RAR

Special Report on Urbanization and Disaster Risk in Latin America and the Caribbean

Emily Wilkinson and Armando Caroca Fernández

UNDRR
UN Office for Disaster Risk Reduction

1. Introduction

The Sendai Framework for Disaster Risk Reduction 2015—2030 (Sendai Framework), the United Nations 2030 Agenda for Sustainable Development (2030 Agenda), and the New Urban Agenda all emphasize the need for further action to be taken by local and subnational authorities in urban areas to manage disaster risk and to promote sustainable development. Sustainable Development Goal 11 (SDG 11), which focuses on "mak[ing] cities and human settlements inclusive, safe, resilient and sustainable."[1] is the most relevant of the Sustainable Development Goals (SDGs) to reduce urban risks; Target 11.5 specifically aims by 2030 to "significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses ... caused by disasters ... with a focus on protecting the poor and people in vulnerable situations." [2] Furthermore, Target 11.b sets the goal "by 2020 [to] substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework … holistic disaster risk management at all levels." [3]

Similarly, Article 65 of the New Urban Agenda commits to

> facilitating the sustainable management of natural resources in cities and human settlements in a manner that protects and improves the urban ecosystem and environmental services, reduces greenhouse gas emissions and air pollution and promotes disaster risk reduction and management, by supporting the development of disaster risk reduction strategies and periodical assessments of disaster risk caused by natural and human-made hazards, including standards for risk levels, while fostering sustainable economic development. [4]

This is complemented by further commitments made in other clauses. For example, in Article 67 signatories "commit[ted] ... to improving the resilience of cities to disasters and climate change, including floods, drought risks and heat waves," while Article 77 focuses on the need to "mainstrea[m] holistic and data-informed disaster risk reduction and management at all levels to reduce vulnerabilities and risk, especially in risk-prone areas of formal and informal settlements."[5] Moreover, disaster risk is also mentioned in many other clauses, including Articles 78, 101, 144 and 165.[6]

1 *United Nations, Department of Economic and Social Affairs (n.d.).*
2 *United Nations, Department of Economic and Social Affairs, Statistics Division (n.d.).*
3 *United Nations (2016).*
4 *UN-Habitat (2017).*
5 *Ibid.*
6 *Ibid.*

1.1. Urbanization figures

More than 632 million people currently live in Latin America and the Caribbean (LAC), and its population is expected to grow to 780 million by 2050. Concurrently, 505 million people (or 80 percent) now live in cities, and this rate is expected to reach 87 percent (or 685 million people) by 2050 — while the world is currently about 54 percent urbanized. These figures are far from the average for low-income countries (30.9 percent urbanized) or sub-Saharan Africa (38.8 percent urbanized), but roughly equal to the average of high-income countries (80 percent). Nevertheless, urbanization levels are quite different in each subregion: in the Caribbean, current urbanization is 70 percent, in Central America, it is around 74 percent, and in South America it is about 82.5 percent.[7]

The LAC region has been the most urbanized region in the world for a long time and contains some of its largest cities: Buenos Aires, Lima, Mexico City, Rio de Janeiro and São Paulo all have populations over 10 million people.[8] However, the urbanization rate is rapidly changing. Between 1950 and 1955, the percentage of the urban population increased by 1.86 percent every year, while between 2015 and 2020 urbanization only increased by 0.3 percent annually. It will slow even further in the future: from 2045—2050 the rate of urbanization is expected to be only 0.21 percent.[9] This represents the changing balance between natural population growth and that attributable to rural-urban migration.

Disaggregating urban growth statistics helps to highlight the differences between regions (Figure 1). While the average pace of urbanization in the Caribbean and Central America is slowing faster than in South America, some countries in the subregion are seeing an increased rate of urban growth: El Salvador, Haiti and Honduras have rates above 1 percent.[10] Several Central American countries have been catching up to the rest of Latin America in their rural-to-urban transition process. Triggers such as declining agricultural prices, environmental degradation and disasters have forced many rural households to move to cities.[11] Several Caribbean countries are seeing higher rates of urbanization due to population growth, which is increasing the pressure to convert rural land for housing and other activities, particularly tourism. Rapid tourism-led real estate development over the last four decades has led to the significant expansion of certain urban areas, creating authentic polycentric urban regions in some cases.[12]

By 2050, Antigua and Barbuda, the Bahamas and Barbados are expected to triple their urbanization rate, while the rate in St. Lucia and Trinidad and Tobago may increase by a factor of six.[13] Moreover, the current scattered, low-density Caribbean urban pattern will produce a significant amount of urban land cover.[14] Trinidad and Tobago, for example, is likely to have a seven-fold increase in urban land cover and the associated consequences in terms of environmental degradation.

Figure 1. *Average annual rate of change of the urban percentage by subregion*

Period	Caribbean	Central America	South America	Average
1950—1955	1.06	1.72	1.99	1.86
2015—2030	0.61	0.44	0.25	0.31
2045—2050	0.34	0.31	0.19	0.21

Source: United Nations, Department of Economic and Social Affairs (2018a).

Comparing the urbanization processes in the LAC region to those of other regions is also useful: from 1990 to 2015, the urban population in the LAC region grew approximately 70 percent, which is relatively low when compared to African cities, which doubled their population during the same period. While the urbanization rate in the LAC region increased by 2.6 percent during this period, it increased by more than 5 percent in Africa, by about 2 percent in Asia and remained nearly constant in Europe at 0.6 percent. [15]

7 *In South America, some countries have raised the overall urbanization rate for the continent, like Argentina (at 90 percent) and Uruguay (95 percent). See United Nations, Department of Economic and Social Affairs (2018a).*
8 *Watanabe, M. (2014).*
9 *United Nations, Department of Economic and Social Affairs (2018a).*
10 *Ibid.*
11 *Maria, A., et al. (2017).*
12 *González-Pérez, J.M., et al. (2016); and Mycoo, M. (2017).*
13 *Mycoo, M. (2017).*
14 *Ibid.*
15 *Melchiorri, M., et al. (2018).*

To organize this special report, we have adapted the categorization of cities based on population that was developed by Mansilla,[16] and added the category of megacity:

- 10 million or more: Megacity
- 1—10 million: Large
- 100,000—1 million: Intermediate
- 20,000—100,000: Small
- 10,000—20,000: In urban transition

According to the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), the region is currently undergoing a double transition: an urban transition characterized by a reduced rural-to-urban mobility rate as compared with previous decades, and a demographic transition in which population growth is declining but increasing in average age.[17] The same data reveals that despite the high concentration of population, economic activities and administrative functions in a few large cities and megacities, the relevance of intermediate cities is increasing in economic and demographic terms, which are "signs of deconcentration that distinguis(h) Latin America and the Caribbean from other developing regions."[18]

Figure 2. *Demographic growth rate by city size range in Latin America (country)*

	100,000 - 500,000	500,000 - 1'000,000	1'000,000 - 2'000,000	> 2'000,000	Country growth
Argentina	1.5%	1.2%	0.7%	1.0%	1.1%
Bolivia	3.3%	2.1%	3.7%	n.d.	2.3%
Brazil	2.3%	1.9%	1.6%	1.6%	1.4%
Chile	2.3%	n.d.	n.d.	1.2%	1.4%
Colombia	2.4%	2.2%	1.0%	2.0%	1.1%
Ecuador	2.7%	n.d.	1.9%	2.1%	2.0%
Mexico	2.2%	2.0%	1.4%	0.1%	1.4%
Paraguay	8.0%	0.6%	n.d.	n.d.	2.7%
Peru	2.3%	1.8%	n.d.	2.1%	1.5%
Uruguay	1.0%	n.d.	0.2%	n.d.	0.4%
Venezuela	2.3%	1.9%	1.4%	n.d.	2.0%
Average**	2.3%	1.9%	1.5%	1.6%	1.4%

Source: Inter-American Development Bank (2015).
**Annual growth rates over the last 20 years according to national census data for each country. All cities in the sample countries were included for each size range.*
***The average was calculated according to the number of cities.*

Even though megacities are still relevant — Latin America and the Caribbean have the largest proportion of people living in them[19]— recent population growth has tended to concentrate in intermediate or slightly larger cities. In 2015, there were 645 urban centers with a population of between 100,000 and 2 million people (accounting for 36 percent of the total regional population), with most of the cities (543) falling at the lower end of the range (with populations of between 100,000 and 500,000 inhabitants). This grouping of smaller intermediate-sized cities also has a higher urban growth rate (2.3 percent per year) – a trend that decreases as cities get larger (Figure 2).[20]

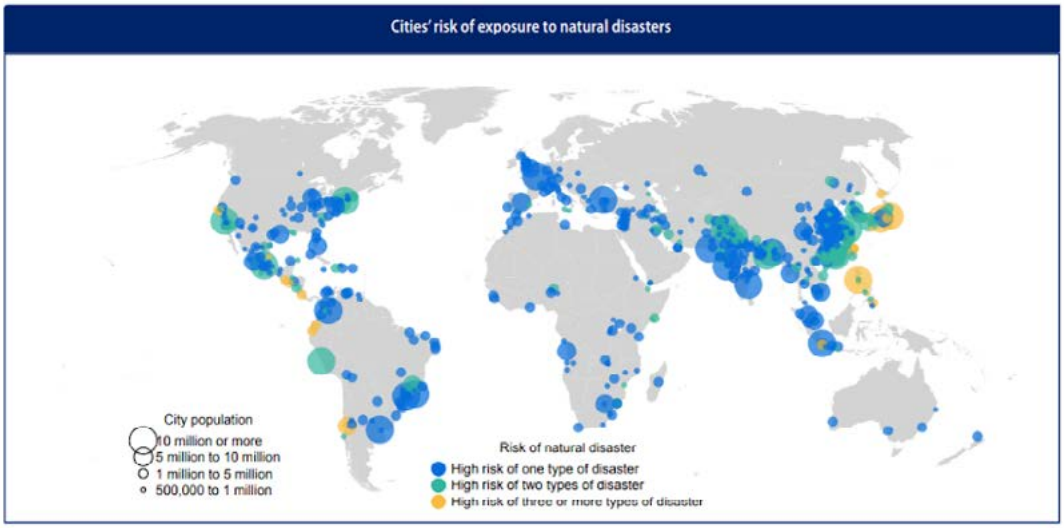
16 *Mansilla, E. (2010).*
17 *United Nations, Economic Commission for Latin America and the Caribbean (2018).*
18 *Ibid.*
19 *In 2018, 14.2 percent of the total population of the region resided in cities of 10 million or more inhabitants. See World Bank (2018).*
20 *Inter-American Development Bank (2015).*

1.2. Urbanization, hazard exposure and disaster impacts

The 2015 report by the United Nations Department of Economic and Social Affairs on urban hazard exposure focused on six types of hazard events (cyclones, floods, droughts, earthquakes, landslides and volcanic eruptions) and assessed 206 Latin American cities with 300,000 or more inhabitants.[21] The report showed that nearly 80 percent of the urban population, or two-thirds of the population of the cities studied, faced high exposure to at least one of the aforementioned hazards, and that roughly 40 percent of the cities were highly exposed to floods, including three megacities: Buenos Aires, Rio de Janeiro and São Paulo. The report also revealed that 20 of the cities were highly exposed to drought and 10 percent were highly exposed to earthquakes.

Disasters affected around 35.5 million people and resulted in 9,370 fatalities in urban and rural areas in Latin America and the Caribbean between 2015 and 2020. Of the 435 disasters in the region during this period that were included in the Emergency Events Database (EM-DAT),[22] 17 of them led to 100 or more fatalities, and 183 resulted in between 10 and 99 deaths.[23] The total regional economic losses were about $119 billion during the same time frame, out of which only $38 billion — less than one-third — were insured. Finally, 132 of the 435 disasters were associated with 2 or more different hazards, and 32 were associated with 3 hazards.[24]

Figure 3. *City exposure to one or more types of disasters*



Of the 1,145 cities with at least 500,000 inhabitants in 2018,679 (59 percent) were at high risk of exposure to at least one of six types of natural disaster, namely cyclones, floods, droughts, earthquakes, landslides and volcanic eruptions. *Taken together, cities of 500,000 inhabitants or more facing high risk of exposure to at least one type of natural disaster were home 1.4 billion people in 2018.

Source: United Nations Department of Economic and Social Affairs (2018a).

1.3. Which cities should we look at?

There are usually two ways of classifying cities – by population and by income level [25]— but at least two more categories are needed to classify cities with regards to risk: hazard exposure and vulnerability.[26] With regards to population, the UNDRR Global Assessment Report on Disaster Risk Reduction (GAR) 2019 only included urban areas with populations greater than 750,000 people. Nevertheless, previous research in eight countries of Latin America shows that more than 60 percent of total disaster events in the past three decades occurred in cities with fewer than 100,000 inhabitants.[27]

21 *United Nations, Department of Economic and Social Affairs (2015).*
22 *Centre for Research on the Epidemiology of Disasters (n.d.).*
23 *The five deadliest events were the earthquake in the Manabí Province of Ecuador in 2016 (672 deaths), Hurricane Matthew in Haiti in 2016 (546 deaths), Volcán de Fuego in Guatemala in 2018 (461 deaths), Hurricane Dorian in the Bahamas in 2019 (370 deaths); and the earthquake in Puebla, Mexico in 2017 (369 deaths).*
24 *Centre for Research on the Epidemiology of Disasters (n.d.).*
25 *Margulis, S. (2016).*
26 *While the authors focus on risks due to climate change, these categories are also used more widely in disaster risk literature.*
27 *Gu, D. (2015).*

Despite their small population in absolute terms, such cities tend to have a higher proportion of disasters.[28] In an assessment of urban vulnerability to disasters in eight Latin American countries, Mansilla observed that large cities of more than 1 million people face the smallest proportion of hazardous events.[29] On the other hand, in countries like Bolivia and Mexico, the largest proportion of events occur in intermediate cities with populations of between 100,000 to 1 million people, while in Colombia, Costa Rica, Ecuador, El Salvador, Guatemala and Peru, small cities of between 20,000 and 100,000 inhabitants experience the largest number of events. Transitioning urban areas of between 10,000 and 20,000 people in Bolivia and Colombia are affected by a high number of hazardous events: around 22 and 28 percent of total events, respectively.[30] Up-to-date data and further research are needed to confirm these trends.

2. Linking urbanization and disaster risk

At the end of the twentieth century and in the early 2000s, studies of urbanization and disaster risk in the LAC region were concerned with processes of rapid urban expansion and exclusion of the poor that lead to the creation of large informal settlements in marginal and often dangerous areas. In recent years, research has reflected slowing urban growth, and increasingly has focused on processes of urban degradation (both physical and environmental), concentration and densification of the population in hazard-prone areas, and competing land uses in intermediate cities where urbanization tends to be faster than in large cities and megacities.[31] There has also been a sharp increase in journal articles and grey literature linking disaster risk reduction and climate change adaptation agendas in cities, including assessments of the viability of cities under climate change scenarios.[32]

2.1. Disaster risk and sustainability

Globally, academic literature linking urban and environmental issues continues to grow and demonstrates the strong links between disaster risk and environmental conditions in cities that signal a lack of sustainability. Bai et al. summarized the main topics in academic research as: amplified or accelerated environmental impacts of urbanization, varying distribution patterns of impacts, complex interactions and interlinkages, advocacy for the use of a systems approach in cities, an increasing focus on public participation and co-production of knowledge with stakeholders in governance, and moving from understanding and quantifying the impacts of urbanization to understanding processes and underlying mechanisms.[33]

Are these research trends also valid for Latin America? Nearly 25 years ago, Lavell highlighted the need to establish a new research agenda linking urban disaster risk to broader urban environmental changes referred to as environmental degradation.[34] He defined three relevant topics and actors to be investigated. First, the agents responsible for the construction of risk and environmental degradation, including private and public actors, individuals and institutions, and their interactions (including the definition of responsibilities and spatial distribution of effects). Second, the broad group of authorities, public and private actors, and regulations and legal instruments linked with hazards, vulnerabilities and risks that broadly fit within the realm of disaster risk management.[35] And third, the communities and economic sectors affected by risk and degradation. Here, Lavell proposed that an action-research approach should be privileged in order to engage with vulnerable groups, share knowledge, and co-produce locally rooted actions aimed at reducing such vulnerability. A review of the literature suggests that most of this research agenda has been mainstreamed by academia[36] and that international and regional agencies working on development, sustainability, and climate change have adopted many of these ideas.[37]

28 *UNDRR (2019).*
29 *Mansilla, E. (2010).*
30 *Ibid.*
31 *Guida-Johnson, B. and G.A. Zuleta (2019); Mansur, A.V., et al. (2018); Krellenberg, K. and J. Welz (2017); and Pimentel Walker, A.P. and M. Arquero de Alarcón (2018).*
32 *See Filho, W., et al. (2019); Satterthwaite, D., et al. (2018); Mycoo, M. (2017); and Güneralp, B., et al. (2015).*
33 *Bai, X., et al. (2017).*
34 *Lavell, A. (1996).*
35 *Given that it tackles so many institutional levels and liaisons, Lavell suggests that cross-sectoral studies, along with research on decision-making processes and urban management of land and infrastructure, must be prioritized.*
36 *Vallejos Romero, A. (2012); Nión Celio, S. and V. Pereyra (2018); Tumini, I. and A. Poletti (2019); and Güneralp, B., et al. (2015).*
37 *Weekes, C. and O. Bello (2019); Watanabe, M. (2014); Amaratunga, D., et al. (2019); and UNDRR (2019).*

2.2. Extensive and intensive risks and the accumulation of risk

People living in informal settlements and other poorly planned or unserviced urban areas are more likely to face food insecurity, disease, crime, accidents, pollution, lack of sanitation, and access to clean water — all of which have been defined as everyday or chronic risks.[38] Such everyday risks might in turn lead to extensive disaster risks (low-severity, high-frequency hazardous events, and disasters) and intensive disaster risks (high-severity, mid-to-low frequency disasters, mainly associated with major hazards).[39] Unlike intensive disasters, extensive events are far more strongly related to inequality and poverty than to geophysical or hydrometeorological phenomena, and are usually a consequence of poorly planned and managed urban development and building practices, environmental degradation and weak governance.[40]

Extensive risks are particularly challenging to assess. They are difficult to quantify and are not well captured in global risk models, and losses related to extensive risks tend to be underreported in international databases. Meanwhile, most fatalities are the product of intensive shocks, but the number of deaths due to smaller-scale, frequent hazards is increasing. It is estimated that 68.5 percent of all economic losses between 2005 and 2017 were caused by low-severity, high-frequency hazards, although these costs are usually absorbed by affected families. DesInventar Sendai — a conceptual framework, methodology and tool aimed at systematizing and recording small, medium, and large disaster events — is the product of work undertaken by the Network of Social Studies on the Prevention of Disasters in Latin America (known as LA RED by its Spanish acronym) during the 1990s, and has helped to highlight the severe impacts of these small-scale events internationally.[41]

Of particular interest in the literature on urbanization and disasters is the idea that disasters of different types, scales and frequencies and their impacts should be studied comprehensively. The concept of risk accumulation described by Bull-Kamanga et al. posits that instead of thinking about and acting in response to different types of disasters (for example, in terms of intensive and extensive risks), they should be understood as a continuum and tackled accordingly.[42] Indeed, the accumulation of many small events in densely populated areas often leads to large disasters. Furthermore, daily exposure to low-intensity events reduces the ability to prepare for and cope with other shocks.[43] This conceptualization was incorporated into the GAR 2019, which notes that it has become "abundantly apparent" that risk accumulates in urban environments due to the combined effects of intensive, extensive and everyday risks.[44] What is necessary now is to "understand and manage the interdependent, multidimensional variables of risk that are created by, and magnified among, different systems as they interact, across different geographic or spatial scales."[45]

2.3. Prospective, corrective and compensatory risk management

Since the signing of the Hyogo Framework for Action 2005—2015 (HFA), there has been an important conceptual shift in disaster risk management across the LAC region. Instead of thinking about disaster management as a cycle (from pre-disaster mitigation and preparedness to post-disaster response and recovery), concepts of prospective, corrective and compensatory risk management are now well-established in policy and legislation.[46] Prospective risk management aims to prevent the development of new or increased disaster risk, while corrective risk management seeks to remove or reduce already existing disaster risk, including through retrofitting critical infrastructure like schools or hospitals. Compensatory risk management is concerned with managing residual risk that cannot be reduced through preparedness, response, and recovery, insurance, or other risk transfer instruments. Later refinement of this typology has seen the separation of reactive from compensatory management — the former having more to do with preparedness and response and the latter with reconstruction, recovery, and resilience.

38 *UNDRR (2019).*
39 *UNDRR (2020).*
40 *UNDRR (2019).*
41 *Red de Estudios Sociales en Prevención de Desastres en América Latina (n.d.) and UNDRR (n.d.).*
42 *Bull-Kamanga, L., et al. (2003).*
43 *Blaikie, P., et al. (1994); and Kasperson, J.X., et al. (1996), as cited in Pelling, M. (2003).*
44 *UNDRR (2019).*
45 *Ibid.*
46 *Lavell, A. and M. Argüello Rodríguez (2003).*

3. Historical drivers and accumulation of disaster risk in cities

Lavell and Brenes identified five historical urban processes that largely explain how urban risk is constructed over time:[47]

1. high rates of densification, concentration and centralization, of the population, which increase exposure to hazards
2. environmental degradation that produces new socionatural and anthropic hazards
3. sociospatial segregation linked to unequal distribution of income and services, which affects land markets and urban rent and excludes communities by forcing them to settle in hazardous areas
4. lack of redundancy in infrastructure such as communication and energy networks, water and sewerage pipes depended upon by different parts of a city, and the failure to provide services to new urban areas at the required pace
5. urban and municipal governance issues related to poor land use planning and a lack of coordination between different jurisdictions in the city that often accompany the four previous risk drivers

Mansilla developed a specific categorization of historical drivers of urban risk in Latin America.[48] These can be roughly grouped into structural issues related to economic modelling and demography, planning issues linked with territorial, physical, and environmental features and their governance, and land issues including land management, markets, stakeholders, and ownership.

3.1. Structural drivers of urban risk

The relative prosperity achieved during industrialization in the first half of the twentieth century in Latin American countries ended in the 1980s after a series of financial crises including the oil crisis, debt crisis, and multiple economic depressions. The application of the neoliberal economic model and structural adjustment policies, first in Mexico and then across the region, broadened the gap between the rich and poor and increased socio-spatial segregation. Mansilla described the period between 1990 and 2010 in Latin American cities as one characterized by the deficit of service coverage — especially sanitation — and an acute increase in informal employment, income inequality, and poverty. In terms of improving the living conditions of slums inhabitants and fighting poverty, Mansilla concludes that "the efforts of the last three decades have been lost."[49]

The HABITAT III Regional Report: Latin America and the Caribbean — Sustainable Cities with Equality[50] highlighted an important reduction in absolute poverty since 1990: the regional average GDP per capita rose from $4,112 to $6,109 between 1990 and 2013, and the percentage of the population that could be described as the urban poor fell from 41.4 to 23.2 percent during the same period. Nevertheless, inequality in cities remained high (Figure 4), particularly in terms of income distribution and spatial segregation. Furthermore, the risk of falling below the poverty line is still a major threat due to the slowing rate of poverty reduction and international economic stagnation in recent years.

Figure 4. *Latin American cities' income inequality: 1990–2010 (Gini coefficient)*

Source: United Nations, Economic Commission for Latin America and the Caribbean (2017).

47 *Lavell, A. (2020); and Lavell, A. and A. Brenes Torres (2018).*
48 *Mansilla, E. (2010).*
49 *Ibid.*
50 *United Nations, Economic Commission for Latin America and the Caribbean and UN-Habitat (2017).*

3.2. Planning issues

Most large cities and megacities in the region are located in hazardous places — for example, at the foot of volcanoes, next to rivers, on coastlines or on top of water-saturated soil or active seismic faults.[51] Pre-existing hazardous conditions are exacerbated by multiple processes of socially produced environmental degradation. Some illustrative examples of this kind of degradation are: the 500 or more wells in the urban area of Buenos Aires that have been shut down in the last 30 years due to poor water quality, the high rate of microbiological contamination (50 percent) in the Rimac River — the main source of fresh water for Lima, Peru — that is produced by the metropolis itself, and the 100,000 tonnes of organic pollutants per year that Colombia and Mexico produce and dump into the northwest Pacific Ocean.[52]

From the mid-twentieth century onward, all urban physical transformations — growth, degradation and densification — in Latin America "have been the result of public policies and urban management strategies".[53] Mansilla has argued that the urban population grew faster than the capacity of local governments to direct such growth, causing poorly planned cities with marginalized and hazardous areas for migrants and the poor. According to the latest available data on the provision of services, in poor peri-urban areas access to safe drinking water may still be as low as 16.5 percent, despite the fact that overall access in the region exceeds 90 percent.[54] Collective water treatment has doubled its coverage in less than a decade (from 14 percent to 28 percent), but on average only between 20 to 30 percent of water collected in the region is treated. Furthermore, around nearly 50 percent of urban waste is disposed of improperly,[55] and while there is much more awareness on the topic now, recycling plants are almost non-existent. The informal sector continues to undertake most of the recycling done across the region.

Figure 5. *Selected indicators from Habitat III National Reports (country)*

	Urban		Informal settlements		Deprivations	
Country	Population (million)	% of national Population	Population (million)	% of urban Population	Lacked Piped water	Lacked Sewerage Connection
Argentina	36.49	91.0%	6.39	16.7%	19.0%	45.0%
Barbados*	0.18	66.0%	-	-	3.26%	94.0%
Bolivia	6.79	67.5%	3.21	44.9%	16.7%	59.8%
Brazil	160.93	83.5%	38.49%	22.3%	3.0%	8.44%
Chile	16.17	87.0%	0.83	0.52%**	0.1%	3.5%
Colombia	34.70	76.0%	4.88	13.1%	6.0%	15.0%
Costa Rica	3.84	76.8%	0.003	0.1%**	0.57%	3.72%
Cuba*	8.57	76.8%	-	-	7.7%	6.0%
Dominican Republic	8.48	78.9%	1.20	12.1%	53.7%	30.3%
Ecuador	9.09	62.7%	1.98	21.8%	11.0%	13.0%
Guatemala	8.41	51.5%	2.79	34.5%	9.4%	17.7%
Honduras	4.43	53.9%	1.23	34.9%	2.6%	10.5%
Jamaica	1.45	54.0%	0.92	60.5%	6.8%***	0.7%***
Mexico	81.20	72.3%	10.85	14.4%	4.0%	9.2%
Paraguay	4.08	60.5%	0.72	17.6%	12.1%	7.4%
Peru	23.89	77.0%	8.23	34.2%	8.4%	12.3%
Uruguay	3.08	93.4%	0.16	5.0%	6.0%	43.0%
Total / Mean	411.78	72.28%	81.90	20.8%	10.02%	22.33%

Source: Based on the Habitat III National Reports of selected countries.

Source: Sandoval, V. and J.P. Sarmiento (2019)

51 *For example, Quito, Ecuador is located on the slopes of an active volcano and Mexico City, Mexico is situated on top of five lake beds and several rivers.*
52 *United Nations, Economic Commission for Latin America and the Caribbean and UN-Habitat (2017).*
53 *Mansilla, E. (2010).*
54 *United Nations, Economic Commission for Latin America and the Caribbean (2017).*
55 *Inter-American Development Bank, et al. (2010), as cited in United Nations, Economic Commission for Latin America and the Caribbean (2017).*

3.3. Land issues

Land is undoubtedly a critical issue in the creation of urban disaster risk, although not all experts agree on why. For some, the application of a neoliberal economic model has led to the state losing its planning role, prompting a decentralization of decision-making and a liberalization of urban land markets. The result has been widening spatial segregation and market-driven land use, resulting in increasing disaster risk, particularly for poor populations who are forced to live on the peripheries of cities in hazardous areas due to the lack or high cost of land.[56] An 2017 ECLAC report on resilient cities[57] did not criticize the rollback of the state or the privatization of land markets, but maintained that the difficulties around urban land management stem mainly from the lack of adequate and long-term programs aimed at improving public management systems, the lack of available information (or the capacity to use it), and poor institutional coordination. An additional constraint identified was the inability of states to capture revenues from land transactions.

Urban informality and precariousness have deep historical roots in Latin America, and around 70 percent of all Latin American cities started as unplanned illegal occupation of land.[58] Precariousness is a complex phenomenon that manifests at minimum on the physical, legal, and socioeconomic dimensions. Each dimension is strongly intertwined with the others, yet there is little current research in the region on the link between economic growth, poverty, informality and urban vulnerability, arguably due to the perception that informal patterns of growth resulting from rural-urban migration are no longer occurring.[59]

Attempts to understand informal settlements from a disaster risk perspective are fairly recent in the LAC region. Sandoval and Sarmiento explore the potential relationships between informal settlements, national urban development policies, and disaster risk reduction strategies.[60] Similarly, Knowledge in Action for Urban Equality (KNOW) recently published a report on Lima, Peru that links informal settlements, inequality, and disaster risk through the notion of "urban risk traps" described as "the sum of everyday risks and small-scale disasters which impact impoverished urban dwellers to a greater extent than in other areas of the city."[61]

Another report on Lima examines three categories of inequality as a means of understanding the links between economic growth, poverty, informality, and urban vulnerability: (1) social inequality, (2) economic inequality, and (3) regional (urban or city-level) inequality, the latter of which is understood as a territory with disparity or lags in economic growth when compared to other regions or cities.[62] Inequalities increase pressure on particular territories, compromising their long-term sustainability and resulting in levels of poverty, overcrowding, unhealthy conditions, pollution, social insecurity, high levels of traffic, and — most importantly for this paper — the production of vulnerability and disaster risk.

In many parts of Latin America, legal and illegal (or informal) land markets coexist, arguably due to the difficulties that much of the urban population faces in accessing formal land markets, but also due to recent withdrawals of public housing programs, loans, and subsidies. Private loans are equally inaccessible for the urban poor,[63] making it very difficult for people to legally purchase land in safer locations in a city.

4. New risk drivers in cities

The Regional Action Plan for the Implementation of the New Urban Agenda in Latin America and the Caribbean 2016—2036 states that "the central challenge of urban management in the region … focuses on improving quality of life in cities, closing inequality gaps and achieving sustainable outcomes in cities."[64] To achieve these goals, historical drivers of urban risk must be tackled alongside new aspects such as climate change. Heatwaves, drought, heavy downpours, and coastal flooding are all projected to increase in frequency and intensity worldwide in the coming decades.[65]

Climate change impacts must also be seen in the light of other parallel processes such as the occupation of urban hazard-prone areas by new internal and external forced migrants, the privatization of urban space and urban service provision, the process of lower middle-class occupation of hazard-prone areas as land becomes scarce, and the rapid growth of many smaller cities due to new incentives for migration internally and across borders.[66]

56 *Mansilla, E. (2010).*
57 *United Nations, Economic Commission for Latin America and the Caribbean (2017).*
58 *Mertins, G. (2009), as cited in Marin, J., et al. (2018).*
59 *Castro et al. (2015), as cited in Marin, J., et al. (2018).*
60 *Sandoval V. and J.P. Saramiento (2019).*
61 *Knowledge in Action for Urban Equality (2018).*
62 *Chávez Eslava, A. (2019).*
63 *Mansilla, E. (2010).*
64 *ECLAC (2018).*
65 *Wilkinson, E., et al. (2020a).*
66 *Wilkinson, E., et al. (2020).*

4.1. Rapid growth in intermediate cities

Intermediate cities have populations of between 300,000 to 500,000 people. They have doubled in number over the last two decades, while megacities of over 10 million inhabitants have seen a slowing or zero relative growth in recent years.[67]

In the future, cities with less than 300,000 inhabitants and cities of between 1 and 5 million people are forecast to grow the most. This trend must nevertheless be seen in the context of an overall low rate of population increase in the region.[68] The appearance of new intermediate cities opens a window of opportunity for more sustainable development and less environmental degradation but also poses some challenges — for example, the asymmetries in management capacity between large and intermediate cities, with the latter category likely to have less economic and human resources available. Additionally, there has historically been little research, data and monitoring in such cities, including on disaster risk.

The above notwithstanding, the GAR 2019 notes that none of the recent international agreements (the Sendai Framework, New Urban Agenda, Paris Agreement, and the SDGs) focus in any depth on the very different conditions that exist in the broad spectrum of cities and urban contexts (for example, the New Urban Agenda does not consider city typologies or the implications of city or population size).[69] However, several research-based initiatives do focus on small and intermediate cities in the LAC region (see Section 6).

According to Lavell and Brenes, disaster risk management in intermediate cities will assume greater importance in the future, as urban growth trends are exceeding existing institutional capacities in areas that until just a few decades ago were mainly rural.[70] The authors present the case of the city of Choloma, Honduras, whose growth over the last 40 years has been rapid and was impacted since the 1990s by the fast growth of a *maquiladora* industry located in the San Pedro Sula conurbation. The municipality of Choloma had a population of only 35,000 in 1974, which increased to almost 243,000 by 2015 — during which time it transitioned from being predominantly rural to predominantly urban. The internal migration of people looking for jobs in this growing industrial hotspot drove this population growth, particularly from 1990 onwards.

This case has been studied by using a research method called Forensic Investigation of Disasters (FORIN) created by the International Science Council (ICSU) and its Integrated Research on Disaster Risk (IRDR) program.[71] Its aim is to gain deep insight (via case studies) into the concrete ways, factors and processes through which disaster risk is created and augmented. In the case of Choloma, the FORIN research found that the underlying drivers of risk were:

- Environmental degradation: In general terms, Central American cities like Choloma grow at the expense of natural areas and damage surrounding ecosystems.
- Vulnerable livelihoods: High levels of social exclusion underpin the creation of disaster risk.
- Poor local and urban governance: This is defined as the main driver producing and perpetuating disaster risk. The city of Choloma suffers from the consequences of incomplete land use strategies.[72]

4.2. Aggravated risks in large urban centres

Overcrowding in historically large cities, including in informal areas and through processes like *allegamiento*,[73] brings new hazards, negative environmental externalities, and unexpected overload to existing infrastructures, which in turn affect economic growth, productivity and quality of life.[74] Some of these hazards are infectious epidemics, exposure to environmental pollutants, consumption of processed foods, a sedentary lifestyle, hazardous work environments, and,

67 *ECLAC and UN-Habitat (2017).*
68 *Ibid.*
69 *UNDRR (2019).*
70 *Lavell, A. and A. Brenes Torres (2018).*
71 *Oliver Smith, A., et al. (2016).*
72 *Lavell, A. and A. Brenes Torres (2018).*
73 *"The term allegado (literally: close, near or related) is used in Chile to refer to poor families or individuals who live in the homes of their relatives. Allegados* usually do not pay rent but make small contributions toward household utilities and other expenses." See Ossul, I. (2019).
74 *ECLAC (2018).*

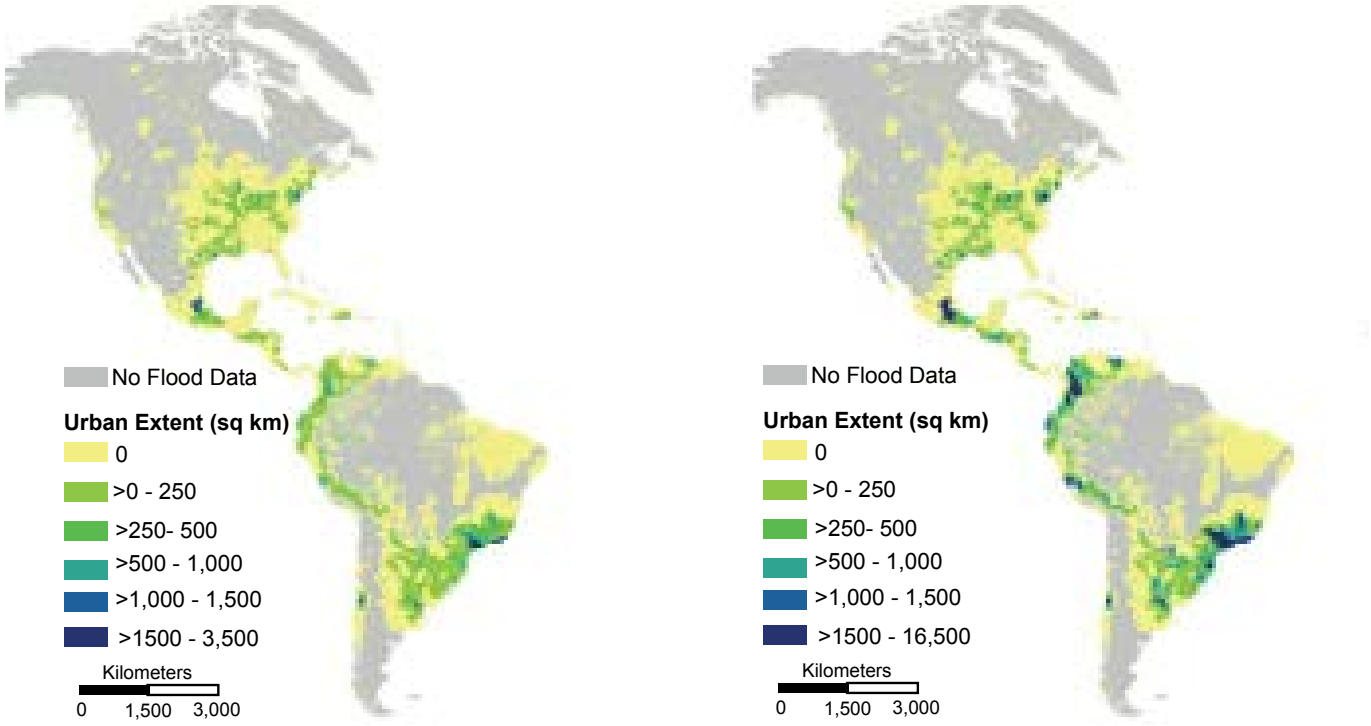
potential social conflicts and violence.[75] Other common hazards include:

- Fire: There is an increasing economic impact and mortality caused by urban fires in densely populated human settlements,[76] as seen in the 2014 wild and urban forest fires in Valparaiso, Chile, where urban unplanned growth has spread beyond the city limits and is now approaching large forestry crops (see Section 6).

- Heat waves: Extensive built-up areas and impermeable land cover lead to the loss of environmental services like water infiltration and heat mitigation.[77] This is relevant as "thermal conditions are among the environmental factors that most affect people's well-being and health."[78] High levels of imperviousness reduce the absorption or retention of superficial rainwater runoffs, and thus are highly linked to the generation of future hazards.

- Urban flood risk and drought: It is expected that between 2000 and 2030 global urban land exposed to flood (without including the effects of climate change) will increase by 2.7 times, urban land exposed to drought will double, and urban areas exposed to both hazards will increase by a factor of 2.5. By 2030, almost half of global urban expansion (over 500,000 km2) will take place in high-frequency flood zones.[79]

Figure 6. *Urban land in high-frequency flood zones in 2000 and 2030 by watershed*



Source: Güneralp, B, et al. (2015).

Informality and overlapping vulnerabilities

High rates of urbanization have not reduced the level of poverty or inequality in the region, partly due to the high levels of informality found in cities. Over 111 million people out of 600 million currently live in informal settlements[80] suffering from overlapping socioeconomic and environmental deficits and potential vulnerabilities.

Informality can be characterized as the main force driving and facilitating poor people's access to secure housing and their integration into the city.[81] Nonetheless, it also creates huge challenges for disaster risk management. Informal settlements tend to be located on steep terrains or complex geographical configurations, making them prone to subsidence, landslides and mudslides.[82]

Climate change impacts on urban settlements

75 *ECLAC and UN-Habitat (2017).*
76 *UNDRR (2019).*
77 *Müller, A. and R. Höfer (2014), as cited in Krellenberg, K. and J. Welz (2017).*
78 *Ibid.*
79 *Güneralp, B., et al. (2015).*
80 *Watanabe, M. (2014).*
81 *Rosenzweig, C., et al. (2018).*
82 *Ibid.; and UN-Habitat (2003).*

Figure 7. *Latin America and the Caribbean (26 countries): urban population living in slums between 2005 and 2014 (percentage)*

*Source: UN-Habitat Global Urban indicator Database 2014, based on household surveys considering the characteristics of lack of adequate water and sanitation and sufficient space (more than three persons per room or durable housing) *Belize: Data for 2005 is from 2007.*

Cities in the LAC region are strongly affected by climate change, despite their relatively low contribution to global greenhouse gas emissions.[83] There are, however, several institutional barriers to integrating climate change adaptation into urban planning, including a lack of climate resilience in cities' vision of development, limited understanding of the hazards, vulnerabilities, and resulting risks, lack of coordination between administrative and sectoral levels of city management, inadequate implementation and financial capacities, and poor connection between climate adaptation and disaster, and other risk management efforts on the one hand and cities' development visions and strategies on the other.[84] Taking the complexity of adapting to climate change in urban areas into account, Dodman et al. identified five agendas for low-income or highly vulnerable urban contexts: economic success, poverty reduction and basic service provision, disaster risk reduction, climate change mitigation, and climate change adaptation.[85] Although there might be tensions among these objectives and there is often competition for resources, they are closely interrelated, and actions that achieve synergies across these agendas and communities of practice are recommended.

5. Urbanization and disaster risk hotspots

This section looks in more detail at specific urban areas in Latin America and the Caribbean where patterns of urbanization are creating or reconfiguring disaster risks.

5.1. The Amazon Delta Estuary cities

The Amazon Delta Estuary (ADE) cities are among the fastest growing in the region. The urban population has grown 300 percent over the last 40 years[86] and is expected to grow by more than 50 percent in the next 10 years, further expanding the river margins and critically impacting the ecosystem services provided by the delta and estuary.[87] Between 60 and 90 percent of the urban population in the ADE area lives in conditions of moderate-to-high vulnerability due to flood exposure, a deficit of services and infrastructure, low-income levels, and other socioeconomic factors.

The city of Belém in northern Brazil is the largest of the ADE cities, with a population of 1.5 million people and a density of about 1,315 inhabitants/km2. Currently, most of its inhabitants have limited or non-existent access to infrastructure and services, a situation that is not expected to change anytime soon as municipal and state governments have been unable to address the needs of the expanding urban population. Like most ADE cities, Belém is located on a low-level tidal river plain, with about 40 percent of its area below sea level. This is aggravated by intense tropical rains of over 3,000 mm per year and the severe floods that occur when heavy rains coincide with high tides. In the near future, climate change is likely to increase the intensity and frequency of seasonal tropical floods and accelerate sea level

83 *ECLAC (2017); and Wilkinson, E., et al. (2020a).*
84 *Rosenzweig, C., et al. (2018).*
85 *Dodman, D., et al. (2019).*
86 *Mansur, A., et al. (2018); and Mansur, A. and E. Brondizio (2017).*
87 *Mansur, A., et al. (2018).*

rise, conditions which will be further exacerbated by anthropic pressures in the region.[88]

Accelerated urban growth has brought increased densification and competition for land with little institutional planning or management. This in turn has increased pressure on river channels, raising the level of sewage inputs, waste disposal and river sedimentation and increasing water levels and pollution. Recently built infrastructure and growing urbanization have negatively affected the traditional relationship of the people with the water and are is diminishing their agency on specific, small-scale adaptive capacities. The urban poor have lost their traditional ability to deal with floods due to financial limitations and a generalized sense of powerlessness.[89]

Figure 8. *City of Belém, Brazil*

Source: Mansur, A., et al. (2018). Satellite image (above), changes in urban growth in Belém from 2000–2010 (bottom left) and a view of the Amazon River Delta (bottom right). Photo Credit: Eduardo Brondizio.

88 *Ibid.*
89 *Ibid.*

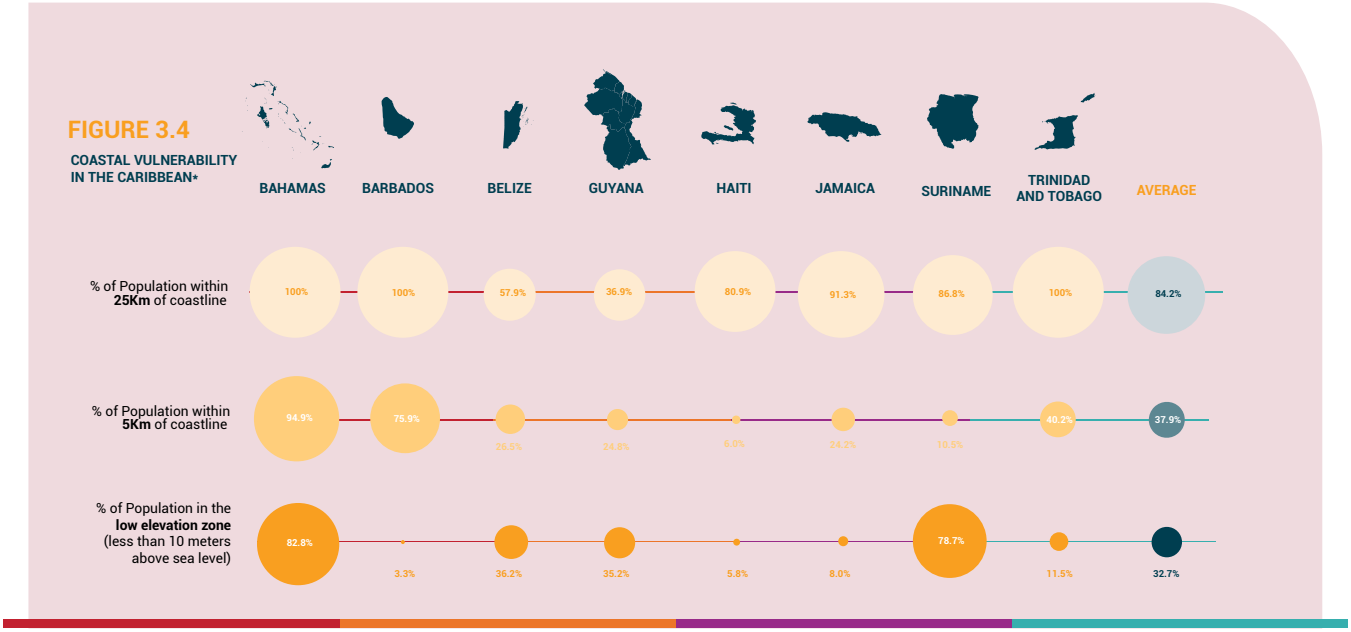
5.2. Coastal cities in the Caribbean

One of the most critical cases of interaction between urbanization, climate change and natural hazards can be found in Caribbean cities. Around 6.4 million people currently live in member states of the Caribbean Community (CARICOM), with some countries projected to have the fastest urban growth rates in the LAC region.[90]

Among CARICOM countries, there are multiple examples of environmental degradation due to urbanization. In the mountainous islands, pollution in upper watersheds and deforestation is affecting coastal cities downstream, producing water pollution and coral reef damage. In Trinidad, 46 percent of agricultural land has been repurposed for low-density housing in recent years, while Port-of-Spain, the capital city, has suffered devegetation and loss of wetlands due to land reclamation and port expansion. In Jamaica, 10 percent of informal settlements are in environmentally sensitive areas, which are also the places most severely affected by disasters.[91] More than half of informal settlements in Kingston, St. Andrew and St. Thomas are within 100 meters of a flood-prone waterway. [92]

Over 70 percent of the Caribbean population lives in coastal cities, many of them located in low-elevation areas with high exposure to storm surges. Belize has one of the highest levels of exposure, with 45 percent of its population living on the low-lying coastline in dense urban areas like Belize City, where around 20.5 percent of the total population resides. The area is particularly vulnerable to storms as it is around one to two feet below sea level.[93] Barbados, Guyana, Jamaica, and Trinidad and Tobago are also highly exposed, with around 45 percent of their population living within 5 km of the coastline. Currently, an estimated 83 percent of the population of CARICOM countries experience flooding due to the failure of drainage systems, while approximately 85 percent of wastewater is discharged untreated into the sea, and only 17 percent of all households are connected to sewerage and black water treatment.[94]

Figure 9. *Coastal vulnerability in the Caribbean*



Source: Donovan, M. and M. Mycoo (2016).

Most of these issues are linked to planning and governance, including outdated planning instruments, weak institutional capacity, limited human, technical and financial resources, lack of political will, lack of transparency, and scarce public awareness and knowledge (among others). On a more positive note, multiple international frameworks and agreements have recently acknowledged the urgency to improve urban resilience, including Rio+20 (2012), the SAMOA Pathway (2014), the 2030 Agenda (2015), the Sendai Framework (2015), and the Paris Agreement (2015).

90 *Mycoo, M. (2017).*
91 *Ibid.*
92 *Government of Jamaica, as cited in Mycoo, M. (2017).*
93 *Rosenzweig, C., et al. (2018).*
94 *Mycoo, M. (2017).*

5.3. The Sacrifice Zone: Anthropic risk areas

As recommended in the Sendai Framework, the focus of disaster risk management has begun to broaden to include man-made, biotic, and technological hazards. These arguably "new" kinds of disasters are strongly linked with urban and/or industrial environments.[95] Modern manufacturing and industrial processes within or next to city centers can become a serious menace to city dwellers due to hazardous processes prone to error, system failures, and other unexpected outcomes.[96] Furthermore, the interactions between natural and anthropic systems are not yet fully understood, let alone well managed, and "a perfect storm is created by the complex interlinkages of different natural and anthropogenic events and processes."[97]

Latin American cities have transitioned over the last 20 years from having an industrial economic base to having a mixed service-oriented economy. However, the growth of intermediate cities in the region is likely to be linked to manufacturing industries and natural resource extraction.[98]

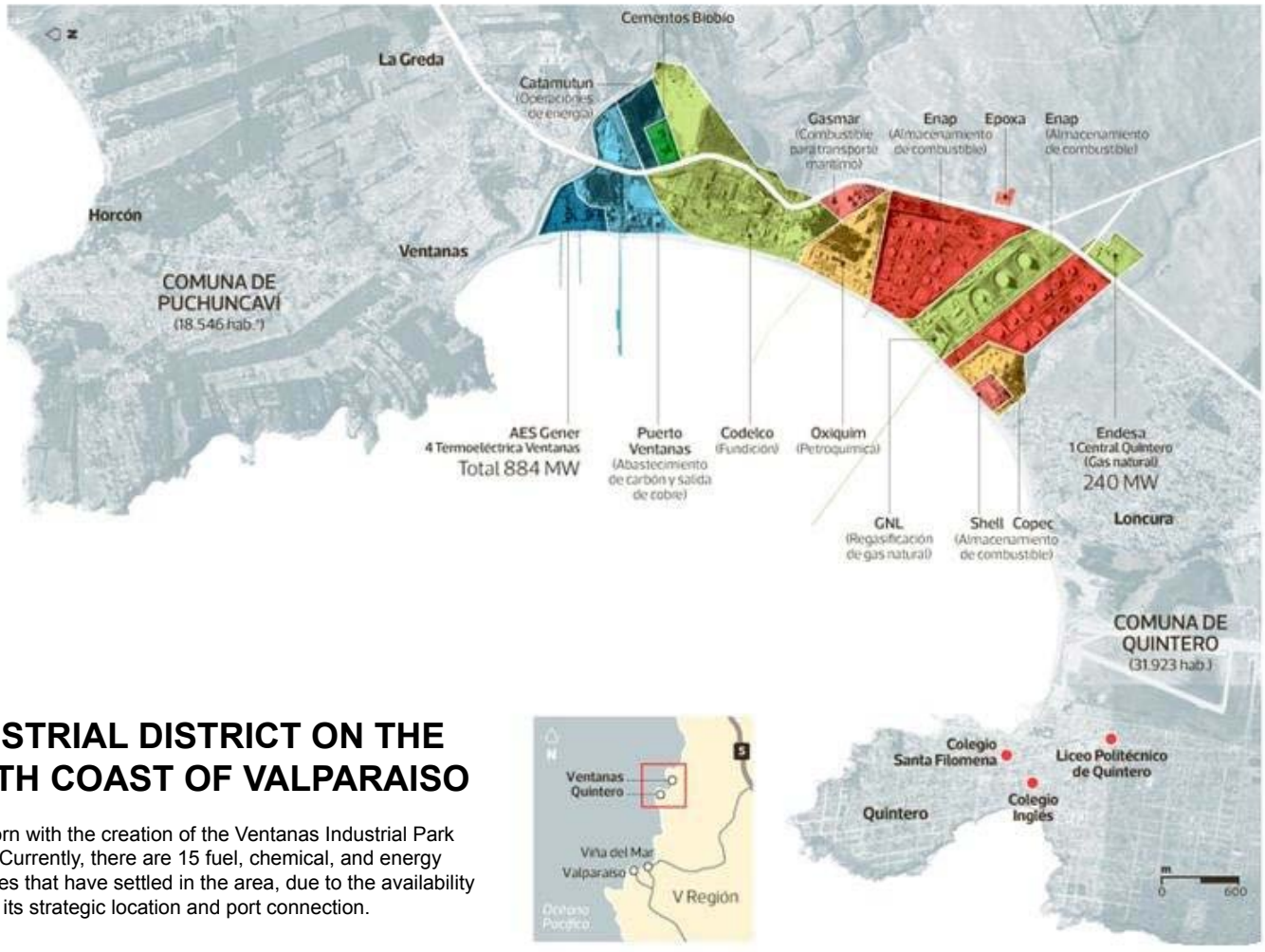
So-called 'sacrifice zones', as they are known in Chile, exemplify the kinds of anthropogenic risks that are being produced in intermediate urban areas. Most of Chile's coal-powered plants are in small and medium-sized cities. One example is the city of Puchuncaví, an area in urban transition with a population of around 15,000 people. Since the 1960s, a large industrial complex has been expanding and degrading the environment by polluting the water, air and soil and in so doing has become a constant health hazard to its citizens. The Chilean government, keen to foster private investment and prioritize economic growth over environmental concerns, has allowed this industrial park to continue operating.[99]

Figure 10. *Puchuncaví, Chile (adjacent to the Ventanas industrial complex)*

Source: Hormazabal Poblete, N., et al. (2019); and Aguilera Salazar, M. (2018).

95 UNDRR (2019).
96 Lavell, A. (1996).
97 UNDRR (2019).
98 ECLAC and UN-Habitat (2017).
99 Hormazabal Poblete, N., et al. (2019).

Figure 11. *Location and type of industries next to Puchuncavi, Chile*



INDUSTRIAL DISTRICT ON THE NORTH COAST OF VALPARAISO

It was born with the creation of the Ventanas Industrial Park in 1961. Currently, there are 15 fuel, chemical, and energy companies that have settled in the area, due to the availability of water, its strategic location and port connection.

Source: Sandoval, G. and D. Astudilio (2018).

6. Addressing urban risk through disaster risk management

Recent conceptual and policy innovations aimed at improving urban governance and reducing risks in the LAC region use a combination of disaster risk management approaches and contributions from other disciplines like climate change science, environmental science and participatory design. They entail strong collaboration between different stakeholder groups and strong local leadership. Some of the most prominent of these innovations are described below.

6.1. Science-based decision-making

Disaster risk management should take into account expected physical damage and loss and the socioeconomic vulnerability that contributes to the impact of disasters.[100] A good example of the use of this perspective took place in the city of Manizales, Colombia, which has approximately 400,000 inhabitants and is located in the Colombian Central Mountain Range. A holistic disaster risk assessment was carried out based on a Comprehensive Approach to Probabilistic Risk Assessment (CAPRA)[101] and applied to each district of the city. This diagnosis was then used to guide the Urban Disaster Risk Management Plan and incorporated into the Socioeconomic Development Plan (2016–2019) to identify the main actions needed in each district to reduce specific risks over time.

100 Carreño Tibaduiza, M. L., et al., (2017). Carreño Tibaduiza, M. L., et al., (2017).
101 See Cardona, O.D., et al. (2012); and Carreño Tibaduiza, M. L., et al., (2017).

6.2. Local leadership

Local authorities across Latin America and the Caribbean have demonstrated their ability to implement disaster risk management and adaptation strategies with relatively little support from national governments. The Climate Resilient Cities in Latin America initiative (known as *Iniciativa Ciudades Resilientes al Clima en América Latina* in Spanish) has documented a number of prominent cases,[102] including through the *Ciudades Auto-Sostenibles Amazónicas* (CASA) project, which strengthened local livelihoods while aiming at increasing food security and the empowerment of women and girls.[103] Similarly, the *Medios de Vida y Cambio Climático* project is addressing health and access to water issues intensified by climate change through the development of a rainwater collection system. These projects are multisectoral and tackle multiple objectives, including social development. Their implementation has been achieved in a relatively short time by sensibly using local knowledge and fostering collective action. Nevertheless, the importance of international funding is acknowledged as being critical to achieving certain independence from national institutions.[104]

The city of Santa Fe in Argentina, an intermediate city of 400,000 inhabitants, provides a good example of a local government able to implement strong and independent local policy. It was the first municipality to adopt and implement a disaster risk management policy in Argentina and stands out as an example for many cities around the world. Its municipal disaster risk management office is responsible for preparedness, response and recovery and receives its annual budget directly from the mayor (as of December 2019). The office also has a cross-cutting role in mainstreaming disaster risk management in other sectors of the local government, which ensures that additional resources are made available for flood risk management. Having a strong disaster risk management policy has helped the city government secure financing from higher administrative levels, but also from international donors including The Rockefeller Foundation and the French Facility for Global Environment. The role of city-to-city networks has also been critical in terms of learning from others and empowering city leadership through recognition from abroad. Moreover, the municipal government acknowledges that disaster risk management is not only about grey infrastructure and other physical measures but about education and culture. It created a risk communication program to develop a shared culture of prevention, especially among children.[105]

6.3. Prospective risk management

The growing number and magnitude of disasters — which are likely to increase further with climate change and other urban processes — have prompted a shift from corrective strategies that reduce existing risks to a more proactive attitude (or prospective approach) that focuses on avoiding new risk creation in a territory.[106] This can be achieved by improving spatial or physical planning and building codes, regulating private investment, and increasing the use of risk analysis. Due to its nature, this approach is inherently connected with development strategies and models.

The prospective approach is increasingly mentioned in guidelines, grey literature, and guidance issued by national governments, including in Chile, Guatemala and Peru.[107] One report from Peru makes for particularly interesting reading as it aims to incorporate prospective and corrective management strategies into the participatory budgeting processes of regional and local governments. An evaluation of the results of implementing these new approaches is needed.

102 Villamarín, G., et al. (2019).
103 Dupar, M., et al (2018).
104 Villamarín, G., et al. (2019).
105 Hardoy, J., et al. (2019a); and Filippi, M.A. (2019).
106 Lavell, A., et al. (2003); and Narváez, L., et al. (2009).
107 Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres (CENEPRED) and Presidencia del Consejo de Ministros de Perú (n.d.); Narváez, L., et al. (2009); and Palma-De Cuevas, S.I. (2016).

6.4. Regional urban agendas and city-to-city networks

Despite a burgeoning literature and a plethora of guidelines on urban resilience, it is important to avoid blueprints or generic solutions to urban risk problems. Many experts are instead championing local "urban agendas" adapted to specific contexts, capacities, and resources.[108] ECLAC and UN-Habitat have developed a Regional Action Plan to adapt and implement the New Urban Agenda in Latin America,[109] and this has been adopted and modified for the Caribbean subregion to include policies aimed at integrating climate change adaptation, disaster risk management, and land use planning, implementing building codes to increase urban resilience to climate change; and accessing specific financial instruments like climate change funding and insurance schemes.

Many transnational municipal networks now exist and are working on issues like climate, energy, and sustainability (some examples include the ICLEI Local Governments for Sustainability, the C40 Cities Climate Leadership Group and, The Rockefeller Foundation 100 Resilient Cities initiative). Among these, the UNDRR Making Cities Resilient campaign is a good example of a growing network of municipal governments working towards improving disaster risk management in cities.[110] These networks play a critical role in peer-to-peer knowledge exchange among cities — but they can also become a mechanism through which cities can start to advance their own agendas, increase their capacity for political maneuvering in international negotiations, and strengthen their ability to influence national governments.

6.5. Participatory disaster risk management planning

Although historically participatory processes have their roots in rural development, advocacy for participation in urban disaster risk management planning is becoming stronger. Hardoy et al. presented the cases of three small cities in Latin America in which local institutions lacked the necessary capacity and knowledge to undertake disaster risk management measures alone.[111] The authors argued that participatory planning that engaged local authorities and key stakeholders to increase urban resilience can be a feasible and suitable option.

Figure 12. *Participatory planning for resilient housing in Valparaíso, Chile*

Source: Ojeda, L., et al. (2018). A family arranging units to design their household in Valparaiso, Chile (left) and a February 2018 model comparing assisted self-construction and standard housing (right).

108 *Mycoo, M. (2017).*
109 *ECLAC (2018).*
110 *Filippi, M. A. (2019).*
111 *Hardoy, J., et al. (2019). The three cities are Dosquebradas, Colombia; Santa Ana, El Salvador; and Santo Tomé, Argentina.*

6.6. Green infrastructure and ecosystem-based solutions

One of the biggest obstacles to development in Latin America and the Caribbean is low investment in urban infrastructure. It is estimated that governments only spend 3 percent of regional GDP, or half of what is needed to meet current demand.[112] Green infrastructure is increasingly used throughout the region due to its capacity to control urban growth and protect the environment while bringing livelihood, recreational and psychological co-benefits.[113] Regional organizations including the Inter-American Development Bank (IDB) have also stressed that green infrastructure can be built rapidly and provide a cost-effective alternative to grey infrastructure.[114]

These and other "nature-based solutions" that restore and protect ecosystems and have a protective function against natural hazards are starting to become a key component of local disaster risk management strategies in the region.[115] The 2018 Regional Action Plan to implement the New Urban Agenda argues that planning and governance must aim to promote the sustainable use of resources and ecosystem services, and that small-scale experiences have demonstrated that well-managed ecosystems can contribute to disaster risk reduction while being "cost-effective, multifunctional, and win-win solutions, especially in the long run."[116] The number and scale of these nature-based solutions are expected to rise substantially over the next few years across the region.

6.7. Linking to climate change adaptation

Increasingly, the need to look ahead to potential risks created by climate change is being acknowledged in disaster risk management policies.[117] Filho et al. describe major changes underway in two large Latin American cities to help protect development gains, maximize disaster risk management interventions and reduce the escalating risk from climate change:[118]

- Montevideo, Uruguay has moderate exposure to sea level rise and high exposure to coastal flooding. The Government Office of Climate Change (DCC) developed the Global Environment Fund (GEF) Project called 'Implementing Pilot Adaptation Measures to Climate Change in Coastal Areas of Uruguay', and a National Adaptation Plan (NAP) for Cities and Infrastructures (2017–19). Subnational governments along the coast are also developing the Metropolitan Climate Plan for Urban and Coastal Adaptation.

- Lima, Peru is vulnerable to glacier melting and faces severe water shortages. Existing and proposed interventions focus on the capture and storage of rainwater during the wet season, and the government is planning to invest in dams, tunnels, and reservoirs to prevent flooding.

Overall, there are many specific examples of innovative policies and instruments being used across the LAC region to manage disaster risk in urban areas, although many of these continue to be focused on larger and capital cities (Box 1). The challenge ahead is to share and institutionalize good practices where they exist, particularly measures that address the many complex drivers of poverty, inequality, marginalization, and environmental degradation that contribute to risk in urban areas and to future challenges associated with climate change.

112 ECLAC (2018).
113 Güneralp, B., et al. (2015).
114 Muñoz Castillo, R. and T.L. Crisman (2019).
115 Bai, X., et al. (2017).
116 ECLAC (2018).
117 Mansur, A., et al. (2018).
118 Filho, W., et al. (2019).

Box 1. Research and action-oriented disaster risk management initiatives in Latin America cities

The **Climate and Development Knowledge Network (CDKN)**[119] supported several urban resilience initiatives, including CASA, a research project that developed innovative participatory processes to co-produce sustainable spaces and promote alternative livelihood systems in the Amazon. It focuses on migrants affected by the changing climate and increasing deforestation in the Peruvian Amazon River basin.

Climate Resilient Cities in Latin America Initiative [120]

Main research topics:

- Building climate-resilient and inclusive urban futures
- Business and investment opportunities for climate-resilient development in cities
- Promoting innovative governance at multiple urban scales to build resilience

Some projects include:

- Participatory Decision-Making Approach: Towards Resilient and Inclusive Urban Development in Latin America: Action-research exploring and promoting participatory planning options for sustainable and climate-resilient development in fast-growing intermediate cities in Latin America.
- Urban triangular cooperation: Project aiming at developing climate resilience in the Paraná basin through strengthening cross-border city cooperation and the participation of multiple actors.
- Climate Resistant Coyuca: Project aiming at achieving a participatory and gender-sensitive climate change strategy. The project focused on the risks associated with climate change in coastal urban areas.

LA RED[121]

The Network of Social Studies on the Prevention of Disasters in Latin America (LA RED) was formed in August 1992 to establish links between Latin American institutions and professionals in order to stimulate and strengthen the study of the social dimensions of risk and to define new ways to manage disaster risk. LA RED emerged in response to the research trends of that moment, which were dominated by approaches derived from the natural sciences and engineering and focused only on large disasters.

Knowledge in Action for Urban Equality (KNOW)[122]

Despite the relevance of understanding the interactions between different scales of disasters, there are surprisingly few detailed studies documenting the accumulation of extensive risks in urban settlements. One exception is the KNOW project, which has explored the spatial correlation between disaster and 'everyday' risks in Barranquilla, Colombia, San Jose, Costa Rica, and Lima, Peru. In Lima, some preliminary findings show that risk exposure reinforces inequalities — or in other words that "inequality and risk are not understood as a cause-effect relation but rather as an interdependent circular relationship," and that "the accumulation of everyday risks and small-scale disasters leads to the consolidation of urban 'risk traps' as citizens must constantly invest to mitigate these risks."[123]

119 Climate and Development Knowledge Network (n.d.).
120 Villamarín, G., et al. (2019).
121 La Red de Estudios Sociales en Prevención de Desastres en América Latina (n.d.).
122 Knowledge in Action for Urban Equality (n.d.).
123 Ibid.

References

Aguilera Salazar, Miguel (2018). Zona de Sacrificio Quintero-Puchuncaví. Red de Bibliotecas Populares del Gran Valparaíso, 6 December. Available at https://reddebibliotecaspopulares.cl/2018/12/06/zona-de-sacrificio-quintero-puchuncavi/.

Amaratunga, Dilanthi, Pournima Sridarran and Richard Haigh (2019). Making Cities Resilient Report 2019: *A snapshot of how local governments progress in reducing disaster risks in alignment with the Sendai Framework for Disaster Risk Reduction*. Geneva: UNDRR.

Bai, Xuemei, et al. (2017). Linking Urbanization and the Environment: Conceptual and Empirical Advances. *Annual Review of Environment and Resources,* vol. 42 (October).

Blaikie, Piers and others (1994). *At Risk: Natural Hazards, People's Vulnerability, and Disasters.* London, United Kingdom: Routledge.

Bull-Kamanga, Liseli, et al. (2003). From everyday hazards to disasters: the accumulation of risk in urban areas. *Environment & Urbanization*, vol. 15, No. 1.

Cardona, Omar Dario, et al. (2012). CAPRA - Comprehensive Approach to Probabilistic Risk Assessment: International Initiative for Risk Management Effectiveness. Conference Paper for the Fifteenth World Conference on Earthquake Engineering. Lisbon, September.

Carreño Tibaduiza, Martha Liliana, et al. (2017). Holistic Disaster Risk Evaluation for the Urban Risk Management Plan of Manizales, Colombia. *International Journal of Disaster Risk Science,* vol. 8, No. 3.

Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres (CENEPRED) and Presidencía del Consejo de Ministros de Perú (n.d.). *Lineamientos para incorporar la Gestión Prospectiva y Gestión Correctiva en los Presupuestos Participativos.* Accessed on 7 June 2020. Available at https://cenepred.gob.pe/web/wp-content/uploads/Guia_Manuales/Lin-GP-GC-PP.pdf.

Chávez Eslava, A. (2019). Informe anual de actividades septiembre 2018—septiembre 2019. Paquete de Trabajo 2: Resiliencia Urbana Equipo Perú. Lima, Perú: Knowledge in Action for Urban Equality (KNOW).

Dupar, Mairi and CDKN Global (2018). Empowerment of women and girls could transform Latin America's climate resilience. *Climate and Development Knowledge Network*, 24 October. Available at https://cdkn.org/2018/10/feature-empowerment-of-women-and-girls-could-transform-latin-americas-climate-resilience/?loclang=en_gb.

Climate and Development Knowledge Network (CDKN) (n.d.). Region: Latin America and the Caribbean. Accessed on 10 February 2020. Available at: https://cdkn.org/regions/lac.

Centre for Research on the Epidemiology of Disasters (n.d.). Emergency Events Database (EM-DAT). Accessed on 10 July 2020.

Dodman, David, et al. (2019). Editorial: Responding to climate change in contexts of urban poverty and informality. *Environment & Urbanization*, vol. 31, No. 1.

Donovan, Michael G. and Michelle Mycoo (2016). A Blue Urban Agenda: Adapting to Climate Change in the Coastal Cities of Caribbean and Pacific Small Island Developing States. Washington, D.C.: Inter-American Development Bank. Available at https://publications.iadb.org/publications/english/document/A-Blue-Urban-Agenda--Adapting-to-Climate-Change-in-the-Coastal-Cities-of-Caribbean-and-Pacific-Small-Island-Developing-States.pdf.

Filho, Walter, et al. (2019). Assessing the impacts of climate change in cities and their adaptive capacity: Towards transformative approaches to climate change adaptation and poverty reduction in urban areas in a set of developing countries. *Science of the Total Environment*, vol. 692.

Filippi, Maria Evangelina (2019). Understanding disaster risk management as an everyday concept and practice in municipal government policy, planning and management: learning from the experience of Santa Fe, Argentina, with urban flood risk. Doctoral thesis, University College London. Available at https://discovery.ucl.ac.uk/id/eprint/10101357/.

González-Pérez, Jesús M, et al. (2016). Urban growth and dual tourist city in the Caribbean. Urbanization in the hinterlands of the tourist destinations of Varadero (Cuba) and Bávaro-Punta Cana (Dominican Republic). *Habitat International*, vol. 58.

Gu, Danan (2019). *Exposure and vulnerability to natural disasters for world's cities.* Technical Paper No. 2019/4. United Nations, Department of Economic and Social Affairs, Population Division.

Guida-Johnson, Bárbara and Gustavo A. Zuleta (2019). Environmental degradation and opportunities for riparian rehabilitation in a highly urbanized watershed: the Matanza-Riachuelo in Buenos Aires, Argentina. *Wetlands Ecology and Management,* vol. 27, No. 2-3.

Güneralp, Burak, Inci Güneralp and Ying Liu (2015). Changing global patterns of urban exposure to flood and drought hazards. *Global Environmental Change*, vol. 31.

Hardoy, Jorgelina, et al. (2019). Participatory planning for climate resilient and inclusive urban development in Dosquebradas, Santa Ana and Santa Tomé. Environment & Urbanization, vol. 31, No. 1.

Hardoy, Jorgelina, et al. (2019a). *Local Disaster Risk Reduction and Resilience Strategies:* Words into Action. Geneva, Switzerland: UNDRR.

Hormazabal Poblete, Nina, et al. (2019). Habitar en una zona de sacrificio: análisis multiescalar de la comuna de Puchuncaví. *Revista Hábitat Sustentable*, vol. 9, No. 2.

Inter-American Development Bank (2015). *Actualización Universo de Ciudades Emergentes*. Available at: https://www.yumpu.com/en/document/read/52997705/actualizacion-universo-de-ciudades-ices.

Inter-American Development Bank, Pan American Health Organization and the Inter-American Association of Sanitary and Environmental Engineers (2010). *Regional Evaluation on Urban Solid Waste Management in Latin America and the Caribbean: 2010 Report.*

Kasperson, Jean X., Roger E. Kasperson and B.L. Turner (1996). *Regions at Risk: Comparisons of Threatened Environments.* Tokyo, Japan: United Nations University Press.

Knowledge in Action for Urban Equality (KNOW) (2018). Metropolitan Lima: Urban inequality and how to address it. City Brief. Lima, Peru.

_____ (n.d.). Accessed on March 7, 2020. Available at https://www.urban-know.com/.

Krellenberg, Kerstin and Juliane Welz (2017). Assessing Urban Vulnerability in the Context of Flood and Heat Hazard: Pathways and Challenges for Indicator-Based Analysis. *Social Indicators Research: An International and Interdisciplinary Journal for Quality-of-Life Measurement,* vol. 132, No. 2 (June).

La Red de Estudios Sociales en Prevención de Desastres en América Latina (LA RED) (n.d.). Available at https://www.desenredando.org. Accessed on February 10, 2020.

Lavell, Allan (1996). "Degradación ambiental, riesgo y desastre urbano. Problemas y conceptos: hacia la definición de una agenda de investigación". *In Ciudades en Riesgo: Degradación Ambiental, Riesgos Urbanos y Desastres.* La Red de Estudios Sociales en Prevención de Desastres en América Latina (LA RED).

_____ (2000). Desastres Urbanos: *Una Visión Global. Woodrow Wilson Center and ASIES Guatemala*.

Lavell, Allan, et al. (2003). *La Gestión Local del Riesgo: nociones y precisiones en torno al concepto y la práctica*. Centro de Coordinación para la Prevención de los Desastres Naturales en América Central (CEPREDENAC) and United Nations Development Programme (UNDP). Available at https://www.desenredando.org/public/libros/2006/ges_loc_riesg/gestion_riesgo_espanol.pdf.

Lavell, Allan and Manuel Argüello Rodríguez (2003). Gestión de riesgo: un enfoque prospectivo — Las Naciones Unidas y su respuesta ante el Mitch. Colección Cuadernos de Prospectiva 3. Tegucigalpa, Honduras: United Nations publication.

Mansilla, Elizabeth (2010). Riesgo Urbano y Politicas Publicas en America Latina: La Irregularidad y el Acceso al Suelo. *In Revealing Risk, Redefining Development: Global Assessment Report on Disaster Risk Reduction* (GAR 2011). Geneva: UNISDR, UNDP and Corporación OSSO. Available at: https://www.preventionweb.net/english/hyogo/gar/2011/en/bgdocs/Mansilla_2010.pdf.

Mansur, Andressa V. and Eduardo Brondizio (2017). Challenges of Transitioning to Sustainable Urban Infrastructure in the Amazon Delta and Estuary. T*he Nature of Cities,* 16 April.

Mansur, Andressa V, et al. (2018). Adapting to urban challenges in the Amazon: flood risk and infrastructure deficiencies in Belém, Brazil. *Regional Environmental Change*, vol. 18, No. 5.

Margulis, Sergio (2016). *Estudios del cambio climático en América Latina: Vulnerabilidad y adaptación de las ciudades de América Latina al cambio climático.* United Nations publication.

Maria, Augustin and others, eds. (2017). *Central America Urbanization Review: Making Cities Work for Central America.* Washington, D.C.: International Bank for Reconstruction and Development and The World Bank.

Marin, Juliette, Ingrid Mendez and Juan Pablo Sarmiento (2018). Dimensionando la precariedad urbana y su vínculo con la gestión del riesgo de desastres. REDER, vol. 2, No. 2.

Melchiorri, Michele, et al. (2018). Unveiling 25 years of Planetary Urbanization with Remote Sensing: Perspectives from the Global Human Settlement Layer. *Remote Sensing,* vol. 10, No. 5.

Mertins, Guenter (2009). Megacities in Latin America: Informality and Insecurity as Key Problems of Governance and Regulation. Die Erde, vol. 140, No. 4.

Muñoz Castillo, Raul and Thomas L. Crisman (2019). *The role of Green Infrastructure in Water, Energy and Food Security in Latin America and the Caribbean*: Experiences, Opportunities and Challenges. Washington D.C.: Inter-American Development Bank.

Mycoo, Michelle (2017). A Caribbean New Urban Agenda post-Habitat III: Closing the gaps. Habitat International, vol. 69.

Narváez, Lizardo, et al. (2009). L*a gestión del riesgo de desastres: Un enfoque basado en procesos*. San Isidro, Perú: Secretaría General de la Comunidad Andina.

Nión Celio, Soledad and Valentina Pereyra (2018). Social construction of risk in the Uruguayan agricultural sector: challenges for union activity. *Salud Colectiva*, vol. 14, No.4.

Ojeda, Lautaro, et al. (2018). Co-production after an urban forest fire: post-disaster reconstruction of an informal settlement in Chile. *Environment & Urbanization*, vol. 30, No. 2.

Oliver Smith, Anthony, et al. (2016). *Investigación Forense de Desastres: un marco conceptual y guía para la investigación.* Coyoacán (D.F.), Mexico: Universidad Nacional Autónoma de México.

Ossul, Ignacia (2019). Allegados (Chile). Global Informality Project. Accessed on 11 July 2020. Available at https://www.in-formality.com/wiki/Allegados_(Chile).

Palma-De Cuevas, Susana Isabel (2016). Planificación estratégica, sistémica y prospectiva para prevenir y mitigar riesgos de desastre en áreas urbanas históricas de Guatemala. *Quivera Revista de Estudios Territoriales,* vol. 18, No. 2.

Pelling, Mark (2003). *The Vulnerability of Cities: Natural Disasters and Social Resilience.* London, United Kingdom: Earthscan Publications, Ltd.

Pimentel Walker, Ana Paula and Maria Arquero de Alarcón (2018). The Competing Social and Environmental Functions of Private Urban Land: The Case of an Informal Land Occupation in São Paulo's South Periphery. *Sustainability*, vol. 10, No. 4160.

Rosenzweig, Cynthia E., et al. eds. (2018). *Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network (ARC3.2)*. Cambridge, United Kingdom: Cambridge University Press.

Sandoval, Gabriela and Daniela Astudillo (2018). Quintero y Puchuncaví: la zona de sacrificio. La Tercera, 24 August. Accessed on 10 February 2020.

Sandoval, Vicente and Juan Pablo Sarmiento (2019). A Neglected Issue: Informal Settlements, Urban Development, and Disaster Risk Reduction in Latin America and the Caribbean. Available at https://www.preventionweb.net/files/66656_f447finalrevisedsandovalsarmientoan.pdf.

Satterthwaite, David, et al. (2018). Responding to climate change in cities and in their informal settlements and economies. Paper prepared for the IPCC for the International Scientific Conference on Cities and Climate Change in Edmonton, March 2018. International Institute for Environment and Development. Available at https://pubs.iied.org/sites/default/files/pdfs/migrate/G04328.pdf.

Tumini, Irina and Angela Poletti (2019). Natural disaster and informality (re)production in Chile. City, Culture and Society, vol. 19.

UNDRR (n.d.). DesInventar Sendai. Available at https://www.desinventar.net/index.html. Accessed on 10 July 2020.

_____ (2019). *2019 Global Assessment Report on Disaster Risk Reduction*. United Nations publication.

_____ (2020). Terminology. Available at https://www.undrr.org/terminology. Accessed on 10 July 2020.

UN-Habitat (2017). *The New Urban Agenda.* United Nations Conference on Housing and Sustainable Urban Development (Habitat III), 17-20 October 2016, Quito, Ecuador. A/RES/71/256*.

United Nations (2016). Transforming our world: the 2030 Agenda for Sustainable Development.

United Nations, Department of Economic and Social Affairs (n.d.). The 17 Goals. Accessed on 9 February 2022. Available at https://sdgs.un.org.

_____ (2015). Risks of Exposure and Vulnerability to Natural Disasters at the City Level: A Global Overview. Population Division Technical Paper No. 2015/2. United Nations publication.

_____ (2018a). World Urbanization Prospects: The 2018 Revision, Online Edition. Available at https://population.un.org/wup/Download/.

United Nations, Department of Economic and Social Affairs, Statistics Division (n.d.). SDG Indicators: Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development. Accessed on 9 February 2022. Available at https://unstats.un.org/sdgs/indicators/indicators-list/.

United Nations, Economic Commission for Latin America and the Caribbean (ECLAC) (2017). Gestión del Riesgo de Desastres por Eventos Extremos y por Conductas Humanas, Ciudades Resilientes (IGGRD). Available at https://www.cepal.org/en/node/39506.

_____ (2018). *Regional Action Plan for the implementation of the New Urban Agenda in Latin America and the Caribbean 2016—2036*. United Nations publication. Available at https://repositorio.cepal.org/bitstream/handle/11362/42146/7/S1800032_en.pdf.

United Nations, Economic Commission for Latin America and the Caribbean and UN-Habitat (2017). *HABITAT III Regional Report: Latin America and the Caribbean—Sustainable Cities with Equality.* United Nations publication.

Vallejos Romero, Arturo (2012). Institutional Trust and Communication in the Perception and Social Construction of Risk. Perfiles Latinoamericanos, vol. 20, No. 39 (January/June).

Villamarín, Gabriela, et al. (2019). Documento de Síntesis: Aportes de la Iniciativa Ciudades Resilientes al Clima. Quito, Ecuador: Climate & Development Knowledge Network (CDKN), future latinoamericano, International Development Research Centre (IDRC) and the Government of Canada.

Watanabe, Max (2014). Urban disaster risk management in Latin American cities. Evidence and Lessons from Latin America (ELLA). Available at: https://www.preventionweb.net/files/44804_urbandisasterriskmanagementlatiname.pdf.

Weekes, Colleen and Omar D. Bello (2019). Mainstreaming disaster risk management strategies in development instruments (II): Policy briefs for Barbados, Guyana, Saint Lucia, Suriname, and Trinidad and Tobago. Studies and Perspectives Series—ECLAC Subregional Headquarters for the Caribbean, No. 75. United Nations publication.

Wilkinson, Emily, et al. (2020). Special Report on Human Mobility and Disaster Risk in Latin America and the Caribbean. Annex to the Regional Assessment Report on Disaster Risk in Latin America and the Caribbean (RAR-LAC 2021). Panama City, Panama: UNDRR.

_____ (2020a). Special Report on Climate Change and Disaster Risk in Latin America and the Caribbean. Annex to the Regional Assessment Report on Disaster Risk in Latin America and the Caribbean (RAR-LAC 2021). Panama City, Panama: UNDRR.

World Bank (2018). Open Data: Urban population growth (annual %) - Latin America & Caribbean. Accessed on 7 March 2020. Available at: https://data.worldbank.org/indicator/SP.URB.GROW?locations=ZJ.

RAR

UNDRR
UN Office for Disaster Risk Reduction