies and codes for affordable housing, the assessment of the issues faced by occupants on the ground, and the pilot projects – prompted and informed the recommendations put forward in this white paper. These include notes for the extension of different instruments of planning – National Building Codes (NBC), Model Building Bye-Laws (MBBL), Development Control Regulations (DCR) , and Green building rating systems – that have a bearing on the design and construction of low-income affordable housing in urban areas.

1.3.3. Prospects for Alignment with SDGs and NDC

The recommended transition of policies and programmes outlined in this white paper has the potential to positively contribute to India's adherence to the United Nations' New Urban Agenda and the Sustainable Development Goals (SDGs). The SDGs that this white paper addresses include -

- **Goal 3: Good Health and Well-being -** Ensure healthy lives and promote well-being for all at all ages
- **Goal 5: Gender equity -** Achieve gender equality and empower all women and girls.
- **Goal 6: Clean water and Sanitation -** Ensure availability and sustainable management of water and sanitation for all.
- **Goal 11: Sustainable Cities and Communities -** Make cities and human settlements inclusive, safe, resilient and sustainable

- **Goal 13: Climate Action** - Take urgent action to combat climate change and its impacts.

Goal 3: Good Health and Well-being

Goal 5: Gender equity

Goal 6: Clean water and Sanitation

Goal 11: Sustainable Cities and Communities

Goal 13: Climate Action

Figure 03: The SDGs that will be addressed through this white paper (Source: www.sdgs.un.org/goals)

Moreover, the energy consumption from residential buildings in urban areas is predicted to rise by more than eight times by 2050[11], making energy-efficiency strategies of vital importance. In the case of the extensive demand for affordable housing in India, the short term demand for energy is limited, but a latent demand for energy can be expected as temperatures rise due to climate change and disposable incomes increase within lower-income groups. Mandating climate-sensitive passive design in residential buildings can reduce the potential demand for air-conditioning or cooling energy by 30 to 35%[12,13]. This also becomes a significant contribution toward curtailing the energy intensity of development, and supporting India's commitment in its Nationally Determined Contribution (NDC) to bring down the GHG emissions intensity of its GDP by 45% by 2030 from the 2005 level.

[11] Shukla, Y., Rawal, R., & Shnapp, S. (2014). Residential buildings in India: Energy use projections and savings potentials. Growth, 800, 1000.

[12] Gondal, I. A., Syed Athar, M., and Khurram, M. (2019). Role of Passive Design and Alternative Energy in Building Energy Optimization. Indoor Built Environment.

[13] Al-Tamimi, N. (2022). Passive Design Strategies for Energy Efficient Buildings in the Arabian Desert. Frontiers in Built Environment, 7, 805603.

2. DEFINING HEALTHY BUILDINGS

It is axiomatic to consider that buildings, especially homes and the built environment of residential neighbourhoods, have a significant bearing on the health and well-being of residents. WHO upholds that poor housing conditions are one of the mechanisms through which social and environmental inequality translates into health inequality, which further affects quality of life and well-being. Ensuring healthy and safe dwellings for all has implications for national, regional and local governments and instruments of planning that set standards and determine the institutional context for housing design and construction.

There are several definitions of 'healthy building' including definitions by WHO, UNEP, UN-Habitat, and LEEDS (Leadership in Energy and Environmental Design) Green Building Certification. WHO defines healthy housing as a shelter that supports a state of complete physical, mental and social well-being[14]. UN-Habitat identifies the issue of health in housing at the city, regional and territorial urban level by linking climate change, health, a healthy environment with the built environment and social inclusion[15].

A review of global literature reflects that much of the concerns for healthy buildings in literature are for artificially-controlled indoor environments in the developed world: sick building syndrome, indoor air quality, communicable infectious diseases, active cooling anticipating temperature rise and heat waves. There exists no theoretical framework to define ‘healthy buildings’ for developing countries like India where the majority of buildings, especially residential buildings for lower income groups, are not closed and artificially conditioned.

This white paper outlines a holistic definition of ‘health and well-being’ appropriate for affordable low-income housing. It defines ‘healthy buildings’ as buildings, residential communities and their neighbourhoods that protect and promote holistic health and well-being – considering physical, social and psychological health of occupants. In that vein, ‘healthy buildings’ are defined from this three-point perspective to provide a framework for determinants of health for the design of homes and residential neighbourhoods:

- The definition looks at the expectations of physical, social, and psychological health and well-being of residents of all ages and gender categories. It is acknowledged that these three dimensions of health are closely interconnected and affect one another.

[14] WHO (2018). WHO housing and health guidelines. World Health Organization, Geneva.
[15] UN-HABITAT, WHO. (2020). Integrating health in urban and territorial planning: a sourcebook. World Health Organization, Geneva.

- It looks at the exposure of residents to the hazards and stress due to the environmental impact of climate change and urban development – extreme temperatures, storm events, noise, and air pollution – from which the built environment must provide protection and resilience for recovery.

- It considers the base requirements that need to be fulfilled and are affordable, with the presently available resources, in the design of construction of affordable housing for low-income groups in a developing country like India.

As discussed, the low-income sections of urban populations are the most vulnerable to the effects of climate change. Their newly developed residential neighbourhoods are often densely populated. This fact offers the advantages of shared community assets to build-in resilience to overcome disruptive events. There is also a need to optimise the passive design of the buildings to be climate-responsive and secure environmental conditions, such as adequate light, ventilation, and green open space, for health and well-being. Importantly, health and well-being would include social and psychological aspects of health that arise with high densities, especially from the point of view of women and children.

This white paper proposes the following elements that when read together constitute a holistic definition of 'healthy building'. Each of the defining elements listed below apply to the levels of the individual home, the building, the residential community, and the neighbourhood.

PHYSICAL HEALTH	SOCIAL HEALTH	PSYCHOLOGICAL HEALTH	RESILIENCE AGAINST CLIMATE CHANGE (AND PANDEMICS)
- Thermal Comfort - Visual Comfort - Protection from Pollution and Diseases	- Social Interaction - Gender Equity - Adequate space - limits to crowding and densities	- Limits to overcrowding, privacy, and sense of safety - Access to Nature - Aesthetics, Choice, and Flexibility	- Protection from disruptions - Adaptation to climate change impacts - Disaster preparedness
Applicable to the individual home, the building, the residential community, and the neighbourhood.			

Figure 04: Proposed indicators for healthy affordable housing. (Source: Author)

2.1. Physical Health

Thermal and visual comfort are principal objectives for the design of buildings. In the context of the imperatives of climate change mitigation design, comfort gains greater importance. This co-benefit climate change mitigation, as heating, cooling and lighting tend to account for around half of a building's energy consumption, making thermal and visual comfort a key consideration to promote energy efficiency. Another important factor for the health and well-being of occupants is protection from diseases and pollution. These factors are closely linked to density of living, ventilation potential, and segregation from high pollution areas.

2.1.1. Thermal Comfort

Thermal comfort and thermal health encompass all of the impacts of thermal conditions on health, including mortality, that go beyond just comfort. The survey conducted of affordable housing in Gujarat during the living lab showed that 80% of homes were not thermally comfortable during the peak summer months (May 2022- June 2022). The houses on the top floor did not have insulation, exposing them to a higher radiant temperature.

Indoor thermal comfort is influenced by a number of factors including the building design, building orientation, building structure, occupant density, ventilation strategies, and mode of ventilation. Healthy buildings need to ensure indoor thermal comfort for occupants while minimising the need for energy for cooling and the consequent carbon emissions. As temperatures rise and extreme heat and cold waves increase, the optimisation of climate-responsive passive design of buildings along with their neighbourhood design becomes an absolute requirement.

Action 01 - Healthy Buildings and their neighbourhood will optimise the integration of climate-responsive passive strategies and low-energy devices to maximise the duration of indoor thermal comfort.

2.1.2. Visual Comfort

Visual comfort is characterised by a sufficient amount of natural light (and, secondly, artificial light), good glare control, and access to views of the outdoors. The survey conducted during the living lab showed that 70% of houses did not have access to adequate daylight levels in the living room, the most commonly used space by the residents.

Buildings need to ensure functional daylight illumination for all habitable spaces during day-lit hours to minimise the dependence on electric lighting. In warm climates or seasons, eliminating direct solar radiation with external variable shading systems is called for.

Action 02 - Healthy Buildings will optimise the availability of diffuse daylight during warm/hot periods in all habitable spaces and enable its modulation with external shading systems.

2.1.3. Protection from Pollution and Diseases

Infectious and Vector Diseases

Protection of inhabitants from contracting disease is a fundamental objective in the design of built environments. In dense urban residential areas, the safe disposal and treatment of human excreta are recognised in building codes. Additionally, while the Nation Health Policy recognises the causes and exposure of populations to vector diseases such as Malaria, Dengue and Chikungunya, the codes for the design of the built environment have not yet incorporated preventive measures.

Action 03 - Healthy Buildings will ensure drainage of all outdoor surfaces to avoid waterlogging. Pools and ponds will have larvae-eating fish. Indoor spaces will be protected from mosquitoes with netting.

Communicable Diseases

The global spread and severity of the COVID-19 virus and the correlation of its transmission through touch and air with density of populations and ventilation – implies limits to the occupation density, increase in ventilation of indoor spaces, and provision for secure segregation of infected persons.

Action 04 - Healthy Buildings will enable good ventilation in habitable indoor gathering and meeting spaces.

Action 05 - Healthy buildings and neighbourhoods will provide convenient access to community health and resilience centres equipped for protection and care for the most vulnerable residents during pandemics and heat waves.

Allergies and Respiratory Reactions

Damp or humid indoor air encourages mould growth and may indicate that there is insufficient ventilation to disperse moisture generated from indoor activities like cooking and

bathing[16]. The mould growing on poorly ventilated, damp indoor surfaces has been noted as a cause of chronic allergies and respiratory diseases, especially among children and the elderly. Dampness in buildings is affected by indoor and outdoor conditions in relation to air temperature and air humidity, the degree of air exchange between indoor and outdoor settings, and the generation of humidity within a given building[17].

Action 06 - Healthy Building will avoid causes of dampness in indoor spaces and provide means of flushing out or removal of humidity.

Air Pollution

Air Pollution has been increasing in urban areas throughout the country. As per the WHO, air pollution is one of the greatest environmental risks to health. Medical literature supports that it is the pollution caused by Particulate matter (PM) 2.5 that is most injurious to health. This particulate pollution in urban areas is produced primarily by traffic through the combustion of motor engine fuels. Besides policies for reducing ambient pollution in urban areas, there is a need to protect residents from Traffic Related Air Pollution (TRAP) through sufficient distance and segregation.

Action 07 - Healthy Buildings will require residential neighbourhoods to be segregated from heavy traffic arteries and will minimise the intrusion of polluting motor vehicles and their movement within the residential zones.

Noise Pollution

The physical and psychological effects of loud noises have been well documented. It is established that loud noise inhibits restful sleep and is a cause of subliminal stress. In urban areas this condition is encountered in locations close to heavy traffic arteries. Several research have reported the relationship between exposure to road traffic noise and health problems such as cardiovascular diseases and hypertension, mental disorders, and immune system[17].

Action 08 - Healthy Buildings will require residential zones to be protected from the loud noise of traffic or other sources of loud noise.

[16] WHO (2018). WHO housing and health guidelines. World Health Organization, Geneva.

[17] Geravandi, S., Takdastan, A., Zallaghi, E., Niri, M. V., Mohammadi, M. J., Saki, H., & Naiemabadi, A. (2015). Noise pollution and health effects. Jundishapur Journal of Health Sciences, 7(1).

2.2. Social Health

Social health is the aspect of holistic well-being that relates to connection and community. It is associated with the extent to which a person feels a sense of belonging and social inclusion through community engagement. Positive social health including having meaningful social interactions, lack of conflict, inclusion, and social support. With the lack of sufficient resources and increased vulnerability of low-income communities to disruptions and social stresses, there is a need to facilitate measures to promote social health for their overall well-being in the society.

2.2.1. Social Interaction

Residential buildings and neighbourhoods are spaces for social interaction, group activities and recreation. Spaces adjacent to and near homes need to be designed and built as 'habitable outdoors' that complement individual dwelling units and extend the notion of home beyond the boundaries of the dwelling unit. This provision becomes essential where the home is small and the household size is large, with children and youth forming most residents. Where outdoor and common spaces are inhospitable or taken over by vehicles, vandalism, delinquency, and social crime tend to be higher. Women and children, especially girls, especially need secure, habitable, shaded outdoors adjacent to their homes.

Action 01 - Healthy Building and neighbourhoods will promote social health by designing outdoor and common shared spaces for social interaction, group activities and recreation. Special care will be taken for the recreation of children and youth. Sheltered spaces for group activities will be provided.

2.2.2. Gender Equity

Women at home are the main caregivers and homemakers. They are often secondary income earners, and some are sole earners for the household. Their concern for the health and well-being of the household is deep. The need for hygiene and protection of infants, pregnant women, and elders in the home is strongly felt.

At the community level, women have a natural role in cultural activities and rituals and in nurturing sustainable lifestyles. In healthy homes, women would be the effective change-makers in adopting sustainable lifestyles and managing community assets for preventive hygiene and health. They would be equal stakeholders in operating, managing, and maintaining shared community assets.

Action 02 - Healthy buildings and neighbourhoods will meet the special concerns and needs of women residents concerning hygiene, health care facilities and workspaces for income generation. Healthy buildings and neighbourhoods will engage women as equal stakeholders in the operation, management, and maintenance of the shared community assets.

2.2.3. Adequate Space

Household crowding is a condition where the number of occupants exceeds the capacity of the dwelling space available, whether measured as rooms, bedrooms or floor area, resulting in adverse mental health outcomes[18]. Overcrowding in habitable rooms and adjacent spaces can be a cause of social discomfort and social conflict. There is also evidence that overcrowding restricts physical and emotional spaces, and creates a hindrance to creating supportive social relationships for households[19]

Densities need to have limits even while accounting for resilience and cultural norms. Limiting densities and reducing crowding can support good health outcomes and also contribute to improved educational outcomes, as children are able to study more effectively[20]. Overcrowded spaces and neighbourhoods also endanger health with an increased exposure to various infectious diseases with no social distancing possibilities.

Action 03 - Healthy buildings and neighbourhoods will meet minimum standards for space per person in homes, in the common spaces within buildings and as 'habitable' outdoors and terraces.

2.3. Psychological Health

Mental health is impacted by the built environment. Living in an unsafe or insecure built environment can cause psychological stress. As stress and overcrowding cause conflict, it can lead to further housing problems and poor mental health. Overcrowding, antisocial behaviour, and social and psychological stress also lead to sleep issues and anxiety which affect overall well-being. Although vulnerable groups like women, young children and senior citizens are impacted quite visibly, various other emerging mental health issues of stress, anxiety, and depression have become commonplace in modern-day urban living.

[18] Gove, W.R., Hughes, M., Galle, O.R. (1983) Overcrowding in the household: an analysis of determinants and effects. Academic Press. New York and London.
[19] Firdaus, G. (2017). Built Environment and Health Outcomes: Identification of Contextual Risk Factors for Mental Well-being of Older Adults. Ageing International 42, 62-77.
[20] Braconi, F. (2001). Housing and Schooling: the Urban Prospect. Citizen's Housing and Planning Council. New York.

2.3.1. Limits to Overcrowding, Privacy, and Sense of Safety

It is seen that high densities combined with high-rise buildings resulting from increasing FSI tend to create socially and psychologically adverse conditions. It creates a feeling of loss of privacy and threat to safety among women, and a sense of alienation and confinement experienced by the elderly and children. Overcrowding and lack of privacy, especially for women and adolescent girls, further cause social attrition and mental stress.

Research shows that in-house crowding resulting from high densities of low-income housing also has a severe impact on the psychological health of occupants, especially children[21]. Furthermore, high-rise construction also often cause undue problems for older people and women, carrying shopping and small children, and make it more difficult for parents to supervise their children playing outside. There is also a perception that high-rise apartments are less safe from crime and housing height is associated with decreased levels of mental health.[22]

Action 01 - Healthy buildings and neighbourhoods will, in their planning and design of internal and external spaces, observe limits to occupant density to avoid overcrowding and offer occupants the means of balancing their needs for community and for privacy according to their preferences.

2.3.2. Access to Nature

Connection and engagement with nature in the day-to-day patterns of living can be an antidote to the sense of alienation experienced in urban 'concrete jungles' and dense neighbourhoods. The therapeutic and stress-releasing value of engagement with and experience of nature – seasonal cycles, flora and fauna – is well recognised. Integrating nature in the built environment of housing can thus have a positive impact on the health and well-being of occupants.

Action 02 - Healthy buildings and neighbourhoods will integrate positive open green spaces and will provide places, terraces, and balconies for growing and tending plants by residents.

[21] Evans, G. W., Lercher, P., & Kofler, W. W. (2002). Crowding and children's mental health: the role of house type. Journal of Environmental Psychology, 221-231.
[22] Howden-Chapman, P. (2004). Housing Standards: A Glossary of Housing and Health. Journal of Epidemiology & Community Health, 58(3), 162-168.

2.3.3. Aesthetics, Choice, and Flexibility

A top-down determinism by designers and developers in the design of habitable spaces in housing often constrains the choice and flexibility available to resident owners in being able to adapt their necessarily small homes according to their needs and priorities. Conversely, the provision of flexibility and choice in the utilisation of internal space and inviting personalisation of building elements would enhance the residents' sense of individual and collective agency.

Action 03 - Healthy buildings and neighbourhoods will provide useful flexibility in the design of structural systems and the planning of internal spaces of the residential units.

2.4. Resilience against Climate Change (and Pandemics)

It is now established that climate change related extreme events will be experienced in all parts of India. These take the form of heat waves, droughts, and intense rainfall with or without cyclonic storms. Heat waves in urban areas are exacerbated with Urban Heat Island effect in densely developed urban areas and the heat released by motor traffic and electromechanical equipment. Moreover, disruptions like flash floods ask for extra preventive and adaptation measures. The character and severity of impacts from climate extremes depend not only on the extremes themselves but also on exposure and vulnerability, which are heightened for low-income communities.

2.4.1. Protection from Disruptions and Resilience

These events affect poor households the most, especially the elderly, the sick and infants. This requires the provision of resilience centres to be instituted at the community level. The recent experience of the COVID-19 pandemic has shown the need for resilience centres that may also provide isolation and emergency care to the community.

Action 01 - Healthy Buildings and its neighbourhood call for additional measures to be adopted in their design and additional facilities at the neighbourhood level for the more vulnerable sections of the resident population as a measure of resilience during periods of extreme events and contagious epidemics.

2.4.2. Adaptation to Climate Change Impacts

In 2020, scientists at the Indian Institute of Tropical Meteorology forecast that climate change would make the South Asian monsoon more erratic than before. That was borne out within a

year: there were many rainless days during the 2021 June-September monsoon, punctuated by bouts of heavy rainfall in the plains and cloudbursts in the Himalayas. These are worsened by poorly planned flood-control measures such as dams and embankments. The recent drastic experience of high rainfall and flash floods in the monsoon in 2023 as the northern parts of the country experiences record monsoon rains, highlights the critical need for measures for adaptation to floods.

Action 02 - Healthy Buildings and its neighbourhood will ensure the protection of habitable spaces and essential services against flooding and contamination of drinking water during extreme rainfall events.

2.4.3. Disaster Preparedness

There is also a need for preparedness for unpredictable, erratic and disruptive impacts of climate change, with community resources that can come to use during extreme events. This is necessary to manage vulnerability and reduce the negative impact of disasters amplified by climate changes.

Action 03 - Healthy Buildings and its neighbourhood will provide a reserve store of drinking water to meet essential needs during periods of drought.

3. RECOMMENDATIONS FOR POLICIES, CODES, AND REGULATIONS

3.1. Coordinated Policy Objectives: A Systemic Approach

The **National Urban Habitat and Housing Policy** (NUHHP) formulated by the Ministry of Housing and Urban Affairs (MoHUA), and the **National Health Policy** (NHP) by the Ministry of Health and Family Welfare (MoHFW) are the Central Government policies that have a bearing on the provision of affordable housing in urban areas and the health and well-being of residents in the face of the effects of climate change. It is, therefore, necessary that the objectives of these policies are in alignment so that these two policies are mutually supportive and consistent.

Both policies were framed before the threats and impacts of climate change on cities were severely experienced and recognised with urgency. The same applies to the experience of the COVID-19 pandemic. The NUHHP needs to be revised in light of climate change to incorporate objectives for mitigation and resilience. The NHP also requires preventive measures in response to climate change related stress and health risks, and in light of learnings from COVID-19. The two policies, thus, need a coordinated extension to incorporate aspects of health and resilience to climate change for low-income urban residents. They need to then recommend provisions for building bye-laws and town planning guidelines to be incorporated in the NUHHP. The **Heat Action Plans** (HAPs) provide the basis for the measures to be included.

The **National Building Code (NBC)** of India, formulated by the Bureau of Indian Standards (BIS), provides the basis for the Development Control Regulations (DCR) and local building bye-laws that are implemented by State Governments and Urban Local Bodies (ULBs). Various sections of the Code are identified where extensions and amendments can be made to include minimum and mandatory standards for the health, well-being, and climate resilience of occupants in low-income housing. These will inform the review and revision of the Code which is due in 2024-25.

Once the recommendations are incorporated into the NBC, they could then be integrated into the **Development Control Regulations (DCR**) and local building bye-laws of the states. The Ministry of Housing and Urban Affairs (MoHUA) also formulates the **Model Building Bye-laws (MBBL**). Additionally, Town Planning, though a state subject, is based on the **Urban and**

Regional Development Plans Formulation and Implementation (URDPFI) Guidelines developed by the Institute of Town Planners, India (TPI) along with the Ministry of Housing and Urban Affairs (MoHUA). These too can be aligned with the amended Code with a focus on low-income housing in urban areas. It is to be emphasised that upgrading the NUHHP, NBC and MBBL in a coordinated manner is a necessary strategic step toward effecting appropriate changes consistently at the State level and for instituting mandatory provisions for execution by Urban Local Bodies (ULBs).

Additionally, the **Pradhan Mantri Awas Yojana - Urban** (PMAY-U) – a flagship programme of the Central Government – acts as the primary engine for promoting affordable housing in India. It is supported by the promotion of housing finance regulated by the National Housing Bank (NHB). The National Housing Bank, which received 'green' finance for affordable housing, is also developing procedures for the disbursement of funds tied to the assurance of green and environmentally sustainable performance for climate change mitigation in the built environment. This implies that green design and construction – including passive design strategies for climate comfort and reducing energy demand, design for health and well-being, resource efficiency, and resilience – would soon be a prerequisite for financing low-income affordable housing in urban areas.

It is thus opportune to align the provisions of PMAY-U concerning the definitions of the minimum requirement for eligibility with the progressive measures for health, well-being and climate resilience. Moreover, it is expected that the mission will be extended further. As PMAY awaits reformulation for the coming decade, this paper strongly recommends that the minimum standards for PMAY-U bring all forms of group housing under an upgraded NBC and MBBL would dedicate a special section to affordable housing. A shortcut to implementation would be the formulation of Model Building Bye-laws (MBBL) for PMAY-U that supersede DCR and other existing bye-laws which are at variance.

Finally, it is recognised that **Green Building Rating Systems** also have a bearing on the outcomes of residential developments for low-income groups in urban areas, as the certifications are recognised for financial support, subsidies, and incentives in the affordable housing sector. These certification systems provide third-party certification of the 'green' performance of buildings and projects by evaluating a wide range of parameters. Critical parameters are mandated to be satisfied, while other parameters may be responded to according to the nature of the project and its opportunities and limitations. The paper, therefore, recommends extensions and improvements in the parameters of the rating systems to include objectives of healthy buildings and climate change resilience. These extensions/amendments would be consistent with revisions to the NBC and MBBL.

3.1.1. Institutional Framework

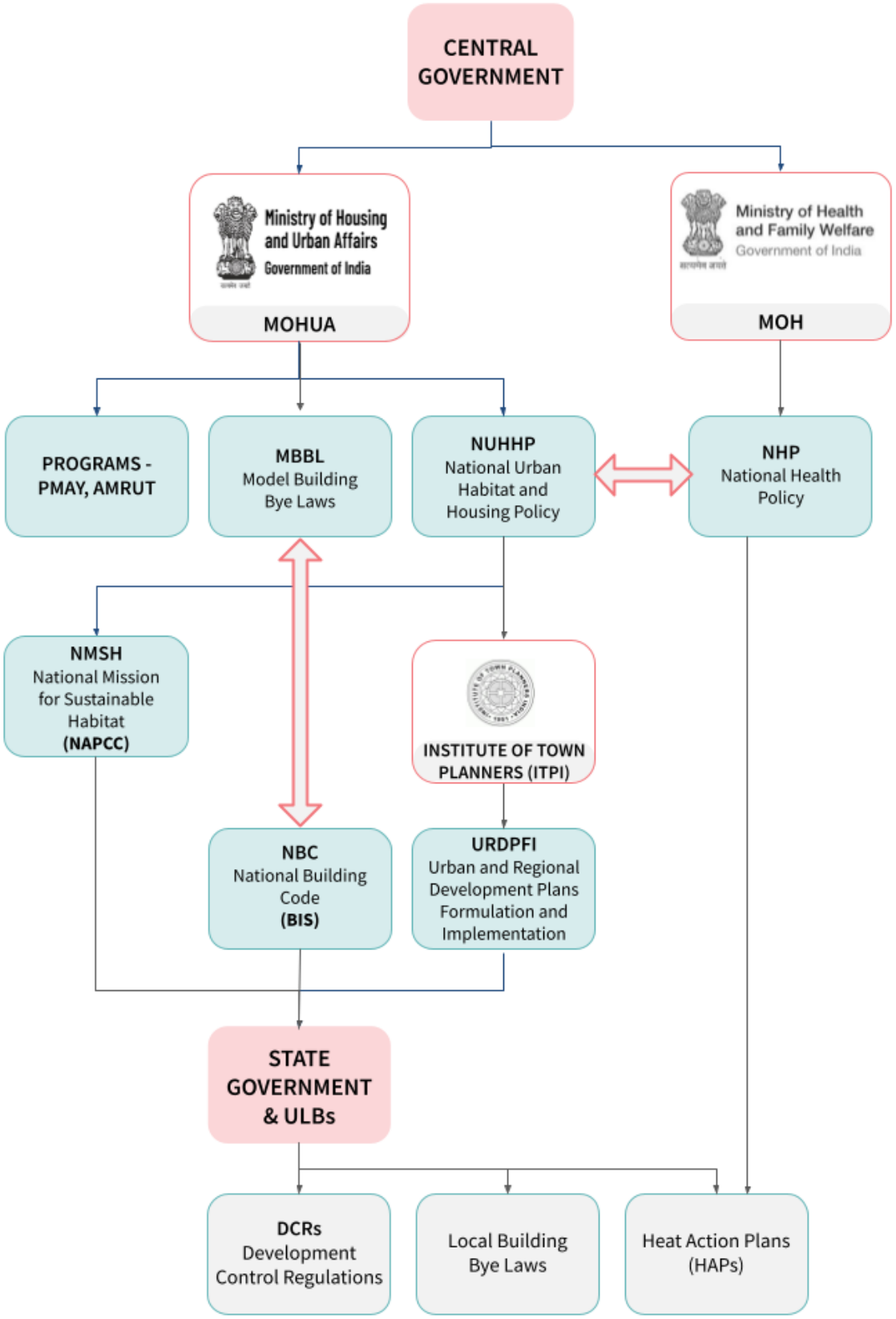

Figure 05: The proposed institutional and regulatory framework for harmonising policy objectives (Source: Author)

The paper proposes the coordination of the National Urban Habitat and Housing Policy (NUHHP) and the National Health Policy (NHP). Design and construction practices are guided primarily by the National Building Code (NBC), Model Building Bye-Laws (MBBL) and the Development Control Regulations (DCR). The NBC and the MBBL are provided by the Central Government and are adopted by Urban Local Bodies (ULBs) for their building bye-laws, while the DCR are developed by individual States, there can be a significant difference in their response to the NHUPP and URDPFI.

It is therefore necessary that these different policies and planning instruments are harmonised and are in alignment. This would provide the framework for programmes such as the PMAY and AMRUT and local building bye-laws to be suitably aligned. The NBC in its section 11 - Approach to Sustainability - covers significant environmental issues at the urban neighbourhood level, which can be taken as guidance for DCRs and local building bye-laws. Figure 05 shows the proposed institutional framework for coordinating policy objectives and implementation through the relevant governance and planning instruments - both horizontally and vertically.

3.1.2. Roadmap for Unified Design Guidelines

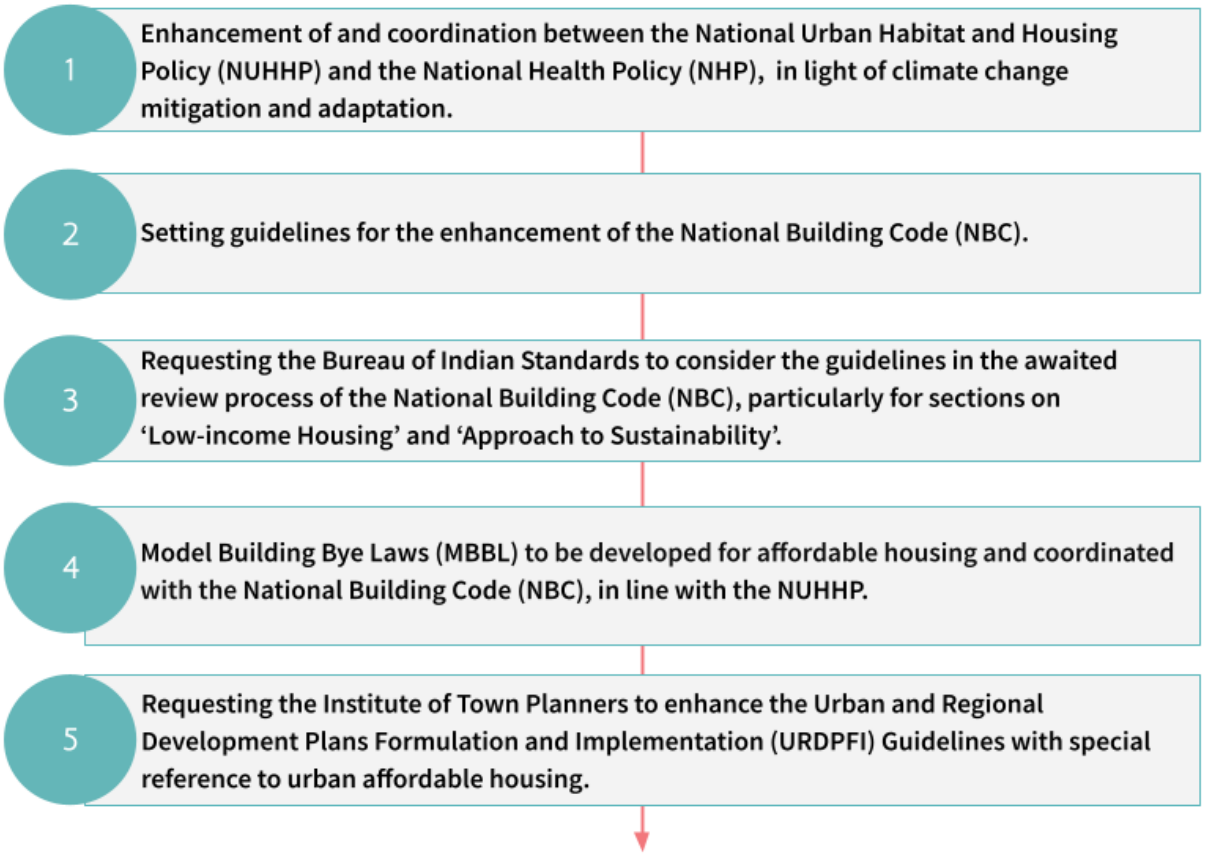

Figure 06: The proposed road map for next steps to be undertaken. (Source: Author)

Considering the acceleration in urbanisation in India and the increasing demand for affordable housing in urban areas on the one hand, and the inevitable impacts of climate change on the health and well-being of poor urban populations on the other hand, it is necessary to put in place enhanced and coordinated policies, programmes, standards, and regulations prospectively. The moment for action has arrived. Figure 06 translates the proposed institutional framework into a pragmatic, step-by-step roadmap for action.

3.2. Notes on Extension of Codes, Bye-laws and Rating Systems

3.2.1. National Building Code, 2016

The NBC is a wide-ranging comprehensive document that lays down a set of minimum provisions designed to achieve safe and sustainable building construction and development. The NBC has a section devoted to low-income housing - IS 8888:2020 - Requirements for Low Income Housing for Urban Areas in Part 3 - Development Control Rules and General Building Requirements. The code recognises the unique challenge posed by low-income housing to judiciously balance the requirements for health – both structural and occupant's basic needs of a shelter.

The NBC also has a section on sustainable practices, Part 11 - Approach to Sustainability, that provides guidance on passive design of building envelopes, adopting the Indian Adaptive Thermal Comfort model for comfort standards. This is the most recent and progressive chapter. It provides guidance on design for environmental protection, resource, and energy efficiency toward curtailing GHG emissions.

The National Building Code 2016 was put together before the severe impacts of climate change were recognised as urgent and pressing concerns, and before the commitments to reduce GHG emissions became a primary national objective. It is thus timely to include in its anticipated review and amendment - measures for passive design for climate comfort and reducing energy demand, and resilience against climate change threats and disruptions. It would also be valuable for NBC to extend its scope to address the health and well-being of occupants and include measures for reducing the social and psychological stress felt by vulnerable populations. These considerations would require evaluating the limits to building heights and densities in urban affordable housing.

Some key measures that may be incorporated are listed below. The Model Building Bye-laws and the green rating systems would also need to be brought in line with the NBC.

Physical Health and Resilience against Climate Change

1) Adherence to Eco Niwas Samhita (ENS) Energy Conservation Building Code (ECBC) (R) for thermal comfort – this could be made prescriptive, giving standard solutions for walling, windows, external shading and roofing for ease of implementation.
2) Provision for mechanically aided ventilation.
3) Mandating roof construction with reflective coating and high insulation.
4) Provision of sheltered resilience centres.
5) Protection of homes from mosquitoes and vermin.
6) Provision for roof-mounted Solar PV as a resilience measure for assuring minimum electricity supply for essential functions.
7) Provision of emergency water storage at the community level.
8) Minimum buffer between land for affordable housing and major transportation arteries to minimise air pollution.
9) Residential zones are to be protected from the loud noise of traffic or other sources of loud noise.
10) Design of on-site drainage for no stagnant water.

Social Health and Psychological Health

1) Recommendation for design to permit flexibility in the partitioning of internal spaces.
2) Limit building heights to stilts plus four storeys as a fundamental requirement.
3) Limit to densities of housing (DUs/hectare of land) to avoid overcrowding.
4) A minimum standard for accessible shared space, sheltered or open, adjacent to homes as compensation for small dwelling units with high occupancy.
5) Inclusion of women in post-occupancy management of community assets as changemakers for sustainable lifestyles.
6) Limit to hard paving and vehicular access, minimum standards for green and soft ground.
7) Review of on-site provision of vehicular parking to maximise green open spaces.
8) Review of fire tender access rules to optimise green open space.
9) Prohibit FAR incentives that contradict social and cultural appropriateness and environmental sustainability.

3.2.2. Model Building Bye Laws, 2016

The Model Building Bye-laws have been prepared by the MoHUA to be adopted and adapted for local building bye-laws of the ULBs. They lay down minimum standards for the adequacy of size, hygiene, and safety of buildings. The MBBL provide the blueprint for local building bye-laws. In this regard, they need to be brought to parity with the NBC.

When seen from the viewpoints of the health and well-being of occupants and resilience to Climate Change, the MBBL perhaps requires significant improvement and extension. Considering the urgent need to upgrade the quality of affordable housing, it would be opportune to prepare a set of building bye-laws dedicated to affordable housing as defined under the PMAY. Although building bye-laws are limited to the physical functioning of buildings, they need to be seen in conjunction with the DCR for affordable housing projects. It is proposed here that both of these be attached as mandatory requirements for eligibility of projects under PMAY(U). A fast-track solution would be for model building bye-laws for projects under PMAY(U) to supersede local building bye-laws where they improve the provisions of the existing local building bye-laws.

The key measures that need to be incorporated into the MBBL are listed below.

Physical Health and Resilience against Climate Change

1) Adherence to ENS ECBC (R) for thermal comfort – this could be made prescriptive, giving standard solutions for walling, windows, external shading and roofing for ease of implementation.
2) Provision for mechanically aided ventilation.
3) Mandating roof construction with reflective coating and high insulation.
4) Provision of sheltered resilience centres.
5) Protection of homes from mosquitoes and vermin.
6) Provision for roof-mounted Solar PB as a resilience measure.
7) Provision of emergency water storage at the community level.
8) Minimum buffer between land for affordable housing and major transportation arteries to minimise pollution.
9) Design of on-site drainage for no stagnant water.

Social Health and Psychological Health

1) Recommendation for design to permit flexibility in the partitioning of internal spaces.
2) Limit building heights to stilts plus four stories as a fundamental requirement.
3) Limit to densities of housing to avoid overcrowding.
4) A minimum standard for accessible shared space, sheltered or open, adjacent to homes as compensation for small dwelling units with high occupancy.
5) Inclusion of women in post-occupancy management of community assets as changemakers for sustainable lifestyles.
6) Limit to hard paving and vehicular access, minimum standards for green and soft ground.
7) Review of on-site provision of vehicular parking to maximise green open spaces.
8) Review of fire tender access rules to optimise green open space.

3.2.3. Development Control Regulations

The Development Control Regulations (DCR) are prepared by states and are applicable to all urban areas. The permissible intensity of development and density in terms of Floor Space Index (FSI) for housing, and land-use are determined by city Master Plans. The DCR prescribes the requirements for vehicular access, parking, set-backs and ground coverage. Neither the Master Plan nor the DCR have any special provisions for affordable housing. Nor do these legally binding documents make specific provisions for climate change mitigation, resilience against extreme weather events and heat waves.

In the context of rising temperatures and heat waves and other extreme weather events due to climate change, it would be valuable for DCRs to have to include resilience measures and to extend its scope to address health risks and wellbeing of occupants. Some key measures that may be incorporated are listed below.

Physical Health and Resilience against Climate Change

1) Minimum buffer between land for affordable housing and major transportation arteries to minimise pollution.
2) Protection from flooding during extreme weather events.

Social Health and Psychological Health

1) Limit to building heights to stilts plus four storeys as a fundamental requirement.
2) Limit to densities of housing (DUs/hectare of land) to avoid overcrowding.
3) Limit to hard paving and vehicular access, minimum standards for green and soft ground.
4) Review of on- site provision of vehicular parking to maximise green open spaces.
5) Review of fire tender access rules to optimise green open space.

3.2.4. Green Building Rating Systems

The rating systems that are currently applicable to or are being patronised by affordable housing developers in India are:

1) GRIHA (for Affordable Housing) – developed by Green Rating for Integrated Habitat Assessment (GRIHA) Council
2) IGBC Green Affordable Housing – Developed by the Indian Green Buildings Council (IGBC)
3) EDGE Homes – developed by International Finance Corporation (IFC) of the World Bank
4) GEM Sustainability Certification Rating Program – developed by the Associated Chambers of Commerce and Industries (ASSOCHAM)

Collectively, these rating systems go beyond the mandatory requirements of codes and bye-laws in that they consider the impact of the project site location, the protection and improvement of the site's natural assets, and evaluate the degree of environmental protection a project attains and evaluate occupants' well-being. However, they take the planning regulations and the building bye-laws, good or bad, as a given, remaining silent on their environmental impacts.

Certification by GRIHA and IGBC Green Affordable Housing has been accepted by the Ministry of Environment for fast-tracking procedures for environmental clearance that is mandatory for large developments. Some ULBs offer incentives to developers and homeowners based on the certification from these two rating systems. We propose that the MoHUA may convene a workshop bringing together representatives of the four rating systems discussed briefly below with the objective of aligning them with the proposed enhancements in policy objectives, NBC and MBBL.

(a) Green Rating for Integrated Habitat Assessment (GRIHA) (for Affordable Housing)

GRIHA rating system offers a GRIHA rating specifically designed for affordable housing. In the context of rising temperatures and heat waves and other extreme weather events due to climate change, it would be valuable for GRIHA for Affordable Housing to include resilience measures and to extend its scope to address health risks and well-being of occupants. Some key measures that may be incorporated are listed below.

Physical Health and Resilience against Climate Change

1) Prescription on cross ventilation and external shading of windows according to orientation.
2) Provision of habitable outdoors adjacent to dwelling units.
3) Provision of sheltered resilience centres.
4) Protection of homes from mosquitoes and vermin.
5) Provision for roof mounted Solar PV as a resilience measure in case of electricity supply failure.
6) Provision of emergency water storage at the community level.
7) Minimum buffer between land for affordable housing and major transportation arteries to minimise pollution.
8) Protection from flooding during extreme weather events.
9) Ensuring drainage for no stagnant water on site.

Social Health and Psychological Health

1) Provision social spaces adjacent to dwelling units as secure spaces for women and girls.

2) Provision for on-site, home-based income generation activities
3) Limits to building heights and densities in affordable housing developments for cultural appropriateness and to avoid overcrowding.
4) Inclusion of women in post-occupancy management of community assets as changemakers for sustainable lifestyles.
5) Design for adaptability and flexibility in the subdivision of internal spaces of dwelling units
6) Distributing green areas among housing blocks for connection with Nature and for safe places for children

(b) Indian Green Building Council (IGBC) Green Affordable Housing and IGBC Health & Well-being

IGBC's rating system also offers a rating specifically for affordable housing. In the context of rising temperatures, heat waves, and other extreme events due to climate change, it would be valuable for IGBC AFFORDABLE HOUSING to include resilience measures and extend its scope to address health risks and the well-being of occupants. Some key measures that may be incorporated are listed below.

Physical Health and Resilience against Climate Change

1) Minimum standards for passive design – insulation, ventilation, external shading.
2) On-site waste management and recycling.
3) Provision of habitable outdoors adjacent to dwelling units.
4) Provision of sheltered resilience centres.
5) Protection of homes from mosquitoes and vermin.
6) Provision for roof-mounted Solar PV as a resilience measure.
7) Provision of emergency water storage at the community level.
8) Minimum buffer between land for affordable housing and major transportation arteries to minimise pollution.
9) Protection from flooding during extreme weather events.
10) Minimum on-site solar PV as a resilience measure for maintaining essential services.
11) Ensuring drainage for no stagnant water on site.

Social Health and Psychological Health

1) Provision of social spaces adjacent to dwelling units as secure spaces for women and girls
2) Provision of on-site community facilities
3) Provision for on-site, home-based income generation activities
4) Limits to building heights and densities in affordable housing developments for cultural appropriateness and to avoid overcrowding.

5) Inclusion of women in post-occupancy management of community assets as changemakers for sustainable lifestyles.
6) Design for adaptability and flexibility in the subdivision of internal spaces of dwelling units
7) Distributing green areas among housing blocks for connection with Nature and for safe places for children

(c) Excellence in Design for Greater Efficiencies (EDGE)

The EDGE rating system limits itself to evaluating the environmental impacts of building construction – energy, water, materials. The social and psychological co-benefits of environmentally responsible design are implicit in its evaluation structure and are not dealt with separately. It is focussed on achieving resource efficiency and climate change mitigation. EDGE certification has EDGE Homes that addresses housing. It can provide a passport for investment in projects and companies like IFC and other investors.

In the context of rising temperatures and heat waves and other extreme events due to climate change, it would be valuable for EDGE to include resilience measures and to extend its scope to address health risks and well-being of occupants. Some key measures that may be incorporated into EDGE are listed below.

Physical Health and Resilience against Climate Change

1) Minimum standards for passive design – insulation, ventilation, external shading
2) On-site waste management and recycling
3) Provision of habitable outdoors adjacent to dwelling units
4) Provision of sheltered resilience centres
5) Protection of homes from mosquitoes and vermin
6) Provision for roof-mounted Solar PV as a resilience measure.
7) Provision of emergency water storage at the community level
8) Minimum buffer between land for affordable housing and major transportation arteries to minimise pollution.
9) Protection from flooding during extreme weather events
10) Minimum on-site solar PV as a resilience measure for maintaining essential services.

Social Health and Psychological Health

1) Provision of social spaces adjacent to dwelling units as secure spaces for women and girls
2) Provision of on-site community facilities

3) Provision for on-site, home-based income generation activities
4) Limits to building heights and densities in affordable housing developments for cultural appropriateness and to avoid overcrowding.
5) Inclusion of women in post-occupancy management of community assets as changemakers for sustainable lifestyles.
6) Design for adaptability and flexibility in the subdivision of internal spaces of dwelling units
7) Distributing green areas among housing blocks for safe places for children

(d) GEM Sustainability Certification Rating Program - For New Buildings, Homes and Factory Buildings

GEM has adopted a structure similar to GRIHA and IGBC. Its differentiator is that it is more suited to commercial developments. Corporate Social Responsibility is cited as a lever for investments for minimising environmental impact of real estate development. As would be expected it has strong emphasis on post occupancy management and maintenance of building services.

GEM does not have a special system designed for affordable housing. A special rating system for affordable housing would be desirable if the rating system values patronage for this rapidly growing sector. Since a rating system for affordable housing is yet to be developed under GEM, the recommendations for what may be addressed by the rating system from the point of view of climate resilience and health and well-being would be on the lines for the three rating systems discussed above.

4. CONCLUSIONS AND NEXT STEPS

The time is now opportune to upgrade policies and programmes for affordable housing in our cities to address the issues of climate change related risks to low-income urban housing and stresses on the health and well-being of residents, which is compounded by high-density urban development. This paper has developed a holistic framework that defines Healthy Building in this context. The recommendations proposed in this paper are also economically affordable and administratively feasible within our present resources.

The task falls under the purview of the Ministry of Housing and Urban Affairs (MoHUA) principally and also the Ministry of Health and Family Welfare (MoHFW) of the Government of India. At the primary level, the NUHHP and the NHP need enhancement. It will be important to align the elements of policies, programmes, codes, and bylaws under the umbrella of MoHUA to be consistent and coordinated. This is als the right time to recast the PMAY-U so that it provides the impetus to promote and protect the health and well-being of poor citizens in their homes and neighbourhoods.

The white paper lays the groundwork to translate the guidelines into evidence-informed, quantifiable, technical clauses for the Bureau of Indian Standards (BIS) for the awaited review process of the National Building Code (NBC). The recommendations drafted in the white paper provide a framework for a detailed analysis of the aspects of the National Building Code that need amendment, extension, or introduction of additional pressing concerns that are currently untouched in the code. Once the recommendations are incorporated into the NBC, they can then be integrated into the Development Control Regulations (DCR) and Building Bye-laws of the states. The recommendations could also be included by extending the scope of Green Building rating systems that are recognised for financial support, subsidies, and incentives in the affordable housing sector.

It is hoped that this White Paper will provide guidance for the Ministry of Housing and Urban Affairs (MoHUA), the Ministry of Health and Family Welfare (MoHFW), and the Review Committees of the Bureau of Indian Standards (BIS) for the National Building Code (NBC) – to harmonise their actions for healthy affordable housing for urban populations. It is a crucial window of opportunity for these various instruments of town planning to include minimum and mandatory standards for the health, well-being, and climate resilience of residents of low-income housing.

5. REFERENCES

Al-Tamimi, N. (2022). Passive Design Strategies for Energy Efficient Buildings in the Arabian Desert. Frontiers in Built Environment, 7, 805603.

Braconi, F. (2001). Housing and Schooling: The Urban Prospect. Citizen's Housing and Planning Council. New York.

Evans, G. W., Lercher, P., & Kofler, W. W. (2002). Crowding and Children's Mental Health: The Role of House Type. Journal of Environmental Psychology, 221-231.

Firdaus, G. (2017). Built Environment and Health Outcomes: Identification of Contextual Risk Factors for Mental Well-being of Older Adults. Ageing International 42, 62-77.

Geravandi, S., Takdastan, A., Zallaghi, E., Niri, M. V., Mohammadi, M. J., Saki, H., & Naiemabadi, A. (2015). Noise Pollution and Health Effects. Jundishapur Journal of Health Sciences, 7(1).

Gondal, I. A., Syed Athar, M., and Khurram, M. (2019). Role of Passive Design and Alternative Energy in Building Energy Optimization. Indoor Built Environment.

Gove, W.R., Hughes, M., Galle, O.R. (1983) Overcrowding in the Household: An Analysis of Determinants and Effects. Academic Press. New York and London.

Howden-Chapman, P. (2004). Housing Standards: A Glossary of Housing and Health. Journal of Epidemiology & Community Health, 58(3), 162-168.

IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Krishnan, R., Sanjay, J., Gnanaseelan, C., Mujumdar, M., Kulkarni, A., & Chakraborty, S. (2020). Assessment of Climate Change over the Indian Region: A Report of the Ministry of Earth Sciences (MOES), Government of India. Springer Nature.

Kumar, S., Singh, M., Chandiwala, S., Sneha, S., & George, G. (2018). Mainstreaming Thermal Comfort for All and Resource Efficiency in Affordable Housing: Status Review of PMAY-U Mission to Understand Barriers and Drivers. New Delhi: Alliance for an Energy Efficient Economy.

Ministry of Housing and Urban Poverty Alleviation. (2017). Report of Working Group on Migration. Government of India.

Mohanty, Abinash. (2020.) Preparing India for Extreme Climate Events: Mapping Hotspots and Response Mechanisms. New Delhi: Council on Energy, Environment and Water.

Roy, D., & Meera, M. L. (2020). Housing for India's low-income urban households: A demand perspective (No. 402). Working Paper. Indian Council for Research on International Economic Relations (ICRIER), New Delhi.

Shukla, Y., Rawal, R., & Shnapp, S. (2014). Residential Buildings in India: Energy Use Projections and Savings Potentials. Growth, 800, 1000.

United Nations, Department of Economic and Social Affairs, Population Division (2019). World Urbanization Prospects: The 2018 Revision (ST/ESA/SER. A/420).

WHO (2018). WHO Housing and Health Guidelines. World Health Organization, Geneva.

Worldbank. (2011). Urbanisation in India. www.worldbank.org/en/news/feature/2011/09/22/india-urbanization.