



Resilience of Cities, Infrastructure and Settlements Outlook

*Resilience for All: Enabling
transformative implementation*

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Resilience of Cities, Infrastructure and Settlements

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Summary

Adverse impacts of climate change are posing growing threats to the socioeconomic development of Asia and the Pacific region. Cities, as hubs of economic activity, face heightened risk of extreme weather events exacerbated by social vulnerability. Infrastructure development is taking place at a rapid pace in the region, often ignoring climate risk considerations and falling short in addressing broader environmental sustainability challenges. The coupling of climate change and rapid development amplifies risks to infrastructure, settlements and cities. These impacts are likely to exacerbate existing inequalities (e.g., urban health inequities) and social vulnerabilities of those living on the margins. Planning and governance structures must thus meet the increasing demand for adequate, safe housing, clean water, sanitation, healthy food and protection from natural hazards and climate change.

Across the region, we are observing the development of formal adaptation and sectoral plans. Still, government agencies often lack the investment frameworks to translate their plans into actions through sustained finance. Increased investments in physical infrastructure are being made in the region with some consideration of climate change. The use and integration of big data and open-source data for making decisions related to adaptation planning is also being observed. There is a greater understanding of the significance and role of Nature-based Solutions (NbS) for resilience building. Gender mainstreaming is occurring across formal adaptation interventions, while there is greater integration of Indigenous and Local Knowledge into infrastructure and urban resilience building activities.

Several barriers related to transformative adaptation were identified. In response, key opportunities to support transformative adaptation in the context of cities, infrastructure and settlements are proposed. These include: 1) scaling up adaptation efforts at the sub-national and local levels, with attention to broader sustainability challenges at the city and sectoral levels; 2) expanding and embedding Nature-based Solutions in cities and alongside grey infrastructure; 3) increasing efforts to scale-up targeted adaptation measures that are pro-poor and gender-responsive to build resilience in urban informal settlements; and 4) leveraging the growing climate finance landscape following new commitments by financial institutions.

I. Introduction

Adverse impacts of climate change are posing growing threats to the socioeconomic development of Asia and the Pacific region. The findings from the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) provide strong evidence of the severe, widespread, and increasingly irreversible impacts of climate change on humans and ecosystems (IPCC, 2022a). These impacts are being felt in different parts of Asia and the Pacific region, affecting food production, water security, human health and well-being, infrastructure, and settlement. For example, in 2022, extreme climate events included devastating floods in Pakistan, severe drought in the People's Republic of China, and heat stress in different parts of South Asia. The impacts of slow-onset trends are also being felt across the region. For example, coastal regions of Viet Nam are already facing saltwater intrusion, contaminating drinking and irrigation water and amplifying the effects of drought, as witnessed during the 2015–2016 drought. (World Bank, 2019). Additionally, the world is in a polycrisis, with rapid biodiversity loss, water, air and land pollution coupled with increased conflicts, raising issues of power, security, equality and justice (Lawrence, Janzwood, & Homer-Dixon, 2022). For example, declining biodiversity and ecosystem services exacerbate climate vulnerabilities for urban populations, infrastructures and settlements, whilst rapid rates of urbanisation lead to more settlements and urban migration, decreasing green spaces and ecosystem services. These compounding and cascading impacts also undermine progress and efforts to meet the Sustainable Development Goals (SDGs).

Cities act as focal points of economic activities and are often climate risk hotspots. Much of the rapid population and economic growth is occurring in urban areas in Asia and the Pacific region. Urbanisation increases demand for foods requiring more energy-intensive production, increases dependence on imports and may increase the vulnerability of cities to weather-induced food shortages. The pace and patterns of rapid and often unplanned urban development, poor environmental management, and overexploitation of natural resources have contributed to increasing exposure and vulnerabilities of people and assets to climate-related hazards (Aylett, 2015; Jones & Lea, 2013). Rural-to-urban migration has given rise to a range of urbanisation issues – increasing demand for adequate and safe housing and infrastructure, clean water and sanitation, access to healthy food, and protection from natural hazards (Tyler & Moench, 2012). For example, in Pacific Islands, 60 percent of people live in urban centers and experience very high urbanisation rates (4.3%) compared with the global average (1.3%) (Cocklin & Keen, 2000). This trend will likely persist, given increasing rural-to-urban migration and high levels of fertility across the Pacific Islands (Connell, 2011; WHO, 2015). In comparison, an increased aging population across Asia is already creating enormous pressures on infrastructure, housing, jobs, energy, transport, health and education. Additionally, slums or informal settlements continue to grow rapidly across Asia, home to more than 500 million slum-dwellers (Barten et al., 2011; Gale, 2015). Most living in informal settlements are engaged in the informal labour sector and subsequently vulnerable to both climatic and non-climatic stresses. Many cities across the Asia-Pacific region continue to focus on current urban challenges whilst failing to consider emerging and growing trends in an integrated manner such as examining the interactions between climate change and trends in population aging, growing inequality, and land-use change (ibid). The coupling of climate

change and rapid unplanned urbanisation amplifies risks to infrastructure, settlements and cities. These impacts are likely to exacerbate existing inequalities (e.g., urban health inequities) and social vulnerabilities for those living on the margins. Urban planning and governance structures must factor in climate considerations to meet the increasing demand for adequate, safe housing, clean water, sanitation, healthy food, and protection from natural hazards.

Climate impacts are affecting the performance of infrastructure systems. Extreme weather events are increasingly disrupting the services provided by critical infrastructure (energy, water, and transport) to households, firms, and businesses. For example, a report by the World Bank highlights that if we continue to build infrastructure that is not climate resilient, the additional cost will be \$1 billion over the next decade (Gourdon & Steidl, 2019). Similarly, for the wider blue economy, with over 90% of the world's trade being seaborne, climate risk is increasingly identified as a key risk to the operations of ports and maritime supply chains. With the projected increase in extreme weather events due to climate change, such impacts will further increase, causing huge strain on public budgets and reducing the attractiveness for private sector actors to invest in such sectors. Reliable infrastructure such as water and sanitation, energy, transport, and hospitals are essential for raising people's quality of life. It is thus crucial that countries invest in climate and disaster-resilient infrastructure (World Bank, 2019).

Urban settlements are highly exposed and vulnerable to climate hazards. Increased extreme climatic events such as flooding can generate communicable disease outbreaks and often impact marginalised communities such as squatter settlements, which are often sited in physically vulnerable areas. For example, much of Jakarta lies below sea level and is vulnerable to tidal flooding, storm surges, and sea level rise due to climate change. In North Jakarta, both poverty and flooding rates are highest in the city, exacerbating the risk for those living in slums. Extreme climate events can have secondary impacts such as supply chain disruptions, food shortages and loss of livelihoods (e.g., in small businesses and the informal sector). Urban congestion and unplanned roads can complicate evacuation and relief efforts in acute disasters, placing an additional burden on infrastructure, including the soft infrastructure such as the human resource capacities and policies/strategies that underpin emergency management systems.

Increasing climate risk calls for transforming ways in which development is pursued. Climate risk is likely to intensify and occur both sooner and at a larger scale than previously assessed. The recent IPCC report highlights the requirement for transforming the way in which cities, infrastructure, and human settlement are planned, developed and governed to improve human health and well-being, enhance sustainable development, build resilience to various climate and non-climatic stresses and protect the environment (IPCC, 2022). For example, the report stresses that urban adaptation provides a significant opportunity for supporting climate resilient development that is transformative. Integrated development planning that connects innovation and investments in social, ecological and grey/physical infrastructures can significantly increase the adaptive capacity of urban settlements and cities (ibid).

Transformative climate adaptation should aim to catalyse systemic change. This includes nonlinear reorganizations of infrastructure, ecosystems, lifestyles, institutions, and governance (Rachunok & Nateghi, 2021). Certainly, this conceptualisation draws attention to the need to consider issues of power, norms, scale, and diverse systems in our examination of adaptation as it pertains to cities, infrastructure and settlements. Significant differences in vulnerability, resilience and adaptive capacity exist in the region due to its diverse geophysical contexts and underlying socioeconomic conditions. What may be considered transformative in a specific place and time may be maladaptive in another context. However, the extent to which these adaptation interventions spur transformative change on the ground is yet to be explicitly unpacked and assessed at the national level amongst developing countries. There is also a need to recognize the limits of certain adaptation interventions and consider a pathways approach that focuses on smaller scale transitions to continuously learn and examine feedback to avoid dangerous lock-ins (Haasnoot et al., 2013).

In the sections that follow, this paper provides a brief overview of the current and emerging trends related to transformative adaptation of cities, infrastructure and settlements across the region by drawing on some case examples of adaptation initiatives that have been recently implemented. It is then followed by a brief discussion of key barriers related to the enablers of transformative adaptation and resilience building that includes: *policy and governance, planning and programming, science and assessment, technologies and practices and finance and investments*. The final section presents a set of opportunities that can be exploited to enable transformative adaptation moving forward.

II. Current Status and Emerging Trends Related to the Resilience of Cities, Infrastructure and Settlements in the Region Against Climate Change

This section discusses with examples some of the key trends emerging in the region that have the potential to contribute towards transformative adaptation of cities, infrastructure, and settlements.

Climate adaptation plans being formulated prioritise infrastructure-related adaptation actions but typically lack the investment frameworks to translate actions into bankable initiatives. Across the region, National Adaptation Plans (NAP) and Nationally Determined Contributions (NDCs) of various countries and their commitments under the Paris Agreement are being developed or updated. The recent iterations of these plans provide a comprehensive picture of adaptation-related needs and priorities. Subsequently, various sectors (e.g., water, transport, health) related to cities, settlements and infrastructure have been identified as critical for building resilience with a list of adaptation activities identified using processes that often engage across sectors and tiers of governance. For example, the National Adaptation Plan of Fiji has identified "infrastructure" and "human settlements" as two of the five sectoral priorities for adaptation. Infrastructure-related adaptation priorities identified in the Fiji NAP include actions in the context of water and sanitation, energy, and transport sectors and recognize the importance of infrastructure for communications during disasters, facilitating relocation of communities from sea-level rise and for food security. Similarly, the National Adaptation Plan of Timor Leste has identified infrastructure-related adaptation priorities, which include the identification of infrastructure vulnerabilities, improvement of regulatory framework, and implementation of climate resilient infrastructure. While identification of such priorities is critical, these plans often lack the investment frameworks to translate these adaptation priorities into actions through sustained finance. In the absence of such aspects, it becomes challenging for government agencies to mobilise and attract the finance needed (public, private and blended) to implement adaptation priorities or to turn adaptation activities into bankable projects.

Increased investments in physical infrastructure in the region with some consideration of climate adaptation. Post-COVID-19 recovery efforts have spurred countries to rethink development and ensure such activities support green investments and consider climate change and the SDGs. Many countries in their COVID-19 recovery plans have prioritised green and resilient approaches. For example, Nepal has adopted the Green, Resilient and Inclusive Development approach to systematically address the impacts of COVID-19 and Nepal's structural challenges, including high vulnerability to climate change and large infrastructure gaps. Through the implementation of such frameworks, increased investments in physical infrastructure in the region can be observed with some consideration of climate change. However, an increased requirement for green infrastructure remains, particularly those that include Nature-based Solution (NbS) within urban (or grey) spaces. Certainly, there is a need to pursue decision-making for such infrastructure based on a robust understanding of long-term climate risk if we are to avoid dangerous lock-in of risks in decades to come. Paradoxically, in the rush to build back better, the health impacts of new infrastructure investments to both communities and natural systems are often overlooked. The Philippines is one of the only countries in the region that has recently mandated Health Impact

Assessments (HIA) to be undertaken as part of new infrastructure developments (DoH & DIL, 2021).

Trend toward the use and integration of climate data and information for decision-making.

Notably, the increased use and integration of climate data and information (including efforts involving local communities and women's groups) for making decisions related to adaptation planning is observed across the region. Subsequently, climate risk information (e.g., hazard maps, exposure and vulnerability assessments and downscaled climate projections) is more accessible at the decision-making level within government agencies (e.g., provincial government). This may be due to previous efforts regionally (e.g., Regional Climate Consortium for Asia and the Pacific Data Portal¹) and at the country level to invest in capacity building and data sharing platforms (e.g., the Pacific Climate Change Data Portal²). Global efforts to build north-south climate data and assessment capabilities have also helped advance this space. Investments have been made in many countries within the region to develop downscaled climate models and risk maps that can inform national adaptation planning efforts. Such initiatives have often been supported through regional or transboundary partnerships that bring diverse stakeholders together (e.g., academic institutions, government agencies and CSOs). For example, the Australian government's chief scientific body, the CSIRO, has a partnership with national meteorological services across the Pacific Islands. Here, the focus is on the co-production of guidelines and hazard-based climate change impact assessments with sector-based stakeholders in order to update local climate projections (CSIRO, n.d.). Such efforts have been spearheaded by regional organisations such as the Secretariat of the Pacific Regional Environment Programme (SPREP) as part of the Next Generation Climate Projections for the Western Tropical Pacific. A prime example from Asia is the Mekong River Commission which provides toolkits, forecasting and data to support decision making related to water resource management and climate change in the Lower Mekong River Basin where many climate vulnerable coastal cities are located. However, further work is needed to strengthen the capacity of developing countries, particularly targeting local or municipal governments to make the maximum use of such data and information for decision-making in the context of land use planning, infrastructure, and settlement planning.

Increased recognition of the role of Indigenous and Local Knowledge (ILK) Systems and bottom-up approaches for climate risk assessments. Concurrently, there has been an increased recognition of the role of Indigenous and Local Knowledge (ILK) Systems and bottom-up approaches for climate risk assessments to inform urban and settlement planning which is encouraging and timely. For example, one of the first Green Climate Fund adaptation projects administered by the United Nations Development Programme (UNDP) was the revival of the ancient water tanks of Sri Lanka built by the Kings during pre-colonial times to save and re-use water, allowing the cultivation of rice in the dry zone adapt to a changing climate. This highlights that such infrastructure-based adaptation projects do not necessarily need to promote new technologies and innovations. Similarly, in atolls nations such as Micronesia, communities are using their agency and applying local knowledge to rehabilitate traditional

¹ <https://www.rccap.org/>

² <https://www.pacificclimatechangescience.org/climate-tools/pacific-climate-change-data-portal/>

water wells by cleaning them, planting vegetation buffer strips around wells and streams to stabilise degraded banks and reduce sedimentation and installing concrete covers over the wells to reduce trash and other pollutants from entering the wells (McLeod et al., 2019). Lessons from the implementation of such approaches need to be further shared and disseminated to promote scaling up and out. Jodhpur city, in the Indian state of Rajasthan, is characterised by a hot, arid climate due to its very high potential for evaporation of water and depletion of groundwater. It faces the compounding climate-related risks of cyclic droughts, extreme heat and building water stress. The city is exploring the use of traditional vernacular architectural practices and traditional water management systems to modify extreme temperatures, protect citizens from heatwaves and cope with water scarcity (ICCRUM, 2022). Further collaboration with Mahila Housing Trust will overcome inequalities and empower local women to participate in the design, planning and implementation of climate actions.

Greater understanding of the significance and role of NbS for resilience building. Intertwined with ILK is the increased understanding amongst government agencies and other actors of the significance of NbS and its role in supporting climate resilience building outcomes in both human and natural systems (Fernandes et al., 2022). In Hue City, Vietnam, for example, NbS has been adopted as an approach to enhance flood resilience by cleaning and restoring urban water bodies such as ponds and rivers that had become clogged up from pollution. Through the support from IUCN, water bodies were dredged to enhance their functions for recreational and flood regulation purposes. Regeneration of the ponds for flood retention had to be integrated into a wider consideration of blue-green-grey infrastructure. Mangroves were planted to reduce coastal flood risk. As there were no locally sourced mangroves, nurseries were established as part of the project through a women's union selling mangroves so as to provide an economic benefit (IUCN & FEBA, 2021). In Chennai, India, the local government, with support from the Asian Development Bank (ADB), is implementing NbS solutions as part of drainage infrastructure to reduce flood risk. Clearly, there are opportunities to expand such initiatives related to NbS at scale.

Increased engagement with the private sector in urban and infrastructure resilience. Increased engagement of the private sector in pursuing climate resilient planning and infrastructure can be seen. For example, the master plan for greenfield development of New Clark City in the Philippines has identified opportunities for private sector engagement in promoted NbS solutions. Increasingly, contracts of public-private partnerships require the need to consider climate risk in the planning, implementation and operations of critical infrastructure assets. Private sector is also recognizing the business opportunities associated with resilient products and services. For example, providing the technologies for early warning systems related to dengue and malaria, developing financial products and soft loans to help smaller businesses innovate and adapt or actively developing new partnership models with the private sector to support investments in infrastructure (ADB, 2022; Schaer & Kuruppu, 2018). However, the extent of these in supporting transformative adaptation is yet to be scrutinised and examined comprehensively.

Gender mainstreaming is happening across many formal interventions. The impacts of climate change affect women and girls differently due to gender roles, systemic inequalities, and socioeconomic status. Across a majority of urban and infrastructure resilience adaptation

initiatives, gender mainstreaming is being implemented. However, there is a limited focus on intersectionality aspects (e.g., race, caste, religion). Additionally, inclusive approaches that address deeper structural barriers and power inequalities are lacking, particularly for informal and marginalised communities who are most vulnerable to climate change.

As heat increases, it will likewise double the disproportionate heat-related pressures on labor productivity and health that women in India are already experiencing. A collaborative partnership between Arsht-Rock, the Self-Employed Women's Association (SEWA), and private sector microinsurance firm Blue Marble Micro launched the Extreme Heat Income Insurance for women. The parametric insurance was designed to cover the worst heat-related losses for women working in India's informal sector (e.g., in industries ranging from waste recyclers to market vendors). The pilot is paid out when temperature thresholds are met; these payments allow members the flexibility they need to either work more safely or stay home when the heat becomes threatening (Arsht-Rockefeller Foundation Resilience Center, 2023).

III. Barriers Associated with the Five Enablers of Resilient Cities, Infrastructure and Settlements

This section provides a brief snapshot of the key barriers as they relate to the five resilience building enablers. In addressing these barriers, it is vital to understand the underlying drivers and the broader processes/structures mediating them in certain systems and contexts.

Policy & Governance

Building codes and infrastructure standards remain outdated and fail to account for climate change. Policies and regulations associated with development control such as building codes, zoning regulations, and infrastructure standards, are aimed at regulating the location, density, layout, and design of permitted development. They typically specify the minimum requirements to adequately safeguard the health, safety, and welfare of infrastructure users and building occupants. Thus, if developed and enforced with due consideration of natural hazard information, policies related to development control can be a very effective tool for limiting exposure and vulnerability to climate hazards. Conversely, if ignored, they can potentially contribute to increasing climate risk by increasing the exposure and vulnerability of assets to natural hazards (ADB, 2016). While the use of development control regulations is common in the region, in most cases, these policies remain outdated in terms of factoring information on changing hazard patterns due to climate change (Guimont, 2022). Moreover, there remains a large gap in creating a culture of compliance with such regulations, especially at the local level. Significant effort is needed to ensure these regulations are updated regularly to reflect the dynamic nature of changing climate risks and enhance local enforcement capacity. Designing incentives to encourage the private sector and households to adopt such regulations for building climate-resilient settlements is equally important. Efforts to strengthen partnerships between national and local governments and private planners, engineers, architects, and construction workers involved in the infrastructure and construction sector have become critical.

Limited efforts to strengthen policies to support climate resilience building of local and provincial governments. Climate policies and plans are increasingly decentralising roles and responsibilities related to climate risk management at sub-national and local levels. Considering that climate risk is largely shaped at the local level due to factors contributing to exposure and vulnerabilities, it becomes critical that sub-national and local governments are involved in prioritising resilience measures in the context of infrastructure and settlement planning. However, there remains a large mismatch between assigned responsibilities at the local level and the availability of tools, resources, and capacity among sub-national and local governments for operationalising such responsibilities. For example, in countries pursuing decentralisation, much of the responsibilities related to the delivery of basic services is the mandate of local governments. However, increasing climate risk directly impacts the performance of infrastructure and basic services. This requires local governments to have the capacity to understand current and future climate risks and use such information to design, implement and operate infrastructure for basic services (Mukheibir et al., 2013). While technical capacity at the local level is critical for performing such functions, so is the need for national governments to provide appropriate policies, incentives, and financial support to local

governments for performing such responsibilities. It is also important that the capacity to strengthen sub-national and local capacity for resilience building promotes a systems approach to looking at climate risk and resilience solutions beyond administrative boundaries.

Limited policies to support resilience building of informal workers, migrants and refugees who are largely residing in informal settlements. With the rapid growth of urban areas, it is not surprising that efforts to strengthen urban resilience have received growing attention in the last decade. However, the focus of such attention has largely been in the context of infrastructure investments that help reduce/avoid climate related economic losses. While critical, such a focus on avoiding economic losses tends to prioritise policies and investments to protect infrastructure in areas of higher economic importance and leave out high hazard prone areas which are often resided by the poor and informal settlements. Moreover, a focus on economic losses may tend to leave out the need to prioritise interventions critical for strengthening the well-being of the urban population, especially the poor, informal workers, migrants, and refugees who are the most vulnerable to climate impacts. Such interventions would include improved enforcement of pro-poor and risk informed land use management practices, strengthening shock-responsiveness of social protection systems to cater to the needs of the urban poor households, strengthening urban public health infrastructure linked to early warning systems, and introduction of inclusive financial products and services targeted at building resilience of the poor and vulnerable.

Science & Assessment

Limited integration of interventions that are co-produced by engaging diverse stakeholders (e.g., residents in informal settlements working with local government). Building resilience at a systems level requires a suite of adaptation solutions that can meet the needs of all and enable transformative change. Recognizing that climate risk and perception of risk are very context-specific, it becomes critical that a diverse set of stakeholders are involved in assessing risk and collectively co-producing adaptation solutions. This includes stakeholders from national and local governments, engineering and environmental associations, urban planners, community groups, especially women's groups, academia, and the private sector. Such a whole of society approach to assessing risk and identifying adaptation solutions will ensure equitable and sustainable impacts. Current scientific assessment processes for climate planning, including gathering data and information, are often contained to formal organisations such as Meteorological Offices, Water Planning Departments or National Scientific Bodies whose mandate precludes meaningful engagement with non-scientific organisations or communities. Lessons can be learned from other sectors such as biodiversity management and Integrated Water Resource Management Planning ((Binney et al., 2010; Scott et al., 2012; Tengo, Brondizio, Elmqvist, Malmer, & Spierenburg, 2014). Despite national adaptation planning efforts encouraging transdisciplinary approaches by engaging across diverse stakeholders and knowledge systems, these processes often fail to translate to the city or provincial planning levels (Burch, 2010). There seems to be a lack of political will and capacity gaps at these scales of governance to engage in such participatory processes for data gathering and co-creation (Block & Paredis, 2013; Hage, Leroy, & Willems, 2006).

Limited focus on long-term planning due to integration of scenarios that have a level of uncertainty. Decisions related to infrastructure and settlements typically involve long-term planning and have the advantage of steering long-term growth in certain directions. With

increasing climate risks, it becomes critical that every decision related to infrastructure, urban development, and settlement planning factor in medium and long-term considerations of climate risk. Often, translating scenarios from the regional to local scales requires a level of adaptive management in policymaking and implementing adaptation actions to mitigate uncertainties (Walker, Haasnoot, & Kwakkel, 2013). However, city level planning processes remain rigid and often lack the presence of flexible processes for continuous reflection, learning and adjustment needed to reduce uncertainty in climate scenarios. The knowledge and capacity for such planning efforts are particularly limited in developing countries as education and training offered through urban planning courses remain outdated with limited consideration of climate adaptation (Leal Filho et al., 2023; Newsome, Newsome, & Miller, 2023). This is critical especially to ensure decisions to build infrastructure and settlements in certain areas do not inadvertently lock in risks and contribute to maladaptation. Further, the uncertainties may be related to future scenarios and climate projections and their impact, socioeconomic changes with time, and the availability of adaptation solutions. Thus, it is important that risk-informed long-term planning for infrastructure and settlement factor in uncertainties through adaptive management practices that involve keeping options open to avoid creating path dependencies and lock-in.

Technologies & Practices

Adaptive management as a practice is not fully institutionalised in infrastructure programming. Adaptation, as a dynamic process, needs to evolve with changing climate risks and socioeconomic development. This requires adopting adaptive management practices that provide opportunities for implementing adaptation measures while learning which measures are most effective at achieving specific objectives and suitably adjusting the measures to respond to changing needs. Although some sectors such as water infrastructure have adopted these practices, the broader integration of adaptive management in designing investments for infrastructure and urban resilience remains limited. (Fane, Blackburn, & Chong, 2009; Sustainable Futures, 2011). Institutional weaknesses and a lack of resources or investments that encourage these approaches curtail the adoption and mainstreaming of adaptive management into infrastructure programming for cities and settlements. Moreover, the absence of strong linkages among planning, assessment and decision-making, and evaluation functions can obstruct the adoption of adaptive management (Moser & Ekstrom, 2010). There's also a general shortfall in the legal and institutional frameworks necessary to provide the governance flexibility required for adaptive infrastructure planning (Månsson et al., 2023).

Use of citizen science to monitor climate impacts on various systems (e.g., dengue vectors, water quality, biodiversity) remains limited. Climate risk is changing due to changes in hazard patterns, and exposure and vulnerability from socioeconomic changes. It becomes critical to closely monitor the changes and how they impact different systems such as health, water, and food. The involvement of citizens in monitoring such climate impacts remains largely limited and thus fails to inform scientific assessments which often becomes the basis for decision-making for investments. Such initiative would also enable the cross-fertilisation of knowledge whilst empowering and providing agency to communities that may not necessarily have a voice in formal adaptation planning efforts. Many formal adaptation planning efforts fail to develop frameworks and processes to integrate communities into data gathering to inform

decision making. Although participatory processes are widely adopted for engaging communities in the co-design of adaptation initiatives, the tools and formal structures to facilitate long-term community participation and inputs remain weak (UNESCO, 2023). There remains limited awareness among scientists of the value citizen science can offer to urban resilience building and the types of scientific projects that could benefit from community input. Additionally, there is often a bias among scientists toward non-community-generated data sources (Albagli & Iwama, 2018).

Planning & Programming

Limited application of planning processes that take systems approaches and consider co-benefits to other sectors/systems whilst existing approaches remain largely asset focused. Planning processes, such as infrastructure planning continue to focus primarily on the resilience of infrastructure assets compared to building resilience through infrastructure systems. While important, such an approach fails to consider infrastructure, cities, and settlements as systems with upstream and downstream linkages, and thus, climate impacts and adaptation solutions have knock-on effects on different parts of the system. Such an asset focused approach has higher chances of promoting decisions that might lock in risks and contribute towards maladaptation. There is an urgent need to promote planning processes and strengthen institutional capacity to adopt a systems approach for pursuing resilient and inclusive development. Such an approach will allow better linkages between rural and urban areas and deal with issues such as rural-urban migration which are expected to increase in many countries due to growing climate risks. A systems approach in settlement planning will also strengthen the supply chain and thereby deal with issues related to food security and trade. Further, with the transboundary nature of climate risk, a systems approach to infrastructure development will also prioritise much-needed adaptation efforts beyond administrative boundaries and through regional cooperation.

Land use planning in general fails to integrate climate change risks and seldom takes integrated planning approaches. Land use plans can be a very effective tool in building resilience by limiting exposure and vulnerability of assets and populations to natural hazards. The spatial nature of land use plans allows a demonstration of the locational constraints posed by climate hazards on existing and future development of an area. Further, the long-term outlook of land use plans provides an opportunity to factor in longer-term risk considerations, such as threats from changing hazard patterns due to climate change. This is particularly important to protect critical infrastructure, which typically has a longer design life. However, development and enforcement of land use planning in countries in the Asia Pacific region remain limited, and integrated approaches are seldom adopted (ESCAP, 2023).

Under-investments in health systems resilience building, particularly related to early warning systems and heatwave planning. Understanding of the impact of climate change on health systems is increasing in the region and accordingly, health related priorities are being identified in the NAPs as cities are hotspots for climate sensitive diseases such as dengue as well as morbidity related to heat stress. (Fears et al., 2021). However, actions on the ground remain limited, especially at a health systems level and to link such systems with other critical systems such as early warning, land use planning and building control (Whitmee et al., 2015). It is critical to undertake assessments of climate impact on health systems to inform adaptation solutions. Such assessments need to focus on all scales from national to

household and individual to ensure that adaptation responses are inclusive and include a range of solutions starting from upgrading basic services (such as water, sanitation waste collection and drainage), improving access to health infrastructure; operationalisation of heat action plans, and development of inclusive financial risk management products (such as parametric microinsurance) and services targeted at poor and most vulnerable.

Finance & Investment

Funding for NbS remains limited and project-focused rather than process-focused, hindering transformative adaptation. The region faces a significant gap in adaptation finance compared to its growing needs. While many countries have increased their domestic budgets for adaptation measures in recent years, they are mostly used to enhance the resilience of infrastructure assets. While support from development partners for adaptation has increased, it largely remains project-based with limited interventions focusing on programmatic approaches to provide longer-term financing for building resilience. Moreover, financing for NbS remains largely ad-hoc, typically funding pilot projects. Overcoming the financing needs for transformative adaptation measures and integrating NbS requires aligning adaptation goals with wider sector performance targets (for example, urban flood risk reduction through NbS) and incorporating climate risk and adaptation in public investment management. Also, there is a need to strengthen collaboration between global climate funds and financial institutions to join hands in supporting common adaptation programs aligned with the priorities identified in the country's NAPs.

Insurance can play an important role within the suite of financial risk management products but is increasingly unaffordable to the most vulnerable communities due to increasing climate risks (e.g., for SMEs). Climate risk insurance can play an important role within the wider suite of risk management measures to build infrastructure resilience within cities, especially to deal with tail-end events. While the uptake of climate risk insurance products has increased in the region, they remain limited compared to the needs. Efforts are needed to overcome this gap by strengthening policy and legislation related to insurance, involving insurance providers in climate risk assessments, and integrating insurance solutions as part of wider disaster risk financing solutions being adopted by countries. It should be noted that with the speed and intensity at which climate risk is increasing, climate risk insurance will increasingly become unaffordable, especially for products targeted at the poor and most vulnerable population and micro, small and medium-scale enterprises in cities and informal settlements.

IV. Opportunities to Support and Catalyse Transformative Actions, and Potential Actors Identified

In this section, key opportunities to support transformative adaptation in the context of cities, infrastructure and settlements are proposed. Central to these opportunities is the emphasis on delivering tangible transformative adaptation results. It is essential to implement integrated, cross-sectoral initiatives that account for both spatial and temporal dimensions of adaptation while addressing and informing various SDGs.

Promoting adaptation efforts at sub-national and local levels through improved systems and institutional capacity

Greater efforts must be expanded to supporting sub-national and local governments to adapt to climate change in the context of multiple pressures and interconnected risks. Subnational and local governments can play a critical role in implementing risk informed urban planning and delivery of resilient basic services whilst influencing the adaptive capacity of local communities to climate change via policies that may affect disadvantaged communities. Integrating climate adaptation planning at the local level with broader environmental sustainability plans is crucial to tackle multiple crises facing cities and settlements. Local governments often lack the competencies, accountability and capacity to implement adaptation activities or fail to integrate climate change risks into their local development plans or other urban and land use planning strategies. Systems thinking and recognition of cross-scale governance mechanisms will be vital in designing local government adaptation plans that should support integrated activities that produce co-benefits (e.g., tree-planting on city streets can enhance air quality and reduce the heat island effect). Integral to such integrated and risk-informed planning is the consideration of pro-poor adaptation measures and strengthening institutional coordination for emerging issues such as heatwave planning and rural-to-urban migration in the context of climate risk. Additionally, capacity building related to the use of climate data for producing hazard, exposure and vulnerability maps in partnership with local scientific organisations and communities to inform development decisions will be vital. Increased efforts on decentralisation provide greater opportunity to promote such approaches.

Scaling-up and integrating nature-based solutions in cities and into grey infrastructure

NbS as a term is still often misunderstood/misused, leading to incorrect dissemination of practice. More efforts are needed to practically interpret the United Nations Environment Assembly (UNEA) definition³ and advocate standards such as the IUCN NbS Global Standard. This involves a shift from short-term to long-term thinking to effectively assess green-grey

³ In March 2022, the UNEA resolution formally adopted the definition of nature-based solution as 'actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits.'

solutions (Green-Gray Community of Practice, 2020). Innovative financing is crucial to the scaling-up of NbS projects in the region and public procurement for NbS should be designed accordingly. Efforts are still needed to improve the monitoring of NbS benefits and to integrate NbS as a potential solution in all ecosystems. Integration of NbS into policy has witnessed considerable advancements in the climate and biodiversity arenas, but efforts are needed to make the link to less obvious policy areas (e.g., economic development, health, job creation). Associated with this is the need for building capacity at the country level on the design, implementation, and maintenance of NbS in close partnership with local private sector and community groups.

Scaling up targeted pro-poor and gender responsive adaptation measures to build climate resilience of informal settlements

Urbanisation and poverty are growing features in Asia and the Pacific region, with informal settlements, home to many urban poor and marginalised communities, being particularly vulnerable to climate change impacts due to their high exposure and limited resilience-building capacity. In some cases, these informal settlements arise as a direct consequence of climate risk, as rural populations are forced to migrate to cities to avoid worsening climate impacts on their livelihoods. Thus, building the resilience of these informal settlements through improved urban development, infrastructure and settlement planning becomes crucial. Urban land use practices can promote inclusive and gender-responsive urban planning and design to limit the exposure of the urban poor to natural hazards. Incentive mechanisms can also be put in place to support informal settlements, especially women-headed households, and invest in resilience measures. Social housing and basic service delivery can promote pro-poor solutions by integrating passive and gender-inclusive design features. The adaptive capacity needs of communities in informal settlements must be strengthened, including those in other vulnerable or disadvantaged groups such as minorities, migrants, women and those with disabilities. Adaptation should be framed as a social justice issue in such contexts (Shi et al., 2016). Certainly, it will require changes in how governments, particularly local or municipal governments work with communities to ensure initiatives address root causes of vulnerabilities and interventions that open up new choice sets for these communities are promoted. Integrating justice criteria into infrastructure systems and urban design processes is vital to catalyse equitable adaptation on the ground and to ensure disadvantaged groups are not displaced due to such investments (ibid). Issues such as power inequalities, increasing the voice and agency of these communities and tackling the underlying drivers of marginalisation must be considered if we are to re-distribute resources, power and risks (Rachunok & Nateghi, 2021).

Increased climate finance due to increased commitments from financial institutions and development of innovative financial instruments to mobilise financing for adaptation.

Many cities, particularly smaller ones, face barriers to financing infrastructure needed to meet climate goals and often lack revenue sources for investing in green-gray infrastructure. In recent years, there has been a growing engagement of Ministries of Finance in climate adaptation issues, supporting adaptation investment planning for cities and addressing

capacity gaps at the municipal planning level⁴. This trend is crucial for incorporating climate risk into fiscal sustainability and advancing climate-informed public financial management systems. Likewise, the growing commitment of development financial institutions to adaptation is encouraging. The multilateral development banks have financial targets for adaptation, established climate risk screening and assessment procedures for infrastructure, integrated adaptation measures into design, and are exploring new financial instruments to encourage adaptation investment. Other banking and financial instruments are also signing up for the Task Force on Climate Related Financial Disclosure, enhancing climate risk management and investment portfolios related to cities, infrastructure, and settlements. The region is also witnessing the development of new financial instruments to mobilise resources for adaptation. Examples include the recently issued resilience bonds by the Asian Infrastructure Investment Bank (AIIB) and the blue bonds by the Fijian Government. These innovative financial instruments are shifting investment focus from grey to green. Project Preparation Facilities that have been developed aim to support cities in adapting to climate change, helping municipal governments to identify and co-design community based finance solutions that address local adaptation needs (La Salle, 2023). Similarly, at the country level, local governments and other national government agencies need to ensure that there are transparent delivery mechanisms through which this funding can be disbursed for the purposes of adaptation whilst also ensuring there is capacity amongst these agencies to access this finance (Ayers, 2009). Moreover, it will be vital to support national government agencies with developing adaptation investment plans that articulate how to transform their pipeline of adaptation projects outlined in their National Adaptation or Sectoral Adaptation Plans into bankable projects.

⁴ See: <https://www.citygapfund.org/what-we-offer> ; <https://citiesclimatefinance.org/publications/what-is-a-project-preparation-facility/>

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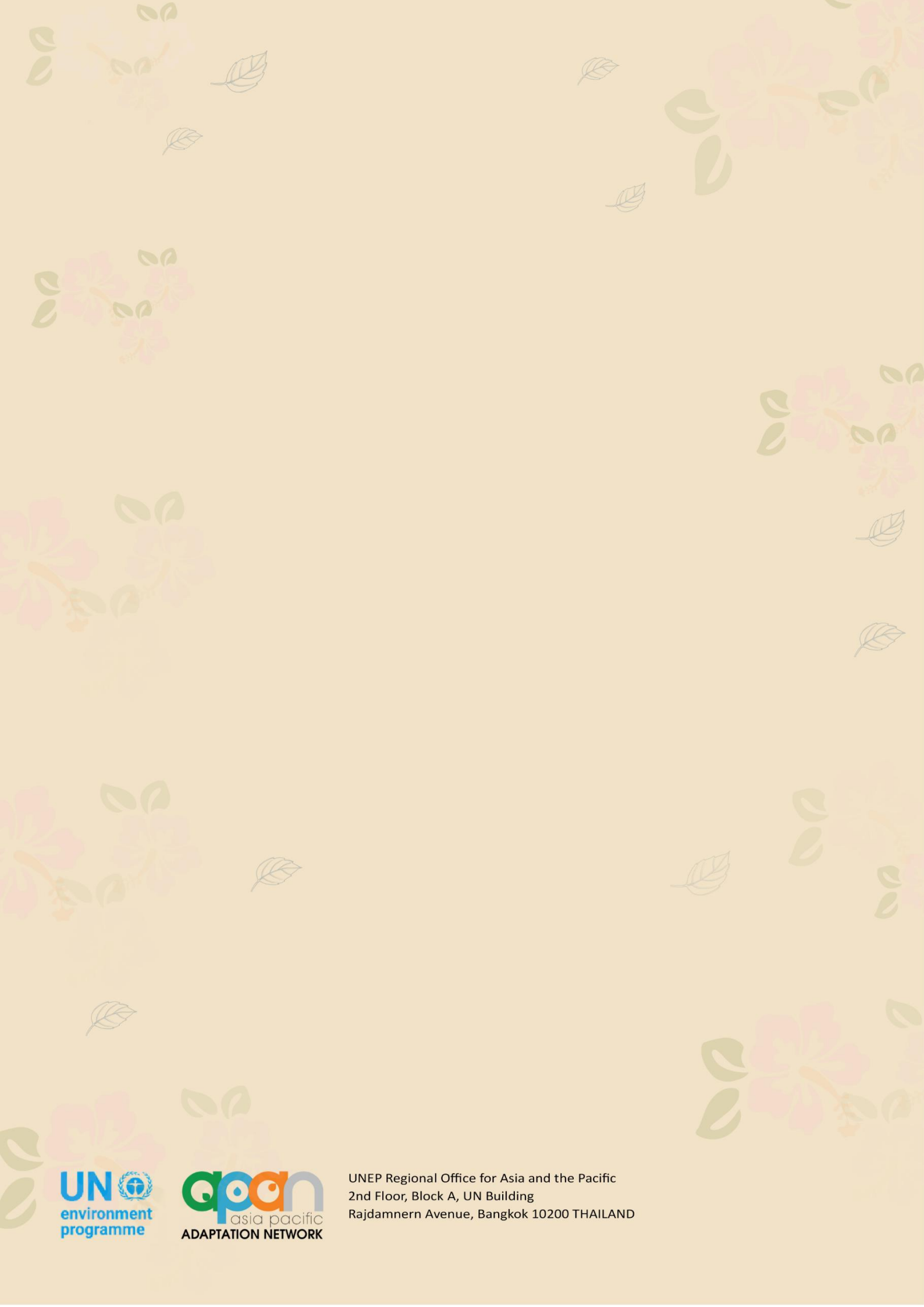
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