Task Force 3:
LiFE, Resilience, and Values for Wellbeing

MAINSTREAMING CLIMATE RESILIENCE IN URBAN INFRASTRUCTURE PLANNING

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Abstract

More than half the world's population now live in urban areas. The figure is projected to reach two-thirds by 2050. Megacities of more than 10 million people will be the economic powerhouses driving future global gross domestic product (GDP). However, climate change impacts and extreme weather events are increasingly disrupting critical systems, escalating operating costs and funding gaps, and having other adverse spill-over effects on societies and economies across the world. The G20 is well poised to provide a roadmap for mainstreaming resilience into urban infrastructure development and planning. Cooperation with regional organisations will be crucial to forge effective partnerships, share knowledge and expertise, and leverage innovative financing mechanisms to deliver tangible outcomes. This Policy Brief explores the role of strategic foresight to build long-term resilience and operationalise the G20 Action Agenda on Adaptation and Resilient Infrastructure.[1]

The Challenge

1

Urban areas are vulnerable to hazard risks.

According to the 2017 *Asia Pacific Disaster Report*, between 2015 and 2030, populations at 'extreme risk' in the Asia Pacific region will grow by 50 percent in 26 cities, and 35-50 percent in another 72.[2] Urban populations exposed to 'extreme and high risks' are also likely to rise significantly. Cities in areas vulnerable to multiple hazards are also the ones that have grown rapidly in population between 1950 and 2014, implying that greater infrastructural investments are needed in these hazard-sensitive areas.[3]

Significant disparities exist in the region's cities and these are increasing with the trend of 'hazard impacts' on infrastructure.[4] In particular, rapid rural-to-urban migration has resulted in millions of urban dwellers living in poverty with substandard housing that lacks access to services and social protection, causing a cycle of poverty and inequality whenever a disaster strikes.[5] This growth is taking shape on vulnerable lands, along river banks, drainage channels and steep slopes that are exposed to multiple and perennial hazards.

Disasters in urban areas of developing countries often tend to be more destructive and much harder to recover from than in developed ones.[6] Not only do these areas have poor quality development and are short of resources, but managing the aftermath of a disaster is also made more difficult by the complexities of land tenure, high densities of populations, and increasing high-rise structures, as well as the need to support floating populations due to rapid migration. These risks further sprawl outside the city limits to peri-urban areas which have quickly become attractive due to the reduced costs of housing there. However, these areas often have unsafe buildings and inadequate critical infrastructure due to lack of developmental regulations.

Between 1970 and 2018, the Asia Pacific region lost US$1.5 trillion, mostly as a result of floods, storms and droughts, earthquakes and tsunamis. The Economic and Social Survey of Asia and the Pacific 2019 found that, in the Pacific small island developing states for example, the average annual loss associated with shocks and stresses is about 18 percent of total infrastructure investment, or nine times the regional average.[7] Much of this

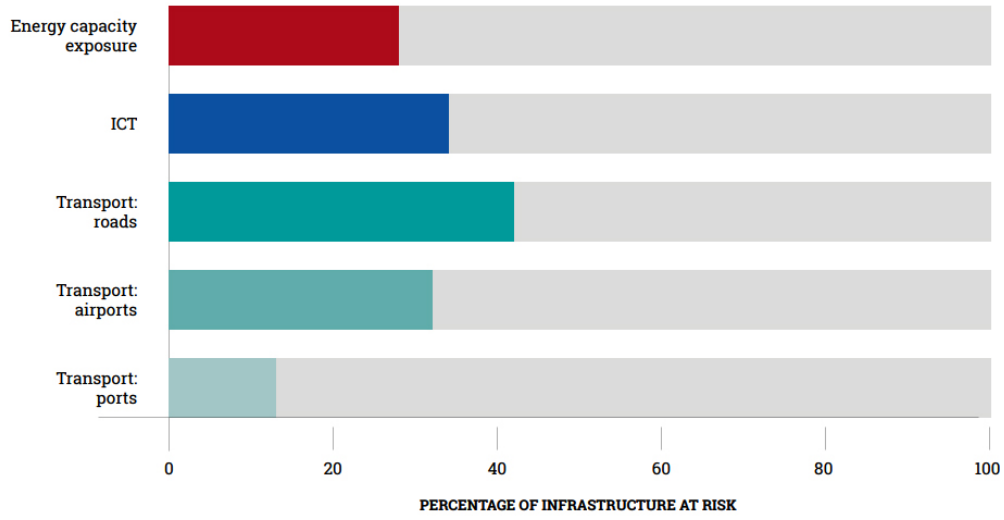
infrastructure is located in urban areas. While it is known that natural hazards have caused large-scale economic damage in the Asia-Pacific region, including in infrastructure, many projects still remain risk-blind.[8]

The 2019 Asia-Pacific Disaster Report notes that one reason for increasing economic losses is the added vulnerability and exposure of critical infrastructure that is being developed without understanding the full risk.[9] As seen in Figure 1, the proportion of each type of infrastructure exposed to multi-hazards are: energy power plants (28 percent); fibre-optic cables (34 percent); road infrastructure (42 percent); airports (32 percent); and ports (13 percent).

The impacts of climate change will continue to heighten.

The impacts of climate change are multi-sectoral. Climate change increases both the frequency and intensity of disasters and is poised to cause more damage to infrastructure than ever before. Additionally, the urbanisation process itself, if not risk-informed, can generate vulnerability and exposure to risk which, combined with climate change, further drives urban risk.[11]

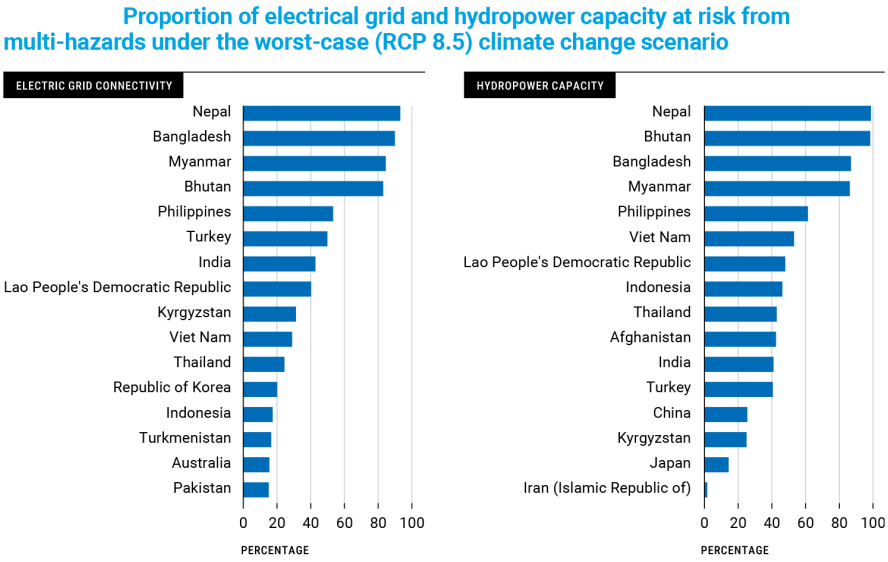
Figure 1: Infrastructure at Risk to Multiple Hazards (%)



Climate change impacts have demonstrated the need for more integrated and resilient infrastructure systems, particularly those supporting key services related to health, education, transport and information and communications technology (ICTs). Figure 2, for example, shows that under a worst-case climate change scenario (RCP 8.5[a]), electrical grid and hydropower capacity are at high risk of exposure across Asia, with knock-on consequences for other forms of infrastructure as well. In Kyrgyzstan, for instance, the third most vulnerable country in Central Asia, the UN's Economic and Social Commission for the Asia Pacific (ESCAP) estimates that climate change, leading to greater evaporation losses and glacial melting, could cause an acute energy crisis.[12] (The country draws 90 percent of its energy needs from hydropower.)

Existing infrastructure's incapacity to withstand hazard impacts highlights the importance of ensuring that climate change information is adequately integrated into future infrastructure planning. To maximise the economic and social benefits of infrastructure, current and future investments must take into account climate risk.

Figure 2: At-Risk Infrastructure Under Climate Change Scenarios



Source: Asia Pacific Disaster Report, 2017[13]

a Representation Concentration Pathways (RCPs) are models of climate change impact, depending upon the extent of temperature rise. RCP 8.5 is the worst possible scenario modelled, assuming global warming of 8.5 watts per square metre of the Earth or a temperature rise of 4.3 degrees C above pre-industrial levels by 2100.

The G20's Role

2

The G20 nations, representing a population of 4.7 billion people,[14] are exposed to significant risks from climate disasters, which pose a significant challenge to their critical infrastructures. In the current World Risk Index, four G20 countries—India, Indonesia, Mexico and China—are among the top 10 most vulnerable nations globally.[15] The economic impact of disasters in the G20 countries amounts to an estimated annual average loss of US$218 billion.[16] Prioritising disaster risk resilience measures will help G20 go a long way in mitigating these losses and protecting development gains.

Yet the dominant urban planning model in the majority of nations still focuses on engineering/hard infrastructure solutions and economics rather than on a more comprehensive and transformative approach addressing long-term resilience, especially shocks stemming from increasing climate extremes. A warming climate is certain to place future infrastructure investments at risk. The widening adaptation gap in cities will have unprecedented consequences. Low- and middle-income and developing countries are particularly vulnerable given their lack of capacity, equity, and adequate resources coupled with already existing development challenges that constrain their ability to mitigate or adapt to uncertain climate risks.[17]

By 2030, Asia is expected to have 3.3 billion urban dwellers; by 2050, 4.9 billion.[18] Studies predict that by mid-century, 70 Indian cities will have more than 1 million inhabitants. Long-term projections indicate that by then, India will be in the grip of such extreme heat that outdoor working capacity would reduce by 15 percent. This could cost the country 2.8 percent of its gross domestic product (GDP) by 2050 and 8.7 percent by 2100.[19] East and South-East Asia will face an increased risk of flooding. It is predicted that over one-third of Asian cities with about 932 million residents will be living in flood-prone areas by mid-century.[20] Keeping climate resilience at the heart of urban infrastructure development is vital to achieving sustainable urban transition.

The G20 Bali Leaders' Declaration calls for stepping up infrastructure investments, especially for low- and middle-income and other developing

countries. Such investments, however, need to take into account multi-hazard impacts under different climate change scenarios, estimating damage and losses and societal impacts due to disruptions in services in the short, medium and long term.

This calls for not only investment in systemic thinking, integrated planning across multiple stakeholders, and comprehensive multi-hazard risk assessment, but also consensus building. The G20 can play an important role in this. It is well poised to provide a roadmap for mainstreaming resilience in urban infrastructure development and planning, which will lay the foundation for aligning growth trajectories with climate realities.

In particular, the G20 can facilitate (a) risk informed infrastructure development, (b) strengthening of risk governance, (c) integration of nature-based solutions into infrastructure development, and (d) regional and sub-regional actions for risk informed infrastructure through the G20 platform.

Recommendations to the G20

3

New approaches to infrastructure development must be risk-informed at all levels—economic, social and environmental. They should be inclusive, and support resilience for sustainable development as the UN's Sustainable Development Goals (SDGs) emphasise. 'Leaving no one behind' (LNOB) is a central tenet of the 2030 Agenda for Sustainable Development.[21] The four priorities for action in the Sendai Framework of Disaster Risk Reduction (SFDRR) provide a critical framework to achieve and maintain resilient infrastructure. Using these four priorities as guidelines, this policy brief makes the following recommendations:

Build a comprehensive, multi-hazard understanding of risk while developing infrastructure.

Risks cannot be fully understood through a piecemeal approach to hazards. An integrated system is needed, using climate risk models and a multi-hazard approach which addresses investments in critical infrastructure, especially those that serve the most vulnerable populations. The *2021 Asia Pacific Disaster Report,* for example, locates the most exposed sections under 'current', 'moderate' and 'worst-case' climate change scenarios.[22]

Risk scenarios also need to identify the impacts of intensive risks, both those which arise from infrequent but severe hazards—such as cyclones or earthquakes—and those from hazards that are frequent but have relatively less severe impacts—such as drought or urban migration—but disproportionately affect local infrastructure systems providing essential services. A comprehensive understanding of risk will allow for risk prevention and reduction, inclusion of new, emerging and evolving risks, and climate change adaptation and resilience measures in infrastructure planning, development, operation and maintenance.

Further, the understanding of risk must go beyond assessing the potential or actual damage to infrastructure to a more comprehensive analysis taking into account the interdependences of systems and the ways that disruption of critical infrastructure in one sector can cascade into others. Risk assessment should consider the diverse needs of multiple users and how different

hazards might result in service disruptions which, while not damaging and destroying the facilities, impede access or disrupt service provision. (Examples would be a power outage in a hospital, or schools being closed to contain the spread of a disease.) Applying a gender or disability lens across an infrastructure project cycle, including design and preparation, financing and budgeting, procurement and contracts, implementation, operations and maintenance and monitoring, for instance, would help reveal and address the differentiated risks to different population groups.[23]

Risk-informed infrastructure also calls for investments in capacity-building for appropriate skills and knowledge, as well as institutional strengthening for robust governance and regulation. The G20 can facilitate knowledge sharing and capacity building on multi-hazard risk assessment by promoting research, dissemination of case studies, and providing training to member countries. It can also support the development of robust risk management strategies in infrastructure planning. It can promote data sharing and standardisation to improve risk assessment and monitoring, encouraging the use of common data standards and interoperable systems for better decision-making in infrastructure development.

Finally, risk assessments for infrastructure projects rarely include the needs of the most vulnerable populations. It is important to ensure that these are. Indeed, sustainable infrastructure can only be delivered when all three pillars—economic, environmental, and social—are considered together in comprehensive climate and disaster risk assessment and in developing future risk scenarios.

Strengthen risk governance.

Governing bodies and policy and legislative systems should have the authority, legitimacy, accountability, the necessary access to financing, skills, and knowledge to effectively plan, develop, operate and maintain infrastructure throughout its life cycle. Strong inclusive governance and a comprehensive systems approach to building resilient infrastructure, keeping in view the close linkages between assets, knowledge, and institutions, will protect vulnerable and marginalised groups, become gender inclusive and embrace climate-

friendly technologies. Standards of infrastructure development which can integrate these approaches must be considered by government monitoring systems. The G20 can work towards establishing such standards and guidelines. This would include setting criteria to assess and manage climate risks in infrastructure projects, incorporate climate resilience into design and construction processes, and ensure the use of appropriate materials and technologies.

Invest in nature-based solutions as part of the infrastructure development ecosystem.

Using nature-based solutions can be critical for resilient infrastructure development. Most infrastructure finance is directed towards large scale projects.[24] Therefore, investing in hazard and climate-resilient local infrastructure systems that provide essential services – such as local road and water distribution networks or health and education facilities – can support closing last-mile gaps, and ensuring that essential services are accessible to all. The G20 can play a pivotal role in policy advocacy as well as finance mobilisation for nature-based solutions. It can advocate integration of nature-based solutions into infrastructure development policies and strategies. By highlighting the multiple benefits of solutions such as climate change mitigation, biodiversity conservation, and community resilience, the G20 can encourage member countries to prioritise them in their infrastructure planning and investment decisions. The G20 can also facilitate the mobilising of financial resources for nature-based solutions. This includes promoting public and private sector investments in infrastructure projects that incorporate nature-based approaches and exploring innovative financing mechanisms for them. This may entail harnessing financial resources from governmental sources, multilateral institutions, capital markets, insurance companies, philanthropic organisations, and local communities.

Take advantage of regional and sub-regional cooperation mechanisms.

To build resilient infrastructure, countries in the Asia-Pacific can take advantage of a number of regional and sub-regional cooperation mechanisms. These include not only the G20 forum

but also platforms such as the ESCAP Asia-Pacific Disaster Resilience Network, the Asia-Pacific Partnership for Disaster Risk Reduction, the Asia-Pacific Ministerial Conferences on Disaster Risk Reduction, the Pacific Resilience Partnership, the South Asian Association for Regional Cooperation (SAARC), the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), the Economic Cooperation Organisation (ECO) and the Trilateral Cooperation Secretariat. These mechanisms can be used to exchange technical knowledge, case studies, lessons learned, and innovative solutions, fostering mutual learning and collaboration. As traditional infrastructure assessments are time consuming and cost-heavy, new assessment options, such as low- or no-cost stress tests, could support nations in conducting first-stage assessments and setting their priorities at regular intervals, taking into consideration new and changing hazard conditions.

Attribution: Aparna Roy and Madhurima Swaisgood, “Mainstreaming Climate Resilience in Urban Infrastructure Planning,” *T20 Policy Brief*, July 2023.

Endnotes

1 This G20 Action Agenda on Adaptation and Resilient Infrastructure is concluded by the G20 Environment Ministers as one of outcomes of the G20 Adaptation Work Program (2018-2019), which outlines actions, initiatives, and best practices that G20 members wish to highlight and share with other countries, drawing upon relevant discussions under the CSWG. The Action Agenda contains a variety of actions on climate change adaptation, disaster risk reduction, and quality and resilient infrastructure at multilateral, bilateral, regional, national, and local levels. Refer to: Group of 20, "G20 Action Agenda on Adaptation and Resilient Infrastructure," Japan, 2019.

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Annexure 1

Coverage of infrastructure in national climate risk assessments in G20 countries

	Agency	Year	Sectoral Focus			Climate Hazard Focus			Nature of Assessment	
			Multi Sectors	Transport Only	Water Only	Multi-hazard	Coastal change only	Flooding only	Qualitative	Quantitative
ARGENTINA	Ministry of Environment and Sustainable Development/ National Cabinet on Climate Change	2017	x	x	x				x	
AUSTRALIA	DCEE	2023#								
		2011								
	DCC	2009	x	x		x	x		x	x
	ATSE	2008	x						x	
BRAZIL	Ministry of Science, Technology and Innovations (MCTI)	2020	x			x			x	x
	MoE	2016	x			x				x
CANADA	Natural Resources Canada	2021	x			x			x	x
	Infrastructure Canada	2018	x			x			x	
	ACT	2017****	x			x				x
	Natural Resources Canada	2014	x			x			x	Case studies
CHINA	PRC	2018	x			x			x	
FRANCE	ACPR	2021##	x			x				x
	Ministry of Ecology andSustainable Development	2018	x						x	
		2009	x			x				x
GERMANY	Federal Environment Agency	2021	x			x				x
		2015	x			x			x	
INDIA	NITI Aayog	2019			x	x				x
	Department of Science and Technology	2018	x							x
	Ministry of Agriculture and Farmers Welfare	2019***				x				x
	Ministry of Environment,Forests and Climate Change	2019**	x			x				x
		2010			x	x			x	

	Agency	Year	Sectoral Focus			Climate Hazard Focus			Nature of Assessment	
INDONESIA	Ministry of Environment and Forestry	2022	x			x			x	x
	Ministry of National Development Planning/ National Development Planning Agency (BAPPENAS)	2012	x			x			x	
ITALY	Ministry of the Environment and the Sea	2023*	x			x			x	x
		2021	x			x			x	x
		2014	x			x			x	
JAPAN	Central Environment Council	2020	X			X			X	X
		2015	x			x			x	
KOREA	Ministry of Environment	2020	X			X			X	X
		2010	x			x				x
MEXICO	Ministry of the Environment and Natural Resources	2018		X		X			X	
		2013			x		x	x		x
RUSSIA	MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT	2023	x						x	
	Roshydromet	2017	x			x			x	x
SAUDI ARABIA	KSA	2022	x				x		x	
		2015	x				x		x	
SOUTH AFRICA	Department of Environmental Affaris	2018	x			x			x	
	Davis, C. (ed)	2011	x			x			x	
TURKEY	Ministry of Environment , Urbanization and Climate Change	2023	x			x			x	
		2012	x			x				x
UNITED KINGDOM	National Infrastructure Commission	2021	X			x			x	
		2018	x			x			x	
	Committee on Climate Change	2017	x			x				x
		2016	x			x				x

	Agency	Year	Sectoral Focus			Climate Hazard Focus			Nature of Assessment	
UNITED STATES	U.S. Global Change Research Program	2023*	x			x			x	
		2018	x			x			x	x
	Environmental Protection Agency	2021			x	x			x	
		2017	x			x				x

**Under preparation*

***Pilot Study at district scale*

**** Only for Agriculture sector (CRIDA-ICAR report)*

***** Only for Australian Capital Territory Area*

 # Budgeted study for second risk assessment after 2011, will be finalised and out in 2024

Transitional Risks

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