HABITAT III POLICY PAPER FRAMEWORK

8 – URBAN ECOLOGY AND RESILIENCE

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(not edited version)

This Habitat III Policy Paper Framework has been prepared by the Habitat III Policy Unit 8 members and submitted by 31 December 2015. It has followed the Habitat III Policy Paper Framework template provided by the Habitat III Secretariat to all Habitat III Policy Units[1].

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The composition of the Policy Unit 8 can be consulted at www.habitat3.org

[1.] Note by the Secretariat: In specific cases slightly changes to the Habitat III Policy Paper Framework template have been accepted such as addition of executive summaries, introductions, bibliography, etc. However all frameworks have been adapted to the three basic expected accomplishments: challenges, priorities and implementation. The Habitat III Policy Paper Framework template can be consulted at: www.habitat3.org

Introduction

By the middle of this century, an estimated 70% of the global population of 9 billion will live in urban areas. Many of these urban settlements are already in fragile ecosystems and disaster-prone areas, putting an unprecedented number of people at risk.

The ecological health of urban areas is a crucial component of ensuring that these habitats thrive as supportive and productive systems. Many pressures currently exist, from population growth to environmental change, and others will arise in the coming decades. Climate change alone will place new social, fiscal and political pressures on urban systems, with a ten-fold increase in flood-related losses to $52 billion by 2050, and forty percent of urban residents affected by water stress.

Seventy percent of the urban infrastructure that will exist in 2050 has not yet been built, so there is a significant opportunity to create new urban landscapes, both in new and existing cities that take into account urban ecology and resilience principles.

Key concepts

Urban ecology

Urban ecology is the systems-based understanding of biotic and physical elements that occur in urban areas. It recognizes the interaction between natural systems and social and cultural systems, and many others. Urban ecology places particular importance on natural ecosystems and the primacy of natural systems in contributing to livelihoods, wellbeing and resilience.

Resilience

Resilience is both a complex and dynamic system-based concept, used in different ways in a variety of disciplines, and a simple concept, referring to the ability of a system to return to a previous state following a shock. More usually in relation to urban systems, it refers to the potential for individuals, communities, and ecosystems to recover from a range of shocks and stresses. At the urban scale, various frameworks have been proposed, but what most of them have in common is an acceptance that resilience requires both 'hard' protective infrastructure and 'soft' systems such as knowledge and institutions. The concept of resilience when applied effectively can provide a useful base for more substantial changes in the underlying social, political and economic drivers of risk and vulnerability.

Factors that influence resilience of people include the functions, organizational structures, physical entities, and spatial scales[i] of the places they inhabit. A resilient system can continually survive, adapt and grow in the face of disturbances in an integrated and holistic manner for the well-being of the individuals and collectives. Those disturbances may be discrete and temporary, such as a natural disaster, or endure over a longer period, such as a shift in climate.

Resilience and urban ecology have overlapping characteristics. They both are founded on systems (ie the interrelationships) of the city, its people and its landscape, and both are fundamental to well-being and transformative change at an urban scale. This policy unit thus sees urban ecology and resilience operating in tandem in cities, and will not analyse as two distinct 'issues'.

1. Challenges: Identify challenges, including structural and policy constraints	
Vision	There needs to be a global paradigm shift in the way we build cities: i. The future city will be designed for improved urban ecology and resilience with multiple benefits that simultaneously address long-term economic development, social equity and environmental quality. ii. The future city will be resilient on a number of scales: neighbourhood, district, city, region. iii. The city will maximize the advantages of its natural environment. iv. The city will reflect local culture and emerging demographics, and its residents will be educated and aware of the need for resilience. v. The city will have green infrastructure, accessibility and mobility, good urban form, greater collaboration between stakeholders and empowerment of marginalized communities vi. The city will harness the available potential of renewable energy to meet growing demands in an environmentally-sustainable, cost-effective and secure manner. vii. The city will be developed through processes of preparedness and adaptive mitigation privileging design methodologies and capable of responding to shocks and stresses. viii. Legal and institutional development, governance and policy coordination will accompany technological innovation towards enhanced resilience, increased community participation and reduction of environmental impact.
a. Review of the Habitat III issues papers	**a.1 Main recommendations from the issue papers:** i. A review of the eight Millennium Development Goals (MDG) and the seventeen Sustainable Development Goals (SDG) reveals an obvious paradigm shift. The SDGs[1] reflect the increasing level of awareness and concern about the effect of development

[1] http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

	efforts and natural phenomena such as climate change on the global environment. The SDGs explicitly address cities in Goal 11: 'Make cities and human settlements inclusive, safe, resilient and sustainable,' and include related and inter-linked goals on sustainable consumption and production, poverty reduction, water management, and resilient infrastructure. ii. The three Habitat 3 Issue Papers most closely related to Policy Unit 8 are papers 15, 16, and 17.[2] The papers identify the challenges to be met to achieve the SDGs and look carefully at the issues and opportunities of urbanization, including the effects of climate change on ecology and resilience. iii. Issue Paper 15 on Urban Resilience highlights the effect of ecosystem degradation and the loss of ecosystem services on urban resilience, and the importance of enabling city systems to withstand and recover quickly from multiple and varied shocks and stresses. iv. Issue Paper 16 notes that the rapid and extensive changes over the past 50 years threaten the ecosystems that support human well-being. It proposes that urbanization planning needs to shift toward a more ecosystem-oriented approach. v. Issue Paper 17, *Cities and Climate Change and Disaster Risk Management,* notes that awareness and knowledge of the vulnerabilities of urban populations to the impacts of climate change and disaster risk needs to increase, and translation of knowledge into practice is needed. Population growth, the need for adaptation, and development deficits caused by human and financial resource shortages all contribute to the urgency for better risk management. vi. The strong linkage to other Issue Papers on topics such as governance (6), urban and spatial planning (8), public space (11), infrastructure (18) and smart cities (21) among others underscores the pivotal role of ecology and resilience in the New Urban Agenda.

[2] http://www.habitat3.org

b. Review / analysis of key publications / documents	**b.1 Key challenges highlighted by the existing research** Implementing a paradigm shift in the way cities are built above will require addressing diverse challenges ranging from governance to planning to livelihoods and consumption. The following section describes many of these challenges in order to inform our policy priorities, noting that each city will face a unique cultural, natural and socioeconomic context: 1.b.1 Governance i. Lack of coherence, coordination, collaboration and overlap between different authorities and sectors (e.g. health, environment, energy, transport and housing) ii. Limited decentralization and lack of empowerment of local authorities and local communities. Scale of decision-making and scale for action often not aligned, iii. Limited roles for diverse local actors within cities (women, grassroots, other marginalized groups) iv. Too many vested interests that provide resistance to transformation and new approaches v. Limited attention to environmental management on political agendas and short-term perspective on use of natural resources vi. Inadequate legal and institutional framework; poor and weak inter-agency coordination and collaboration vii. Overlapping and conflicting administrative structures viii. Lack of financial discipline ix. Jurisdiction challenges where ecological and administrative boundaries conflict 1.b.2 Policy i. Policies overly or insufficiently 'top-down' – need balance between institutional policies and grassroots participation ii. Lack of integration of policy issues such as environmental management , urban health, ecosystems services and disaster reduction into other policy areas, weak link between resilience and green growth iii. Policies limited in scope, non-inclusive, and non-participatory (e.g. with women and other marginalized groups) iv. Policies fragmented, conflicting, weak and/or lack coordination and enforcement v. Lack of policy on urban health and poor management of extreme health events vi. Limited compliance with and enforcement of policies

	vii. Limited awareness and education of the public and policymakers viii. Lack of inclusion of ecosystem services in urban policies and management 1.b.3 Capacity i. Lack of financial resources to dedicate to urban ecology and resilience because they are seen as non-essential ii. Lack of contextually specific tools (both place-specific and culture-specific) iii. Silos between disciplines: little collaboration; little coordination iv. Limited knowledge of urban ecology and resilience by public and those involved in urban management v. Lack of information available to local communities 1.b.4 Planning i. Tenure and property rights regimes that limit coherent planning or create perverse incentives ii. Land conversion and land degradation patterns that reduce resilience and threaten local food security iii. Need for systemic planning which simultaneously integrates housing, transport, energy and green systems iv. Need to recognize interdependence of urban and rural areas in terms of ecological and resilience effects including migration, food security, water management, etc. v. Lack of enforcement of land use zoning and management of illegal settlement and encroachment vi. Urban planning culture and practices are slow to change and adapt vii. Unsustainable land use practices such as development of greenfields instead of brownfields 1.b.5 Infrastructure i. Inadequate infrastructure to deliver accessible, reliable, cost-effective, and resource-efficient services ii. Lack of adaptable infrastructure that can respond to effect of changes, such as changing climate iii. Limited funding for ambitious investments in more resilient infrastructure iv. Lack of understanding of the long-term cost-benefit analysis of infrastructure 1.b.6 Environment

	i. Increased shocks and stresses requiring adaptation i. Mitigation of climate change may carry significant costs ii. Pollution of rivers and streams with impacts on green space iii. Lack of efficient waste management systems iv. Environmental inequality and injustice v. Spread of unplanned habitation that adversely affects resources vi. Negative aspects of urban environment on ecosystem and human health such as pollution, congestion, radiation, glare, damage from unsafe structures, loss of ecosystem services vii. Low quality and accessibility of green space 1.b.7 Culture, Livelihoods and Consumption i. Unsustainable lifestyles and consumption patterns ii. Inequality and lack of equitable accessibility iii. Low levels of public awareness on resilience and the link between ecosystem services and urban residents iv. Resistance to change v. Unemployment vi. Poverty vii. Discrimination based on race, gender, ethnicity, etc. viii. Cultural/ethnic constraints
c. Identify examples, projects, practices	**c.1 List of examples/projects** Fundamentally there is diversity between cities in terms of environmental landscapes, land uses, land tenure, use and management of green structures, and contribution to environmental degradation and/or enhancement, economy, and governance. Here we will include case studies from a number of different city types with unique challenges.

d. Identify research and data	**d. 1. SGD goals and targets** A review of the eight Millennium Development Goals (MDG) and the seventeen Sustainable Development Goals (SDG) reveals an obvious paradigm shift. The SDGs reflect the increasing level of awareness and concern about the effect of development efforts and natural phenomena such as climate change on the global environment. The SDGs explicitly address cities in Goal 11: 'Make cities and human settlements inclusive, safe, resilient and sustainable,' and include related and inter-linked goals on sustainable consumption and production, poverty reduction, water management, and resilient infrastructure.
	d.2 List of other indicators to be taken into account Resolving the challenges outlined above should ideally be informed by appropriate data, preferably disaggregated in meaningful ways such as by gender, place, and culture. Where comprehensive data is lacking, it is essential that policymakers are able to move forward with the best information currently available and learn to function with a level of uncertainty, as changes in the global environment dictate that adaptive mitigation efforts be made without full certainty of the outcomes. Meanwhile, efforts should be made to gather data through innovative and participatory means that will inform policymakers of trends and impacts and allow for feedback and iteration.
2. Priorities: Identify the policy priorities & critical issues for implementation of a new urban agenda	
a. Establish criteria for identifying policy priorities	**a.1 List of criteria (see Annex 1)** • Impact • Equity • Feasibility • Diversity

	• Co-benefits • Transformability • Replicability
b. Define key transformations to achieve by policy priorities	**b. 1 List of key transformations** 2.b.1 Governance i. The national governance context should enable strengthened urban policies through improved stakeholder coordination and empowerment of local authorities and communities with appropriate resources and incentives and decision-making power. There should be greater overlaps in governance layers with fewer hierarchies. ii. Environmental, climate, and disaster risk management should be integrated, with broad participation by stakeholders enabling transformative change to occur at the individual, corporate, neighbourhood, community and local government levels. iii. Greater authority and finance for managing and enforcing land use, property rights and environmental services should be devolved to the level of the municipality or metropolitan area. iv. Problems should be considered through multiple lenses and knowledge gaps identified and addressed. 2.b.2 Policy i. Policies for resilience of cities should be refined specifically to the place; they should relate closely to sustainable development and appropriate use of resources; incorporate integration of environmental, climate, disaster risk management, economic, and social objectives; consider the wider system and connectivity to rural areas; and be supported by a comprehensive and tailored "how to" menu of recommendations. ii. Governments and policymakers should be more explicit about climate change adaptation, with a sense of urgency and dedicated time and resources to restore what has already been damaged. iii. Urban form should take shape in collaboration with residents and other stakeholders to make it resilient and locally relevant. Citizens should be more involved in policy formulation and implementation. Both governments and multilaterals should listen to and consider the voices of communities, especially women, grassroots and marginalized groups who may. Those who do not

	have a theoretical knowledge but have practical experience of daily challenges need to be heard. iv. Policy needs to emphasize preparedness and mitigation of risks in addition to responding to shocks and stresses (adaptive mitigation). v. Update and enforce relevant policies as context changes, such as appropriate building codes that reflect both affordability and safety, and that are low-carbon and climate resilient. vi. Policy needs to create market-based mechanisms to price in environmental 'externalities' vii. Policy needs to be planned at regional and cross-border scales. viii. Incorporate principles of resilience into policymaking: diversity, redundancy, modularity, feedback sensitivity, capacity for adaptation, environmental responsiveness and integration.3 ix. Include spatial designers at earlier stages in the policy process. 2.b.3 Capacity i. Build capacity, knowledge and instruments for individuals, communities and organizations to manage urban ecosystems for reduction of resilience to shocks and stresses ii. Provide investment in infrastructure and environment based on an understanding of which communities are most at risk. iii. Increase education about urban ecology and resilience at all age levels, from primary school through universities and continuing education. iv. Encourage the use of Information and Communication Technology tools to enhance and enable resilience. v. Promote research and data-gathering on urban ecosystems and resilience. vi. Increase the financial management and revenue-raising capacity of local authorities to create the resources needed for investment. vii. Develop community funds to support investments in resilience. viii. Invest in the capacity of marginalised groups (e.g. women, indigenous people) to influence the formulation, implementation

[3]From resilientcity.org

	and monitoring of resilience policies and measures for adaptation, mitigation of shocks, and recovery. ix. Create mechanisms for assessing indicators and feedback. x. Integrate diverse disciplinary approaches for improved understanding and ideas. 2.b.4 Planning i. Urban planning models should be more efficient, adaptable, creative and inclusive in order to better respond to urban shocks and stresses. ii. Assess the cost-effectiveness of hybridised natural ecologies before using other means to solve urban problems iii. Good urban form should consider accessibility and zones based on walking, cycling, public transport, and transport of goods and services in resource and energy-efficient ways. iv. Increase low-carbon urban planning. Make use of renewable energies appropriate to the specific context. Promote use of energy-efficient and safe buildings through planning. v. Set targets for achieving and maintaining a specific amount and geographic distribution of open space and public space. vi. Ensure that planning decisions are adaptable. vii. Recognise the potential benefits of both self-sufficiency and connectivity in planning decisions viii. Ensure that policies address degrading urban environments under multiple and mixed property rights systems. ix. Address urban-rural linkages and explicitly consider these relationships in building and reinforcing resilience. x. Encourage tenure systems that do not exclude the poor and women from owning and controlling land, including farmland. xi. Planning should be considered integratively and collaboratively in the urban system. 2.b.5 Infrastructure i. Investments should be made in sustainable and efficient infrastructure that can meet growing demands for services such as energy, water, and food, while ensuring environmental sustainability and climate resilience. ii. Create enabling conditions for the development of renewable energy infrastructure and energy efficiency measures through dedicated policies and regulations, and innovative models of ownership and financing.

	iii. Formulate clear targets (e.g. on energy, mobility, density) to set the direction for current and future action. iv. Allow for variability in infrastructure to accommodate local ecosystems. 2.b.7 Environment i. Work towards integrated hybrid ecosystems in cities through both new design and retrofitting of existing structures. ii. Design open space that integrates daily amenities and provides co-benefits for resilience. iii. Realize the potential of cities to function as vehicles of transformation towards green growth. iv. Maximize diversity in physical environment. v. Utilize locally relevant tools for valuing ecosystems services to inform planning. vi. Provide opportunities for slow adaptation that allows feedback into the system. 2.b.8 Culture, Livelihoods and Consumption i. Support social resilience to enhance the ability of individuals, households, communities and organizations to respond to shocks and stresses. ii. Ensure that human health and well-being are incorporated into assessment and planning processes. iii. Empower women and marginalized communities to actively participate in the formation of urban structure and function. iv. Catalyze behaviour changes that enable a healthier urban ecology and enhanced resilience.
c. Identify common external factors favourable to the success of the policy priorities	**c. List of external factors** These priorities need to be coordinated with the priorities of other policy papers in order to provide a coherent view of overall prioritization of resources. Priorities need to acknowledge that every city and every community is different, and every part of every city is different. Cities need to develop their own specific strategies for resilience, but most importantly tie these strategies into existing priorities for change in governance, planning, and cultural practice.

3. Implementation: Develop action-oriented recommendations	
a. Identify key actions at all levels of implementation	**a.1 Key recommendation for action** <u>a.1 Create an enabling framework</u> • Design a systematic and ongoing public participation process • Consider national high-level expert panel to support the framework i. Many of the necessary activities that need to be implemented to enhance urban ecology and resilience depend on the existence or creation of an appropriate enabling framework. This type of enabling setting can only evolve over time, and in association with broader processes that incorporate higher levels of public participation and increase both the responsibility and accountability of local or municipal governments. At the same time, these need to be supported by national policies and international frameworks that facilitate local and municipal actors to take these actions. ii. An extensive body of evidence points to the centrality of broad stakeholder and public participation – in particular engagement of both women and men, and of different age groups including the young and the elderly – as a key factor influencing the extent to which environmental issues of various types are prioritised in urban development. The Towards a Green Economy report concluded: a. *Only a coalition of actors and effective multilevel governance can ensure the success of green cities. The most important fundamental enabling condition is a coalition of actors from the national and local state, civil society, the private sector and universities who are committed to advancing the green economy and its urban prerequisites*."[4] iii. In many cases, there are tensions between the capacities and responsibilities of local and municipal governments. Municipal

[4] *Towards a Green Economy.*

	authorities may be responsible for managing the urban environment, but frequently have little influence in determining the overall legal or policy framework.[5] Where municipal authorities are given greater responsibilities – for example in being able to issue Green Bonds or similar financial instruments – this can greatly enhance their capacity to act effectively. iv. At the same time, mechanisms that encourage active civil society and private sector engagement in decision-making about urban ecological and resilience concerns can help to ensure that interventions achieve their goals. Firstly, effective citizen engagement in project identification and prioritisation is likely to ensure that actions are based on a shared vision and meet the needs of all urban residents. Secondly, the inclusion of civil society and the private sector in the implementation of activities means that there is likely to be greater 'ownership' of these interventions, and that they will be maintained and protected more effectively, in part because the capacity of various actors will be strengthened to take proactive measures. And finally, if urban residents perceive that interventions are contributing to their wellbeing they may be more likely to be directly involved in the implementation and maintenance of ecological and resilience projects, potentially generating cost savings. v. Examples of this type of mechanism include national forums bringing together different cities and researchers like Finland's Hinku process,[6] national sustainable development commissions,[7] and expert panels which connect the latest research and innovation to policymaking.[8] <u>a.2 Planning and designing interventions</u> • Use multi-stakeholder approach and public participation process to shape interventions • Develop appropriate policy instruments

[5] *Integrating the environment in urban planning and management.*
[6] http://www.hinku-foorumi.fi/en-US
[7] For example, http://www.ym.fi/en-us/The_environment/Sustainable_development
[8] For example, Finland's panel on climate change http://www.ilmastopaneeli.fi/fi/in-english/

	• Set targets, criteria, and monitoring indicators • Include ex ante evaluations for the interventions to identify expected and unexpected, direct and indirect impacts • Consider nature-based solutions and circular economy to ensure green growth and sustainable development • Ensure interventions contribute to all dimensions of sustainable development, including social wellbeing, livelihoods, and ecological boundaries Targets can set the direction of current and future local action. Local governments can set targets through integration into municipal operations, into city strategies and plans, or through sector-specific targets. For example, Malmö in Sweden set targets for climate neutrality and 100% renewable energy that are integrated and mainstreamed across the city's plans.[9] Regulation can also be used to require a certain action without narrowly prescribing how the action shall be implemented. In this manner, regulation can stimulate innovation. Sao Paulo created a Solar Ordinance that all new residential, commercial and industrial buildings must install solar water heating systems to cover at least 40% of the energy used for heating water. The regulation stimulated market demand for this technology and caused a reduction in the production costs, and is being replicated in other Brazilian cities.[10] <u>a.3 Implementing activities</u> • Engage relevant planning and management organizations in operationalizing interventions to implementable actions • Create long-lasting, cross-sector and public-private working groups to oversee implementation • Allocate appropriate capacity to implement • Ensure activities contribute to economic, social and ecological sustainability, including climate-smart and climate-resilient solutions Coordinate effectively among different groups and agencies

[9] Source: IRENA (2013), Renewable Energy Policy in Cities: Selected Case Studies (Available at: http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=286

[10] Ibid.

	Examples of coordination include the climate change coordination offices established in three Vietnam cities through ACCCRN, and the creation of a coordination mechanism to manage water and early flood warnings in Surat, India.
b. Analyse financial resources required and instruments for their sustainability	**b. 1 Financial resources (see Annex 2)** <u>Examples of financial instruments to support policies</u> i. Municipal Green Bonds ii. Transferable development rights (TDR) iii. Insurance iv. Contingent credit facilities vi. Carbon credits vi. 'Pay-as-you-save' and 'pay as you go' schemes
c. Establish indicators of successful implementation, monitoring and evaluation	**c.1 Indicators of success (see Annex 3)** A wide range of indicators can be used to track progress towards more ecologically friendly and resilient cities. These include household indicators for consumption, urban circular economy indicators, sustainable land use planning criteria and indicators, and monitoring of sustainable urban zonation. In addition, specific mechanisms and approaches have been developed to track the usage of particular resources in cities, to measure resilience, and to assess overall progress towards sustainability. Indicator frameworks for urban ecology and resilience: • City Resilience Framework – Arup • Global Initiative for Resource Efficient Cities • Sustainable development of communities – indicators for city services and quality of life (IS037120)

Annex 1

Criteria for the establishment of priority strategies	Demonstration of criteria	Significance
2.a.1 Impact	The success of any strategy will be determined by its uptake within the community and the potential for behaviour change within any city. To achieve this, all strategies should demonstrate not only technical merit, but also their potential to effect change, and should be accompanied by a communication strategy.	Impact is of high significance: a policy or strategy will only have merit when both its benefits and impact are recognised.
2.a.2 Equity	Strategies should demonstrate that they can have an effect for all socio-economic groups; and that vulnerabilities of all are addressed. Policies should recognise a universal 'par' whereby threats affecting developing nations can be addressed for significance against those of developed nations.	Equity targets will need global agreement.
2.a.3 Feasibility	Strategies should be developed on the basis that they are implementable within strict timeframes	Feasibility will need to be worked out with economic targets
2.a.4 Diversity	Strategies should demonstrate that they accommodate all cultures, and do not disadvantage any culture.	Diversity targets will vary from place to place.
2.a.5 Co-benefits	Strategies should demonstrate co-benefits: e.g. they will have positive impacts for sustainability, social equity, and / or environmental health, while addressing vulnerabilities.	Fundamental to successful application of resilience principles is recognition of co-benefits in strategies
2.a.6 Transformability	All policies and strategies should demonstrate the potential for transformation of communities, not just change for physical environment	Important, but may vary from place to place.
2.a.7 Replicability	Strategies should be implemented on the basis that they can be repeated, so lessons learnt can be well understood and used for future initiatives.	Importance will vary from place to place

Annex 2

Examples of instruments to ensure financial sustainability of intervention

Instrument / Mechanism	Definition	Contribution to ecology and/or resilience	Examples of cities where implemented
i. Municipal Green Bonds	A municipal bond is a security or debt obligation issued by a local (usually city) government. The investor effectively lends money to the local government, in return for which they are paid a specified amount of interest until the bond's maturity date, when the principal is repaid to the investor. For a 'green' municipal bond, the loan must be used to finance environmentally-friendly infrastructure.	A municipal bond raises the finance for local governments to invest in infrastructure. The green label requires that this infrastructure has a positive impact on the environment. Green municipal bonds have been used for bioenergy, solar and wind power, improving the energy efficiency of buildings, and low-carbon public transport systems such as hybrid buses.	Johannesburg (South Africa), Gothenburg (Sweden), Spokane (USA)
ii. Transferable development rights (TDR)	TDR is a land zoning or planning tool used to manage spatial development by re-directing new developments to sites that are less socially, culturally or environmentally sensitive. Essentially, the right to develop one particular area (the 'sending area') is transferred to another area (the 'receiving area'). The person or institution who owns the sending area is compensated for the loss of those development rights with a share of revenue generated from development in the receiving area.	TDR provides a way to protect ecosystems that contribute to resilience, such as wetlands that absorb excess run-off during heavy rains and therefore reduce flooding. TDR has also been used in Mumbai to protect informal settlements from being relocated and to generate revenue for upgrading.	Mumbai (India), Hong Kong (China), Tokyo (Japan), New York (USA)

iii. Insurance	Insurance is an arrangement whereby an institution agrees to provide compensation for a specified event, such as a hurricane or tsunami, in return for regular payments. This permits cities or other actors to transfer much of their risk to insurers and reinsurers.	While households, local governments, businesses and other actors will still bear much of the impact of shocks, insurance transfers many of the financial costs of these shocks to another party. By paying for rebuilding, health care and other costs after an event, insurance can facilitate recovery.	Insurance is typically taken out by individual actors (households, businesses, etc) through commercial insurers, but city governments can support this through information and enabling financing mechanisms.
iv. Contingent credit facilities	Contingent credit facilities allow a government body to 'draw down' funds in the immediate aftermath of a natural disaster, such as an earthquake or cycle. To date, this facility has usually been attached to a larger loan through a multilateral development bank, and the government can access this line of credit only in the event of an emergency.	Contingent credit reduces the scale of reserves that a government needs to have available, while ensuring enough liquidity to launch an emergency response and begin recovery in the event of a shock. In other words, contingent credit provides a government with the finance to immediately respond to events rather than have to negotiate terms with prospective lenders.	Seychelles, Fiji and Peru
vi. Carbon credits	A carbon credit is a financial instrument that represents one tonne of carbon dioxide equivalent being removed from the atmosphere through sequestration or not being emitted through choice of a low-emission technology. A carbon credit can be sold by the actor who has avoided or removed one unit of CO_2 emissions to another actor, who can offset the reduction against their own carbon footprint.	The resources from carbon credits can be used to finance mitigation projects that enhance resilience, such as waste-to-energy infrastructure that both reduces the size of landfills (and therefore risk of disease) and generates energy that can support development.	Chandigarh (India), Hefei (China),

vi. 'Pay-as-you-save' and 'pay as you go' schemes	'Pay as you save' and 'pay as you go' schemes aim to spread the costs of infrastructure over a substantial period of time. A body with large financial resources provides the capital investment, and is repaid in small instalments by the user/owner.	'Pay as you save' and 'pay as you go' schemes help to finance the high upfront costs of new infrastructure that can enhance resilience. For example, it can fund retrofitting to improve building efficiency so that households are less vulnerable to extreme temperatures and energy price shocks, or it can fund new infrastructure to improve households' access to energy and water.	'Pay as you save' is widely used in the UK to cover the costs of refurbishing houses to improve their energy efficiency. 'Pay as you go' is widely used in sub-Saharan Africa to cover the costs of solar home systems.

Annex 3

Table of indicator frameworks for urban ecology and resilience:

Indicator Framework	Key elements covered	Source / Comments
City Resilience Framework – Arup	Assesses resilience according to four over-arching themes: leadership and strategy; health and wellbeing; economy and society; urban systems and services. Each of these is composed of a range of sub-themes and a further set of specific indicators.	Open access: www.arup.com/cri
Global Initiative for Resource Efficient Cities	Using the strategic advantage of cities, the GI-REC aims to support the development of "resource efficient cities" where such cities are defined as those that "combine greater productivity and innovation with lower costs and reduced environmental impacts, while providing increased opportunities for consumer choices and sustainable lifestyles" (IRP Working Group on Cities). The Initiative encourages stakeholders to reimagine the lifestyles, processes, and physical structures of cities, to promote more sustainable use of current resources. It also provides avenues for cities to contribute to global environmental goals. The GI-REC is currently piloting a toolkit/approach to measure resource efficiency at city level.	Unpublished draft available here.
Sustainable development of communities – indicators for city services and quality of life (IS037120)	A set of quantitative indicators covering economy, education, energy, environment, finance, fire and emergency response, governance, health, recreation, safety, shelter, solid waste, telecommunication and innovation, transportation, urban planning, wastewater, water and sanitation.	Published by International Standards Organisation