

CLIMATE-RESILIENT URBAN PLANNING FOR RAPIDLY GROWING CITIES

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Abstract

Rapid urban growth is increasing the exposure of people, infrastructure, housing, and essential services to heat waves, intense rainfall, flooding, drought, coastal hazards, and other climate-related stresses. Cities that expand without adequate land-use control, service provision, ecosystem protection, and risk-sensitive infrastructure often create long-term vulnerability for residents, particularly in informal, low-income, and environmentally exposed settlements. Climate-resilient urban planning therefore requires more than emergency response; it requires the systematic integration of climate risk information into decisions about where and how cities grow.

This study examines the planning principles, spatial strategies, and governance mechanisms that can help rapidly growing cities become more resilient to climate change. The paper uses an evidence-informed conceptual and comparative approach to analyze five urban planning dimensions: risk-sensitive land use, blue-green infrastructure, resilient housing and public facilities, low-carbon and reliable mobility networks, and inclusive governance. Particular attention is given to the need to manage urban expansion away from floodplains, unstable slopes, coastal buffers, and extreme-heat hotspots while improving access to water, sanitation, public open space, early-warning systems, and essential services.

The analysis shows that climate-resilient outcomes are strongest when adaptation, environmental protection, social equity, and infrastructure investment are treated as integrated planning priorities. Nature-based solutions, compact mixed-use development, drainage-sensitive design, heat-responsive public space, building standards, and community participation can reduce multiple risks at the same time. The study concludes that rapidly growing cities should adopt flexible, place-based, and inclusive planning frameworks that can learn from changing climate conditions and guide development toward safer, healthier, and more sustainable urban futures.

Keywords: Climate-Resilient Urban Planning, Rapid Urbanization, Urban Resilience, Climate Adaptation, Blue-Green Infrastructure, Risk-Sensitive Land Use, Sustainable Cities, Heat Mitigation, Flood Management, Inclusive Governance

1. INTRODUCTION

Cities are becoming the principal locations of population growth, economic activity, infrastructure investment, and environmental change. Rapid urbanization can generate employment, innovation, and better access to services; however, unmanaged growth also concentrates people and assets in areas exposed to floods, heat stress, water scarcity, coastal erosion, and infrastructure failure. Climate change intensifies these pressures by increasing the frequency or severity of many urban hazards and by placing additional stress on systems that already operate with limited capacity.

Climate-resilient urban planning is a forward-looking approach that prepares urban systems to anticipate, absorb, adapt to, and recover

from climate-related shocks and long-term stresses. It connects spatial planning, ecosystem management, infrastructure design, housing policy, public health, disaster-risk reduction, and local governance. Rather than treating climate adaptation as a separate technical project, resilient planning incorporates climate considerations into master plans, zoning regulations, capital-investment decisions, development controls, and neighborhood improvement programs.

The need for this approach is especially urgent in rapidly growing cities, where new roads, housing, commercial areas, and public facilities are being built at a large scale. Decisions made during this period can either reduce future exposure or lock communities into risk. Expansion into low-lying

floodplains, wetlands, informal settlements on steep slopes, and areas without adequate drainage can create avoidable long-term losses. In contrast, directing growth toward safe serviced land, protecting ecological buffers, and designing infrastructure for changing climate conditions can increase safety and improve quality of life.

This paper explores how climate-resilient urban planning can guide rapidly growing cities toward more secure and equitable development. It reviews core concepts, identifies practical planning dimensions, presents a comparative framework for urban contexts, and discusses how local governments can translate resilience principles into implementable planning actions.

2. LITERATURE REVIEW

Climate resilience has become an important theme in urban studies because cities are complex systems in which environmental, social, economic, and infrastructure conditions interact. Research on urban resilience emphasizes that a city should not be assessed only by the strength of its physical structures. Resilience also depends on the ability of institutions, communities, service providers, and ecosystems to respond to uncertainty, reduce exposure, and maintain essential functions during disruption.

The literature identifies rapid land conversion, loss of vegetation, inadequate drainage, dispersed urban form, weak building control, and unequal access to services as major factors that can increase climate risk. The impacts of these conditions are not evenly distributed. Households with insecure tenure, limited income, poor-quality housing, and weak access to public services often face the highest exposure while having the least capacity to recover. For this reason, equitable planning and community participation are widely recognized as essential components of climate resilience.

A growing body of scholarship also shows that urban adaptation and mitigation can be planned together. Compact, mixed-use, and transit-oriented development can reduce travel demand while improving access to services. Green corridors, urban forests, wetlands, permeable surfaces, and water-sensitive design can help manage runoff, lower local temperatures, improve air quality, and provide

recreational space. These co-benefits make integrated planning particularly valuable for cities with limited land, finance, and administrative capacity.

2.1 CLIMATE RISK AND RAPID URBAN GROWTH

- Rapid population growth can increase settlement expansion into environmentally sensitive and hazard-prone locations when safe, serviced land is not available.
- Urban heat is often intensified by dense impervious surfaces, limited tree cover, heat-retaining building materials, and insufficient shaded public space.
- Flood risk rises when natural drainage channels, wetlands, and permeable landscapes are replaced by unplanned construction and undersized drainage networks.
- Climate exposure is shaped by social conditions, including housing quality, tenure security, access to public transport, health services, water supply, and emergency support.

2.2 PRINCIPLES OF CLIMATE-RESILIENT URBAN PLANNING

- Risk-sensitive land use directs development away from high-hazard zones and protects floodplains, coastal buffers, steep slopes, urban forests, and water bodies.
- Flexible planning recognizes that climate conditions, demographics, technology, and local priorities change over time and therefore requires regular review and adjustment.
- Integrated infrastructure planning considers water, drainage, sanitation, energy, mobility, housing, health, and public spaces as connected systems rather than isolated sectors.
- Equity-oriented planning prioritizes residents who face the greatest climate exposure and supports meaningful participation in decisions that affect neighborhoods and livelihoods.

2.3 BLUE-GREEN INFRASTRUCTURE AND NATURE-BASED SOLUTIONS

- Urban trees, parks, green roofs, bioswales, restored wetlands, and permeable streets can reduce heat stress and manage stormwater at the neighborhood scale.

- Blue-green networks improve the continuity of water and ecological systems while creating public space, recreation opportunities, and environmental benefits.
- Nature-based solutions are most effective when they are protected through land-use controls, connected to maintenance budgets, and designed with local hydrological conditions in mind.
- Green infrastructure should complement, not replace, essential engineered systems such as drainage, water supply, sanitation, flood protection, and emergency access.

2.4 PLANNING AND GOVERNANCE CHALLENGES

- Fragmented institutional responsibilities can delay adaptation when land use, infrastructure, public health, and disaster-management decisions are prepared separately.
- Limited planning finance and weak maintenance arrangements can reduce the long-term effectiveness of drainage, green infrastructure, and public-space investments.
- Informal and underserved settlements require upgrading strategies that combine tenure security, basic services, safe housing, and community-led risk reduction.
- Effective resilience planning requires transparent risk information, enforceable development controls, local participation, and regular review of implementation progress.

3. OBJECT OF STUDY

The present study focuses on climate-resilient urban planning for rapidly growing cities. The central purpose is to examine how land-use decisions, infrastructure systems, ecosystem protection, housing standards, mobility planning, and local governance can reduce climate risk while supporting inclusive urban development. The study treats resilience as a planning capacity that helps cities prepare for climate uncertainty, limit avoidable exposure, maintain essential services, and recover more effectively after disruptive events.

The analysis is conceptual and comparative. It does not report observations from one specific city; instead, it synthesizes widely used planning dimensions to show how different urban contexts may require different combinations of interventions. The framework is intended to support planners, local governments, researchers, and development practitioners in identifying priorities for climate-resilient growth.

3.1 THEORETICAL BASIS AND URBAN CONTEXTS CONSIDERED

From a planning perspective, climate resilience is shaped by the relationship between hazard exposure, physical vulnerability, social vulnerability, environmental conditions, and institutional capacity. The study considers representative urban contexts in order to compare common climate pressures and the planning responses needed to address them.

S.No.	Urban Context	Major Climate Exposure	Climate-Resilient Planning Response	Key Significance
1	Coastal growing city	Sea rise and storm surge	Coastal buffers; elevated services; managed growth	Protects people, services, and ecosystems
2	River-basin city	Flooding and drainage overflow	Floodplain reserve; retention areas; blue-green corridors	Reduces runoff and protects access routes
3	Heat-stressed inland city	Heat waves and water stress	Tree canopy; cool roofs; shaded public space	Improves health and thermal comfort
4	Semi-arid expanding city	Drought and water scarcity	Reuse systems; recharge zones; demand management	Strengthens water security
5	Hillside peri-urban city	Slope failure and erosion	Controlled growth; stabilization; early warning	Reduces risk for vulnerable communities

3.2 STUDY OBJECTIVES

- To examine the relationship between rapid urban growth, climate exposure, and long-term urban vulnerability.
- To identify planning strategies that reduce flood, heat, drought, coastal, and infrastructure-related risks.

- To analyze the role of blue-green infrastructure, risk-sensitive land use, resilient housing, and mobility planning.
- To compare climate-resilient planning priorities across representative urban contexts.
- To develop an integrated conceptual framework for inclusive and climate-responsive urban growth.

4. RESEARCH METHODOLOGY

The study adopts a conceptual and comparative research methodology. It draws on established literature, international urban-climate assessments, and planning frameworks to identify the main conditions that influence climate resilience in rapidly growing cities. The methodology is designed to connect climate hazards with practical spatial-planning responses rather than to measure the performance of a single city.

A qualitative planning framework is used to examine the interaction between urban growth patterns, ecosystem services, infrastructure systems, housing conditions, and institutional capacity. The analysis recognizes that cities differ in their geography, income level, administrative structure, and climate exposure; therefore, resilient planning should be adapted to local circumstances while following common principles of risk reduction, flexibility, inclusion, and ecological protection.

4.1 RESEARCH DESIGN

- The study follows an evidence-informed conceptual and comparative research design.
- Urban climate risks are examined through the linked dimensions of exposure, vulnerability, adaptive capacity, and planning response.
- The framework compares representative city contexts rather than producing city-specific statistical estimates.
- The analysis emphasizes integrated planning because climate impacts commonly affect multiple sectors at the same time.

4.2 ANALYTICAL FRAMEWORK

- Risk-sensitive land use and urban growth management.
- Blue-green infrastructure, water-sensitive design, and ecosystem protection.

- Resilient housing, public facilities, and basic urban services.
- Reliable and low-emission mobility systems with safe emergency access.
- Participatory governance, data use, finance, maintenance, and institutional coordination.

4.3 SPATIAL AND PLANNING INDICATORS

- Extent of development in floodplains, coastal buffers, heat-prone areas, and unstable slopes.
- Access to drainage, water supply, sanitation, health facilities, safe public space, and emergency routes.
- Continuity and condition of parks, water bodies, wetlands, tree cover, and permeable surfaces.
- Quality of building standards, tenure security, land information, and enforcement mechanisms.
- Availability of climate-risk data, neighborhood participation, maintenance plans, and adaptation finance.

4.4 PARAMETERS OF ANALYSIS

The analysis evaluates the following planning and resilience parameters:

- Climate hazard exposure and spatial concentration of people and assets.
- Land-use compatibility and protection of ecological and risk-buffer zones.
- Capacity of drainage, water, sanitation, energy, health, and mobility systems.
- Heat mitigation through shade, tree cover, cool materials, ventilation, and accessible public space.
- Social inclusion, participation, affordability, tenure conditions, and access to essential services.
- Institutional coordination, monitoring, maintenance, and ability to update plans over time.

4.5 PROCEDURE OF STUDY

- Review climate-resilience concepts, planning literature, and international urban-development frameworks.
- Identify recurring climate risks associated with rapid and unplanned urban expansion.
- Organize planning responses into land use, ecosystems, infrastructure, housing, mobility, and governance dimensions.

- Compare representative urban contexts to identify location-specific priorities.
- Interpret how integrated interventions can reduce vulnerability and create wider environmental and social benefits.
- Develop practical implications for resilient master planning and neighborhood-scale implementation.

4.6 ANALYTICAL APPROACH

- Qualitative comparison of urban risk patterns and planning responses.
- Assessment of interactions between physical infrastructure, environmental systems, and social vulnerability.
- Identification of co-benefits and trade-offs associated with different resilience interventions.
- Use of an illustrative planning matrix to demonstrate priority-setting for rapidly growing cities.

5. DATA ANALYSIS

The data analysis is based on a structured qualitative synthesis of the planning dimensions identified in the literature. The purpose is not to claim that all rapidly growing cities face the same conditions; instead, the analysis demonstrates how climate risk can be interpreted through common planning questions. These include: Where is new development occurring? Which hazards are likely to affect people and services? Which natural systems should be protected? Which infrastructure systems are weakest? Who faces the greatest exposure and least capacity to recover?

The synthesis indicates that urban growth becomes more climate resilient when land, infrastructure, and ecosystems are planned together. Conventional patterns of growth often separate housing, employment, water systems, and ecological areas into disconnected sectors. This can create drainage bottlenecks, long travel distances, fragmented green space, and unequal access to services. An integrated approach instead uses climate-risk mapping, growth management, infrastructure sequencing, and neighborhood-level participation to coordinate development decisions.

The comparative assessment also indicates that no single intervention is sufficient. A drainage upgrade may reduce floodwater in one area, but flood exposure can continue if upstream wetlands are lost or new settlements are permitted in low-lying land. Similarly, tree planting can improve thermal comfort, but its impact will be limited without reliable maintenance, water access, safe sidewalks, and inclusive public-space design. Climate resilience therefore depends on combinations of spatial, ecological, technical, social, and institutional measures.

5.1 ILLUSTRATIVE COMPARATIVE PLANNING ASSESSMENT

Table 2 presents an illustrative matrix for interpreting the contribution of selected planning measures. The classifications are conceptual and are intended to show relative planning importance rather than numerical performance values for a particular city.

Planning Dimension	Typical Risk in Rapid Growth	Priority Climate-Resilient Measure	Expected Contribution
Land-use management	Settlement expansion in exposed areas	Hazard mapping, protected buffers, serviced growth areas, development control	High - prevents avoidable future exposure
Blue-green infrastructure	Runoff, heat build-up, ecological loss	Wetlands, urban forests, retention areas, permeable streets, shade networks	High - manages multiple risks and provides co-benefits
Housing and public facilities	Unsafe structures and service interruption	Climate-responsive codes, retrofits, safe schools and clinics, basic services	High - protects health and essential functions
Mobility and emergency access	Transport disruption and isolated communities	All-weather access, safe walking routes, transit connectivity, evacuation planning	Medium to high - supports continuity and response

Planning Dimension	Typical Risk in Rapid Growth	Priority Climate-Resilient Measure	Expected Contribution
Governance and participation	Weak coordination and unequal adaptation	Community engagement, transparent data, maintenance plans, climate budgeting	High - enables implementation and accountability

6. DISCUSSION

The analysis confirms that climate-resilient urban planning should be understood as a development strategy rather than a narrow disaster-management activity. Rapidly growing cities make long-term decisions every day through land allocation, housing approvals, road investments, utility extensions, public-space design, and neighborhood upgrading. When climate information is absent from these decisions, development can intensify exposure and make future adaptation more expensive. When climate resilience is integrated from the beginning, new growth can be directed toward safer, more efficient, and more equitable patterns.

One of the most important findings is the role of risk-sensitive land use. Restricting development in floodplains, river corridors, steep slopes, coastal buffers, and extreme-heat hotspots can avoid the creation of new vulnerabilities. However, restrictions alone are not sufficient. Local governments must also provide practical alternatives, including serviced land, affordable housing, secure tenure, public transport, and access to employment. Otherwise, low-income households may continue to occupy high-risk locations because safer options are unavailable.

Blue-green infrastructure is another central element of resilient planning. Parks, trees, wetlands, restored streams, rain gardens, urban agriculture, and permeable surfaces can create a distributed system of climate protection. These measures are particularly useful because they can address runoff, heat, biodiversity, public health, and neighborhood amenity at the same time. Their success depends on design quality, land protection, maintenance, and community stewardship. Nature-based solutions should therefore be embedded in statutory plans, infrastructure programs, and local budgets rather than treated as isolated beautification projects. The discussion also highlights the importance of governance.

Climate resilience requires coordination among planning departments, utility providers, transport agencies, public-health institutions, disaster-management authorities, community organizations, and private developers. Cities need transparent risk information, implementation responsibilities, reliable maintenance arrangements, and financial mechanisms that support early action. Participatory processes are important because residents can identify local hazards, service gaps, and practical constraints that may not be visible in city-wide data.

Finally, resilience planning must address equity. Climate risks are often amplified by social inequality, insecure housing, poor service access, and limited political voice. A plan cannot be considered resilient if it protects high-value areas while leaving vulnerable neighborhoods without drainage, shade, safe housing, or emergency support. Inclusive planning should therefore prioritize basic services, neighborhood upgrading, accessible public space, and the active participation of communities most affected by climate change.

7. CONCLUSION

This study presented a conceptual and comparative examination of climate-resilient urban planning for rapidly growing cities. The analysis showed that climate resilience is shaped by the combined performance of land use, ecosystems, infrastructure, housing, mobility, social inclusion, and governance. Cities that continue to expand without climate-risk information, environmental protection, and adequate service planning may create long-term exposure to floods, heat waves, water scarcity, and infrastructure disruption.

The study emphasizes that resilient planning should guide urban growth toward safe and serviced locations, protect blue-green networks, improve the reliability of essential infrastructure, strengthen housing and public facilities, and include communities in decision-making. These actions create benefits

beyond risk reduction by improving health, mobility, environmental quality, public space, and local livelihoods.

The paper concludes that rapidly growing cities need adaptable and place-based planning frameworks that can respond to changing climate conditions. Future work can apply the

proposed framework to specific cities using spatial data, local climate projections, service-access indicators, and participatory assessment. Such applications can help translate the broad principles of climate resilience into practical, accountable, and equitable urban development strategies.

8. REFERENCES

1. 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. doi:10.1017/9781009325844
2. Dodman, D., Hayward, B., Pelling, M., Castan Broto, V., Chow, W., Chu, E., Dawson, R., Khirfan, L., McPhearson, T., Prakash, A., Zheng, Y., & Ziervogel, G. (2022). Cities, settlements and key infrastructure. In Climate Change 2022: Impacts, Adaptation and Vulnerability. Cambridge University Press. doi:10.1017/9781009325844.008
3. UN-Habitat. (2022). World Cities Report 2022: Envisaging the Future of Cities. United Nations Human Settlements Programme, Nairobi.
4. United Nations Department of Economic and Social Affairs. (2019). World Urbanization Prospects: The 2018 Revision. United Nations, New York.
5. United Nations Office for Disaster Risk Reduction. (2019). Global Assessment Report on Disaster Risk Reduction. United Nations, Geneva.
6. Jha, A. K., Miner, T. W., & Stanton-Geddes, Z. (Eds.). (2013). Building Urban Resilience: Principles, Tools, and Practice. World Bank, Washington, DC.
7. Rosenzweig, C., Solecki, W. D., Hammer, S. A., & Mehrotra, S. (Eds.). (2011). Climate Change and Cities: First Assessment Report of the Urban Climate Change Research Network. Cambridge University Press.
8. Meerow, S., Newell, J. P., & Stults, M. (2016). Defining urban resilience: A review. *Landscape and Urban Planning*, 147, 38-49. doi:10.1016/j.landurbplan.2015.11.011
9. Meerow, S., & Newell, J. P. (2019). Urban resilience for whom, what, when, where, and why? *Urban Geography*, 40(3), 309-329. doi:10.1080/02723638.2016.1206395
10. Ahern, J. (2011). From fail-safe to safe-to-fail: Sustainability and resilience in the new urban world. *Landscape and Urban Planning*, 100(4), 341-343. doi:10.1016/j.landurbplan.2011.02.021
11. Gill, S. E., Handley, J. F., Ennos, A. R., & Pauleit, S. (2007). Adapting cities for climate change: The role of the green infrastructure. *Built Environment*, 33(1), 115-133. doi:10.2148/benv.33.1.115
12. Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., Haase, D., Knapp, S., Korn, H., Stadler, J., Zaunberger, K., & Bonn, A. (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas: Perspectives on indicators, knowledge gaps, barriers, and opportunities. *Ecology and Society*, 21(2), 39. doi:10.5751/ES-08373-210239
13. Raymond, C. M., Frantzeskaki, N., Kabisch, N., Berry, P., Breil, M., Nita, M. R., Geneletti, D., & Calfapietra, C. (2017). A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. *Environmental Science and Policy*, 77, 15-24. doi:10.1016/j.envsci.2017.07.008
14. Demuzere, M., Orru, K., Heidrich, O., Olazabal, E., Geneletti, D., Orru, H., Bhawe, A. G., Mittal, N., Feliu, E., & Faehnle, M. (2014). Mitigating and adapting to climate change: Multi-functional and multi-scale assessment of green urban infrastructure. *Journal of Environmental Management*, 146, 107-115. doi:10.1016/j.jenvman.2014.07.025
15. Hamin, E. M., & Gurran, N. (2009). Urban form and climate change: Balancing adaptation and mitigation in the U.S. and Australia. *Habitat International*, 33(3), 238-245. doi:10.1016/j.habitatint.2008.10.005
16. Bulkeley, H., & Tuts, R. (2013). Understanding urban vulnerability, adaptation and resilience in the context of climate change. *Local Environment*, 18(6), 646-662. doi:10.1080/13549839.2013.788479

17. Satterthwaite, D., Huq, S., Pelling, M., Reid, H., & Romero Lankao, P. (2007). Adapting to Climate Change in Urban Areas: The Possibilities and Constraints in Low- and Middle-Income Nations. International Institute for Environment and Development, London.
18. Seto, K. C., Guneralp, B., & Hutyra, L. R. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences*, 109(40), 16083-16088. doi:10.1073/pnas.1211658109
19. McPhearson, T., Pickett, S. T. A., Grimm, N. B., Niemela, J., Alberti, M., Elmqvist, T., Weber, C., Haase, D., Breuste, J., & Qureshi, S. (2016). Advancing urban ecology toward a science of cities. *BioScience*, 66(3), 198-212. doi:10.1093/biosci/biw002
20. Adger, W. N. (2000). Social and ecological resilience: Are they related? *Progress in Human Geography*, 24(3), 347-364. doi:10.1191/030913200701540465
21. Fussler, H.-M. (2007). Vulnerability: A generally applicable conceptual framework for climate change research. *Global Environmental Change*, 17(2), 155-167. doi:10.1016/j.gloenvcha.2006.05.002
22. Davoudi, S. (2012). Resilience: A bridging concept or a dead end? *Planning Theory and Practice*, 13(2), 299-333. doi:10.1080/14649357.2012.677124
23. Sharifi, A. (2019). Resilient urban forms: A review of literature on streets and street networks. *Building and Environment*, 147, 171-187. doi:10.1016/j.buildenv.2018.09.040
24. Sharifi, A. (2019). Resilient urban forms: A macro-scale analysis. *Cities*, 85, 1-14. doi:10.1016/j.cities.2018.11.023
25. Anguelovski, I., Shi, L., Chu, E., Gallagher, D., Goh, K., Lamb, Z., Reeve, K., & Teicher, H. (2016). Equity impacts of urban land use planning for climate adaptation: Critical perspectives from the global north and south. *Journal of Planning Education and Research*, 36(3), 333-348. doi:10.1177/0739456X16645166
26. Revi, A., Satterthwaite, D. E., Aragon-Durand, F., Corfee-Morlot, J., Kiunsi, R. B. R., Pelling, M., Roberts, D. C., & Solecki, W. (2014). Urban areas. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. Cambridge University Press.
27. OECD. (2020). *Cities in the World: A New Perspective on Urbanisation*. Organisation for Economic Co-operation and Development, Paris.
28. UN-Habitat. (2020). *World Cities Report 2020: The Value of Sustainable Urbanization*. United Nations Human Settlements Programme, Nairobi.
29. Pelling, M. (2003). *The Vulnerability of Cities: Natural Disasters and Social Resilience*. Earthscan, London.
30. IPCC. (2023). *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva. doi:10.59327/IPCC/AR6-9789291691647