Making cities in conflict areas more resilient

A conceptual iteration: using the Climate Resilience and Security Monitor for policies in practice

The Hague Centre for Strategic Studies

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INITIATIVE

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Summary

By 2050, the UN estimates that 70 percent of the global population will be living in urban areas. Therefore, understanding and anticipating the ability of cities to manage and avoid the negative effects of climate-related changes and events – for example, hurricanes, overpopulation or supply chain disruption – is of utmost importance. This paper presents a conceptual framework to empirically quantify the climate resilience of cities to guide policy makers and community leaders in identifying challenges and opportunities.

This paper introduces the concept of urban resilience. This should be understood as a continuous process with three dimensions: **maintaining** – the ability of an urban area to endure the effects of an event and maintain the normal functioning of the urban environment; **recovering** – the speed at which an urban area is able to restore the normal functions of the urban environment and return to its pre-event state; **learning** – the ability to translate lessons learned from past experiences into actionable policy making and to implement those policies.

Each dimension of urban resilience is divided into critical functions that a city should ideally provide in order to be resilient. For each of these functions, corresponding indicators measure the degree to which the capacity is mature. With this information, this paper introduces a first conceptual iteration of a Climate Resilience and Security Monitor that could be used by policy makers and urban planners.

On the basis of the research, some important observations and recommendations are made. When tested, the analysis revealed that the level of resilience did not necessarily correspond to economic development; it also found that conflict significantly lowered overall urban resilience to climate-related impacts. Large sprawling cities typically score poorly on maintaining resilience. While recovery and learning capacities are usually present in urban areas, very dense urban areas are particularly vulnerable to climate disasters. Cities in the global north have built learning capacity; they have made efforts to share best practices (e.g., the Rockefeller Foundation's Resilience initiative, efforts by UN CPI and CRI, etc); and they have considered the lessons learned and implemented guidance. Those efforts should be continued and strengthened.

We attempted to test our framework for data analysis in three cities in conflict-prone territories: Bamako (Mali), Maiduguri (Nigeria, Lake Chad Region) and Baghdad (Iraq). We came to the conclusion that data availability constitutes a fundamental challenge, hence the analysis of the three cities is to be read as a first stab towards a more comprehensive data analysis. Nevertheless, it provides an overview that identifies

more precisely which aspects of resilience are currently lacking in data. In addition, analysis of the three cases suggested that city resilience in those areas cannot be developed without addressing the root causes of conflict in the entire area, as city-level resilience in conflict areas is closely related to the national level.

Data analysis can help to bolster the learning capacity of cities to cope with climate impacts that could increase tensions in large urban areas. However, there is a significant difference the availability of data between the developed and the developing world. Data collection in developing countries (and cities) should be strengthened to better estimate climate-related security risks in urban areas and bolster their capacity to maintain key functions and recover and learn from climate events in their own and comparable cities.

1 Introduction: focusing on urban areas

It is becoming increasingly clear and accepted that climate change can influence and amplify international, regional and local conflict. From the crop failures that preluded the Syrian civil war, environmental degradation that is undermining the tenuous peace in Darfur, and the disastrous humanitarian crisis in the Horn of Africa, climate change can exacerbate or even cause instability, insecurity and conflict. It is therefore paramount to underscore the need to understand the climate change and security nexus.[1] The Planetary Security Initiative (PSI), initiated by the Dutch Ministry of Foreign Affairs, focuses on the issue of conflict and peace in times of climate change and global environmental challenges.

This paper serves as a conceptual iteration with a first suggestion on operationalization of bringing urban climate change resilience and data monitoring together. It aims to use data to monitor the role of cities in conflict and climate change, and to identify possible steps for city planners and municipal decision makers in constructing their policy, through the use of data analysis in order to take action on the ground. The Economics to Planetary Security Monitor (PSI)[2] that was developed for 2016 PSI conference shows the four separate layers of the climate-conflict nexus. Efforts to develop and map resilience options for these threats on a country level is an active area of ongoing research. Given the increasing importance of cities as nexi of economic and social activity, we discuss how the existing country level Economics to Planetary Security Monitor can be expanded, adapted and potentially used in practice at a city level.

With urbanization accelerating, and an expected 70% of the world population living in urban areas by 2050[3], city level analysis is paramount. Urban space is where political allegiances and contestations are forced to take place, since political power is often

1 The relation between climate and conflict sometimes referred to as the climate-conflict nexus, for further reading see: United Nations Office for the Coordination of Humanitarian Affairs, "Understanding the Climate-Conflict Nexus," OCHA Policy and Studies Series (United Nations, May 2016), https://www.unocha.org/sites/unocha/files/Understanding%20the%20climate-conflict%20nexus.pdf. and http://www.un.org/en/events/environmentconflictday/pdf/UNEP_Sahel_EN.pdf.

2 To access the HCSS/Clingendael Economics of Planetary Security Monitor, see here https://dwh.hcss.nl/apps/planetarysecurity/.

3 United Nations, Department of Economic and Social Affairs, and Population Division, *World Urbanization Prospects: The 2014 Revision: Highlights*, 2014.

highly concentrated in urban areas (because of living proximities, more distributed land ownership, informal settlements, etc.). In the event of crop failure, cities are critical as they are not only the terminus for agricultural supply chains, but also destinations for rural populations seeking better prospects. To this end HCSS & Clingendael have developed the Climate Resilience and Security Monitor as a concept and a first effort at quantifying resilience on the sub national level with a focus on urban areas. For the expansion and adaptation of the existing monitor towards a Climate Resilience and Security Monitor that includes data at the city level, we will build upon work already undertaken in this field, in particular those of the 100 Resilient Cities Network and UN-Habitat City Prosperity Index (CPI).

Central to these efforts is the notion of resilience, more specifically urban resilience. As such, a literature review reflects the current discussion on resilience applied to urban areas. This is followed by an analytical framework with a measurement and definition of (urban) resilience with underlying indicators, drawn from the 100 Resilient Cities Network and the United Nations (UN). Since data analysis on the city level is a relatively new field and data availability is often lacking, two different indices will be analyzed. One is a hybrid of both city and national level indicators based on the 100 Resilient Cities Network, and the second is based on several UN efforts. To concretize the discussion and show the challenges and opportunities of such monitoring, we describe both the conceptual framework to measure urban resilience to climate change and examine three categories of cities in Mali, Iraq and Nigeria. To conclude, an overview is provided of how the monitor could be improved to guide future action towards environmental, conflict and economic resilience in conflict prone urban areas.

2 Resilience from national to local level

With the Economics of Planetary Security Monitor[4], it is possible to provide an integrated overview of climate change and security resilience on a country level, consisting of four layers: environmental stress, political conflict, economic stress and overall resilience. For several years, different initiatives have been started to quantify, map and measure possible effects of climate change and resilience at the city level. We look at two initiatives, the 100 Resilient Cities Network and the UN-Habitat City Prosperity Index (CPI), which have the potential to provide (data) input that could be utilized in an urban/city level perspective of resilience. This would allow the current Economics to Planetary Security Monitor to expand with a city level layer and lead to the production of the Climate Resilience and Security Monitor.[5]

Some cities face wider challenges; they not only have to cope with the challenges combating climate change and fostering economic development, but are also confronted with ongoing armed conflicts, either at the city level or impacting it. For these cities, social and violent conflict and its direct impacts is more pressing for policymakers than focusing on long term aspects of resilience. There is academic consensus that there are relationships between climate change and conflict, and that urban resilience is a multidimensional concept that can mitigate the risks of this nexus at the urban scale; therefore, an adequate definition of what 'resilience' and specifically 'urban resilience' entails is required.

Resilience

Developing a monitor requires a wider understanding on the concepts 'resilience' and 'urban resilience'. Looking into the academic literature, a broad definition of today's resilience, applicable to a broad range of systems and disturbances, would *be the ability of a system to react to sudden events resulting in changes, shocks or crises affecting said*

4 HCSS/Clingendael Economics to Planetary Security Monitor, see: https://dwh.hcss.nl/apps/planetarysecurity/.

5 For the HCSS/Clingendael Climate Resilience and Security Monitor see: https://dwh.hcss.nl/apps/planetary_security/.

system[6]. These events can be caused by nature (e.g. weather-related hazards[7]) as well as by humans (e.g. terrorist attacks[8]). Events are often inevitable[9] and the consequences are uncertain[10]. The concept of resilience was first introduced in ecological matters, defined as *the measure of persistence of systems and their ability to absorb change and disturbance and still maintain the same relationship between populations or state variables*.[11] Since then, resilience is applied to multiple different ecological systems, resulting in Holling (1996) to make a distinction between engineering resilience – focusing on the return to the equilibrium after a disturbance – and ecological resilience – believing that there are multiple steady states, reached when disturbance results in major changes in the structure of the system.[12]

Other scholars have challenged these dominant perspectives on resilience by applying it to social-ecological systems,[13] understanding systems as constantly changing in nonlinear ways.[14] In response, a third perspective to resilience has emerged – evolutionary resilience –, challenging the idea of equilibrium and advocating that

6 Richard Friend and Marcus Moench, "What Is the Purpose of Urban Climate Resilience? Implications for Addressing Poverty and Vulnerability," *Urban Climate* 6 (December 2013): 98–113, https://doi.org/10.1016/j.uclim.2013.09.002. Yosef Jabareen, "Planning the Resilient City: Concepts and Strategies for Coping with Climate Change and Environmental Risk," *Cities* 31 (April 2013): 220–29, https://doi.org/10.1016/j.cities.2012.05.004. Jabareen.

7 Richard J. T. Klein, Robert J. Nicholls, and Frank Thomalla, "Resilience to Natural Hazards: How Useful Is This Concept?," *Environmental Hazards* 5, no. 1 (January 2003): 35–45, https://doi.org/10.1016/j.hazards.2004.02.001.

8 Kevin C. Desouza and Trevor H. Flanery, "Designing, Planning, and Managing Resilient Cities: A Conceptual Framework," *Cities* 35 (December 2013): 89–99, https://doi.org/10.1016/j.cities.2013.06.003.

9 J P Evans, "Resilience, Ecology and Adaptation in the Experimental City: Resilience, Ecology and Adaptation," *Transactions of the Institute of British Geographers* 36, no. 2 (April 2011): 223–37, https://doi.org/10.1111/j.1475-5661.2010.00420.x.

10 Friend and Moench, "What Is the Purpose of Urban Climate Resilience?"; Stephen Tyler and Marcus Moench, "A Framework for Urban Climate Resilience," *Climate and Development* 4, no. 4 (October 2012): 311–26, https://doi.org/10.1080/17565529.2012.745389. Eva-Maria Stumpp, "New in Town? On Resilience and 'Resilient Cities,'" *Cities* 32 (June 2013): 164–66, https://doi.org/10.1016/j.cities.2013.01.003. Sarah Orleans Reed et al., "'Shared Learning' for Building Urban Climate Resilience – Experiences from Asian Cities," *Environment and Urbanization* 25, no. 2 (October 2013): 393–412, https://doi.org/10.1177/0956247813501136.

11 C S Holling, "Resilience and Stability of Ecological Systems," *Annual Review of Ecology and Systematics* 4, no. 1 (November 1973): 1–23, https://doi.org/10.1146/annurev.es.04.110173.000245.

12 Crawford Stanley Holling, "Engineering Resilience versus Ecological Resilience," *Engineering within Ecological Constraints* 31, no. 1996 (1996): 32.

13 Carl Folke, "Resilience: The Emergence of a Perspective for Social–ecological Systems Analyses," *Global Environmental Change* 16, no. 3 (August 2006): 253–67, https://doi.org/10.1016/j.gloenvcha.2006.04.002.

14 Sara Meerow, Joshua P. Newell, and Melissa Stults, "Defining Urban Resilience: A Review," *Landscape and Urban Planning* 147 (March 2016): 38–49, https://doi.org/10.1016/j.landurbplan.2015.11.011.

complex systems may change, adapt and transform in response to stresses and strains.[15] With this addition, resilience becomes better applicable to non-ecological systems, such as cities, that do not only change when a certain threshold is reached.

Urban resilience

Given the growing importance of cities,[16] a conceptualization of how urban resilience is different from generalized resilience is required. To further narrow down the definition of resilience to an urban context, an academic literature study is conducted, resulting in the following definition: urban resilience is the capability of a city to maintain during, recover from, and adapt to changes in the system, induced by destructive (climate-related) events. According to the literature[17], urban resilience consists of three dimensions oriented around resilience as a cycle: maintaining, recovering and learning. The first dimension of resilience – maintaining – is about the ability of a city to preserve its essential basic structure, manage a crisis and to keep functioning during and shortly after a destructive event.[18] The second dimension measures the ability of a city to recover from change and to return to the equilibrium or steady-state from before the disturbance[19] – similar to the perspective of engineering resilience, as described in the previous paragraph. The faster a city recovers after an event[20] and the more aspects and functions of the city that can be restored,[21] the more resilient the city is. The third dimension of urban resilience describes the degree to which a city is capable

15 Simin Davoudi et al., "Resilience: A Bridging Concept or a Dead End? 'Reframing' Resilience: Challenges for Planning Theory and Practice Interacting Traps: Resilience Assessment of a Pasture Management System in Northern Afghanistan Urban Resilience: What Does It Mean in Planning Practice? Resilience as a Useful Concept for Climate Change Adaptation? The Politics of Resilience for Planning: A Cautionary Note: Edited by Simin Davoudi and Libby Porter," *Planning Theory & Practice* 13, no. 2 (June 2012): 299–333, https://doi.org/10.1080/14649357.2012.677124.

16 Desouza and Flanery, "Designing, Planning, and Managing Resilient Cities."

17 See bibliography for a comprehensive overview.

18 Rajib Shaw and IEDM Team, "Climate Disaster Resilience: Focus on Coastal Urban Cities in Asia," *Asian Journal of Environmental and Disaster Management* 1, no. 2009 (2009): 101–16. Jabareen, "Planning the Resilient City." Lawrence J. Vale, "The Politics of Resilient Cities: Whose Resilience and Whose City?" *Building Research & Information* 42, no. 2 (March 4, 2014): 191–201, https://doi.org/10.1080/09613218.2014.850602. Arjen E. J. Wals, ed., *Social Learning towards a Sustainable World: Principles, Perspectives, and Praxis* (The Netherlands: Wageningen Academic Publishers, 2007), https://doi.org/10.3920/978-90-8686-594-9.

19 Davoudi et al., "Resilience." Shaw and IEDM Team, "Climate Disaster Resilience: Focus on Coastal Urban Cities in Asia." Vale, "The Politics of Resilient Cities."

20 Davoudi et al., "Resilience."

21 Vale, "The Politics of Resilient Cities."

of learning from former changes.[22] This includes changing, adapting and transforming in response to the endured stresses, in order to become more resilient in the future.[23] This corresponds with the evolutionary perspective of resilience, believing that changes in the system are inevitable and can be desirable. These three dimensions will form the basis of the new developed framework to measure urban resilience, adding to already existing (urban) resilience frameworks. Literature on the topic of resilience in general thus identifies the following taxonomy, with the three key elements[24]:

- **Maintaining:** The ability of an urban area to endure the effects of an event, resist material degradation and continue the normal operation of the urban environment.

- **Recovering:** The speed at which an urban area is able to restore the normal operation of the urban environment and return to the pre-event state of equilibrium.

- **Learning:** The ability to translate lessons learned from past experiences, local or otherwise, into concrete, actionable policy making and execute upon those policies within the context of the urban area.

The three elements can be seen as three successive and partly overlapping processes of (urban) resilience, with 'maintaining' representing the first process of a climate event, 'recovering' the second, and 'learning' as the final stage. In order to achieve each process of resilience, different policy objectives, and therefore dimensions, are relevant. The 'maintaining' and 'recovering' processes could be categorized as elements of crisis management. That is to say, the policy objectives in these stages are *in response* to a crisis, rather than *in anticipation* of a crisis. The degree to which a city is able to maintain its structural and social integrity is largely the function of the magnitude of the event and the overall development level of the city. The recovery stage, similarly, is in response to the specific needs and deficiencies that occur in the wake of an event. These may include the restoration of electrical and water utilities, reconstruction and other activities in order to restore public order and day to day operation of an urban area. The third stage, 'learning', stands apart from the previous two, as its policy objectives pertain to the adaptation of the urban area in anticipation of subsequent events and the overall efforts to mitigate their impacts. Hence this final process is inherently forward looking in

22 Desouza and Flanery, "Designing, Planning, and Managing Resilient Cities." Orleans Reed et al., "'Shared Learning' for Building Urban Climate Resilience – Experiences from Asian Cities." Tyler and Moench, "A Framework for Urban Climate Resilience."

23 Davoudi et al., "Resilience." Davoudi et al. Orleans Reed et al., "'Shared Learning' for Building Urban Climate Resilience – Experiences from Asian Cities."

24 We note that the concept of resilience is dynamic and subject to reinterpretation. The work of Mark Pelling & Arabella Fraser is particularly insightful on this trend.

its attempt to consolidate past experiences and to translate these into actionable points of improvement.

Current efforts at city-level mapping and data collection

While there is a range of tools[25] and there is a proactive attempt to build new tools from a range of actors, within the context of this first conceptualization we chose to focus, for now, on the City Prosperity Index (CPI) and City Resilience Index (CRI). As such, these two indices will form the core of the Climate Resilience and Security Monitor. This is by no means to say that these are the only efforts at mapping city level resilience.

UN-Habitat City Prosperity Index (CPI)[26]

Multiple efforts are underway to generate indices and rankings of cities globally. The UN-Habitat City Prosperity Index is currently the most comprehensive city index that is publically available. Its purpose is to measure the degree to which cities are prospering in terms of development level, inclusivity, rule of law, economic output and environmental policy. While measuring prosperity is not the same as measuring resilience, the data collected in the CPI measures some of the indicators that are relevant in resilience such as infrastructure development and socio-economic equity. As such, the CPI provides a valuable source of data that may be utilized in constructing a city level monitor, even if it conceptually differs in its purpose.

The 100 Resilient Cities City Resilience Index (CRI)[27]

The most comprehensive effort to quantify, map and measure specifically resilience on a city level is currently being conducted within the Rockefeller Foundation's '100 Resilient Cities Network'. The purpose of this network is for cities to define and implement resilience strategies and policies based on their own local problems. In addition, the network serves as a platform to share lessons learned and best practices, as cities in different locations may face similar problems. Measuring resilience within the 100 Resilient Cities Network currently takes place via a composite indicator, the City Resilience Index. The CRI consists of 4 main themes, 12 dimensions and 52 indicators (Figure 1).

25 A non-exhaustive list would include the The World and Region Prosperity City Index (WCPI, RCPI5), The UrbanArk, The Arup and Lloyds City Risk Index, and the Global Infrastructure Basel Foundation (GIB), the ICLEI Transformative Action Programme (TAP).

26 For more information see http://cpi.unhabitat.org/.

27 City Resilience Index, http://www.cityresilienceindex.org/.

Figure 1 The City Resilience Index[28]

While the CRI is specifically aimed at measuring urban resilience it is more suited towards evaluating highly developed cities. As such, it provides a starting point to re-conceptualize resilience to be applicable to the conflict-climate nexus and be more applicable beyond the global north. In order to do so, the different city functions defined in the CRI may be deconstructed into the three processes of resilience, and following this, relevant (and available) indicators may be assigned to measure each of these reallocated city functions.

28 Research conducted within the Rockefeller Foundation's 100 Resilient Cities Network, see http://www.cityresilienceindex.org/.

3 Introducing the Climate Resilience & Security Monitor

For this section, the indicators used to measure the maintaining, recovering, and learning processes have been detailed and adapted into a single monitor. Subsequently, separate case studies will be done to analyze how the monitor can be utilized in four cities with different characteristics.

To properly differentiate between the national level Economics to Planetary Security Monitor and the city level Climate Resilience & Security Monitor, which is foreseen to be focused at the city level in cities in conflict areas, a brief overview is provided of the taxonomy of the former. The Economics to Planetary Security Monitor provides integrated information on a national level, and consists of four layers: environmental stress, political conflict, economic stress and overall resilience. In 2016, the analysis of the monitor identified three categories of countries and which corresponding type of action is required for environmental, conflict and economic resilience (Textbox 1). While the focus areas in the Planetary Security Initiative fall in the A and B categories, this national categorization does not necessarily reflect the output of the city level monitor, as there can be sizable differences between urban and rural areas when it comes to resilience.

Textbox 1 Type of action required for environmental, conflict and economic resilience

Main categories of countries in which different actions are required for environmental, conflict and economic resilience based on The Economics of Planetary Security Monitor.[29]

Category A – Peace First, Development and Climate Resilience Later
The countries within this category are for example: Sudan, Pakistan, Afghanistan, Somalia and Yemen. These countries are characterized by high conflict vulnerability, high environmental stress and low economic resilience, and are also usually affected by war.
For these countries, conflict is the overriding risk factor.[30]

Category B – Economies at Risk in a Low-Carbon World
The countries within this category are for example: Saudi Arabia, Russia and Australia. These countries are heavily invested in carbon and non-renewable energy, with the export of fossil fuels often a key ingredient in maintaining their levels of economic prosperity. This category includes countries with a minimally diversified economy.

Category C – Synthesizing Climate Change Mitigation with Development
The countries within this category have a stronger and more diversified economic basis and are not currently in conflict. The countries within this category are for example: China, Mexico and Thailand. These countries possess a strong economical basis with which they can develop policies that address both climate change resilience and development schemes.

Current data deltas, limitations & solutions

As indicated prior, city level data is still limited in its availability. The framework used for the first conceptualization of the Climate Resilience & Security Monitor utilizes a variety of indicators, yet not all these indicators are available on a city level, yet. There are numerous reasons for this. First, there are significant discrepancies between cities in the global North and those in the global South, with data availability being

29 The Economics of Planetary Security: Climate Change as an Economic Conflict Factor, https://hcss.nl/report/economics-planetary-security-climate-change-economic-conflict-factor.

30 For a further elaboration on conflict as a risk factor and the used indicators see The Economics of Planetary Security: Climate Change as an Economic Conflict Factor, https://hcss.nl/report/economics-planetary-security-climate-change-economic-conflict-factor.

highly concentrated on more developed economies in the North. Second, while it is often possible to work with data proxies such as night light emissions for development levels, these data sets are geospatial datasets that require exact boundaries to be drawn for city limits. This is especially difficult in rapidly developing cities, and as such was beyond the scope of this first suggestion on operationalization. Finally, datasets like Afrobarometer are regional and are thus difficult to incorporate into a global monitor.

Given this data deficiency, some assumptions were made in constructing the monitor. For example, in some cases, sufficient coherence between the city and national levels is assumed that, lacking city level data, a national metric will be sufficient. The underlying argumentation is that for example corruption reflects a broader cultural norm and the data at the moment lacks diversification between the countryside and the city. As such, when data is only available on the national level, these types of national metrics, which can be assumed to be representative on the city level, will be used.[31] Another example is the overall level of political (in)stability, which should not vary significantly between urban and rural areas. For other metrics, such as the socio-demographics, there could be large differences, and the use of a city level metric is highly desirable.[32] As such, an underlying assumption throughout this study is that the national level of resilience is related to the urban level of resilience and that especially for the conflict metrics used (as city level data is lacking), the manifestations of conflict on the national and urban level cannot be separated at present. Nonetheless, the authors are acutely aware that this assumption is controversial, and hold that efforts must be made to close this data gap.

One of the most comprehensive efforts to gather such city level statistics is the UN-Habitat City Prosperity Index (CPI).[33] The CPI measures along broadly similar dimensions as the Climate Resilience & Security Monitor, including infrastructure, government and legislation, and social inclusion. While prosperity is of course conceptually different from resilience, the fact that specifically city level data is available along similar dimensions is promising. As it stands, the CPI index is limited to 400 cities worldwide. Unfortunately this touches upon what is a perennial issue in the field of urban resilience. Either some sort of hybrid model that mixes city and national level indicators, such as the Climate Resilience and Security Monitor model, or a city level indicator model, like the CPI, must be used. The former may be criticized as distorting the analysis, whilst the latter suffers from low data coverage. Until such a time when more complete data is available at the city level, the most efficacious method would be to use a side-by-side comparison of the

31 Naturally, city level data would be preferable. Given that this is not always possible, it is necessary to compromise.

32 Given the lack of available data, a national level index is used nonetheless.

33 For more information on the CPI see https://unhabitat.org/urban-initiatives/initiatives-programmes/city-prosperity-initiative/.

hybrid and city-only models, where the macroscopic view of the former is supplemented by the more microscopic view offered by the latter.

Despite these limitations however, the monitor represents a crucial step in the transition towards city level data and offers a comprehensive overview of the strengths and shortcomings of cities globally. With climate mitigation and adaptation, where policy is increasingly formulated on the sub-national level, it is critical for policy makers to be able to identify what aspects of resilience an urban area is currently lacking and which actionable points can be taken to remedy this. In addition, the monitor can be used to show which cities in the world share similar challenges, and thereby aid in identifying potential partners for collaboration and the sharing of best practices. Further augmentation of the monitor with more precise local data could eventually allow for the evaluation of resilience on a street-by-street level and not only quantify resilience, but locate it.

(Data) analytical framework for urban resilience

Out of the two frameworks of city level analysis, only the 100 Resilient Cities Network CRI focuses explicitly on resilience. The UN CPI is a valuable addition because it offers more comprehensive data on a large number of cities globally, but it measures prosperity rather than resilience. Nonetheless, some of the dimensions measured in both indices overlap, such as indicators regarding development level and infrastructure. For the purpose of designing the analytical model, the CRI will be leading, with the UN CPI being used as a data source when such overlapping dimensions exist. Applying the CRI Urban Resilience Index to the 'maintaining, recovering and learning' framework outlined above leads us to the following model for a monitor that should be able to identify areas of concern on a city level. Figure 2 outlines the main indicators used in the existing CRI framework of the 100 Resilient Cities Network.

Figure 2 Main dimension in the CRI transposed on the Climate Resilience & Security process framework

Maintaining	Recovering	Learning
• Minimize human vulnerability • Reducing exposure & fragility	• Effective provision of critical services • Diverse livelihoods and employment • Comprehensive security & rule of law • Reliable communications and mobility • Effective safeguards to human health and life	• Empowered stakeholders • Sustainable economy • Integrated development planning • Effective leadership & management

Urban Resilience and the Climate Resilience & Security Monitor

Not all aspects of the CRI are suitable for an urban climate-conflict monitor, for example the CRI adapted framework includes both quantitative and qualitative metrics. The latter includes interviews and surveys with city representatives, and are therefore difficult to incorporate from a data perspective. In addition, some urban functions identified by the CRI are particular to more developed cities; the *reducing exposure & fragility* function is understood within the CRI as the ability of a city to physically protect itself, either through improved environmental stewardship or through protective infrastructure.[34] Cities at lower levels of economic development are not able to fund such coordinated construction efforts. Consequently, several adaptations are made to the CRI framework to make it fit for cities in conflict as studied in the concept Climate Resilience & Security Monitor.

Some of the dimensions used in the CRI, such as *Comprehensive security & rule of law*, pertains to multiple elements of resilience. The law enforcement element and a fair justice element differ for example, with the former being more relevant in the **recovering process**, and the latter being crucial for the **learning process**. In these cases, the underlying indicators of such a dimension are separated and reassigned to the relevant process.

Furthermore, several new indicators are added to the Climate Resilience & Security Monitor framework, whilst others have been removed. Social cohesion has been added, defined as the degree to which there is coherence in norms, values and traditions amongst a population. The rationale behind this is that especially in less developed countries or post conflict areas, there is often the need for ad-hoc social collaboration among citizens to make up for reduced urban functions in the short run. However, while the importance of social cohesion is generally agreed upon in the academic literature, the precise measurement of social cohesion is disputed on the basis that the definition of coherence and values are subjective. Furthermore, even if a definition is agreed upon, it is unclear how a measurement could be operationalized. On the other end, the *Integrated development planning* is omitted because the overall goal of the **learning process** is to achieve integrated development planning.

The combined picture of these adaptation results is shown in the framework (Figure 3) below and is further elaborated upon, per phase. The combined picture offers a measurement of resilience that is specifically aimed at *climate change resilience* on the urban level. By combining the CRI framework, which has the goal of measuring

34 The CRI booklet provided on the Rockefeller Foundation website specifically mentions: 'Well-developed understanding and acknowledgement of the role of ecosystems in providing physical protection to the city".

generalized resilience, and adapting it to the maintaining, recovering and learning framework that explicitly deals with managing climatic disaster events, the resultant monitor is designed to measure the climate aspect of resilience.

Figure 3 Climate Resilience & Security Monitor for urban resilience

Phase	Concept	Indicator
Maintaining	Human Exposure	*Population density*
		Population growth rate
	Development Level	*Water infrastructure*
		Energy access
		Human development index
Recovering	Effective Provision of Critical Services	*Logistics performance*
		Maturity of emergency response systems
		Corruption
	Diverse Livelihoods and Employment	*Agricultural dependence*
		HCSS Planetary Security: Economic Resilience layer
	Social Cohesion	*No suitable dataset available*
Learning	Empowered Stakeholders	*Education levels*
		City share of national GDP
	Sustainable Economy	*HCSS Planetary Security: Low Carbon Economy layer*
		Business Environment
		Globalization Index
	Effective Leadership & Management	*HCSS Planetary Security: Socio-demographic layer*
		HCSS Planetary Security: Political Stability layer

Maintaining applied to the Climate Resilience & Security Monitor[35]

Given that the primary objective of the maintaining process is to limit the damage that is incurred over the course of an event, indicators in this process focus on the ability of a city to meet the basic needs of its citizens, such as water, housing and energy. Meeting these demands becomes increasingly difficult in larger cities in developing countries, if the population is growing fast, and more difficult still if countries are currently in conflict. Urbanization, high birth rates or displacement and growing populations can all strain existing resources and infrastructure, increasing overall vulnerability.

As indicated in the box below, the indicators relevant for maintaining are thus connected to exposure and development. The higher the level of vulnerability or human exposure, the more difficult it becomes to withstand an event and maintain an urban area. Similarly, the higher the development level, the greater the chance is that the city will be able to minimize damage. Human exposure, then, reflects the population pressures and the total number of people that are at risk in an event, whereas the development level denotes to what extent these people that are potentially exposed are adequately protected in the physical sense. While cities are inherently densely populated, precise population density is difficult to measure, especially in unplanned cities where both population size and urban surface area are prone to rapid change.

Given the lack of data on the population of cities, a replacement metric is used in the form of the *national* population density. An example of this is a highly dense and unplanned city such as Dhaka (Bangladesh) that scores poorly in both categories, whereas a dense highly developed city like Amsterdam (the Netherlands) would score low for exposure but high for development level. As such, this process of resilience analyzes the risk of catastrophic damage from climate related events, either sudden or gradual.

Concept	Human Exposure	Development level
'Maintaining' Indicators	• Population density • Population growth rate	• Water infrastructure • Energy access • Human development index

35 The ability of a city to endure the effects of an event, resist material degradation and continue normal operation of the urban environment.

Recovering applied to the Climate Resilience & Security Monitor[36]

Indicators in the recovery process reflect the ability to restore functionality to the urban area, the degree to which the urban (and surrounding) economy is able to continue operating during sudden climate stress, and whether the urban community will be able to come together and compensate for the loss of urban functionality. The recovery process is characterized by the capacity and velocity of restoring order and economic stability. Given this goal, the ability to respond to local needs, to provide critical services lost during stress, and to maintain some degree of economic output are critical. While no adequate indicator is available for social cohesion at this moment, studies have indicated that in the wake of climate related events the deterioration of basic government services could be compensated by, for example, ad-hoc voluntary organizations and is therefore a relevant indicator in the ability of an urban area to recover. The exact manifestation of (lack of) social cohesion can depend on the context, ranging from resource mafias to beneficial voluntary organizations. The recovering process therefore describes the ability to manage the direct consequences of a climatic event.[37]

Concept	Effective provision of critical services	Diverse livelihoods and employment	Social cohesion
'Recovering' Indicators	• Logistics performance • Maturity of emergency response systems • Corruption	• Agricultural dependence[37] • HCSS Planetary Security Economic resilience layer	• No suitable dataset available

Learning applied to the Climate Resilience & Security Monitor[38]

Perhaps the area where the greatest impact is possible in terms of over-time improvement is the learning process. As described, the maintaining and recovery processes of resilience are in response to events, meaning proactivity from policy makers is limited to disaster preparation. This stands in contrast to the learning process, where the lessons learned and experiences gained must be translated into actionable points that strengthen a city's resilience. Given this definition, the indicators that pertain to learning center on the governance and social capital aspects of cities. Elements of this ability include indicators of whether there is sufficient political stability and social capital to execute policy, whether the policy making process is sufficiently

36 The speed at which a city is able to restore normal operation of the urban environment and return to the pre-event state of equilibrium.

37 If large sections of an economy are agriculture based, extreme weather events can have disproportionate economic effects. Countries or cities with higher agricultural dependence are therefore more vulnerable.

38 The ability to translate lessons learned from past experiences, local or otherwise, into concrete, actionable policy making and execute upon those policies.

inclusive in its stakeholders, and whether the city is able to make the overall transition to a sustainable economy. The learning process of resilience therefore encompasses an urban area's ability to adapt or mitigate the direct and indirect effects of climate change on all time scales.

Concept	Empowered stakeholders	Sustainable economy	Effective leadership & management
'Learning' Indicators	• Education levels • City share of national GDP	• HCSS Planetary Security Low carbon economy layer • Business environment • Globalization index	• HCSS Planetary Security Socio-demographic layer • HCSS Planetary Security Political stability layer

In addition, layers primarily directed at the national level that were previously developed in the Economics to Planetary Security Monitor are included when quantifying more complex dimensions, such as political stability.[39] This results in a final framework comprised of 8 dimensions, with 21 underlying indicators, of which three are composite indicators drawn from the existing Planetary Security Monitor. A brief overview of the reasoning behind each indicator is provided in the updated online version of Climate Resilience & Security Monitor.

39 See for more details on the underlying indicators and data sets, see https://dwh.hcss.nl/indicators.xhtml.

4 Towards city-level action in conflict areas

Showing the potential of the concept of the Climate Resilience & Security Monitor towards city level action regarding climate and wider resilience, we will apply, as case studies, the monitor to three cities that fall within either the A or B-category of the Climate Resilience & Security Monitor, namely: Bamako, Maiduguri and Baghdad. In the selection of cities as case studies we took into account the focus areas of the 2017 PSI conference. The scores of each focus area is presented in a radar plot below, where scores may range from 0 to 1, with zero being the worst. For a more elaborate methodological note, please see the online monitor.

The first case discusses possible city level action in a selected city in Mali, which was classified in the Economics to Planetary Security Monitor as an 'A-country' due to its conflict and lack of resources. The second and third cases discuss two cities with similar problems in Nigeria and Iraq respectively, both of which were classified as fossil-resource rich 'B-countries' in the Economics to Planetary Security Monitor. In Mali, the city of Bamako as a capital and largest city in the country was selected to be examined in more detail. In the other two countries, respectively the city of Maiduguri – the largest Nigerian city next to Lake Chad – and Baghdad were selected as case-studies. Finally, some closing remarks are made concerning 'C-countries' and their relevance in this study.

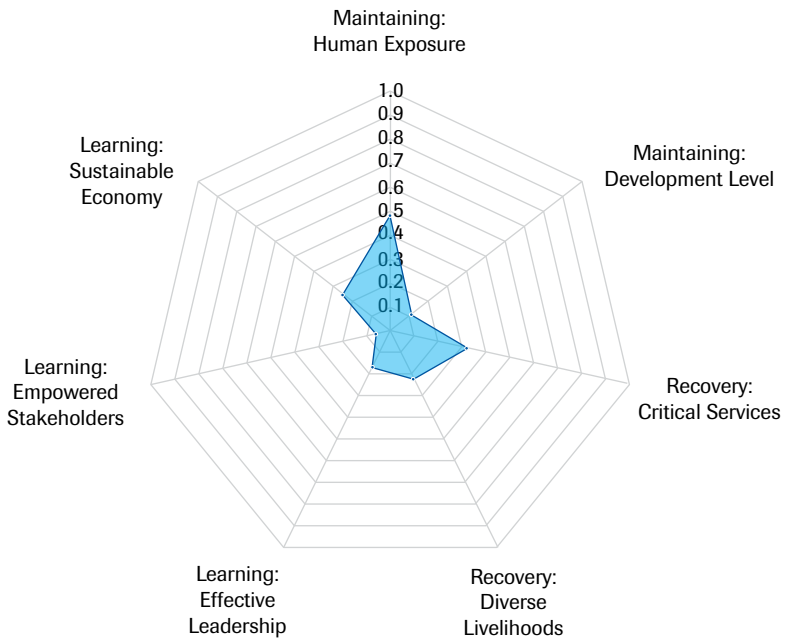
Category A case study: Bamako (Mali)

Mali is an A-category country as identified in the Economics to Planetary Security Monitor. It suffers from high environmental stress, low economic resilience and is, first and foremost, dealing with resolving conflict factors. Therefore, it is mainly in the recovering process of resilience. It is one of the world's poorest countries, and has to deal with high population growth as well as severe droughts and desertification as a result of climate change.[40] The north of Mali in recent years has dealt with armed conflict. Within this situation, resilience in the Malinese capital Bamako seems a significant way off. The city, located along the river Niger, has some 1.8 million

40 World Bank (2017) Mali Country Overview http://www.worldbank.org/en/country/mali/overview; CIA (2017) Mali, World Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/ml.html; Encyclopaedia Brittannica (2017) Mali, https://www.britannica.com/place/Mali.

inhabitants, and with a population growth of approximately 4.5% per year, is one of the fastest growing cities in the world. It has a large informal sector, waste management and sanitation problems, and poverty is widespread. On top of that, the security situation in the city is far from stable, as recent terrorist attacks illustrate. Furthermore, the city and country suffer from an increase in temperature, a decrease in rainfall, and an increase in desertification due to climate change.

Figure 4 Mali main scores in the Climate Resilience & Security Monitor



Analyzing the situation in Mali with the Climate & Security Monitor, it shows a low score in all main indicator categories (Figure 4). Compared to the resilience framework introduced in this paper, the areas 'maintaining' (including indicators such as population growth rate, infrastructure performance, water infrastructure and event intensity) and 'recovering' (including logistics, agricultural dependence, import dependence and social cohesion) seem to score low, whereas the area of 'learning' can hardly be judged at all due to the limited data available.

From monitoring to action: challenges to Bamako

A lack of reliable statistical data makes it difficult to judge exactly where Bamako stands on the road towards resilience and, as a consequence, what the feasible strategies to improve this resilience could be. However, looking into feasible resilience development strategies for the future, the Climate Resilience & Security Monitor suggests that substantial work is required in all indicator categories. For this, the city of Bamako could, as an initial step, build on the limited work that has already been done in the city itself. In the year 2000, the Malinese NGO Alphalog coordinated work on a city development strategy in Bamako that outlined a large consultation process with citizens. Six main goals for the city, focusing on economic development, improvement of local governance, quality of life, education and infrastructure, and stimulation of development of Bamako into a city of culture and sports were identified.[41] The city could also learn from the development and implementation of resilience strategies in nine African cities participating in the 100 Resilient Cities Network. In Accra (Ghana), Addis Ababa (Ethiopia), Cape Town and Durban (South Africa), Dakar (Senegal), Kigali (Rwanda), Lagos (Nigeria), Nairobi (Kenya) and Paynesville (Liberia) where such resilience strategies are being developed to address a variety of similar challenges, such as droughts, population growth, environmental degradation, terrorist attacks, and poverty.

For a more detailed assessment of the relevance of the work done in other cities to Bamako and of the specific needs of the city, better statistics on the current resilience situation in Bamako would be needed. The priority data that are needed for a more detailed picture of the situation in Bamako, and therefore those that offer resilience improvement possibilities, would be figures about the economic situation in the city, also including the informal economy present, infrastructure reliance data, environmental degradation data, as well as more updated information on resilience strategies that are prioritized by the citizens of Bamako themselves.

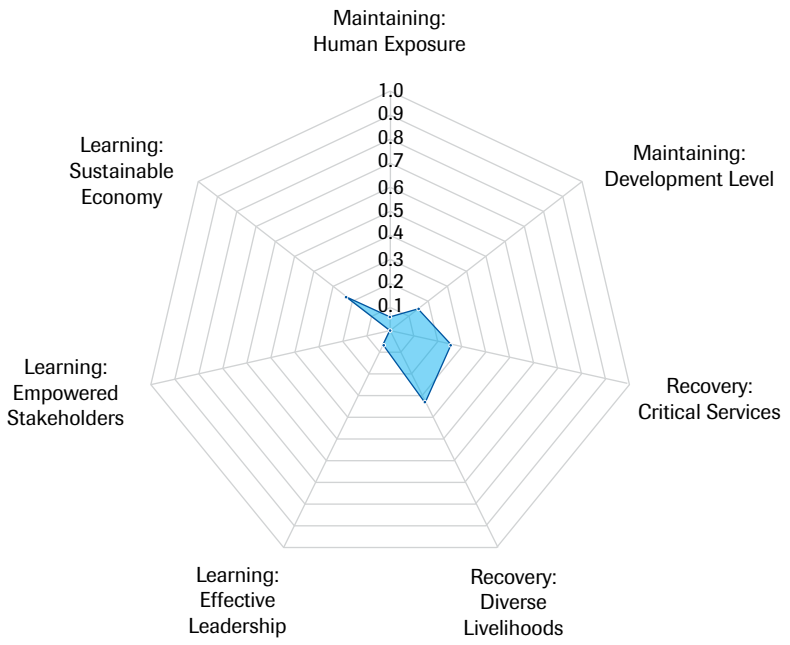
Category B case study: Maiduguri (Nigeria, Lake Chad Region)

Nigeria suffers from ongoing conflict and sectarian violence and is categorized as ‘B-category’ country, meaning that it is both vulnerable to conflict and environmental stress, whilst also being fossil fuel rich. While this has been a boon to economic development up until now, it might become problematic on the way towards a future low-carbon society. Furthermore, Nigeria is ethnically diverse, with over 250 different ethnic groups residing there, as well as fighting an ongoing war with Boko Haram

41 Alphalog (2000) City Development Strategy in Bamako, mirror.unhabitat.org/downloads/docs/BamakoSummary.pdf.

in the north-eastern provinces and suffers from high levels of economic inequality.[42] Nigeria has suffered from droughts in recent years and draw the vast amount of its GDP from fossil resource rents, which make up 93% of exports in terms of value.[43]

Figure 5 Nigeria main scores in the Climate Resilience & Security Monitor



Nigeria scores poorly in overall resilience in the Climate Resilience & Security Monitor, with the total area of the radar covered being significantly smaller than with Mali (Figure 4 & 5). While both development levels and diverse livelihoods is somewhat better than in Mali, they score low in all other main indicator categories. Given the much higher population growth and density, Nigeria's score on human exposure is dramatically worse, a fact which is further exacerbated by frequent flooding. In addition, corruption and ongoing conflict with militant factions further weakens Nigeria's ability to set and achieve long term policy objectives, as in the *Effective Leadership* indicator.

42 World Bank (2017) GINI Coefficient, https://data.worldbank.org/indicator/SI.POV.GINI?locations=NG.

43 The World Bank (2017) Fuel exports 1962-2016, https://data.worldbank.org/indicator/TX.VAL.FUEL.ZS.UN?view=chart.

From monitoring to action: challenges Maiduguri (Lake Chad)

Like in Mali, reliable statistical data on a city level for Maiduguri is largely lacking. It is clear that Maiduguri is far from resilient and needs to take large steps in recovering, maintaining and learning. Their resilience problems are, to a large extent, linked to regional conflict and development.

Maiduguri is a 1.2 million inhabitant city located on the Nigerian side of Lake Chad. It was also the birthplace of the Boko Haram insurgency. Looking at Maiduguri and the Lake Chad region, the effects of climate change are being increasingly felt, manifesting itself through drought, desertification, and overall environmental degradation. This has had consequences for agricultural production in the region, resulting in high prices, severe food shortages[44] and deaths.[45] Making the food chain more resilient against climate change is essential for the economic stability of the city, as alterations to the growing season, onset of rainfall, and climatic variability caused by climate change are likely to further impact food production and crop yield.[46] The Lake Chad Development and Resilience Action Plan (LCDAP)[47], designed for the period 2016-2025, aims to turn the Lake Chad region into a center of regional rural development. Objectives include the improvement of livelihoods, facilitating transport and trade, improving the management of water resources, and promoting the participation and inclusion of inhabitants. However, no urban resilience plan exists for Maiduguri specifically.

A second large problem in the Lake Chad region and the city is the ongoing battle with Boko Haram, posing a threat to human security. The government has offered insufficient protection to inhabitants in the past, resulting in the failed attempt to protect citizens bottom-up by creating Civilian Joint Task Forces (CJTFs). As these groups cooperate with the military, yet are not under military control, this leads to little training of members and massive abuses of power.[48] The Buhari Plan[49] aims to restore the peace and promote social and economic recovery in the north-east of Nigeria. By promoting

44 O.D. Onafeso, C.O. Akanni, and B.A. Badejo, "The Dynamics of Climate Change and Global Warming: Imperatives for Food Security in Nigeria," *Journal of the Geographical Association of Tanzania* 36, no. 1 (2017).

45 H. Angerbrandt, "Nigeria and the Lake Chad Region beyond Boko Haram," Policy Note (Nordic Africa Institute, June 2017), http://www.diva-portal.org/smash/get/diva2:1115195/FULLTEXT01.pdf.

46 Onafeso, Akanni, and Badejo, "The Dynamics of Climate Change and Global Warming: Imperatives for Food Security in Nigeria."

47 "The Lake Chad Development and Climate Resilience Action Plan," n.d., http://documents.worldbank.org/curated/en/365391467995401917/pdf/102851-v1-WP-P149275-Box394847B-PUBLIC-v1-summary-Lake-Chad-Development-and-Action-Plan-English.pdf.

48 Angerbrandt, "Nigeria and the Lake Chad Region beyond Boko Haram."

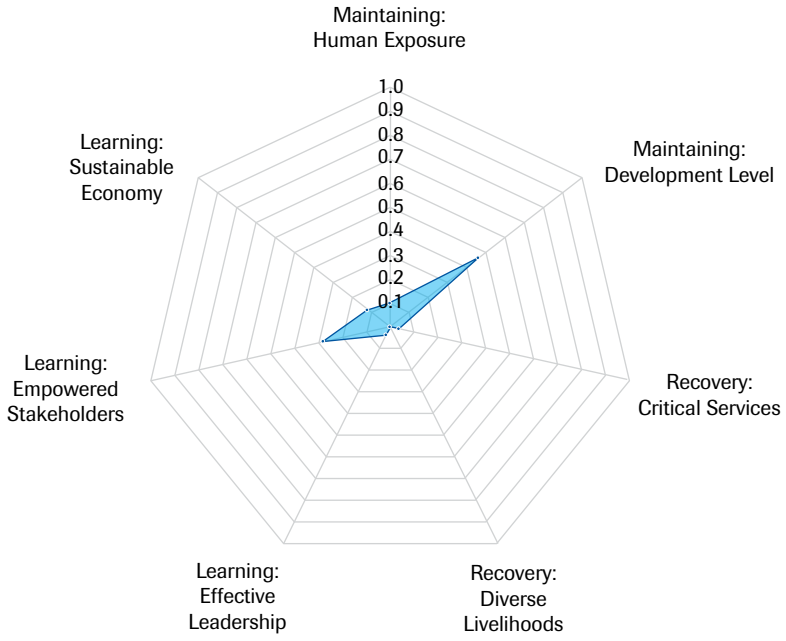
49 "The Buhari Plan: Rebuilding the North East," June 2016, http://carllevan.com/wp-content/uploads/2016/09/Reconstruction-plan-ES-6-20-6-16-1.pdf.

participation, sustainability and resilience, embracing local action, and addressing the underlying causes of conflict, this plan would increase the region's capacity to recover from destruction, as well as decrease the exposure of inhabitants to possible threats while increasing stakeholder resilience. A focused implementation of this plan could be supported by a more detailed monitoring of key resilience indicators.

Category B case study: Baghdad (Iraq)

Iraq shares many of the characteristics of Nigeria, and is also categorized as a B-country. Like Nigeria, it draws the vast majority of its revenues from exporting petrochemicals. There are various ethnic minorities vying for influence in the country, including the Kurdish independence movement in the north. In addition, the ongoing conflict in neighboring Syria and the presence of Daesh/ISIS is a significant stressor for the Iraqi government. Unlike Nigeria however, the trajectory for Iraq in economic terms has shifted significantly, most recently in the wake of the 2003 invasion. The overthrow of Saddam Hussein and subsequent fall of the Ba'ath regime have meant that many of the country's institutions, as well as much of its infrastructure and political structures, needed to be rebuilt.

Figure 6 Iraq main scores in the Climate Resilience & Security Monitor



Iraq's resilience scores reflect its recent history as a relatively highly developed nation and subsequent upheaval over the past decades. *Development levels* are significantly higher than both Mali and Nigeria. On the other hand, Iraq's ability to provide *critical emergency services* is extremely limited, in part attributable to the ongoing sectarian conflict and the fact that emergency services had to be rebuilt following the 2003 US-led invasion. Iraq's population growth rate is high, partially due to high birth rates, but further bolstered by immigrants from neighboring countries, and these two factors in combination result in a poor score for human exposure. Poor performance in logistics and corruption further damage Iraq's resilience capacities and an effective transition into a sustainable economy, given its current dependence on oil exports, would be very difficult.

With 7 million inhabitants, Baghdad is the largest city in Iraq. It has suffered severely from bombings during the Iraq war and is still rebuilding large portions of infrastructure. Currently, the regional and national development plans of several UN agencies play an important role in guiding Iraq's development. Whereas UNIDO aims to develop the private sector in Iraq, UNDP aims to stimulate poverty reduction, democratic governance, crisis prevention & recovery, and women's empowerment.[50] Regional development is stimulated in local area development plans in various regions around Baghdad.[51] Development aid in recent years has helped in recovering some degree of pre-war city life, although corruption is still an important issue and in many parts of the city, safety and security has not yet returned 10 years after the war.[52] Also, a lack of services and poor infrastructure, unrestrained traffic congestion, uncontrolled land use, severe environmental pollution, and a fragmented social fabric in Baghdad still seem to remain unresolved.[53] The Iraqi government has a much stronger presence in Baghdad than in the surrounding rural areas, yet the challenges it faces are deeply seated. While gains can be made domestically, the Iraqi ability to stabilize the region and solve the broader security issues without outside help is limited. More exact data for the monitor could help here to direct aid to the most urgent development issues, with corruption and safety being probably most prominent.

50 UNDP (2016) Country Development Programme 2016-2020.

51 UNDP (2017) Iraq Local Area Development Programme (LADP-EU) http://www.iq.undp.org/content/iraq/en/home/operations/projects/democratic_governance/local-area-development-programme--ladp-eu-.html.

52 Erickson, A. (2013) 10 Years After the Iraq War, How Has Baghdad Changed? Citylab https://www.citylab.com/equity/2013/03/10-years-after-iraq-war-how-has-baghdad-changed/5011/.

53 Tamimi, A.A. (2016) Political influences on Baghdad Urban Development: Past, Present and Future, https://www.linkedin.com/pulse/politic-influences-baghdad-urban-development-past-future-al-tamimi.

Category C countries and cities

As discussed, significantly more efforts have been made towards the construction of indices in the global North than in the South. Indeed, this first attempt at operationalization explicitly seeks to elaborate upon the existing CRI and CPI on the basis that they are northern-centric. As such, the index, as it stands, is more suited for the measurement of less developed cities than it is for highly developed cities. This should not be misconstrued to indicate that developed cities do not need to pursue greater resilience, simply that the considerations for such cities are sufficiently different and well documented that they are not examined within the context of this paper beyond a top level analysis.

While there are various highly developed cities that are located in areas that are vulnerable to sea level rise, such as Miami or Amsterdam, these cities have significantly more funding available to mitigate their physical vulnerability. Instead, it is often the social element of climate change, in the form of socio-economic disruptions or migrant flows that are of concern to cities located in category C-countries. Even for cities with relatively high crime rates, such as Chicago, the degree of violence is only a fraction of those in A and B type countries. While we this is arguably a shortcoming of the current monitor, there is no shortfall of research into the planetary security aspect of developed urban areas.

5 Conclusions and recommendations

In addition to the Economics to Planetary Security Monitor, which provided some insights and recommendations for policy makers on a national level, this first conceptual iteration on the concept Climate Resilience & Security Monitor brings an additional layer of analysis, possibly useful for city policy makers and urban planners. It shows, however, that better data would be needed for a proper application of the monitor at the city level, specifically in conflict areas.

Despite the need for additional data on a city level in conflict areas, the conceptualization of the Climate Resilience & Security Monitor in this stage of development already offers several concrete functionalities that can be of use to policy makers. It already provides an overview that identifies more precisely which aspects of resilience are currently lacking in data analysis efforts and policy attention. In addition, comparisons can be made between cities that have similar challenges, allowing for cities to collaborate and share practices to increase their resilience.

Conclusions

- In principle, national and city governments should be able to identify, set and implement policy goals, just as the private sector and donors need to be able to anticipate, evidence based, whether their investments are adequately safeguarded from climate change and conflicts. For that reason accurate and quantitative data on what resilience capabilities a nation and its cities has or lacks is critical to making informed and effective policy decisions. Funding however, is a perennial issue, especially for category A countries, this will prove to be challenging in current circumstances.
- Developing urban resilience towards conflicts and climate change is a multi-layered and multi-faceted challenge. It underpins the urgent need to further explore and strengthen the possibilities of the monitoring through data of climate resilience and security, and the effects this has at an urban level.
- For cities it is of paramount importance to clearly distinguish what policies to develop for the three processes of resilience (maintaining, recovering and learning), and to acquire and maintain the appropriate capabilities and capacities for these processes.
- The Climate Resilience & Security Monitor could also offer a critical tool for raising awareness to the problems of the climate, conflict and economy nexus to stakeholders and the public at large. It makes clear the necessity for capacity

building to strengthen climate change resilience. Due to its visual qualities and intuitive interface it demonstrates the possibilities, as well as the limitations, to prepare for long-term climate action, even in a situation of acute conflict. For example, more could be done to link in with the wide range of NGOs working in the different areas and to integrate their insights or data (e.g. SIPRI has quite an embedded Mali programme) into the monitor.

- For the case studies, the countries have been dealing with the combined effects of conflict, climate change and economic development in order to achieve resilience. It shows that:
  - The level of economic development and resilience do not correlate one to one. In particular, Iraq and Nigeria scored significantly lower in most dimensions of resilience than Mali, even though their economies are many times larger.
  - City level resilience in conflict areas is closely related to the national level. While it has to be acknowledged that overall data availability on the city level in conflict areas is still poor, the analysis of the three cases suggested that city resilience in those areas cannot be developed without addressing the root causes for the conflict in the whole area.
- As more and better data becomes available, the monitor can be further developed to offer even more information for national and city policy and decision makers to identify the most promising actions towards improving climate, conflict and economic resilience in cities in conflict areas on a sub-city level.
- Finally, the monitor further enables network based city initiatives to identify partners for collaboration and the exchange of lessons learned and practices.

Recommendations

It is made clear in this first conceptualization paper, that in order to unlock the full potential of the Climate Resilience & Security Monitor, better data is required. While it is possible to construct a monitor using a blend of city level and national level metrics, the former is obviously preferable. In particular, city level data is needed on urban population density, maturity of emergency services and social cohesion. For this reason:

- Data collection in developing countries should be strengthened. In particular for countries with lower levels of resilience, data is often lacking or poor. Highly developed nations tend to have the infrastructure and funding to maintain accurate databases on a city level. Efforts, possibly external, are therefore required to expand data coverage to cities and countries that might not have these levels of funding and data infrastructure available.
- Future iterations of the Climate Resilience & Security Monitor might even be used to provide maps of exactly which part of an urban area is at highest risk, although this will require additional high resolution spatial data. Comprehensive efforts to collect and centralize data in a public database that is not limited to highly developed countries are critical steps towards moving into truly data-driven evidence based

policy making. Efforts like the UN CPI and CRI have great potential and should be used to build upon.

- Suggested further improvements of the Climate Resilience & Security Monitor in the future are:
  - Strengthen and improve the monitor by testing the monitor against contemporary findings in conflict, urban resilience and linkages to climate change effects; such as testing against historical conflict trends or focus on data collection in a specific urban area in conflict.
  - Further discuss the selection of indicators and their implications from a scientific angle;
  - Further discuss the development of the monitor with willing municipal stakeholders from the global south. How can the monitor be made useful to them?;
  - Further discuss synergies with the 100 Resilient Cities Network and UN efforts on city level data collection;
  - The further development of the monitor, with the appropriate and (perhaps newly) available data sets is required for supplementary and more detailed analysis.

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